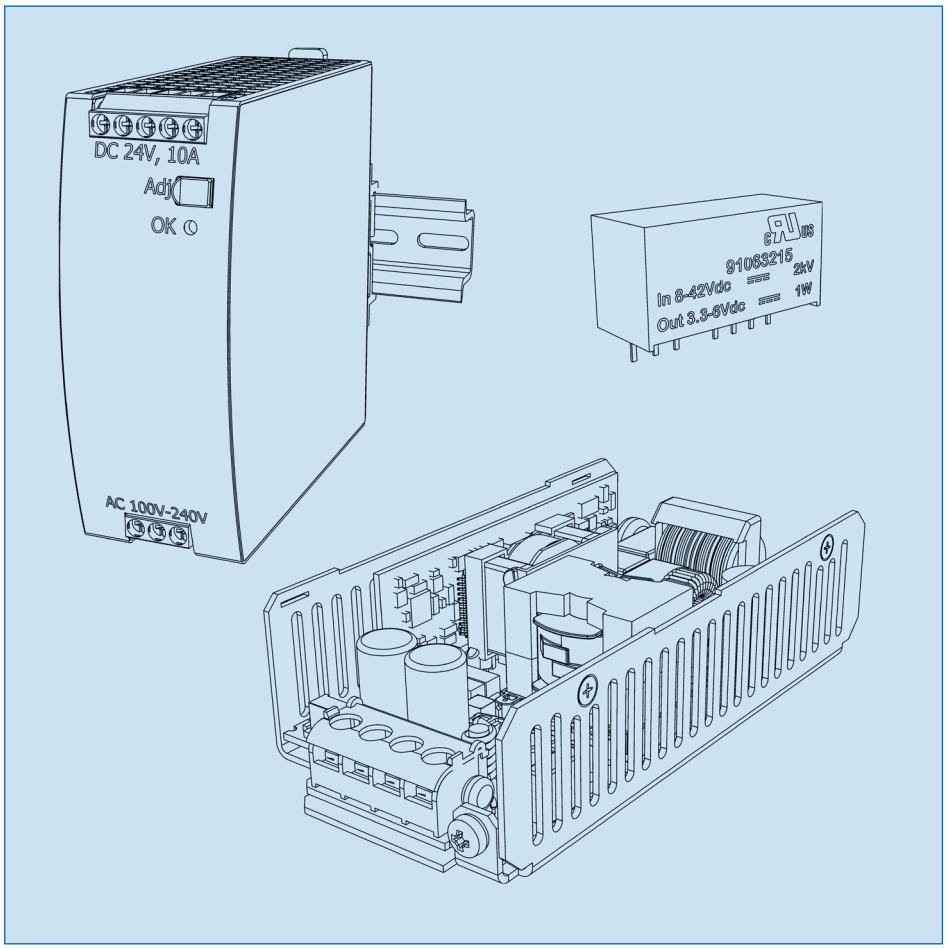
ZVEI:
Die Elektroindustrie

Guideline

# Selection of safety standards for power supplies




Transformers & Power Supplies Division

ZVEI:
Die Elektroindustrie

**Selection of safety standards for power supplies**

Publisher:

ZVEI - Zentralverband Elektrotechnik- und Elektronikindustrie e. V.
German Electrical and Electronic Manufacturers' Association
Transformers & Power Supplies Division
Lyoner Strasse 9
60528 Frankfurt am Main, Germany

Responsible: Dr.-Ing. Rolf Winter
Telephone: +49 69 6302-402
E-mail: winter@zvei.org

www.sicherheit.org

Authors:

| | |
|---|---|
| Bargel, Matthias | MTM Power Messtechnik Mellenbach GmbH |
| Emsermann, Dr. Mathias | Phoenix Contact Power Supplies GmbH |
| Eschle-Reinold, Matthias | TDK-Lambda Germany GmbH |
| Georgius, Holger | Eltek Deutschland GmbH |
| Hartmann, Alfons | Benning Elektrotechnik und Elektronik GmbH & Co. KG |
| Haufler, Sergej | J. Schneider Elektrotechnik GmbH |
| Heinemann, Kai | Block Transformatoren-Elektronik GmbH |
| Heinrich, Steffen | MTM Power Messtechnik Mellenbach GmbH |
| Holzmann, Florian | Murrelektronik GmbH |
| Huber, Martin | J. Schneider Elektrotechnik GmbH |
| Klemm, Clemens | Siemens AG |
| Lauber, Swen | inpotron Schaltnetzteile GmbH |
| Laible, Holger | Siemens AG |
| Leible, Erich | J. Schneider Elektrotechnik GmbH |
| Raspotnig, Michael | PULS GmbH |
| Roberts, Steve | Recom Electronic GmbH & Co. KG |
| Schmitt, Gunter | Eltek Deutschland GmbH |
| Schweizer, Udo | TDK-Lambda Germany GmbH |
| Skrabal, Udo | Phoenix Contact Power Supplies GmbH |
| Uludag, Timur | Würth Elektronik eiSos GmbH & Co. KG |
| Wöhl, Bernhard | inpotron Schaltnetzteile GmbH |

September 2019, 1. Edition

# Content

# 1 Introduction

Electronic power supplies, especially if they include a mains isolation feature, are undoubtedly in the focus of safety approvals due to their hazard potential. Such devices must not pose any danger either in normal or abnormal operation (e.g. in the event of a fault).

