IEC 63318

Edition 1.0 2022-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Specifications for SELV DC systems conforming to the ESMAP multi-tier framework tier 2 and tier 3 requirements for household electricity supply

Spécifications applicables aux schémas TBTS en courant continu conformes aux exigences de niveau 2 et de niveau 3 du cadre multiniveaux de L'ESMAP pour l'alimentation en électricité domestique

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CONTENTS

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SPECIFICATIONS FOR SELV DC SYSTEMS CONFORMING TO THE ESMAP MULTI-TIER FRAMEWORK TIER 2 AND TIER 3 REQUIREMENTS FOR HOUSEHOLD ELECTRICITY SUPPLY

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The text of this International Standard is based on the following documents:

Draft	Report on voting
SyCLVDC/104/CDV	SyCLVDC/118/RVC

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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INTRODUCTION

0.1 Electricity access initiatives

Access to electricity still remains a major challenge for a significant percentage of the human population. It is a key enabler of socio-economic development. United Nations' (UN) Sustainable Development Goal 7 attempts to "Ensure access to affordable, sustainable, reliable and modern energy for all" and a time-bound target for delivery is specifically stated in Target 7.1 which declares that "By 2030, ensure universal access to affordable, reliable and modern energy services".

The UN also recognises that access to energy is not just limited to an electricity supply connection, but rather the usability is indispensable and has mandated that such usability of the energy supply supporting energy access needs to have several technology-neutral attributes: it needs to be adequate in quantity, available when needed, of good quality, reliable, convenient, affordable, legal, healthy, and safe. In addition, the SE4ALL initiative under the UN delivering the SDG-7 goals has established a Multi-Tier framework which includes these attributes not just for quantifying access but also providing a basis for scaling electricity availability.

In addition, Target 7.2 declares that "By 2030, increase substantially the share of renewable energy in the global energy mix" and Target 7.3 states that "By 2030, double the global rate of improvement in energy efficiency". It is therefore obvious that technology is going to be the main driver for delivery of Target 7.2 and 7.3. While the Multi-Tier Framework attempts to be technology-agnostic, the delivery of the afore-mentioned targets ensures that technology cannot be ignored.

0.2 Motivation

The IEC is an advocate of safe electricity supply and has helped to ensure affordable and sustainable electricity supply through its multiple standards. Standards ensure delivery of an electrical eco-system that is well understood in the marketplace, provides acceptable level of service and availability, ensures sustainability and at the same time enables affordability through competing products in the market place and economies of scale.

Standards are applied in many countries throughout the world. IEC International Standards are used routinely in legislation and regulation and are used to support public policy initiatives.

0.3 IEC's role and philosophy

Considering IEC's role as a standards developer with experts in standards and technology, it is imperative that IEC present a framework for electricity access which will provide a set of minimal requirements that ensure that all the attributes associated with electricity supply are addressed. This will help in adoption of solutions that are affordable, scalable and sustainable besides providing support for legislation and regulation. It is hoped that this will also help with investments in this sector to enable delivery of the targets faster than envisioned.

From a standards perspective, the technical committees of IEC are responsible for preparing the required standards. However, a broader solution such as the delivery of energy access based on the Multi-Tier framework is beyond the scope of a single committee within IEC and needs a systems committee to work with technical committees and create a Systems Reference Deliverable which will draw upon the standards of multiple technical committees and call out those particular aspects of a standard that are relevant to a related use case. The resulting document will reflect the accumulated expertise of all the relevant technical committees but restricted to specific use cases. This will help in identifying gaps and creating standards enabling delivery and future amendments easier and faster.

This document is framed in such a manner to include renewable energy and enable higher energy efficiency by adopting a purely DC-based approach rather than conventional AC-based approaches for power delivery and therefore this document will also address Target 2 and Target 3 of SDG-7 goals. With the use of distributed energy sources such as photovoltaics and wind, DC power is naturally made available and loads are increasingly DC based (e.g. LED lamps and TVs). Further, storage using batteries is also inherently DC. Enabling the interconnection of DC sources, storage and loads driven with DC power using a purely DC-based system is a natural and efficient alternative to conventional AC-based approaches. A pure DC-based approach can be deployed much faster, is scalable and can be easily integrated into the utility grid infrastructure when it eventually becomes available.

IEC is constantly developing standards that respond to market needs. This document collates all the relevant standards from IEC technical committees and subcommittees in a coherent manner. This document provides international funding agencies with a reference International Standard, which is a critical need for developing economies struggling with electricity access.

