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EXTENDED VERSION

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This Extended version of IEC 61204-7:2016 includes the provisions of the general rules of IEC 62477-1:2012

Low-voltage switch mode power supplies – Part 7: Safety requirements

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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This Extended version of IEC 61204-7:2016 includes the provisions of the general rules dealt with in IEC 62477-1:2012. Clauses and subclauses of IEC 62477-1:2012 that are applicable in IEC 61204-7:2016 have been introduced in the content in red text.

International Standard IEC 61204-7 has been prepared by subcommittee 22E: Stabilized power supplies, of IEC technical committee 22: Power electronic systems and equipment.

This second edition cancels and replaces the first edition published in 2006. This edition constitutes a complete technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) use of IEC 62477-1 as reference document, instead of IEC 60950-1;

b) modification of the title by deleting the wording “DC output-“ and adding “switch mode”.

IEC 61204-7 has the status of a product standard.

The text of this document is based on the following documents:

FDIS	Report on voting
22E/175/FDIS	22E/177/RVD

Full information on the voting for the approval of this document can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61204 series, published under the general title *Low-voltage power supplies, d.c. output*, can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

This International Standard is to be read in conjunction with IEC 62477-1:2012.

NOTE A consolidated version is under consideration.

Subclauses that are numbered starting from 100 are additional to those in IEC 62477-1:2012.

Additional tables and figures in this document are numbered starting from 100.

New annexes in this document are lettered AA, AB, AC, etc.

The wordings ***SMPS*** and "power supply" are considered to be identical throughout this document.

References of the reference document to clauses or tables, which have been modified in this document, shall be read as reference to the relevant clauses or tables of this document.

Refer to 3.100 for further information on how to read this document.

In this document, the following print types are used:

– Requirements proper and normative annexes: in roman type.

– Notes and other informative matter: in smaller roman type.

– Normative conditions within tables: in smaller roman type.

– Terms that are defined in clause 3 or IEC 62477-1:2012: ***Bold Italic***.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

IEC 62477-1:2012, used by this document as a reference, relates to products that include power electronic converters, with a rated system voltage not exceeding 1 000 V AC or 1 500 V DC. It specifies requirements to reduce risks of fire, electric shock, thermal, energy and mechanical hazards, except functional safety as defined in IEC 61508 (all parts). The objectives of this standard are to establish a common terminology and basis for the safety requirements of products that contain power electronic converters across several IEC technical committees.

IEC 62477-1:2012 was developed with the intention

– to be used as a reference document for product committees inside IEC technical committee 22: Power electronic systems and equipment in the development of product standards for power electronic converter systems and equipment,

– to replace IEC 62103 as a product family standard providing minimum requirements for safety aspects of power electronic converter systems and equipment in apparatus for which no product standard exists, and

NOTE The scope of IEC 62103 contains reliability aspects, which are not covered by this document.

– to be used as a reference document for product committees outside TC 22 in the development of product standards of power electronic converter systems and equipment intended for renewable energy sources. TC 82, TC 88, TC 105 and TC 114, in particular, have been identified as relevant technical committees at the time of publication.

As such, IEC technical sub-committee 22E: Stabilized switched-mode power supplies carefully considered the relevance of each paragraph of IEC 62477-1:2012 for the SMPS and referenced, added, replaced or modified requirements as relevant. This is because product-specific topics not covered by the reference document are the responsibility of the technical committee using the reference document.

The reference document, being a group safety standard, will not take precedence over this product-specific standard according to IEC Guide 104. IEC Guide 104 provides information about the responsibility of product committees to use group safety standards for the development of their own product standards.

LOW-VOLTAGE SWITCH MODE POWER SUPPLIES –

Part 7: Safety requirements

0 Principles of safety

Safety principles of this document follow the concepts of IEC Guide 116 and Annex D of CENELEC Guide 32:2014.

NOTE The principles of safety are mainly adopted from IEC 60950-1:2005/AMD1:2009/AMD2:2013.

0.1 General

The following principles have been adopted by IEC technical committee 22E in the development of this document. These principles do not cover performance or functional characteristics of equipment.

It is essential that designers understand the underlying principles of safety requirements in order that they can engineer safe equipment.