## The Application makes the Difference

No overarching product standard has yet prevailed for power supplies. One reason for this is that the requirements can vary considerably depending on the application and operating conditions. For example, a patient in a hospital who is physically weakened must be better protected than hospital staff or an employee in an office. A further example are differences in the qualification of the operator and thus the foreseeable misuses, which are different for household appliances than for industrial appliances. An industrial appliance can in turn be exposed to significantly higher environmental influences, such as temperature, overvoltage or vibration.

The requirements for power supplies therefore depend on the normative requirements for the expected use or application. If one tries to design a power supply for too many different product standards at the same time, the effort increases immensely and the device may no longer be economically attractive. Due to regional differences and national acceptance requirements, a further unavoidable additional certification expense also arises for devices that are marketed internationally.

Nevertheless, EN 60950-1, which is actually aimed at information technology equipment, has established itself as the most widely used standard in the field of power supplies.

# 2 Phase-out of the widely used EN 60950-1 and its possible Successor Alternatives

Currently, the replacement of EN 60950-1 and EN 60065 by EN 62368-1 is creating a lot of movement in the standards landscape. According to the current status, the presumption of conformity for the EU Low Voltage Directive will be withdrawn from these two standards at the end of 2020. EN 62368-1 is named as the official successor.

The EN 60950-1 was for many years the measure of all things in power supplies. Even though this standard only described information technology equipment within its scope of application, it was used and accepted for the assessment of electrical safety in many other areas. Here a sea-change can now be observed. Writers of standards for the final equipment recognized the lack of a clear specification and now refer back to standards such as EN 61010-2-201, EN 61204-7 or EN 61558-2-16 for compliance for electrical safety. Manufacturers must address this issue. If they just thoughtlessly follow the recommended successor standard EN 62368-1 this can lead to unpleasant surprises.

However, the development of EN 62368-1 is undoubtedly an innovative step towards reducing the diversity of standards and is also a trend-setter with regard to HBSE (hazard-based safety engineering) for the electronics industry. EN 62368-1 combines the areas of information technology (EN 60950-1) with those of audio/video devices (EN 60065). Unfortunately, this standard has only been hesitantly accepted, not least because it has been frequently adapted and amended to the regret of early adopters. At IEC level, the third edition has now been published. Each new edition means that existing approvals have to be revisited and this is always associated with considerable cost and effort. Therefore, it is generally better to wait for stability during the initial phase and not to adopt a new, untried standard too early.

It is also advisable to obtain the assessment of the responsible testing and approval bodies at an early stage when making decisions on the selection of standards and to make use of their experience, since there is often room for interpretation and interpretation in the selection of standards, it may even be helpful in this phase to seek contact with more than

one testing and approval body. As a rule, testing laboratories have preferred standards for which they have more experience and for which the employees are better trained.

Here, however, it is always important to keep an eye on the overall costs of the project. Cheaper testing costs can be deceptive if additional work is required afterwards due to missing standards or acceptance problems.

## 2.1 EN 61204-7 – An Application-independent Alternative

IEC/EN 61204-7 is developing as an interesting and application-neutral alternative. The authors of this standard recognized early on the lack of an explicit standard for switching power supplies and created the standard as Part 7 of the 61204 series of standards with the title: „Power supply devices for low voltage with DC output - Part 7: Safety requirements". In the first edition of this standard, reference was made back to IEC 60950-1. In the second and currently valid edition of this standard, IEC 62477-1 is used as the reference document due to the withdrawal of EN 60950-1.

IEC 62477-1, titled „Safety requirements for power semiconductor inverter systems and equipment - Part 1: General", is a product group standard intended as a basis for the development of various other product standards in the field of power electronics and renewable energy. IEC/EN 61204-7 for switching power supplies, or 61040-2 for uninterruptible power supplies therefore refer back to IEC 62477-1.

IEC/EN 61204-7 is also referenced in 60204-1, one of the most important standards for electrical equipment in mechanical engineering, in the requirements for control power supplies. This helps with an assessment according to the Machinery Directive.

Outside Europe, acceptance of the second edition of IEC 61204-7 also depends on recognition of IEC 62477-1, which is why this standard can only be recommended as an alternative for Europe for the time being.

## 2.2 EN 61204-7 – A Pioneer for New Technologies

The IEC/EN 61558 series of standards focuses on the safety assessment of transformers, power supply units, chokes and corresponding combinations. With part -2-16, a standard has been created that addresses the special requirements and testing of switching power supplies and is applicable to products that do not fall within the scope of IEC 60065 and IEC 60950-1 as well as the IEC 61347 or IEC 61204-7 series of standards. In addition, Part -2-16 contains Annex BB, which addresses the specific requirements and tests of transformers for switching power supplies with an operating frequency greater than 500Hz and has no restrictions in the scope of application.

