



IEC 60364-8-81

Edition 1.0 2026-02

INTERNATIONAL STANDARD

HORIZONTAL PUBLICATION

**Low-voltage electrical installations -
Part 8-81: Functional aspects - Energy efficiency**

CONTENTS

FOREWORD	4
INTRODUCTION	6
81 Energy efficiency	7
81.1 Scope	7
81.2 Normative references	7
81.3 Terms and definitions	8
81.3.1 General	8
81.3.2 Electrical energy management	10
81.3.3 Energy measurement	10
81.3.4 Sectors of activity	11
81.3.5 Abbreviated terms	12
81.4 General	12
81.4.1 Fundamental principles	12
81.4.2 Energy efficiency assessment for electrical installations	13
81.5 Sectors of activities	13
81.6 Design requirements and recommendations	14
81.6.1 General	14
81.6.2 Determination of load energy profile	14
81.6.3 Determination of the transformer and switchboard location with an optimizing method	14
81.6.4 HV/LV substation	14
81.6.5 Losses in the wiring	15
81.6.6 Efficiency of local production and local storage	16
81.7 Determination of the zones, usages and meshes	17
81.7.1 Determining the zones	17
81.7.2 Determining the usages within the identified zones	17
81.7.3 Demand response	17
81.7.4 Determining the meshes	18
81.7.5 Driving parameters	20
81.7.6 Impacts on the design of an electrical installation	20
81.8 Energy efficiency and load management system	21
81.8.1 General	21
81.8.2 User specification	21
81.8.3 Inputs from loads, sensors and forecasts	22
81.8.4 Inputs from the supplies: energy availability and pricing	29
81.8.5 Monitoring the performance of the electrical installation	29
81.8.6 Management of loads through meshes	30
81.8.7 Multi-supply source management: grid, local electricity production and storage	30
81.9 Maintenance and enhancement of the performance of the installation	31
81.9.1 Methodology	31
81.9.2 Installation life cycle methodology	32
81.9.3 Energy efficiency life cycle	33
81.9.4 Data management	33
81.9.5 Maintenance	33
81.10 Parameters for implementation of efficiency measures	34
81.10.1 General	34

8.1.10.2 Efficiency measures	34
8.1.11 Energy efficiency actions	39
Annex A (informative) Determination of transformer and switchboard location	40
A.1 Barycentre method	40
A.2 Total load barycentre	43
A.2.1 General	43
A.2.2 Sub-distribution board locations	44
A.2.3 Iterative process	44
A.3 Method of average route length	44
A.4 Minimum energy moment method	47
A.4.1 General	47
A.4.2 Calculation of load centre coordinates	48
A.4.3 Minimum total energy moment and minimum average load distance of the system	48
A.4.4 Example	48
A.4.5 Principle derivation	50
Annex B (normative) Method to assess the energy efficiency of an electrical installation	54
B.1 General	54
B.2 Electrical installation efficiency classes	54
B.3 Determination of the electrical installation efficiency class	54
B.3.1 General	54
B.3.2 Industrial, commercial buildings and infrastructures	55
B.3.3 Residential	70
Annex C (informative) List of notes concerning certain countries	77
Bibliography	78
 Figure 1 – Classification levels for energy efficiency installations	6
Figure 2 – Energy efficiency and load management system overview	21
Figure 3 – Electrical distribution scheme	24
Figure 4 – Example of measurement equipment selection in an installation	26
Figure 5 – Iterative process for electrical energy efficiency management	31
Figure A.1 – Example 1: floor plan of production plant with the planned loads and calculated barycentre	42
Figure A.2 – Example 2: barycentre calculated	43
Figure A.3 – Example use of the barycentre method in an industrial building	44
Figure A.4 – Example use of the average route length method	46
Figure A.5 – Example use of the minimum total energy moment and minimum average load distance of the system	49
Figure A.6 – Relationship between the system's total energy moment and the system's minimum energy moment	52
Figure B.1 – Level of efficiency of the electrical installation efficiency classes	54
 Table 1 – Measurement applications	23
Table 2 – Overview of the needs for power metering and monitoring	24
Table 3 – Process for electrical energy efficiency management and responsibilities	32
Table A.1 – Cable length for supply of DB	45

