



International
Standard

ISO 5474-2

**Electrically propelled road
vehicles — Functional and safety
requirements for power transfer
between vehicle and external
electric circuit —**

**Part 2:
AC power transfer**

*Véhicules routiers à propulsion électrique — Exigences
fonctionnelles et exigences de sécurité pour le transfert de
puissance entre le véhicule et le circuit électrique externe —*

Partie 2: Transfert de puissance AC

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 22 *Road vehicles*, Subcommittee SC 37 *Electrically propelled vehicles*.

A list of all parts in the ISO 5474 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Electrically propelled road vehicles — Functional and safety requirements for power transfer between vehicle and external electric circuit —

Part 2: AC power transfer

1 Scope

This document in combination with ISO 5474-1 specifies requirements for conductive power transfer using alternating current (AC) with a voltage up to 1 000 V a.c. between electrically-propelled road vehicles and external electric circuits.

NOTE External electric circuits are not part of the vehicle.

This document provides requirements for conductive charging in modes 2, 3 according to IEC 61851-1 and reverse power transfer.

This document applies to vehicle power supply circuits. Examples of circuit diagrams for different configurations of chargers on-board electric vehicles are shown in [Annex A](#).

This document also provides requirements for reverse power transfer through on-board standard socket-outlets and/or a EV plug or vehicle inlet according to IEC 62196-1 or IEC 62196-2 conductively connected to the vehicle power supply circuit. Requirements for AC power transfer using a charger without at least simple separation are under consideration.

This document does not provide:

- requirements for simultaneous operation of multiple EV plugs or vehicle inlets and
- requirements for power transfer while driving (electric road systems)

but they are under consideration.

This document does not provide:

- requirements for mopeds and motorcycles (which are specified in ISO 18246);
- comprehensive safety information for manufacturing, maintenance and repair personnel;
- requirements for vehicle to load adapters.

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.

ISO 5474-1:2024, *Electrically propelled road vehicles — Functional requirements and safety requirements for power transfer — Part 1: General requirements for conductive power transfer*

ISO 6469-3:2021, *Electrically propelled road vehicles — Safety specifications — Part 3: Electrical safety*

IEC 60038, *IEC standard voltages*

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

IEC 60364-8-82:2022, *Low-voltage electrical installations — Part 8-82: Functional aspects - Prosumer's low-voltage electrical installations*

IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage supply systems — Part 1: Principles, requirements and tests*

IEC 60898-1:2015, *Electrical accessories — Circuit-breakers for overcurrent protection for household and similar installations — Part 1: Circuit-breakers for a.c. operation*

IEC 61851-1:2017, *Electric vehicle conductive charging system — Part 1: General requirements*

IEC 62196-1, *Plugs, socket-outlets, vehicle connectors and vehicle inlets — Conductive charging of electric vehicles — Part 1: General requirements*

IEC 62196-2, *Plugs, socket-outlets, vehicle connectors and vehicle inlets — Conductive charging of electric vehicles — Part 2: Dimensional compatibility and interchangeability requirements for a.c. pin and contact-tube accessories*

ISO 15118 (all parts), *Road vehicles — Vehicle to grid communication interface*

IEC 60364-5-54, *Low-voltage electrical installations — Part 5-54: Selection and erection of electrical equipment — Earthing arrangements and protective conductors*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5474-1 and the following apply.

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

— ISO Online browsing platform: available at <https://www.iso.org/obp>

— IEC Electropedia: available at <https://www.electropedia.org/>

3.1

active factor

$\cos \varphi$

for a two-terminal element or a two-terminal circuit under sinusoidal conditions, ratio of the active power to the apparent power

[SOURCE: IEC 60050-131:2002, 131-11-49, modified — The symbol “ $\cos \varphi$ ” was added and the note deleted.]

3.2

protective separation

electrically protective separation

separation of one electric circuit from another by means of:

- double insulation; or
- basic insulation and electrically protective screening (shielding); or
- reinforced insulation

[SOURCE: IEC 60050-826:2004, 826-12-29]

3.3
vehicle-to-load
V2L

power transfer from the vehicle power supply circuit to at least one external electric load, where the load is assumed to be without permanent connection to protective earth

Note 1 to entry: The external electric load can be connected to the vehicle power supply circuit via an on-board standard socket-outlet, or the vehicle inlet, directly or using a *V2L adapter* (3.4).