These principles are not an alternative to the detailed requirements of this document, but are intended to provide designers with an appreciation of the basis of these requirements. Where the equipment involves technologies, components and materials or methods of construction not specifically covered, the design of the equipment should provide a level of safety not less than that described in these principles of safety.

NOTE The need for additional detailed requirements to cope with a new situation is brought promptly to the attention of the appropriate committee.

Designers will take into account not only normal operating conditions of the equipment but also likely fault conditions, consequential faults, foreseeable misuse and external influences such as temperature, altitude, pollution, moisture, overvoltages on the ***mains supply*** and ***non-mains supply***.

Dimensioning of insulation spacings should take account of possible reductions by manufacturing tolerances, or where deformation could occur due to handling, shock and vibration likely to be encountered during manufacture, transport and normal operation.

The following priorities should be observed in determining what design measures to adopt:

– where possible, specify design criteria that will eliminate, reduce or guard against hazards;
– where the above is not practicable because the functioning of the equipment would be impaired, specify the use of protective means independent of the equipment, such as personal protective equipment (which is not specified in this document);
– where neither of the above measures is practicable, or in addition to those measures, specify the provision of markings and instructions regarding the residual risks.

There are two types of persons whose safety needs to be considered, ***operators*** (or ***users***) and ***service persons***.

Operator is the term applied to all persons other than ***service persons***. Requirements for protection should assume that ***operators*** are not trained to identify hazards, but will not intentionally create a hazardous situation. Consequently, the requirements will provide protection for cleaners and casual visitors as well as the assigned ***operators***. In general,

operators should not have access to hazardous parts, and to this end, such parts should only be in service access area or in equipment located in ***restricted access areas***.

When ***operators*** are admitted to ***restricted access areas (RAA)*** they shall be suitably instructed.

NOTE The term "restricted access area" (RAA) is also known as "restricted access location" (RAL).

Service persons are expected to use their training and skill to avoid possible injury to themselves and others due to obvious hazards that exist in service access areas of the equipment or on equipment located in ***restricted access areas***. However, ***service persons*** should be protected against unexpected hazards. This can be done by, for example, locating parts that need to be accessible for servicing away from electrical and mechanical hazards, providing shields to avoid accidental contact with hazardous parts, and providing labels or instructions to warn personnel about any residual risk.

Information about potential hazards can be marked on the equipment or provided with the equipment, depending on the likelihood and severity of injury, or made available for ***service persons***. In general, ***operators*** shall not be exposed to hazards likely to cause injury, and information provided for ***operators*** should primarily aim at avoiding misuse and situations likely to create hazards, such as connection to the wrong power source and replacement of fuses by incorrect types.

Moveable equipment is considered to present a slightly increased risk of shock, due to possible extra strain on the supply cord leading to rupture of the earthing conductor. With hand-held equipment, this risk is increased; wear on the cord is more likely, and further hazards could arise if the units were dropped. ***Transportable equipment*** introduces a further factor because it can be used and carried in any orientation; if a small metallic object enters an opening in the ***enclosure***, it can move around inside the equipment, possibly creating a hazard.

0.2 Hazards

0.2.1 General

Application of a safety standard is intended to reduce the risk of injury or damage due to the following:

– electric shock;
– energy related hazards;
– fire;
– heat related hazards;
– mechanical hazards;
– chemical hazards.

NOTE Radiation hazard are not included, as LEDs used for the purpose of indication and display only are not considered to cause hazardous radiation (e.g. like high intense lighting LEDs).

0.2.2 Electric shock

Electric shock is due to current passing through the human body. The resulting physiological effects depend on the value and duration of the current and the path it takes through the body. The value of the current depends on the applied voltage, the impedance of the source and the impedance of the body. The body impedance depends in turn on the area of contact, moisture in the area of contact and the applied voltage and frequency.

Currents of approximately half a milliamp can cause a reaction in persons in good health and may cause injury indirectly due to involuntary reaction. Higher currents can have more direct

effects such as burn or muscle tetanisation leading to inability to let go or to ventricular fibrillation.

It is normal to provide two levels of protection for ***operators*** to prevent electric shock. Therefore, the operation of equipment under normal conditions and after a single fault, including any consequential faults, should not create a shock hazard.