Table B.1 – Electrical installation efficiency classes	55
Table B.2 – Energy efficiency measures	55
Table B.3 – Determination of energy consumption: coverage	56
Table B.4 – Main substation: consumption	57
Table B.5 – Main substation: location	57
Table B.6 – Method of average route length	58
Table B.7 – Voltage drop	58
Table B.8 – Efficiency of transformer	59
Table B.9 – Efficiency of current-using equipment	60
Table B.10 – Zone	60
Table B.11 – Usage	61
Table B.12 – Demand response: coverage	61
Table B.13 – Demand response: duration	62
Table B.14 – Meshes	62
Table B.15 – Measurement by usages	63
Table B.16 – Occupancy coverage	63
Table B.17 – Occupancy measurement	63
Table B.18 – Energy management system (EEMS)	64
Table B.19 – HVAC control	65
Table B.20 – Lighting control	65
Table B.21 – Performance maintenance process	65
Table B.22 – Frequency of the performance verification process	66
Table B.23 – Data management	66
Table B.24 – Working point of transformer	67
Table B.25 – Presence of continuous monitoring for large energy using systems	67
Table B.26 – Power factor	68
Table B.27 – THD_U	68
Table B.28 – THD_I	68
Table B.29 – Renewable energy source	69
Table B.30 – Electrical energy storage	70
Table B.31 – Energy efficiency measures parameters	70
Table B.32 – Determination of energy consumption	71
Table B.33 – Zones	71
Table B.34 – Demand response coverage	72
Table B.35 – Meshes	72
Table B.36 – Measurement by usages	73
Table B.37 – HVAC control	73
Table B.38 – Lighting control	74
Table B.39 – Renewable energy	74
Table B.40 – Electrical energy storage	75
Table B.41 – Degree of self-sufficiency	76

INTERNATIONAL ELECTROTECHNICAL COMMISSION

Low-voltage electrical installations - Part 8-81: Functional aspects - Energy efficiency

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 60364-8-81 has been prepared by IEC technical committee 64: Electrical installations and protection against electric shock. It is an International Standard.

This first edition cancels and replaces the second edition of IEC 60364-8-1 published in 2019. This edition constitutes a technical revision.

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

- a) modified numbering that allows IEC 60364-7 subparts to amend this document;
- b) alignment of the definitions with IEC 60050-826;
- c) introduction of minimum energy moment method in Annex A;
- d) improvements in Annex B;

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

Draft	Report on voting
64/2799/FDIS	64/2818/RVD

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/publications.

It has the status of a group energy efficiency publication in accordance with IEC Guide 118.

A list of all parts in the IEC 60364 series, published under the general title *Low-voltage electrical installations*, can be found on the IEC website.

The reader's attention is drawn to the fact that Annex C lists all of the "in-some-country" clauses on differing practices of a less permanent nature relating to the subject of this document.

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

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

The optimization of electrical energy usage can be facilitated by appropriate design and installation considerations. An electrical installation can provide the required level of service and safety for the lowest electrical consumption. This is considered by designers as a general requirement of their design procedures in order to establish the best use of electrical energy. In addition to the many parameters taken into account in the design of electrical installations, more importance is nowadays focused on reducing losses within the system and its use. It is important therefore that the design of the whole installation takes into account inputs from users, suppliers and utilities.

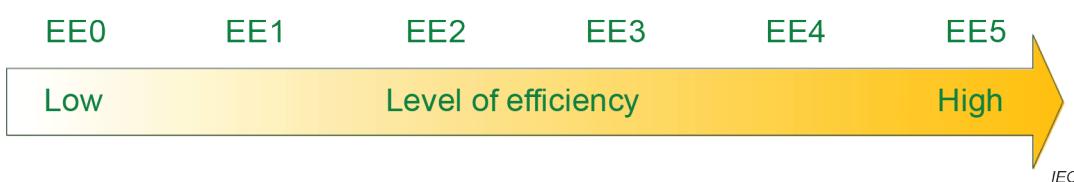
It is important that this document covers existing electrical installations in buildings, in addition to new installations. It is in the refurbishment of existing buildings that significant overall improvements in energy efficiency can be achieved.

The optimization of the use of electricity is based on energy efficiency management, which is based on the price of electricity, electrical consumption and real-time adaptation. Efficiency is checked by measurement during the whole life of the electrical installation. This helps identify opportunities for any improvements and corrections. Improvements and corrections can be implemented by redesign or equipment replacement. The aim is to provide a design for an efficient electrical installation which allows an energy management process to suit the user's needs, and in accordance with an acceptable investment. This document first introduces the different measures to provide an energy efficient installation based on kilowatt-hour (kWh) saving. It then provides guidance on giving priority to the measures depending on the return of investment, in other words the saving of electrical energy and reduction of electrical power costs divided by the amount of investment.

This document is intended to provide requirements and recommendations for the electrical part of the energy management system addressed by ISO 50001.

It introduces requirements, recommendations and methods for the design and the energy efficiency assessment of an electrical installation within the framework of an energy efficiency management approach in order to get the best permanent functionally equivalent service for the lowest electrical energy consumption and the most acceptable energy availability and economic balance.

The assessment method described in Annex B based on the electrical energy efficiency of the installation allows a classification of an energy efficiency installation according to the levels in Figure 1.



NOTE Account can be taken, if appropriate, of induced works (civil works, compartmentalization) and the necessity to expect, or not, the modifiability of the installation.

Figure 1 – Classification levels for energy efficiency installations

This document introduces requirements and recommendations to design the adequate installation in order to give the tenant or the user or, for example, the energy manager the ability to improve the management of the energy performance of the installation.