The peculiarity of this standard is that it also deals increasingly with the new technological possibilities in the development of switched-mode power supplies and their transformers and can be regarded as a pioneer for such technologies. For example, the standard offers solutions for safety assessment for the use of FIW wires („Fully Insulated Winding wires"), which are partly excluded in other standards. Such FIW wires (not to be confused with multi-laminated or foil-wrapped wires) can significantly reduce the size of transformers, but they also involve new risks. Here, IEC/EN 61558-2-16 offers procedures to minimize mechanical, electrical and aging risks and also provides instructions for practical tests.

Another trend in the development of modern switching power supplies is the use of Wide Band Gap semiconductors such as silicon carbide or gallium nitride. These enable significantly higher operating frequencies of switching power supplies, which in turn require a frequency-dependent consideration of air and creepage distances. IEC/EN 61558-2-16 also provides answers on the design of such constructions.

IEC/EN 61558-2-16 is listed in the Official Journal of the EU as a harmonized standard for meeting the requirements of the Low Voltage Directive and is also referenced in 60204-1, one of the most important standards for electrical equipment in mechanical engineering, in the requirements for control power supplies. This helps with an assessment according to the Machinery Directive.

There is currently no UL equivalent for the 61558-2-16. Therefore, acceptance on the American market should be checked in advance.

# 3 What does Safety mean in Standardization?

Safety aspects can usually be divided into three classes; Basic Safety, Essential Performance and Functional Safety.

Basic safety applies to every power supply. This ensures that dangers that can emanate from the power supply itself, such as electric shock, burns, injuries, fire and the like, are reduced to an acceptable level.

The essential features of the system are to be considered as a whole. An essential feature of an infusion device is, for example, the correct flow rate of a drug. If too much or too little is administered, the situation could be dangerous for the patient. This essential feature must not be caused by a malfunction of the power supply (e.g. by a nearby radio).

Functional safety also refers to the overall system. Here the risk of an error with the resulting damage is evaluated. Design guidelines are derived from this. Typical fault patterns of a power supply in this sense are voltage failures, under-voltages and over-voltages as well as oscillations of the output voltage.

# 4 Objectives of this Guide

This „Best-Practice“ guideline deals exclusively with the requirements for the basic safety of power supplies and is intended to serve as a decision-making aid for the technical personnel of the manufacturers and the technically experienced users. This helps to avoid wrong decisions, which are usually associated with high costs and loss of time, at an early stage.

This manual does not replace the study of the relevant standards in the current editions and does not give a complete overview of all requirements that may be possible.

# 5 Application Examples

In the following, individual examples and field reports from different areas and applications of AC/DC and DC/DC power supplies as well as the application of suitable standards are shown. The examples can only illustrate the application of the different standards depending on the field of application and make no claim to completeness or exclusivity. A comprehensive presentation is not possible due to the complexity. As mentioned above, it is advisable to involve customers and testing- and approval-bodies in the decision-making process at an early stage when selecting the normative requirements for power supplies in order to avoid complications later on.

Standards and the acceptance of standards are subject to constant change. The status of standards, design practices and references to standards change and adapt to current needs and requirements. The examples given reflect the status at the time of publication of this guide.

## Example 1: Industrial Switch Cabinet

In the control cabinet of an industrial plant, a power supply is used to supply control units. A 240W device for DIN rail mounting is selected as the power supply, which is supplied by the 3-phase mains and provides the supply voltage of DC 24V for the control and display devices. The DC 24V should be distributed in the application without special touch protection measures. The industrial plant will be distributed worldwide.

### Recommendation for approval:

As these are control units for the industrial environment, EN/IEC/UL 61010-2-201 is primarily recommended. This approval makes it possible to issue an EU declaration of conformity for Europe and a UL listing marking for the USA and Canada in the „Industrial Control Equipment“ category.

The UL 508 standard previously used in the USA for control power supplies was recently replaced by UL 61010-2-201. In the still valid UL 508A for control cabinets, power supplies listed in both UL 508 and UL 61010-2-201 can be loaded with nominal load. For other standards, a maximum load of 50% of the nominal load is generally applicable, which means a power supply with a large oversize.

In addition, IEC 61010-2-201 also covers the safety requirements of other product standards. For example, in the third edition of IEC 61131-2 (equipment requirements and tests for programmable logic controllers) all safety requirements have been removed and reference made to IEC 61010-2-201.

For applications in the field of electrical equipment of machines according to EN 60204-1, EN 61558-2-16 or EN 61204-7 can alternatively be applied within Europe for control power supplies. This can be advantageous if the end-use application must comply with the Machinery Directive.

In countries other than Europe and North America, it may make sense to additionally comply with IEC 62368-1, as other decisions have been made there for recognition. For countries that do not yet use IEC 62368 1, IEC 60950-1 may even continue to be required.

## Example 2: Access Control Airport

The verification of the access authorisation of passengers and airport staff to the secure area (e.g. gate) is increasingly carried out electronically. The printed code of the flight ticket or boarding pass is read in at the access control system and a software control decides whether access is granted or denied.