SPECIFICATIONS FOR SELV DC SYSTEMS CONFORMING TO THE ESMAP MULTI-TIER FRAMEWORK TIER 2 AND TIER 3 REQUIREMENTS FOR HOUSEHOLD ELECTRICITY SUPPLY

1 Scope

This document specifies electrical systems that are intended to be used for electricity access and not connected to a public network such as product kits up to 35 V DC as specified in IEC 62257-9-5 and IEC 62257-9-8 for Tier 2 of the ESMAP Muti-Tier Framework for household electricity supply; and/or 48 V DC fixed installations, for Tier 3 of the ESMAP Muti-Tier Framework for household electricity supply.

This document applies to Tier 2 and Tier 3 installations using SELV DC systems.

2 Normative references

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 60364 (all parts), *Low-voltage electrical installations*

IEC 60364-4-43, *Low-voltage electrical installations – Part 4-43: Protection for safety – Protection against overcurrent*

IEC 60445, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors*

IEC 60884-2-4, *Plugs and socket-outlets for household and similar purposes – Part 2-4: Particular requirements for plugs and socket-outlets for SELV*

IEC 60906-3, *IEC System of plugs and socket-outlets for household and similar purposes – Part 3: SELV plugs and socket-outlets, 16 A 6 V, 12 V, 24 V, 48 V, a.c. and d.c.*

IEC 61056-1, *General purpose lead-acid batteries (valve-regulated types) – Part 1: General requirements, functional characteristics – Methods of test*

IEC TS 61200-101, *Electrical installation guide – Part 101: Application guidelines on extra low-voltage direct current electrical installations not intended to be connected to a public distribution network*

IEC 61215 (all parts), *Terrestrial photovoltaic (PV) modules – Design qualification and type approval*

IEC 61427-1, *Secondary cells and batteries for renewable energy storage – General requirements and methods of test – Part 1: Photovoltaic off-grid application*

IEC 61951-2, *Secondary cells and batteries containing alkaline or other non acid electrolytes – Secondary sealed cells and batteries for portable applications – Part 2: Nickel-metal hydride*

IEC 61960-3, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications – Part 3: Prismatic and cylindrical lithium secondary cells and batteries made from them*

IEC TS 62257-9-5, *Recommendations for renewable energy and hybrid systems for rural electrification – Part 9-5: Integrated systems – Laboratory evaluation of stand-alone renewable energy products for rural electrification*

IEC TS 62257-9-8, *Renewable energy and hybrid systems for rural electrification – Part 9-8: Integrated systems – Requirements for stand-alone renewable energy products with power ratings less than or equal to 350 W*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
rated voltage
rated value of the voltage assigned by the manufacturer to a component, device or equipment and to which operation and performance characteristics are referred

Note 1 to entry: Equipment may have more than one rated voltage value or may have a rated voltage range.

[SOURCE: IEC 60050-442:2014, 442-09-10, modified – Note 2 to entry has been deleted.]

3.2
enclosure
housing affording the type and degree of protection suitable for the intended application

[SOURCE: IEC 60050-151:2001, 151-13-08]

3.3
extra-low voltage
ELV
voltage not exceeding the relevant voltage limit of band I specified in IEC 61140 but not exceeding 60 V DC

[SOURCE: IEC 60050-826:2004, 826-12-30, modified – The words "IEC 60449" have been replaced with "IEC 61140 but not exceeding 60 V DC".]

3.4
kit
series of components needed to make a set that performs a defined function

3.5
SELV system
electric system in which the voltage cannot exceed the value of extra-low voltage:

– under normal conditions and
– under single-fault conditions, including earth faults in other electric circuits

Note 1 to entry: SELV is the abbreviation for safety extra-low voltage.

[SOURCE: IEC 60050-195:2021, 195-06-28]

4 Status and objectives

The content of this document is dedicated to Tier 2 and Tier 3 use cases of ESMAP Multi-Tier Framework. Statements and requirements are based on technology known at the date of its development.

The generic requirements for ESMAP tiers and attributes are shown in Table 1.

