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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 —

Part 2: AC power transfer

FDIS stage

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Contents

Foreword

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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.

Electrically propelled road vehicles — Functional and safety requirements for power transfer between vehicle and external electric circuit ~~— Part 2: AC power transfer —~~

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~~-000V AC~~ 000 V a.c. between electrically-propelled road vehicles and external electric circuits.

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

NOTE External electric circuits are not part of the vehicle.

This document applies to the 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 power transfer interfaces 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:—[1], *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*

[1] First edition under preparation. Stage at the time of publication: ISO/FDIS 5474-1:2023.

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~~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*

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 φ
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 φ” 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
~~**residual current device**~~
~~**RCD**~~
~~mechanical switching device designed to make, carry and break currents under normal service conditions and to cause the opening of the contacts when the residual current attains a given value under specified conditions.~~

~~Note 1 to entry: A residual current device can be a combination of various separate elements designed to detect and evaluate the residual current and to make and break current.~~

~~[SOURCE: IEC 60050-442:1998, 442-05-02, modified — The phrase "or association of devices" was removed and the Note 1 to entry was added.]~~

~~**3.4**~~
vehicle-to-load
~~(~~**V2L**~~)~~
power transfer from the vehicle power supply circuit to at least one external electric load~~. The~~, 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.~~5~~ 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.~~6~~ 5
grid forming mode
mode of reverse power transfer not in parallel with the supply network~~.~~

3.~~7~~ 6
grid following mode
mode of reverse power transfer in parallel and following the operational parameters of the supply network~~.~~

3.~~8~~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:—[2], Clause 4 applies except as follows.

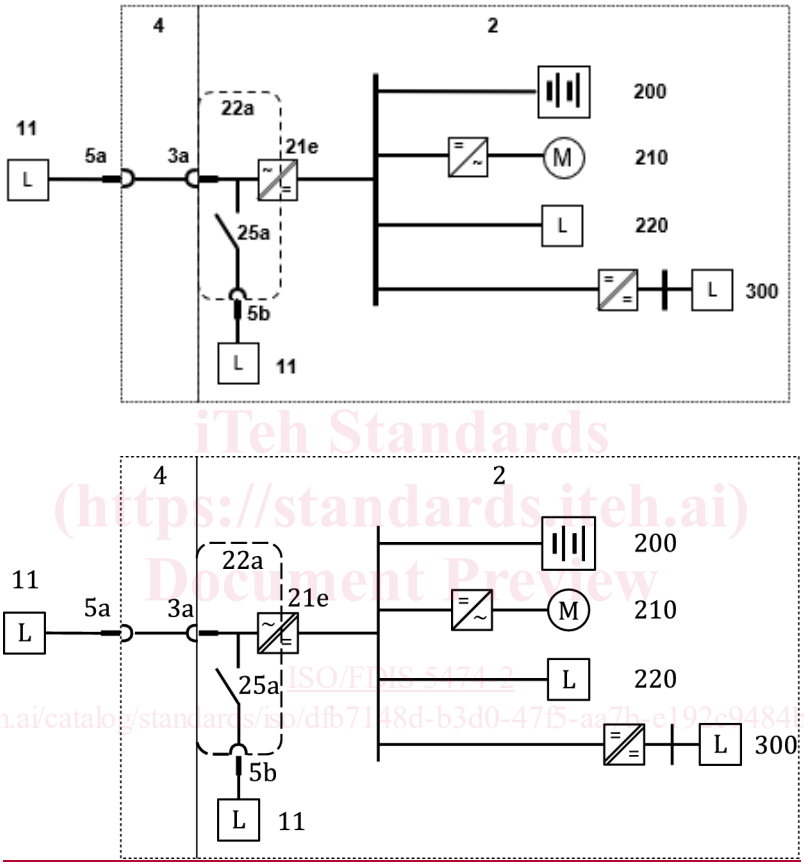
Addition:

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

[2] First edition under preparation. Stage at the time of publication: ISO/FDIS 5474-1:~~2023~~2024.