The opening and closing of the access barriers represents special requirements for the power supplies, as high current loads occur for short periods with very steep rising and falling flanks. The mentioned application is therefore two system parts. The first is a control device that compares the ticket data with a database. On the other hand, there is an electromechanical part of the system in which a motor is electronically controlled to enable or deny access. Both parts of the system are supplied by a common power supply.

### Approval recommendation:

For Europe, the household appliance standard EN 60335-1 is recommended together with the supplementary part -2-103, which contains the special requirements for operators of doors and gates. Alternatively, approval according to EN 62368-1 would also be possible. However, this should be clarified with the customer and the approval authority.

Unfortunately, the EN/IEC 60335 series of standards is not fully harmonised in North America. There is no corresponding counterpart to part -2-103, so for these regions a design and approval according to UL 1310 or UL 62368-1 is recommended.

Outside Europe and North America, IEC 62368-1 makes sense. For countries which do not yet accept IEC 62368-1, a design and approval according to IEC 60950-1 is still recommended.

## Example 3: Telecommunication Power Supply

Power supplies for technical equipment in telecommunications offices (communications switching technology, broadband and other services) are usually provided by rectifier technology (AC 230V input, DC 48 or 60V output). The uninterruptible security of supply is guaranteed by 48V or 60V battery systems.

In some cases, inverter technology is also used, which generates an AC voltage of 230V or 400V AC from the DC battery voltage. These are often not classic UPS systems, which must be developed and approved according to EN 62040-1, but specially developed special devices.

The components in mobile radio base stations are also usually supplied with rectifier technology (AC 230V input, DC 48V output). The same safety standards apply to these power supplies as to the telecommunications equipment in the telecommunications offices.

### Approval recommendation:

For applications in the field of telecommunications power supplies, where safety testing according to EN 60950-1 has been carried out in Europe to date, the use of EN 62368-1 is typically to be expected, but the application of EN 61204-7 is also possible in principle. In the USA, the UL 60950-1 standard is also applied simultaneously with Europe by the UL 62368-1 is superseded. However, there is a significant difference in the type of introduction in the USA compared to Europe.

In Europe there will be a hard transition on 20.12.2020 due to the change in the Official Journal, which transfers the presumption of conformity to the successor standard EN 62368 1.

This regulation does not exist in the USA. There, devices that have already been approved may continue to be placed on the market as long as the approval is still valid. However, new or technically modified devices for the USA will be approved after this date according to UL 62368-1.

In China, IEC 62368-1 has not yet been accepted as the successor to IEC 60950-1. Therefore, it is recommended that telecommunications power supplies intended for the Asian market continue to be designed and approved in accordance with IEC 60950-1.

In the case of equipment for the telecommunications infrastructure which is supplied via remote feed technology using existing copper lines and using EN 60950-21, Part 3 of the series of standards 62368 (EN 62368-3) may also be applied.

## Example 4: Power Supply with Data Interface

In a machining centre (combined drilling, milling and grinding machine) a 24V power supply is used to supply control units. In addition to the actual 24V supply, the power supply also provides operating and service data via an interface. Commercially available laptops, for example, can be connected to the data interface to make the data visible and evaluate it.

### Approval recommendation:

For this example, the same recommendations apply to the power section as in example 1. As this is a classic industrial application, EN/IEC/UL 61010-2-201 is recom¬mended as a priority. This approval package makes it possible to issue an EU declaration of conformity for Europe and a UL listing marking for the USA and Canada in the „Industrial Control Equipment" category.

For applications in the field of electrical equipment of machines according to EN 60204-1, EN 61558-2-16 or EN 61204-7 can alternatively be applied within Europe for control power supplies. This can be advantageous if the end-use application must comply with the Machinery Directive.

Since the power supply can be connected via an interface (LAN, USB) to a commercially available laptop or other signalling device, both the „Industrial Devices" (Ind. Cont. Eq.) and „Information and Communication Devices" (I.C.T.) standard areas are affected. In order to allow the laptop or the signalling device to be connected to the power supply on the data side, an additional design and approval according to EN/IEC 62368-3 is recommended for the interface area. EN/IEC 62368-3 is a supplementary part to EN/IEC 62368-1 that deals with such interfaces.

## Example 5: Power Supply for Medical Devices

A couch is part of a magnetic resonance imaging (MRI) system. The electric drive of the couch brings the patient into the correct position in the tube. This drive is powered by a 500W power supply, which the couch manufacturer installs in his system.

The MRI system is to be regarded as a medical device. All components of this system must meet the requirements of medical devices.

Medical devices are subject to stricter safety requirements than general electronic devices. Patients may be physically weakened, sweat more, or may be connected directly to electrical contacts near the heart, which increases sensitivity to currents and increases safety requirements.

The medical standards distinguish between patient protection (MOPP - Means of Patient Protection), which must be designed in accordance with EN/IEC/UL 60601-1, and operator protection (MOOP - Means of Operator Protection), which can also be implemented in accordance with EN/IEC/UL 60950-1.

In the couch example, a power supply with a protection level of MOPP may therefore be required.

### Recommendation for approval:

The general safety requirements for medical devices are laid down in EN/IEC/UL 60601-1. Since there are no additional parts for the power supply in relation to electrical hazards for this application, the design and approval of the power supply according to Part 1 of this standard is sufficient. Proof in accordance with the medical standard can therefore only be provided separately, e.g. by means of a manufacturer's declaration.

