

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Wireless power transfer – AirFuel Alliance resonant baseline system specification (BSS)**

**(standards.iteh.ai)**

**Transfert d'énergie sans fil – Spécification du système de référence (BSS) pour le système résonant d'AirFuel Alliance**

<https://standards.iteh.ai/catalog/standards/sist/946e1408-853a-4104-8922-1c32fc61e464/iec-63028-2017>



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2017 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 Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://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](http://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 It also gives information on projects, replaced and withdrawn publications.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](http://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](http://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](mailto:sales@iec.ch).

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary on electrotechnology, containing more than 22,000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

#### IEC Glossary - [std.iec.ch/glossary](http://std.iec.ch/glossary)

67,000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

### 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](http://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](http://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](http://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](mailto:sales@iec.ch).

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

#### Glossaire IEC - [std.iec.ch/glossary](http://std.iec.ch/glossary)

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Wireless power transfer – AirFuel Alliance resonant baseline system specification (BSS)**  
**(standards.iteh.ai)**

**Transfert d'énergie sans fil – Spécification du système de référence (BSS) pour le système résonant d'AirFuel Alliance**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 29.240.99; 33.160.99; 35.200

ISBN 978-2-8322-8732-3

**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, definitions, symbols and abbreviated terms.....	10
3.1 Terms and definitions.....	10
3.2 Symbols and abbreviated terms .....	13
3.2.1 Symbols .....	13
3.2.2 Abbreviated terms .....	17
4 System description .....	17
5 Conformance and backwards compatibility .....	18
6 Device types.....	19
6.1 PTU classification .....	19
6.2 PRU category .....	20
7 Power transfer specifications .....	21
7.1 System equivalent circuit and reference parameters .....	21
7.2 General system requirements .....	21
7.2.1 Operating frequency .....	21
7.2.2 $Z_{TX\_IN}$ relationship to $R_{RECT}$ .....	21
7.2.3 Power stability.....	21
7.2.4 PTU co-location protection.....	21
7.2.5 PRU self-protection (informative).....	21
7.3 Resonator requirements.....	22
7.3.1 Resonator coupling efficiency (RCE) .....	22
7.3.2 PTU resonator requirements.....	22
7.3.3 PRU resonator requirements .....	24
7.4 Load parameters.....	26
7.4.1 Load parameters introduction .....	26
7.4.2 Minimum load resistance .....	26
7.4.3 Maximum allowable dynamic load.....	26
7.4.4 Maximum load capacitance.....	26
8 Power control specifications .....	27
8.1 Control objectives .....	27
8.2 PTU specifications .....	27
8.2.1 PTU state .....	27
8.2.2 General state requirements .....	27
8.2.3 PTU power save state.....	29
8.2.4 PTU Low Power state .....	31
8.2.5 PTU Power Transfer state .....	31
8.2.6 PTU Configuration state .....	34
8.2.7 PTU Local Fault state .....	35
8.2.8 PTU latching fault state .....	35
8.2.9 PTU state transitions .....	36
8.2.10 PTU Test Mode.....	39
8.3 PRU specifications.....	39
8.3.1 PRU general requirements.....	39