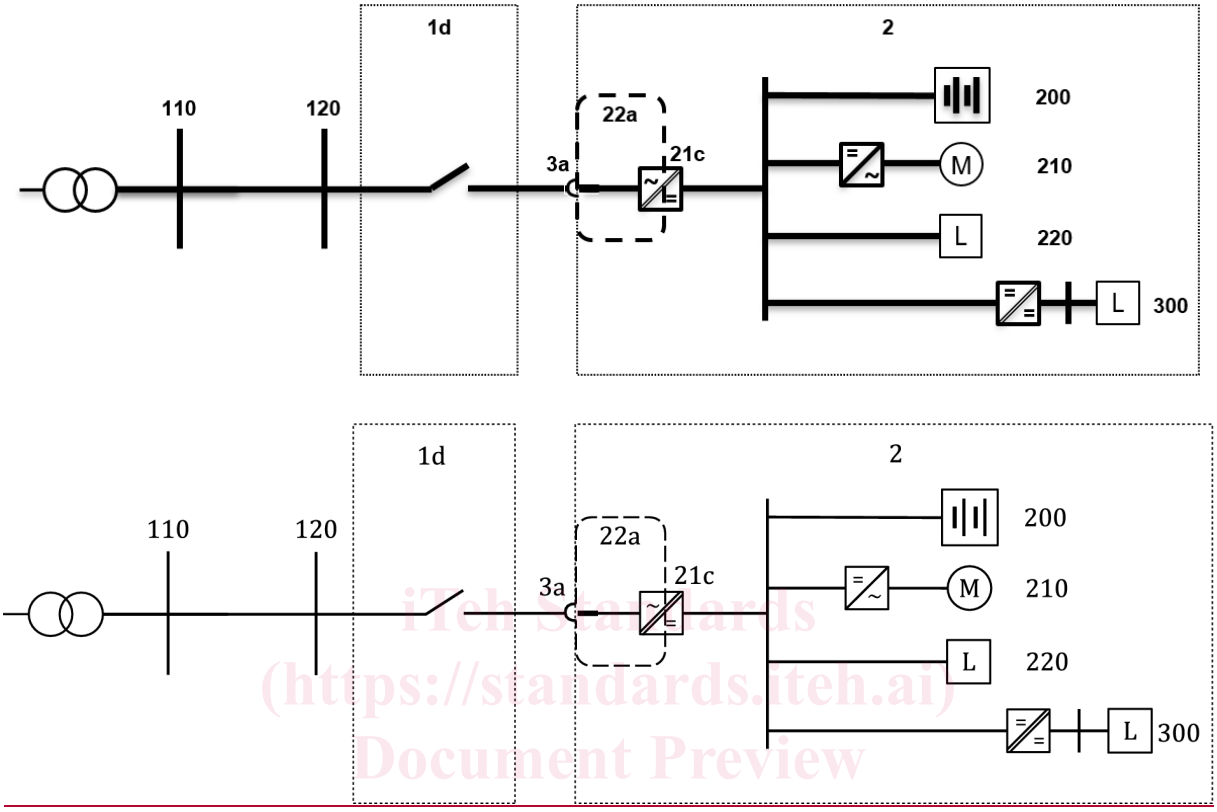
An example for of vehicle-to-home AC reverse power transfer (AC reverse power transfer in grid forming mode or grid following mode to earthed external circuit) is provided in Figure 3.



Key

2	EV
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	AC 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

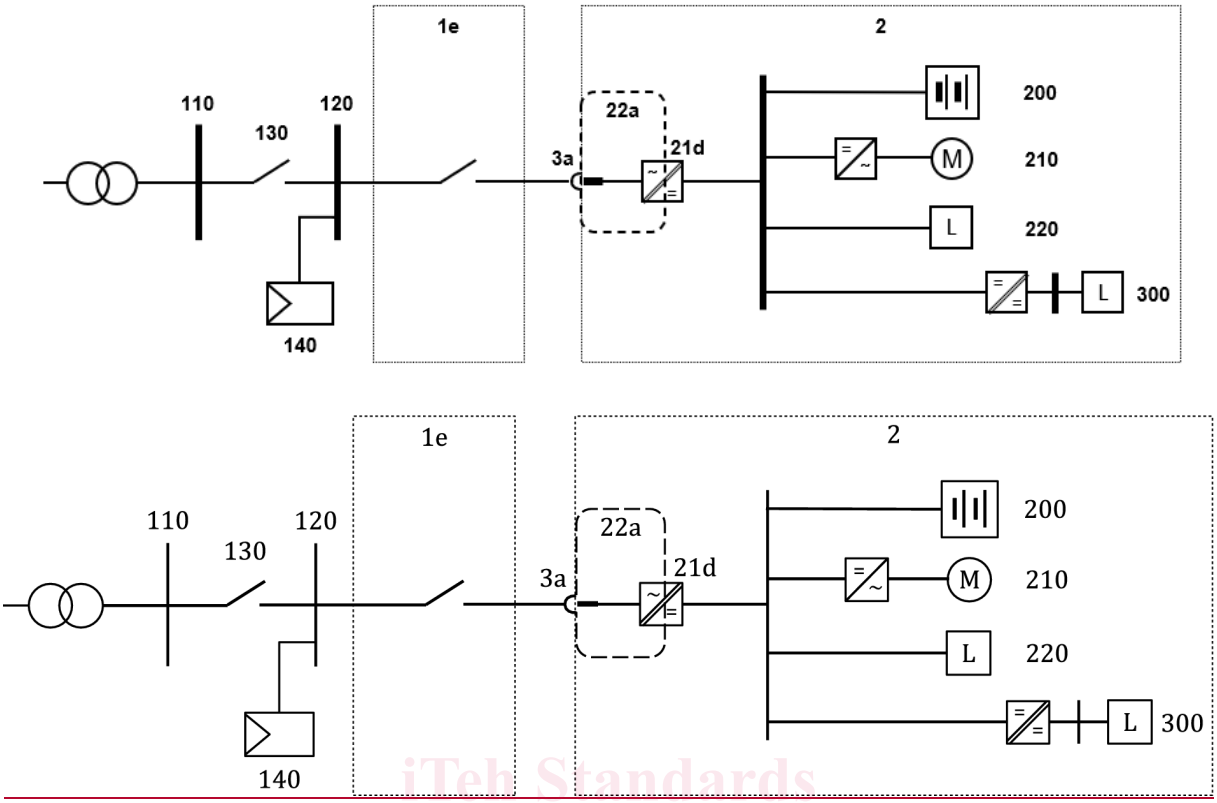
Figure 1 — Single-line diagram of example of vehicle-to-load AC reverse power transfer (AC reverse power transfer in grid forming mode to unearthed external circuit)