### Instructions for issuing the EU declaration of conformity:

According to the EU Medical Device Directive, this power supply is a supplied component which the medical device manufacturer installs in his device. An EU Declaration of Conformity according to the Medical Devices Directive is not considered for such a component and would also be inadmissible.

This component counts as „electrical equipment" and is therefore subject to the Low Voltage Directive. The EN 60601-1 from the medical sector is not listed as a harmonized standard in the Official Journal of the Low Voltage Directive. Due to the more frequent use in the MOOP area, it is recommended to design the power supply according to another listed standard, such as EN 62368-1 or EN 61010 1. However, this is not absolutely necessary. The declaration of conformity according to the Low Voltage Directive is not subject to the standards listed in the Official Journal under this Directive. Any other standard or specification that guarantees product safety may also be used. In this case, the manufacturer must provide proof within the framework of his conformity assessment and document

that this non-listed standard also guarantees safety. If the standard has stricter requirements than the listed one (e.g. EN 60601-1), the proof is naturally no problem.

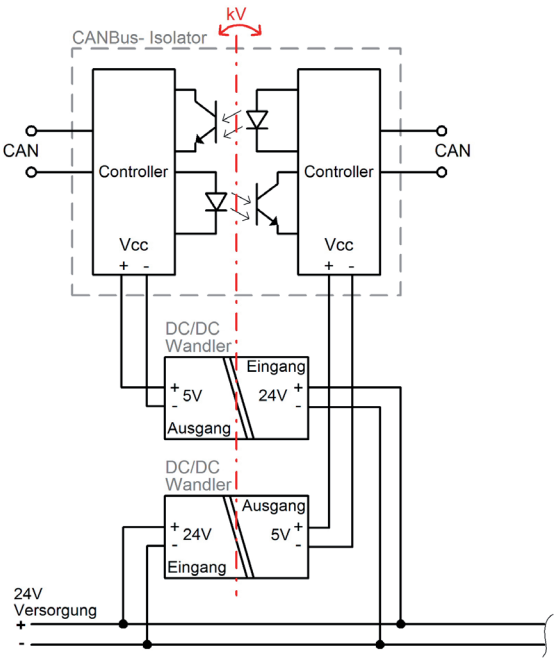
In order to express the suitability of the power supply for use in a medical device in the EU Declaration of Conformity, it can be entered under the heading „Additional information" that the power supply meets the requirements for e.g. 2MOOP (reinforced insulation) in accordance with EN 60601-1. EN 60601-1 may also be included in the list of standards.

Such a power supply can therefore be used both in a medical device and in a non-medical device.

## Example 6: DC/DC Converter for CAN Bus Isolators

The exchange of data by means of communication systems is one of the most important tasks in automation technology. Machine states are recorded and transferred via a bus system to a master computer or a control system. Common interfaces or bus systems are RS232, RS485 or the CAN bus.

**Abb. 1: DC/DC-Wandler für CAN-Bus-Isolatoren**




Source: ZVEI Arbeitsgruppe

Due to the spatial extension of a factory hall, unfavourable and different earth and ground connections can lead to interference effects on the data line. These disturbances are caused by different ground potentials in transmitters and receivers, which can occur, for example, due to interference couplings from adjacent frequency converters or other power-hungry consumers on the line side.

A remedy is provided by galvanic isolation both on the signal side and on the supply side. The CAN bus standard itself does not require galvanic isolation. Practical experience shows, however, that both the signal path and the supply path should be electrically isolated to ensure interference-free communication. Low power DC/DC converters with a power between 1 and 3W have established themselves for galvanic isolation of the supply path.

The requirements for such DC/DC converters (also known as power modules) include high isolation voltages, which can be up to 4kV DC. This ensures that the system remains reliable even with coupled transients.

### Recommendation for approval:

From a legal point of view, a safety assessment is not absolutely necessary in Europe for placing such DC/DC converters on the market, as long as all operating voltages remain below 75Vdc. The Low Voltage Directive only applies to electrical equipment with an operating voltage greater than 75Vdc. The withdrawal of the presumption of conformity of EN 60950-1 at the end of 2020 is therefore meaningless for these products.

From a practical point of view, a design and approval according to IEC 60950-1 is recommended. This avoids problems outside Europe which have not yet been recognised by the successor standard IEC 62368-1. Some product standards also refer to IEC 60950-1. In the long term, however, design and approval in accordance with the new IEC 62368-1 could be advantageous, as national variants of IEC 60950-1 are increasingly being replaced by national variants of IEC 62368-1.

If you want to be absolutely sure, it makes sense to design and approve the DC/DC converter according to various standards.

## Example 7: Power Supply for Motion Detector

Motion and presence detectors are becoming increasingly important thanks to increasing environmental awareness. Automated light switches or taps for toilets and washbasins conserve resources and save costs. This is particularly important in public areas.

Some of today's systems also have radio interfaces, such as Bluetooth, to simplify maintenance and inspection by building management.