8.3.2	PRU state model .....	42
8.3.3	Null state .....	43
8.3.4	PRU boot.....	43
8.3.5	PRU On state .....	44
8.3.6	PRU System Error state.....	44
8.3.7	PRU state transitions .....	45
9	Signaling specifications .....	46
9.1	Architecture and state diagrams.....	46
9.1.1	Architecture .....	46
9.1.2	Overall charge process .....	47
9.2	Charge procedure and requirements .....	49
9.2.1	Removing PRU from WPT network .....	49
9.2.2	Power Sharing mode .....	49
9.3	Bluetooth low energy requirements .....	50
9.3.1	Bluetooth low energy requirements introduction .....	50
9.3.2	Bluetooth low energy objectives.....	50
9.3.3	PTU hardware requirement.....	50
9.3.4	PRU hardware requirement.....	50
9.3.5	Basic network structure .....	50
9.3.6	RF requirements.....	50
9.3.7	Timing and sequencing requirements .....	51
9.3.8	Profile structure .....	54
9.4	BLE profile definition.....	54
9.4.1	GATT sub-procedure .....	54
9.4.2	Configuration .....	54
9.4.3	PRU requirements .....	55
9.4.4	PTU requirements.....	56
9.4.5	Connection establishment.....	56
9.4.6	Security considerations.....	58
9.4.7	Charge completion.....	58
9.5	WPT service characteristics .....	59
9.5.1	WPT service characteristics introduction.....	59
9.5.2	PRU advertising payload .....	59
9.5.3	WPT service .....	61
9.5.4	PRU control.....	63
9.5.5	PTU static parameter .....	65
9.5.6	PRU static parameter characteristic.....	70
9.5.7	PRU dynamic parameter characteristic .....	73
9.5.8	PRU alert characteristic.....	77
9.6	Cross connection algorithm.....	79
9.6.1	Cross connection algorithm introduction .....	79
9.6.2	Definitions .....	79
9.6.3	Acceptance of advertisement.....	79
9.6.4	Impedance shift sensing .....	79
9.6.5	Reboot bit handling.....	80
9.6.6	Time set handling .....	80
9.7	Mode transition .....	81
9.7.1	Mode transition introduction.....	81
9.7.2	Mode transition procedure .....	81

9.7.3	BLE reconnection procedure.....	81
10	PTU resonators .....	84
10.1	PTU resonators introduction.....	84
10.2	Class <i>n</i> design template .....	84
10.2.1	Class <i>n</i> design template introduction.....	84
10.2.2	Table of specifications .....	84
10.2.3	PTU resonator structure .....	84
10.3	Approved PTU resonators .....	84
Annex A (informative)	Reference PRU for PTU acceptance testing .....	85
A.1	Category 1 .....	85
A.2	Category 2 .....	85
A.3	Category 3 .....	85
A.3.1	PRU design 3-1 .....	85
A.3.2	Geometry.....	85
A.4	Category 4 .....	88
A.5	Category 5 .....	88
Annex B (informative)	Lost power .....	89
B.1	Overview.....	89
B.2	General.....	89
B.3	Cross connection issues.....	89
B.4	Handoff issues.....	89
B.5	Power noise issues.....	90
B.6	PTU lost power calculation.....	90
B.6.1	Lost power detection threshold.....	90
B.6.2	Lost power detection speed.....	90
B.6.3	PTU lost power calculation.....	90
B.6.4	PTU power transmission detection accuracy.....	90
B.6.5	PRU lost power reports.....	91
B.6.6	Accuracy of reported power .....	91
B.6.7	Other PRU lost power reports .....	91
Annex C (normative)	User experience requirements .....	92
C.1	General.....	92
C.2	User indication.....	92
C.2.1	PRU user indication .....	92
C.2.2	PTU user indication .....	92
Annex D (informative)	RCE calculations.....	93
D.1	RCE calculation (using S-parameters) .....	93
D.2	RCE calculation (using Z-parameters).....	94
D.2.1	Series tuned case .....	95
D.2.2	Other RCE calculations.....	95
D.3	Conversion between S-parameters and Z-parameters .....	95
Figure 1	– Wireless power transfer system.....	18
Figure 2	– PTU-PRU resonator $P_{TX\_IN}$ .....	19
Figure 3	– PTU-PRU resonator $P_{RX\_OUT}$ .....	20
Figure 4	– Equivalent circuit and system parameters .....	21
Figure 5	– PTU resonator-load considerations .....	24