Key

1d	AC EV supply equipment capable of RPT function grid connected
2	EV
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)



Key

1e	AC EV supply equipment capable of RPT function islanded without grid connection
2	EV
3a	AC vehicle coupler
21d	bidirectional power converter with at least simple separation in grid forming mode or grid following mode
22a	vehicle power supply circuit
110	public network
120	local distribution
130	switching device for islanding
140	PV system
200	RESS
210	electric drive
220	other voltage class B electric loads
300	voltage class A electric loads

Figure 3 — Single-line diagram of example of vehicle-to-home AC reverse power transfer (AC reverse power transfer in grid forming mode or grid following mode to earthed external circuit)

5 Environmental and operational conditions

ISO 5474-1:—[3],—, Clause 5 applies.

[3] First edition under preparation. Stage at the time of publication: ISO/FDIS 5474-1:2023.

6 General safety requirements

6.1 General

ISO 5474-1:—[4], Clause —, 6.1 applies.

6.2 Protection of persons against electric shock

6.2.1 General

ISO 5474-1:—[5], Clause —, 6.2.1 applies except as follows.

Addition:

The vehicle shall provide at least protective separation between the live parts of the vehicle power supply circuit and voltage class A circuits as provision for basic and fault protection.

The vehicle shall provide at least simple separation between the live parts of the vehicle power supply circuit and other voltage class B2 circuits as provision for fault protection.

6.2.2 Compatibility with external safety devices

NOTE 1 The protective provisions of the vehicle are co-ordinatedcoordinated with an EV supply equipment which complies with IEC 62752 for mode 2 and IEC 62955 for mode 3.

Compatibility with continuity checking of the protective conductor shall be achieved by limiting the Y-capacitance according to 6.2.4clause .

NOTE 2 High Y-capacitance of the vehicle power supply circuit can interfere with continuity checking of the protective conductor.

6.2.3 Insulation resistance

~~6.3.1 Insulation resistance~~

ISO 5474-1:—[6], Clause —, 6.2.3 applies.

~~6.3.1~~6.2.4 Touch current

ISO 5474-1:—[7], Clause —, 6.2.4 applies except as follows.

Replacement of the last paragraph:

Conformance shall be tested in accordance with 13.5clause .

EV supply equipment may contribute to the touch current for mode 2 charging with a value up to 1 mA in case of loss of continuity of protective conductor, refer to IEC 62752.

NOTE In normal condition, the resistance of the earth electrode in a TT earthing system can have a value up to 166 Ω, see note in 411.5.1 of IEC 60364-4-41:20152005+AMD1:2017, 411.5.1, NOTE.

~~6.3.2~~6.2.5 Insulation coordination

ISO 5474-1:—[8], Clause —, 6.2.5 applies except as follows.

Addition:

[4] First edition under preparation. Stage at the time of publication: ISO/FDIS 5474-1:2023.
[5] First edition under preparation. Stage at the time of publication: ISO/FDIS 5474-1:2023.
[6] First edition under preparation. Stage at the time of publication: ISO/FDIS 5474-1:2023.
[7] First edition under preparation. Stage at the time of publication: ISO/FDIS 5474-1:2023.
[8] First edition under preparation. Stage at the time of publication: ISO/FDIS 5474-1:2023.