

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Electric vehicle wireless power transfer (WPT) systems –
Part 2: Specific requirements for MF-WPT system communication and activities**

**Systèmes de transfert de puissance sans fil (WPT) pour véhicules électriques –
Partie 2: Exigences spécifiques pour la communication et les activités des
systèmes MF-WPT**



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2023 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Electric vehicle wireless power transfer (WPT) systems –
Part 2: Specific requirements for MF-WPT system communication and activities**

**Systèmes de transfert de puissance sans fil (WPT) pour véhicules électriques –
Partie 2: Exigences spécifiques pour la communication et les activités des
systèmes MF-WPT**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 43.120

ISBN 978-2-8322-6858-2

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	7
INTRODUCTION.....	9
1 Scope.....	10
2 Normative references	10
3 Terms and definitions	11
4 Abbreviated terms	14
5 General system structure and interoperability concept.....	14
5.1 System structure.....	14
5.2 Interoperability concept.....	15
6 General communication requirements.....	15
7 Communication procedure during an MF-WPT session	16
7.1 General.....	16
7.2 Activities	18
7.2.1 Communication setup	18
7.2.2 Fine positioning	18
7.2.3 Pairing.....	23
7.2.4 Authorization and service selection.....	29
7.2.5 Final compatibility check.....	30
7.2.6 Alignment check	31
7.2.7 Prepare power transfer	33
7.2.8 Perform power transfer	34
7.2.9 Stop power transfer	38
7.2.10 Terminate communication.....	39
7.2.11 WPT spot vacancy detection.....	39
7.2.12 Time scheduled power transfer.....	40
7.2.13 Safety monitoring and diagnostics	41
7.2.14 Wake-up after power outage.....	43
7.3 Exception handling.....	43
7.3.1 General	43
7.3.2 Exception descriptions.....	44
7.3.3 Supply device exception handling (WPT_S_ERR).....	45
7.3.4 EV device exception handling (WPT_V_ERR).....	46
Annex A (informative) Use cases	47
A.1 General.....	47
A.2 Use case descriptions	48
A.2.1 UC select supply device	48
A.2.2 UC compatibility check	48
A.2.3 UC fine positioning	49
A.2.4 UC prepare power transfer	50
A.2.5 UC safety monitoring and diagnostics	51
A.2.6 UC perform power transfer	52
A.2.7 UC stop power transfer	52
A.2.8 UC sleep mode (optional)	53
Annex B (informative) Physical definition of links and signals.....	55
B.1 General.....	55
B.2 System architecture	55

B.3	WLAN	55
B.4	LF signal.....	55
B.5	LPE	57
B.6	Power check	58
B.7	External confirmation means.....	58
Annex C (informative) Methods of P2PS signaling		59
C.1	General.....	59
C.2	Fine positioning	59
C.2.1	General	59
C.2.2	Manual	59
C.2.3	LF positioning emitted by EV	59
C.2.4	LF positioning emitted by supply device.....	62
C.2.5	LF parameter exchange	63
C.2.6	Low power excitation (LPE)	66
C.3	Pairing	67
C.3.1	General	67
C.3.2	Coding pattern specification.....	67
C.3.3	Low power excitation (LPE)	68
C.3.4	LF signal	68
C.3.5	External confirmation	69
C.4	Alignment check	70
C.4.1	General	70
C.4.2	Power check.....	70
C.4.3	LPE	71
Annex D (normative) State diagrams of WPT process		72
D.1	General.....	72
D.2	Supply device state definitions.....	72
D.2.1	Supply device state diagram.....	72
D.2.2	System On (WPT_S_ON).....	72
D.2.3	Session initiated (WPT_S_SI).....	73
D.2.4	Awaiting alignment (WPT_S_AA).....	73
D.2.5	Idle (WPT_S_IDLE)	73
D.2.6	Power transfer active (WPT_S_PTA)	73
D.2.7	Power transfer (WPT_S_PT).....	73
D.2.8	Service terminated occupied (WPT_S_STO).....	73
D.2.9	System Off (WPT_S_OFF).....	74
D.2.10	Sleep (WPT_S_SLP)	74
D.2.11	StandBy (WPT_S_STBY).....	74
D.3	Supply device state transitions.....	74
D.3.1	General	74
D.3.2	TS_03 and TS_10.....	76
D.3.3	TS_04 and TS_05.....	76
D.3.4	TS_06.....	77
D.3.5	TS_07, TS_09 and TS_12.....	77
D.3.6	TS_08, TS_14 and TS_16.....	78
D.3.7	TS_13.....	79
D.3.8	TS_11.....	80
D.3.9	TS_15.....	80
D.3.10	TS_17.....	81