Figure 6 – PTU state model .....	27
Figure 7 – Beacon sequences .....	29
Figure 8 – Load variation detection .....	30
Figure 9 – Discovery .....	31
Figure 10 – PTU $I_{TX}$ transition responses.....	32
Figure 11 – PRU state model .....	42
Figure 12 – $V_{RECT}$ operating regions .....	43
Figure 13 – Basic architecture of WPT system .....	47
Figure 14 – Basic state procedure (informative) .....	48
Figure 15 – Registration period timeline example (informative) .....	53
Figure 16 – PTU/PRU services/characteristics communication.....	55
Figure 17 – PRU mode transition – Device Address field set to a non-zero value.....	82
Figure 18 – PRU mode transition – Device Address field set to all zeros.....	83
Figure A.1 – PRU design 3 block diagram .....	85
Figure A.2 – Front view .....	86
Figure A.3 – Back view .....	86
Figure A.4 – Side view .....	87
Figure A.5 – Front view, coil only .....	87
Figure A.6 – Side view, coil only.....	87
Table 1 – PTU classification.....	20
Table 2 – PRU category.....	20
Table 3 – Minimum RCE (percent and dB) between PRU and PTU.....	22
Table 4 – Maximum load capacitance .....	26
Table 5 – Time requirement to enter PTU Power Transfer state .....	28
Table 6 – Sub-state of PTU Power Transfer .....	32
Table 7 – PTU latching faults .....	38
Table 8 – Example of accuracy of reported current .....	42
Table 9 – PRU system errors .....	46
Table 10 – RF budget (informative).....	51
Table 11 – Timing constraints .....	53
Table 12 – BLE profile characteristics .....	54
Table 13 – GATT sub-procedure .....	54
Table 14 – PRU advertising payload .....	59
Table 15 – Impedance shift bit .....	61
Table 16 – WPT service UUID .....	61
Table 17 – WPT service .....	62
Table 18 – GAP service .....	63
Table 19 – GATT service .....	63
Table 20 – PRU Control Characteristic.....	64
Table 21 – Detail: bit field for enables .....	64
Table 22 – Detail: bit field for permission .....	65
Table 23 – Detail: bit field for time set.....	65

IEC STANDARD PREVIEW  
 (standards.iteh.ai)

[IEC 63028:2017](#)

[standards.iteh.ai/catalog/standards/sist/946e1408-853a-4104-8922-](#)

[1c32861e464/iec-63028-2017](#)

Table 24 – PTU reporting static values to PRU .....	66
Table 25 – Detail: bit field for optional fields validity.....	66
Table 26 – PTU power .....	67
Table 27 – Max source impedance.....	68
Table 28 – Max load resistance .....	69
Table 29 – AirFuel protocol revision field .....	70
Table 30 – PTU number of devices .....	70
Table 31 – PRU reporting static values to the PTU .....	71
Table 32 – Detail: bit field for optional fields validity.....	71
Table 33 – Detail: bit field for PRU information .....	72
Table 34 – PRU dynamic parameter characteristic.....	74
Table 35 – Detail: bit field for optional fields validity.....	74
Table 36 – Detail: bit field for PRU alert.....	76
Table 37 – Detail: bit field for PRU alert.....	77
Table 38 – Test mode commands .....	77
Table 39 – PRU alert fields .....	78
Table 40 – Detail: bit field for PRU alert notification .....	78
Table 41 – Mode transition.....	79
Table A.1 – PRU table of specifications .....	85

**iteh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[IEC 63028:2017](https://standards.iteh.ai/catalog/standards/sist/946e1408-853a-4104-8922-1c32fc61e464/iec-63028-2017)

<https://standards.iteh.ai/catalog/standards/sist/946e1408-853a-4104-8922-1c32fc61e464/iec-63028-2017>



## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## WIRELESS POWER TRANSFER – AIRFUEL ALLIANCE RESONANT BASELINE SYSTEM SPECIFICATION (BSS)

### 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.

International Standard IEC 63028 has been prepared by technical area 15: Wireless power transfer, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

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

FDIS	Report on voting
100/2901/FDIS	100/2941/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://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 publication 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.**

## **iTeh STANDARD PREVIEW (standards.iteh.ai)**

[IEC 63028:2017](#)

<https://standards.iteh.ai/catalog/standards/sist/946e1408-853a-4104-8922-1c32fc61e464/iec-63028-2017>

## INTRODUCTION

In today's world, mainstream consumer mobile devices are ubiquitously supported by wireless technologies for data communication and connectivity functions while charging function is primarily supported by wired technologies. The development of wireless power transfer technologies offers increased user convenience for charging mobile devices; technologies include inductive, resonant, uncoupled (RF, ultrasonic, laser) methods.