3.4
V2L adapter

equipment which connects to the vehicle power supply circuit using the vehicle inlet and provides at least one standard socket-outlet for external electric loads

3.5
grid forming mode

mode of reverse power transfer not in parallel with the supply network

3.6
grid following mode

mode of reverse power transfer in parallel and following the operational parameters of the supply network

3.7
isolation

disconnection providing adequate insulation between electrical equipment, a system, an installation or part of an installation and their energy sources

[SOURCE: IEC 60050-195:2021, 195-06-23]

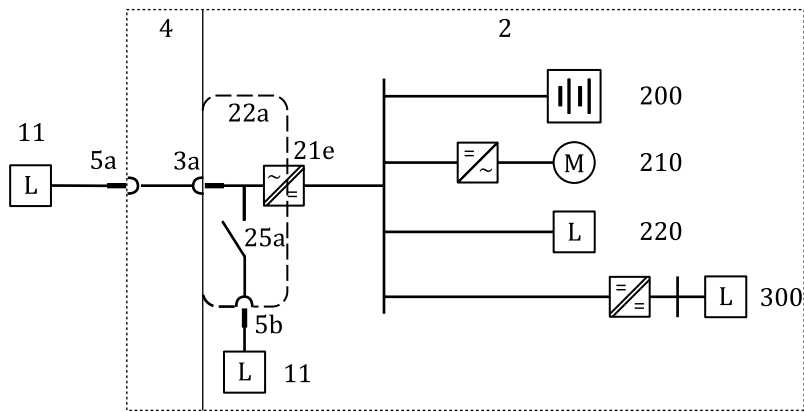
4 System architecture

ISO 5474-1:2024, Clause 4 applies except as follows:

An example of vehicle-to-load AC reverse power transfer (AC reverse power transfer in grid forming mode to unearthed external circuit) is provided in [Figure 1](#).

An example of vehicle-to-grid AC reverse power transfer (AC reverse power transfer in grid following mode to earthed external circuit) is provided in [Figure 2](#).

An example of of vehicle-to-home AC reverse power transfer (AC reverse power transfer in grid forming mode or grid following mode to earthed external circuit) is provided in [Figure 3](#).



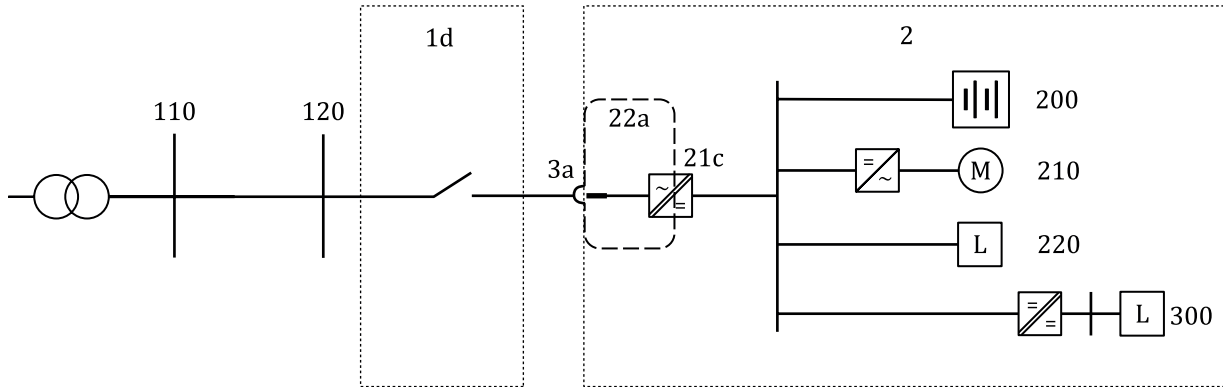
Key

- 2 vehicle
- 3a AC vehicle coupler
- 4 V2L adapter
- 5a socket-outlet provided by V2L adapter and standard plug
- 5b standard socket-outlet provided on-board the vehicle and standard plug
- 11 external electric load
- 21e bidirectional power converter with at least simple separation in grid forming mode
- 22a vehicle power supply circuit
- 25a disconnection device
- 200 RESS
- 210 electric drive
- 220 other voltage class B electric loads
- 300 voltage class A electric loads

Figure 1 — Single-line diagram of example of vehicle-to-load AC reverse power transfer (AC reverse power transfer in grid forming mode to unearthed external circuit)

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Key

- 1d AC EV supply equipment capable of reverse power transfer function grid connected
- 2 vehicle
- 3a AC vehicle coupler
- 21c bidirectional power converter with at least simple separation in grid following mode
- 22a vehicle power supply circuit
- 110 public network
- 120 local distribution
- 200 RESS
- 210 electric drive
- 220 other voltage class B electric loads
- 300 voltage class A electric loads

Figure 2 — Single-line diagram of example of vehicle-to-grid AC reverse power transfer (AC reverse power transfer in grid following mode to earthed external circuit)

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