D.4	EV device state definitions	82
D.4.1	EV device state diagram	82
D.4.2	System On (WPT_V_ON)	82
D.4.3	Session initiated (WPT_V_SI)	82
D.4.4	Awaiting alignment (WPT_V_AA)	83
D.4.5	Idle (WPT_V_IDLE)	83
D.4.6	Power transfer active (WPT_V_PTA)	83
D.4.7	Power transfer (WPT_V_PT)	83
D.4.8	Sleep (WPT_V_SLP)	83
D.4.9	Standby (WPT_V_STBY)	83
D.4.10	System Off (WPT_V_OFF)	83
D.5	EV state transitions	83
D.5.1	General	83
D.5.2	TV_03	84
D.5.3	TV_05	85
D.5.4	TV_06	85
D.5.5	TV_07 and TV_15	86
D.5.6	TV_08, TV_14 and TV_16	87
D.5.7	TV_04 and TV_09	88
D.5.8	TV_10	89
D.5.9	TV_11	89
D.5.10	TV_17	90
Annex E (informative)	Marking of primary device	91
E.1	General	91
E.2	Requirements for detectability	92
E.3	Usage for positioning – Parameter setting and message exchange	92
E.4	Usage for pairing	93
E.4.1	General	93
E.4.2	Parameter setting and message exchange	93
Bibliography		94
Figure 1	– Example of system structure	15
Figure 2	– Chain of activities	17
Figure 3	– Natural offset with different coil geometries	20
Figure 4	– Sequence of parameter exchange for pairing using LPE	25
Figure 5	– Sequence of parameter exchange for pairing using LF signal emitted by the EV/EV device	26
Figure 6	– Sequence of parameter exchange for pairing using LF signal emitted by the primary device	27
Figure 7	– Sequence of parameter exchange for pairing using active optical means (e.g., LED)	28
Figure 8	– Sequence of parameter exchange for pairing using passive optical means (e.g., marker at primary device)	29
Figure 9	– Sequence of parameter exchange for pairing using external confirmation	29
Figure 10	– MF-WPT control system	35
Figure 11	– Classification of system events	43
Figure A.1	– Use cases specific to wireless power transfer	47

Figure B.1 – Example arrangement of the auxiliary LF receivers/transmitters for the primary device and the vehicle.....	56
Figure B.2 – Example arrangement of the auxiliary LF transmitters/receivers for the primary device and the EV	57
Figure C.1 – Example OOK data modulation	60
Figure C.2 – Generalized Manchester encoding	60
Figure C.3 – Example LF signal data format for fine positioning	61
Figure C.4 – Example Explanation of parameters for LF fine positioning	65
Figure C.5 – Coding pattern timing and examples	67
Figure C.6 – Example LF signal data format for pairing.....	68
Figure D.1 – Supply device state diagram	72
Figure D.2 – Transition TS_03 and TS_10	76
Figure D.3 – Transition TS_04 and TS_05	76
Figure D.4 – Transition TS_06	77
Figure D.5 – Transition TS_07, TS_09, TS_12	78
Figure D.6 – Transition TS_08, TS_14, TS_16	79
Figure D.7 – Transition TS_13	79
Figure D.8 – Transition TS_11	80
Figure D.9 – Transition TS_15	81
Figure D.10 – Transition TS_17	82
Figure D.11 – EV device state diagram	82
Figure D.12 – Transition TV_03	85
Figure D.13 – Transition TV_05	85
Figure D.14 – Transition TV_06	86
Figure D.15 – Transition TV_07, TV_15	87
Figure D.16 – Transition TV_08, TV_14, TV_16	88
Figure D.17 – Transition TV_04 and TV_09	88
Figure D.18 – Transition TV_10	89
Figure D.19 – Transition TV_11	90
Figure D.20 – Transition TV_17	90
Figure E.1 – Example for a marking for a primary device	92
Table 1 – Fine positioning setup data from EV	21
Table 2 – Fine positioning setup data from SECC	22
Table 3 – Data transfer during positioning.....	23
Table 4 – Pairing parameters provided by the EVCC to the SECC	24
Table 5 – Pairing parameters provided by the SECC to the EVCC	24
Table 6 – Final compatibility parameters from EV	31
Table 7 – Final compatibility check parameters from SECC	31
Table 8 – Alignment check parameter sent by the EVCC.....	33
Table 9 – Alignment check response parameters sent by the SECC.....	33
Table 10 – Symbols for MF-WPT control system	35
Table 11 – MF-WPT controller inputs and outputs	36
Table 12 – Relative response time for control loops	36