Table 1 – Attributes of access related to electricity energy supply for households as given in the Multi-Tier framework

Attribute	Tier 2	Tier 3
Power capacity ratings (W or daily Wh)	Minimum peak power delivery of 50 W Minimum energy delivery of 200 Wh per day	Minimum peak power delivery of 200 W Minimum energy delivery of 1 000 Wh per day
Availability (duration)	Minimum 4 h per day; minimum 2 h in the evening	Minimum 8 h per day; minimum 3 h in the evening
Reliability	No stated requirement	No stated requirement
Quality	IEC Standards on EMC shall be applied	IEC Standards on EMC shall be applied
Affordability	No stated requirement	Cost of standard consumption package of 365 kWh per year should be less than 5 % of household income
Legality	No stated requirement	No stated requirement
Health and Safety	No stated requirement	No stated requirement

5 Typical use cases and system architectures

5.1 General

The system has distributed energy source(s) using a PV panel and/or battery for storage. The power conversion sub-system is designed such that the voltage levels at each of the interfaces to the PV panel, storage and the delivery interfaces, are operated at the correct voltages.

Figure 1 shows example of the architecture of a circuit of the DC system that can address the requirements for Tier 3 of the Multi-Tier Framework.

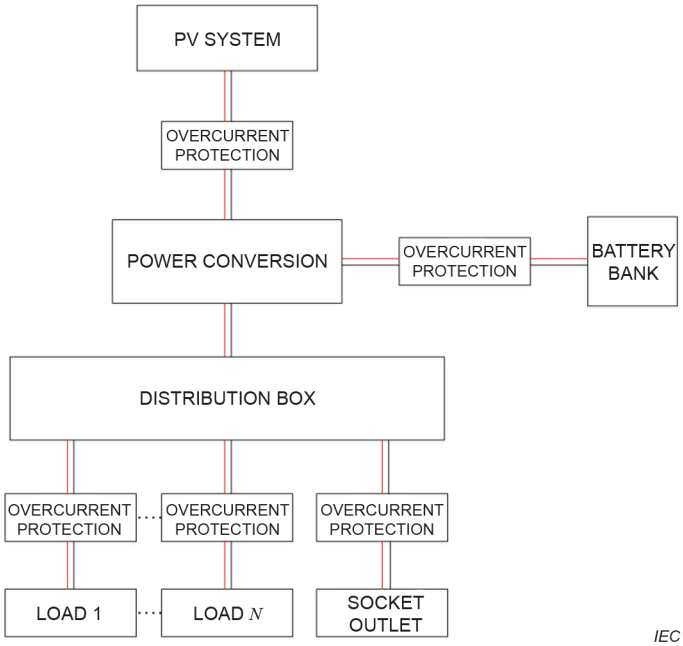

Figure 1 – Example of the architecture of a circuit of the DC system that can address the requirements for Tier 3 of the Multi-Tier Framework

5.2 Typical use cases

5.2.1 Kit (Tier 2)

All the different blocks are typically packaged together and supplied as a single unit. The power control, conversion and storage are typically assembled in a single enclosure and loads are supplied through connectors, flexible cables or socket-outlets. In some cases, the loads can be integral to the enclosure or can be mounted directly on the enclosure (see Figure 2).

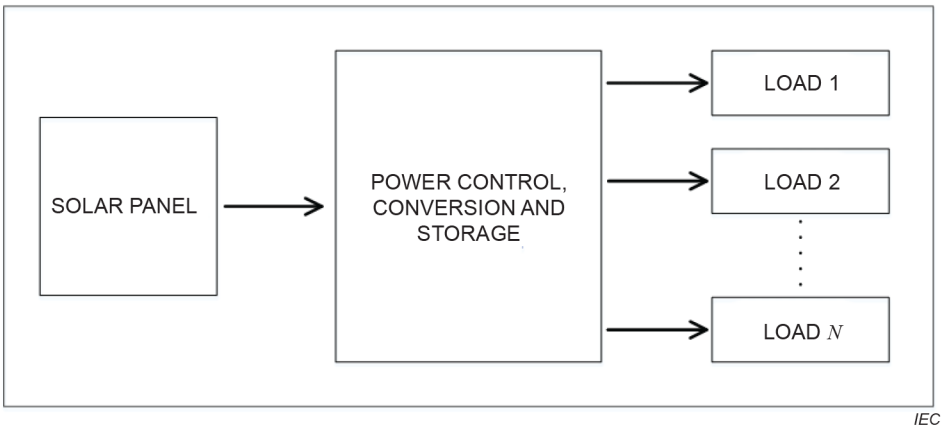

Figure 2 – Block diagram of a kit

5.2.2 House (Tier 3)

For a house, a distribution system is required as the loads are distributed across multiple rooms. Power conversion can be required to supply the individual loads.