Harm may result from

1) contact with hazardous-live-parts,
2) breakdown of insulation between ***hazardous-live-parts*** and accessible conductive parts,
3) contact with circuits above ***DVC As*** limits,
4) breakdown of ***operator*** accessible insulation, and
5) ***touch current*** (leakage current) flowing from ***hazardous-live-parts*** to accessible parts, or failure of a ***protective earthing*** connection. ***Touch current*** may include current due to EMC filter components.

0.2.3 Energy related hazards

Injury or fire may result from a short-circuit between adjacent poles of high current supplies or high capacitance circuits, causing

– burns,
– arcing, and
– ejection of molten metal.

Even circuits whose voltages are safe to touch may be hazardous in this respect.

Examples of measures to reduce risks include:

– separation;
– shielding;
– provision of safety interlocks.

NOTE Safety interlocks are not described within this document.

0.2.4 Fire

Risk of fire may result from excessive temperatures either under normal operating conditions or due to overload, component failure, insulation breakdown or loose connections. Fires originating within the equipment should not spread beyond the immediate vicinity of the source of the fire, nor cause damage to the surroundings of the equipment.

Examples of measures to reduce risks include:

– providing overcurrent protection;
– using constructional materials having appropriate flammability properties for their purpose;
– selection of parts, components and consumable materials to avoid high temperature which might cause ignition;
– limiting the quantity of combustible materials used;
– shielding or separating combustible materials from likely ignition sources;
– using ***enclosures*** or barriers to limit the spread of fire within the equipment;
– using suitable materials for ***enclosures*** so as to reduce the likelihood of fire spreading from the equipment.

0.2.5 Heat related hazards

Injury may result from high temperatures under normal operating conditions, causing

– burns due to contact with hot accessible parts,
– degradation of insulation and of safety-critical components, and
– ignition of flammable liquids.

Examples of measures to reduce risks include:

– taking steps to avoid high temperature of accessible parts;
– avoiding temperatures above the ignition point of liquids;
– provision of markings to warn ***operators*** where access to hot parts is unavoidable.

0.2.6 Mechanical hazards

Injury may result from

– sharp edges and corners,
– moving parts that have the potential to cause injury,
– equipment instability,
– sonic pressure, and
– flying particles from exploding components (like electrolytic capacitors).

Examples of measures to reduce risks include:

– rounding of sharp edges and corners;
– guarding;
– providing sufficient stability to free-standing equipment;
– selecting suitable components, for example electrolytic capacitors with integral pressure relief to avoid explosion;
– provision of markings to warn ***operators*** where access is unavoidable.

0.2.7 Chemical hazards

Injury may result from contact with some chemicals or from inhalation of their vapours and fumes.

Examples of measures to reduce risks include:

– avoiding the use of constructional and consumable materials likely to cause injury by contact or inhalation during intended and normal conditions of use;
– avoiding conditions likely to cause leakage or vaporization;
– provision of markings to warn ***operators*** about the hazards.

0.3 Materials and components

Materials and components used in the construction of equipment should be so selected and arranged that they can be expected to perform in a reliable manner for the anticipated life of the equipment without creating a hazard, and would not contribute significantly to the development of a serious fire hazard. Components should be selected so that they remain within their manufacturers' ratings under normal operating conditions, and do not create a hazard under fault conditions.

1 Scope

1.1 Equipment covered by this document

This part of IEC 61204 specifies the safety requirements for ***switch mode power supply*** (***SMPS***) units supplied by source voltages up to 1 000 V AC or 1 500 V DC providing AC and/or DC output(s), except inverter output(s) establishing AC mains (see exceptions in 1.2).

NOTE 1 This document by definition covers DC-DC converters.

NOTE 2 Power supplies may provide accessory AC mains socket outlets, when such outputs are supplied from the AC mains.

This product standard covers both ***stand-alone*** and ***component SMPS*** as defined in this document. ***DC power and distribution equipment*** which provides, distributes, monitors, and controls isolated ***secondary circuit*** power to other equipment typically used in information and communication technology equipment installations (refer to Annex AC).

Equipment which is within the scope of Annex AC consists of some or all of the following:

– distribution panelboards, powerboards, disconnects, and overcurrent protective devices;

– control and monitoring equipment;

– assemblies consisting of: racks, shelves, and enclosures which could contain any of the above components, interconnecting hardware, ***power supplies*** (such as rectifiers, converters, and inverters), batteries, and any other related peripheral devices.