In general, such devices are assigned to building technology. The power supplies required for automation usually have a low output of less than 10W and must not exceed certain power consumption limits in standby mode.

### Approval recommendation:

For Europe a design and approval according to the household appliance standard EN 60335-1 is recommended. Alternatively, EN 61558-2-16 or EN 61204-7 can also be applied.

There is a special feature in North America. There, the NEC (National Electrical Code) divides circuits into different power classes. With the maximum 10W in this example, the circuit falls into the NEC Class 2 category and is rewarded with simpler installation and fire protection requirements. For example, the cables between the power source and the loads can be laid without complicated cable ducts. A prerequisite, however, is that the power source is listed in accordance with NEC Class 2. The best way to achieve this is to obtain UL 1310 approval.

Even if this application does not correspond to the scope of IEC 62368-1, in practice outside Europe a design according to this standard or IEC 60950-1 is generally accepted.

## Example 8: Power Supply for Chemical Plant

A 24V power supply is used in an I/O control box of a petrochemical plant control system. Flammable gases may occasionally occur in the vicinity of the control box. The devices used in this environment require a medium degree of protection (zone 2) in accordance with ATEX directives.

### Approval recommendation:

In Europe, a design and approval according to ignition protection type „ec" according to EN 60079-7 together with the general requirements of EN 60079-0 is recommended for this application. However, the EN 60079 series of standards only deals with the safety aspects relating to use in potentially explosive atmospheres. This means that for basic safety an additional safety standard from the non-hazardous area is required. EN 61010-2-201 is recommended for this purpose (alternatively EN 61204-7 or EN 61558-2-16). This means that an ATEX certificate can also be obtained.

Outside Europe, with the exception of North America, approval according to the IECEx p rocedure is recommended. This requires a design and approval according to IEC 60079-0 and IEC 60079-7 according to the IECEx procedure.

In North America, hazardous areas are not divided into zones but into „divisions". Although the „division" requirements are generally somewhat lower than the ATEX and IECEx requirements, they must be re-approved in North America. For the above example a Class I Div 2 approval according to the standard ANSI ISA 12.12.01 is recommended. Such an approval can be granted, for example, by UL (Underwriters Laboratories), CSA Group (Canadian Standards Association) or FM (Factory Mutual).

## Example 9: Power Supply for Scale in Distribution System

In a distribution centre for fruit and vegetables, the goods are picked, marked, weighed and distributed. At the heart of the system is a scale that optically recognizes the goods, weighs them, applies a label to them and places them on a conveyor belt.

An external device, which is supplied with mains voltage, is used as the power supply for this scale.

### Approval recommendation:

A balance falls into the category of laboratory and measuring instruments. The balance and the associated components, such as power supplies, should therefore be designed in accordance with EN/IEC/UL 61010-1.

In countries where EN/IEC/UL 61010-1 is not recognized, IEC 62368-1 or IEC 60950-1 is recommended.

## Example 10: Power Supply for Lubrication System

Faultless lubrication of bearings and sliding surfaces plays a key role in ensuring a long service life and smooth operation of machines and systems. Many machines and plants, such as construction machines, generators, conveyor systems, gearboxes of wind generators or bearing systems, use automatic lubrication systems that recognize the condition and carry out targeted lubrication.

Such systems require a central 1-phase or 3-phase power supply in the power range up to several 100W, from which the individual components such as pumps, sensors and alarm systems are supplied. These power supplies are usually designed as touch-protected built-in power supplies and installed inside the machine.

### Approval recommendation:

This example does not deal with typical measurement, control or regulating tasks, as pumps are also operated. Nevertheless, EN/IEC/UL 61010-2-201 is generally accepted due to the industrial nature of the application.

Alternatively, EN/IEC/UL 62368-1 can also be used. Since the predecessor standard EN/IEC/UL 60950-1 was used and accepted for such applications, it is to be expected that a similar procedure will be followed with the successor standard.

Alternatively, EN 61558-2-16 or EN 61204-7 can also be applied in Europe.

For countries where IEC 61010-2-201 or IEC 62368-1 is not yet accepted (e.g. China), IEC 60950-1 is still recommended.

## Example 11: Spare Power System

A backup power plant supplies a traffic light network and prevents traffic chaos in the event of a power failure. The backup power system is designed as a battery-supported, uninterruptible power supply system (UPS system) and can supply up to 25kW in an emergency. The operating voltage of the traffic lights is AC 230V. The input and output of the UPS system is also designed for AC 230V.

### Approval recommendation:

Such UPS systems with AC input and AC output fall within the scope of EN/IEC 62040-1. In the past, EN/IEC 62040-1 referred to EN/IEC 60950-1 with regard to electrical safety; both standards had to be applied together. In the last edition of 2017, however, the reference to IEC 62477-1 changed.

If such a system is also used in the USA, UL 1778 must be used. However, UL 1778 must currently still be applied together with UL 60950-1.

### Comments on other UPS systems:

UPS systems with AC input and DC output fall within the scope of EN/IEC 62040-5-1. Even though this standard is currently still in the draft stage, it can be seen that EN/IEC 62040-5-1 together with EN/IEC 62477-1 will also apply to these UPS systems with regard to electrical safety.