IEC 63028 defines a specific wireless charging approach based on resonant technology and specifies technical requirements for the AirFuel™<sup>1</sup> resonant wireless power transfer (WPT) systems.

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[IEC 63028:2017](#)

<https://standards.iteh.ai/catalog/standards/sist/946e1408-853a-4104-8922-1c32fc61e464/iec-63028-2017>

---

<sup>1</sup> AirFuel™ is the trade name of a product supplied by AirFuel Alliance. This information is given for the convenience of users of this document and does not constitute an endorsement by IEC of the product named.

# WIRELESS POWER TRANSFER – AIRFUEL ALLIANCE RESONANT BASELINE SYSTEM SPECIFICATION (BSS)

## 1 Scope

This document defines technical requirements, behaviors and interfaces used for ensuring interoperability for flexibly coupled wireless power transfer (WPT) systems for AirFuel Resonant WPT. This document is based on AirFuel Wireless Power Transfer System Baseline System Specification (BSS) v1.3.

Products implementing this document are expected to follow applicable regulations and global standards.

## 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.

AirFuel Wireless Power Transfer System Baseline System Specification (BSS) v1.3 [viewed 2017-03-13]. Available at: <http://www.airfuel.org/technologies/specification-download>

AirFuel Wireless Power Transfer System Baseline System Specification (BSS) v1.2.1 [viewed 2017-03-13]. Available at: <http://www.airfuel.org/technologies/specification-download>

Bluetooth core specification v4.0, or later versions as they are available [viewed 2017-03-13]. Available at: [https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc\\_id=229737](https://www.bluetooth.org/docman/handlers/downloaddoc.ashx?doc_id=229737)

CSA4, or later versions as they are available [viewed 2017-03-13]. Available at: [https://www.bluetooth.org/docman/handlers/DownloadDoc.ashx?doc\\_id=269452](https://www.bluetooth.org/docman/handlers/DownloadDoc.ashx?doc_id=269452)

## 3 Terms, definitions, symbols and abbreviated terms

### 3.1 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 <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1.1

##### **advertisement**

connectable, undirected advertising event where the device transmits three WPT service specific ADV\_IND packets and accepts both scan requests and connect requests

Note 1 to entry: There is one ADV\_IND packet transmitted on each of the advertising channels.

Note 2 to entry: Receipt of an advertisement is defined to be receipt of one of the three advertisement packets.

**3.1.2****category**

type of power receiving unit (PRU)

Note 1 to entry: Refer also to the definition of power receiving unit (3.1.17).

**3.1.3****charge area**

<PRU larger than the test area> region of maximum overlap between the PTU charge area and the PRU resonator

Note 1 to entry: The charge area is provided by the vendor, the PRU is the entire device, and the test area is the charge area in tests.

**3.1.4****charge area**

<PRU smaller than the test area> region of maximum overlap between the PTU charge area and the PRU

Note 1 to entry: The charge area is provided by the vendor, and the test area is the charge area in tests.

Note 2 to entry: This does not preclude the PRU resonator being larger than the PTU resonator.

Note 3 to entry: Additionally, "within the charge area" is equated to mean "within the test area".

Note 4 to entry: The charge area includes the specification of the Z heights intended for the final product, from the surface of resonator coil.

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

**3.1.5****class**

type of power transmitting unit (PTU)

[IEC 63028:2017](#)

Note 1 to entry: Refer also to the definition of power transmitting unit (3.1.18) [a-4104-8922-1c32fc61e464/iec-63028-2017](#)

**3.1.6****concurrent multiple charging**

transmission of power from one transmitting resonator to multiple receiving resonators

Note 1 to entry: Magnetic resonant coupling can occur among one transmitting resonator and many receiving resonators, while tight coupling is restricted to only one transmitting coil and one receiving coil. Thus, tightly coupled technology only allows one-to-one power transmission.