All requirements and recommendations of this document enhance the requirements contained in Parts 1 to 8 of the IEC 60364 series.

81 Energy efficiency

81.1 Scope

This part of IEC 60364 provides additional requirements, measures and recommendations for the design, erection, operation and verification of all types of low-voltage electrical installation including local production and storage of energy for optimizing the overall efficient use of electricity.

It introduces requirements, recommendations and methods for the design and the energy efficiency (EE) assessment of an electrical installation within the framework of an energy efficiency management approach in order to get the best permanent functionally equivalent service for the lowest electrical energy consumption and the optimal availability and acceptable cost-effectiveness.

These requirements, recommendations and methods apply, within the scope of the IEC 60364 series, for new installations and modification of existing installations.

This document is applicable to the electrical installation of a building or system and does not apply to products. The energy efficiency of products and their operational requirements are covered by the relevant product standards.

It is possible that another standard provides specific requirements for a particular system or installation application (e.g. manufacturing system covered by ISO 20140 series).

This document does not specifically provide requirements for building automation systems. The contribution of building automation systems to improve energy efficiency of the installation is considered.

This group energy efficiency publication is primarily intended to be used as an energy efficiency standard for the low-voltage electrical installations mentioned in the scope, but is also intended to be used by technical committees in the preparation of publications, in accordance with the principles laid down in IEC Guide 118.

81.2 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 60688, *Electrical measuring transducers for converting AC and DC electrical quantities to analogue or digital signals*

IEC 61557-12, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC - Equipment for testing, measuring or monitoring of protective measures - Part 12: Power metering and monitoring devices (PMD)*

IEC 61869-2, *Instrument transformers - Part 2: Additional requirements for current transformers*

IEC 62053-21, *Electricity metering equipment - Particular requirements - Part 21: Static meters for AC active energy (classes 0,5, 1 and 2)*

IEC 62053-22, *Electricity metering equipment - Particular requirements - Part 22: Static meters for AC active energy (classes 0,1 S, 0,2 S and 0,5 S)*

Bibliography

IEC 60034-30-1, *Rotating electrical machines - Part 30-1: Efficiency classes of line operated AC motors (IE code)*

IEC 60050-826, *International Electrotechnical Vocabulary (IEV) - Part 826: Electrical installations* (available at <http://www.electropedia.org>)

IEC 60050-881:1983, *International Electrotechnical Vocabulary (IEV) - Part 881: Radiology and radiological physics* (available at <http://www.electropedia.org>)

IEC TS 60076-20, *Power transformers - Part 20: Energy efficiency*

IEC 60287-3-2, *Electric cables - Calculation of the current rating - Part 3-2: Sections on operating conditions - Economic optimization of power cable size*

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

IEC 60364-5-52:2009, *Low-voltage electrical installations - Part 5-52: Selection and erection of electrical equipment - Wiring systems*

IEC 60364-5-55:2011, *Electrical installations of buildings - Part 5-55: Selection and erection of electrical equipment - Other equipment*

IEC 60364-6, *Low voltage electrical installations - Part 6: Verification*

IEC 60364-7-712, *Low voltage electrical installations - Part 7-712: Requirements for special installations or locations - Solar photovoltaic (PV) power supply systems*

IEC 60947-6-1, *Low-voltage switchgear and controlgear - Part 6-1: Multiple function equipment - Transfer switching equipment*

IEC 61800-9-1, *Adjustable speed electrical power drive systems - Part 9-1: Ecodesign for power drive systems, motor starters, power electronics and their driven applications - General requirements for setting energy efficiency standards for power driven equipment using the extended product approach (EPA) and semi analytic model (SAM)*

IEC 61800-9-2, *Adjustable speed electrical power drive systems (PDS) - Part 9-2: Ecodesign for motor systems - Energy efficiency determination and classification*

IEC 62586-1, *Power quality measurement in power supply systems - Part 1: Power quality instruments (PQI)*

IEC 62962, *Particular requirements for load-shedding equipment (LSE)*

IEC 62974-1, *Monitoring and measuring systems used for data collection, aggregation and analysis - Part 1: Device requirements*

IEC 62991, *Particular requirements for source switching equipment (SSE)*

IEC 63345, *Energy efficiency systems - Simple external consumer display*

IEC 63402 (all parts), *Energy efficiency - Customer energy management systems*

ISO 20140 (all parts), *Automation systems and integration - Evaluating energy efficiency and other factors of manufacturing systems that influence the environment*

ISO 50001, *Energy management systems - Requirements with guidance for use*

ISO 50006, *Energy management systems - Evaluating energy performance using energy performance indicators and energy baselines*

ISO 52120-1, *Energy performance of buildings - Contribution of building automation, controls and building management - Part 1: General framework and procedures*

NEMA guide TP1, *Guide for Determining Energy Efficiency for Distribution Transformers*

IEEE C57.12.00-2000 *IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers*