Where no standards exist, use of this document for other applications is not precluded.

1.2 Exclusions

This document does not cover:

– functional safety aspects as covered by for example IEC 61508 (all parts);

– reliability and risk considerations (e.g. related to power loss);

– information and communication technology equipment other than ***SMPS*** to such apparatus;

– electrical equipment and systems for railways applications and electric vehicles.

– motor-generator sets;

– uninterruptible power supplies (UPS);

– direct plug-in power units;

– power supplies according to IEC 61558 (all parts) covering linear power supply units incorporating safety isolating transformers providing ***SELV*** or ***PELV*** output(s) in accordance with IEC 60364-4-41 and ***SMPS*** for use with household and other consumer products;

– transformers covered by IEC 61558-1;

– step-down converters covered by IEC 60146-1-1;

– ***SMPS*** and converters for use with or in products covered by IEC 61347-2-2;

– ***AC or DC mains supply*** distribution equipment which is part of the building wiring system and not an integral part of the equipment used in ***DC power and distribution equipment***, batteries, the design or installation of ***DC power and distribution*** conductors and other building installation wiring (not covered by Annex AC).

1.3 Additional requirements

Requirements additional to those specified in this document may be necessary for

– ***SMPS*** which comply with this document and satisfy the requirements of ***SMPS*** for use in or with other equipment, when referenced in such end product standards,

– ***SMPS*** intended for operation in special environments (for example, extremes of temperature; excessive dust, moisture or vibration (e.g. earth quake zones); flammable gases; and corrosive or explosive atmospheres),

– ***SMPS*** intended to be used in vehicles, on board ships or aircraft, or in tropical countries, and

– ***SMPS*** intended for use where ingress of water is possible; for guidance on such requirements and on relevant testing, see IEC 60529.

NOTE Attention is drawn to the fact that authorities in some countries impose additional requirements for health, environmental and similar reasons.

2 Normative references

Clause 2 of IEC 62477-1:2012 applies with the following exceptions/additions:

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

IEC 60245 (all parts), *Rubber insulated cables – Rated voltages up to and including 450/750 V*

IEC 60320 (all parts), *Appliance couplers for household and similar general purposes*

IEC 60384-14:2013, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60417:2002 [online database], *Graphical symbols for use on equipment* [viewed 2016-06-24]. Available at *http://www.graphical-symbols.info/*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013

IEC 60695-11-5, *Fire hazard testing Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 60695-11-20:1999, *Fire hazard testing – Part 11-20: Test flames – 500 W flame test methods*

IEC 60730-1:2010, *Automatic electrical controls – Part 1: General requirements*

IEC 60738-1:2009, *Thermistors – Directly heated positive temperature coefficient – Part 1: Generic specification*

IEC 60747-5-5:2007, *Semiconductor devices – Discrete devices – Part 5-5: Optoelectronic devices – Photocouplers*

IEC 60799, *Electrical accessories – Cord sets and interconnection cord sets*

IEC 60851-3:2009, *Winding wires – Test methods – Part 3: Mechanical properties*

IEC 60851-5:2008, *Winding wires – Test methods – Part 5: Electrical properties*

IEC 60851-6:1996, *Winding wires – Test methods – Part 6: Thermal properties*

IEC 60947-1, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 60947-3, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*

IEC 60990:1999, *Methods of measurement of touch current and protective conductor current*

IEC 61010-1:2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 61058-1:2000, *Switches for appliances - Part 1: General requirements*
IEC 61058-1:2000/AMD1:2001
IEC 61058-1:2000/AMD2:2007

IEC 61293:1994, *Marking of electrical equipment with ratings related to electrical supply – Safety requirements*

IEC 61558-1:2005, *Safety of power transformers, power supplies, reactors and similar products – Part 1: General requirements and tests*
IEC 61558-1:2005/AMD1:2009

IEC 61558-2 (all parts), *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V*

IEC 61810-1:2008, *Electromechanical elementary relays – Part 1: General requirements*

IEC 62368-1:2014, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

IEC 62477-1:2012, *Safety requirements for power electronic converter systems and equipment – Part 1: General*