In the past, DC UPS modules in the lower power range (powers up to 1000W, for example for industrial control systems) were designed and evaluated in accordance with EN/IEC 60950-1. However, EN/IEC 62368-1 as the successor standard to EN/IEC 60950-1 excludes battery backup systems that are not an integral part of the system from the scope of application. For such DC UPS modules with DC input and DC output an approval according to EN/IEC/UL 61010-2-201 is recommended.

## Example 12: LED Lighting

The foyer of a building is to be equipped with LED lighting powered by mains voltage. The use of LED luminaires is associated with a significantly longer service life, a more controllable light quality and a considerably lower energy requirement and thus lower operating costs than the use of traditional light sources such as incandescent or fluorescent lamps. LEDs also have advantages over energy-saving lamps (compact fluorescent lamps) or fluorescent lamps in terms of environmentally friendly disposal, as they contain no mercury.
In contrast to incandescent lamps, as with fluorescent lamps, LEDs require a ballast (power supply) that converts the mains voltage into a suitable constant current or voltage DC supply for the LED light sources in order to operate them correctly.

### Approval recommendation:

The DIN EN/IEC 61347 series of standards applies to control gear (including ballasts) for LED light sources. The LED control gear must be designed in accordance with DIN EN/IEC 61347-2-13 (with reference to DIN EN/IEC 61347-1). LED control gear can be certified according to this series of standards by a testing laboratory. The standards are listed in the Official Journal of the EU and can be used for presumption of conformity under the Low Voltage Directive. The Low Voltage Directive is mandatory in Europe as soon as the supply voltage exceeds 75VDC or 50VAC.

EN/IEC/UL 60335-1 also applies if an LED control gear is installed in kitchen appliances.

For Europe, ENEC marking (European Norms Electrical Certification) is not mandatory, but would be an advantage. Compared to the CE mark, the ENEC mark is not a manufacturer's declaration, but is awarded by independent testing institutes. In addition to the technical characteristics, the manufacturer's quality assurance system and production are also regularly checked.

The IEC 61347 series of standards is not harmonized in North America. If a control gear is used here, UL 8750 is used. For power ratings below 100 W, additional certification to UL 1310 (NEC Class 2) is advantageous. See also example 7.

In countries outside Europe and North America, national approval can be obtained using the CB procedure. The J61347-1 for the PSE marking in Japan, the AS/NZ 61347-1 for the RCM marking in Australia and New Zealand as well as the EAC marking for the Eurasian economic area (Russia, Belarus and Kazakhstan) are particularly worth mentioning here.

.

| Basic Safety Standards for Power Supplies | | Ex. 1 | Ex. 2 | Ex. 3 | Ex. 4 | Ex. 5 | Ex. 6 | Ex. 7 | Ex. 8 | Ex. 9 | Ex. 10 | Ex. 11 | Ex. 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Status: August 2019 | | Industrial Switch Cabinet | Access Control | Tele-communications | SMPS with Communication | Medical Device | DC/DC Converter CAN Bus | Motion Detector | Chemical Plant, ATEX | Weighing System | Lubrication System | Backup Power System | LED Lights |
| IEC/UL/EN 62368-1 | Audio/Video, Information and Communication Technology | <x> | x | x | (x) | | (x) | <x> | | <x> | <x> | | |
| IEC/EN 62368-3 | Audio/Video, Information and Communication Technology - Communication Interfaces | | | (x) | x[a)] | | | | | | | | |
| IEC 60950-1 | Information Technology | (x) | | x | (x) | | (x) | (x) | (x) | (x) | (x) | (x) | |
| IEC/UL/EN 61010-1 | Measuring, Control, Regulation and Laboratory Equipment | | | | | | | | | x | | | |
| IEC/UL/EN 61010-2-201 | Special Requirements for Control Equipment | x | (x) | | x | | | | x | | x | | |
| IEC/UL/EN 60601-1 | Medical Devices | | | | | x | | | | | | | |
| IEC/EN 61204-7[b)] | Low Voltage Switching Power Supplies | (x) | (x) | (x) | (x) | | (x) | (x) | (x) | | (x) | | |
| IEC/EN 61558-2-16[c)] | Safety Transformers and Power Supplies | (x) | | | (x) | | | (x) | (x) | | (x) | | |
| IEC/EN 61347-1<br>UL 8750 | Lamps and Lighting Equipment | | | | | | | | | | | | x |
| IEC/EN 61347-2-13 | Controlgear for LED Modules | | | | | | | | | | | | x |
| IEC/UL/EN 60335-1 | Domestic Appliances | | x | | | | | x | | | | | (x) |
| IEC/EN 62040-1<br>UL 1778 | UPS - Uninterruptible Power Supply Systems | | | | | | | | | | | x | |
| UL 1310 | Class 2 Power Units | | <x> | | | | | <x> | | | | | <x> |
| IEC/UL/EN 60079-0/-7 | Explosive Atmosphere | | | | | | | | x | | | | |
| ANSI ISA 12.12.01 | Explosive Atmosphere - USA | | | | | | | | <x> | | | | |

X One or more of these standards are recommended
(x) Alternatively applicable, explanation see example texts
<x> Alternatively applicable outside Europe, see sample texts for explanation

a) Applicable to the section of the communication interface
b) see explanations in section 2.1
c) see explanations in section 2.2

# 7 An Overview of the Standards and Norms

The following list gives a brief overview of all standards and norms used or mentioned in this document. In addition, there are other standards that may be used. Individual device and project-specific research is required for this.