Table 13 – Perform power transfer request parameters.....	37
Table 14 – Perform power transfer response parameters	38
Table 15 – Exception handling	44
Table 16 – Error respond parameters.....	46
Table 17 – Error request parameters	46
Table A.1 – UC select supply device	48
Table A.2 – UC compatibility check.....	49
Table A.3 – UC fine positioning.....	50
Table A.4 – UC prepare power transfer	51
Table A.5 – UC safety monitoring and diagnostics	52
Table A.6 – UC perform power transfer	52
Table A.7 – UC stop power transfer	53
Table A.8 – UC sleep mode	54
Table C.1 – Additional LF fine positioning setup parameter from EV	63
Table C.2 – Additional LF fine positioning setup data from SECC	64
Table C.3 – Additional LF positioning data exchange	66
Table D.1 – Supply device state transitions.....	74
Table D.2 – EV device state transitions.....	83

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRIC VEHICLE WIRELESS POWER
TRANSFER (WPT) SYSTEMS –****Part 2: Specific requirements for MF-WPT
system communication and activities**

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) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 61980-2 has been prepared by IEC technical committee 69: Electrical power/energy transfer systems for electrically propelled road vehicles and industrial trucks. It is an International Standard.

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

Draft	Report on voting
69/881/FDIS	69/896/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/standardsdev/publications.

In this document, the following print types are used:

- compliance statement: *italic type*;
- transitions in the state diagrams for infrastructure and vehicle: **bold type**;
- states: **bold type**.

A list of all parts of the IEC 61980 series, published under the general title *Electric vehicle wireless power transfer (WPT) systems*, can be found on the IEC website.

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,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The IEC 61980 series is published in separate parts according to the following structure:

- IEC 61980-1 covers general requirements for electric road vehicle (EV) wireless power transfer (WPT) systems including general background and definitions. (e.g. efficiency, electrical safety, EMC, EMF);
- IEC 61980-2 specifically applies to magnetic field wireless power transfer (MF-WPT) for electric road vehicles (EV) and covers specific system requirements including activities and communication between the electric road vehicle side and the off-board side including general background and definitions;
- IEC 61980-3 covers specific power transfer requirements for the off-board side of magnetic field wireless power transfer systems for electric road vehicles (e.g. efficiency, electrical safety, EMC, EMF).

Requirements for on-board side of MF-WPT for electric road vehicles are covered in ISO 19363.

This document has a structure that is independent of IEC 61980-1.

Reference to "technology specific parts" always refer to other parts of the IEC 61980 series.

ELECTRIC VEHICLE WIRELESS POWER TRANSFER (WPT) SYSTEMS –

Part 2: Specific requirements for MF-WPT system communication and activities

1 Scope

This part of IEC 61980 addresses communication and activities of magnetic field wireless power transfer (MF-WPT) systems.

The requirements in this document are intended to be applied for MF-WPT systems according to IEC 61980-3 and ISO 19363.

The aspects covered in this document include

- operational and functional characteristics of the MF-WPT communication system and related activities, and
- operational and functional characteristics of the positioning system.

The following aspects are under consideration for future documents:

- requirements for two- and three-wheel vehicles;
- requirements for MF-WPT systems supplying power to EVs in motion;
- requirements for bidirectional power transfer.

NOTE Any internal communication at supply device or EV device is not in the scope of this document.

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 61980-1, *Electric vehicle wireless power transfer (WPT) systems – Part 1: General requirements*

IEC 61980-3:2022, *Electric vehicle wireless power transfer (WPT) systems – Part 3: Specific requirements for magnetic field wireless power transfer systems*

ISO 15118-20, *Road vehicles – Vehicle to grid communication interface – Part 20: 2nd generation network layer and application layer requirements*

ISO 15118-8:2020, *Road vehicles – Vehicle to grid communication interface – Part 8: Physical layer and data link layer requirements for wireless communication*