In the following list, only the titles of the standards and the associated committees are displayed in addition to the code numbers. It is always recommended to have a look at the table of contents, the introduction and the scope of the standard in order to get a complete picture. This information is available free of charge on the Internet.

### Helpful websites for researching norms and standards::

- VDE website: www.vde-verlag.de/normen
  Here you will find, among other things, tables of contents, introductions and areas of application for standards.
- Website of the IEC Webstore: https://webstore.iec.ch
  Here you will find information on IEC standards, including a PDF standard preview of the first pages containing application notes and references to other relevant standards.
- Website of the DKE: www.dke.de/de
  On this page you will also find information about the committees which work on these standards in Germany and internationally.
- Website with list of UL Standards: https://standardscatalog.ul.com
  Here you will find information on all UL standards, including information on harmonization with CSA and IEC standards or information on acceptance by ANSI (American National Standards Institute).
- EU website for harmonised standards: https://ec.europa.eu/growth/single-market/european-standards/harmonised-standards_en
  All relevant EN/IEC standards and guidelines for CE marking are listed here.

| | |
|---|---|
| 60065 | Audio, video and similar electronic apparatus - Safety requirements<br>(TC 108, K711) |
| 60079-0 | Explosive atmospheres - General requirements<br>(TC 31, K241, NEC 505) |
| 60079-7 | Explosive atmospheres - Equipment protection by increased safety „e“<br>(TC 31, K241, NEC 505) |
| 60335-1 | Safety of Household and Similar Appliances, Part 1: General Requirements<br>(TC 61, UK511.1) |
| 60601-1 | Medical Electrical Equipment, Part 1: General Requirements for Safety<br>(TC 62, SC 62A, UK812.1) |
| 60950-1 | (I.T.E.) Information technology equipment - Safety - Part 1: General requirements<br>(TC 108, K711) |
| 61010-1 | Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements<br>(TC 66, K911) |
| 61010-2-201 | Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-201: Particular requirements for control equipment<br>(TC 65, K911) |
| 61131-2 | Industrial-process measurement and control - Programmable controllers - Part 2: Equipment requirements and tests<br>(TC 65, SC 65B, K962) |
| 61204-7 | Low-voltage switch mode power supplies - Part 7: Safety requirements<br>(TC 22, SC 22E, K331) |
| 61347-1 | Lamp controlgear - Part 1: General and safety requirements<br>(TC 34, SC 34C, UK521.3) |

| | |
|---|---|
| 61347-2-13 | Lamp controlgear - Part 2-13: Particular requirements for d.c. or a.c. supplied electronic controlgear for LED modules (TC 34, SC 34C, UK521.3) |
| 61558-2-16 | Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V - Part 2-16: Particular requirements and tests for switch mode power supply units and transformers for switch mode power supply units (TC 96, K232) |
| 62040-1 | Uninterruptible power systems (UPS) - Part 1: Safety requirements (TC 22, SC 22H, K331) |
| 62368-1 | Audio/video, information and communication technology equipment - (TC 108x, K711) |
| 62368-3 | Audio/video, information and communication technology equipment - Part 3: Safety aspects for DC power transfer through communication cables and ports. (TC 108x, K711) |
| 62477-1 | Safety requirements for power electronic converter systems and equipment - Part 1: General requirements (TC 22, K331) |
| ANSI 12.12.01 | Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations (NEC 500) |
| UL 508 | Standard for Industrial Control Equipment |
| UL 1012 | Standard for Power Units Other Than Class 2 |
| UL 1310 | Standard for Class 2 Power Units |
| UL 1778 | Standard for Uninterruptible Power Systems |
| UL 2367 | Standard for Solid State Overcurrent Protectors |
| UL 8750 | Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products |

# 8 Recommended Reading

- UL Website:
  Transition from the 60950-1/60065 to the 62368-1
  https://ctech.ul.com/en/services/safety/62368-1-hazard-based-safety

- UL PDF Document:
  Transition from UL 508 to UL 61010-2-201
  https://industries.ul.com/wp-content/uploads/sites/2/2017/11/UL_IndustrialPowerSupply_149.02.0118.EN_.EPT_Digital.pdf

- EU Homepage for harmonised Standards:
  https://ec.europa.eu/growth/single-market/european-standards/harmonised-standards_de

# 9 Internet Rreferences

All websites were last visited on 23.08.2019

ZVEI:
Die Elektroindustrie

German Electrical and Electronic
Manufacturers' Association
Lyoner Strasse 9
60528 Frankfurt am Main, Germany
Telephone: +49 69 6302-0
Fax: +49 69 6302-317
E-mail: zvei@zvei.org
www.zvei.org

Source title: PULS GmbH, Würth Elektronik eiSos GmbH & Co. KG