**3.1.7****delta R1**

change in a PTU resonator's measured resistance when a PRU is placed at the center of PTU's charge area as compared to the resistance when no objects are in the charge area

Note 1 to entry: This measurement refers to the use of a PRU with an open-circuit resonator.

**3.1.8****device registry**

list of active PRU's maintained by the PTU

**3.1.9****dominant PRU**

PRU consuming the highest percentage of its rated output power ( $V_{RECT} \times I_{RECT} / P_{RECT\_MAX}$ )

**3.1.10****flexibly coupled wireless power transfer**

power transfer system that provides power through magnetic induction between a transmitter coil and a receiver coil, where the coupling factor (k) between the coils can be within a range between large and very small (e.g., less than 0,025)

Note 1 to entry: Also, in a flexibly coupled system, the transmitter (i.e., the primary) coil can be of the same size, or much larger than the receiver (i.e., secondary) coil. The allowable difference in coil size enables concurrent charging of multiple devices as well as more flexible placement of receiver coils within the charge area.

### 3.1.11 high voltage region

PRU region in which  $V_{RECT}$  levels result in high power dissipation without damaging the PRU

### 3.1.12 keep-out volume

volume outside of the charge area in which no testing is performed

Note 1 to entry: This parameter is defined by the PTU vendor.

### 3.1.13 low voltage region

$V_{RECT}$  voltages below the operational range

### 3.1.14 normal operation

range of all specified WPT states other than PRU System Error state for over-voltage

### 3.1.15 over-voltage

$V_{RECT}$  voltages greater than  $V_{RECT\_MAX}$

Note 1 to entry: Over-voltage can permanently damage PRU components if the PRU does not correct the condition (see 8.3.6).

### 3.1.16 OVP switch

switch in the PRU that opens or closes to protect the PRU

### 3.1.17 power receiving unit

unit receiving electrical power wirelessly from a power transmitting unit

### 3.1.18 power transmitting unit

unit transferring electrical power wirelessly to each power receiving unit

### 3.1.19 rectifier efficiency

ratio of rectified power to PRU received power ( $P_{RECT} / P_{RX\_OUT}$ )

### 3.1.20 resonance

condition of a body or system when it is subjected to a periodic disturbance of the same frequency as the natural frequency of the body or system

Note 1 to entry: At this frequency, the system displays an enhanced oscillation or vibration.

### 3.1.21 resonator

magnetic field generator that satisfies the resonance condition for efficiently transferring electrical power from a PTU to a PRU

Note 1 to entry: Both a coil and an electrical conducting wire are examples of a resonator.

**3.1.22****wireless power transfer**

processes and methods that take place in any system where electrical power is transmitted from a power source to an electrical load without interconnecting wires

**3.2 Symbols and abbreviated terms****3.2.1 Symbols**

For the purposes of this document, the following symbols for variable parameters apply.

**3.2.1.1**
 $\eta_{\text{RECT}}$ 

rectifier efficiency ( $P_{\text{RECT}} / P_{\text{RX\_OUT}}$ )

**3.2.1.2**
 $I_{\text{RECT}}$ 

DC current out of the PRU's rectifier

**3.2.1.3**
 $I_{\text{RECT\_REPORT}}$ 

$I_{\text{RECT}}$  value reported by a PRU to a PTU

**3.2.1.4**
 $I_{\text{RX\_IN}}$ 

RMS current out of the resonator/into the rectifier, while in the PRU on state

**3.2.1.5**
 $I_{\text{TX}}$ 

RMS current into the PTU resonator coil

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)  
<https://standards.iteh.ai/catalog/standards/sist/946e1408-853a-4104-8922-1c32f61e464/iec-63028-2017>

**3.2.1.6**
 $I_{\text{TX\_LONG\_BEACON}}$ 

RMS current into the PTU resonator during the long beacon period in the PTU power save state

Note 1 to entry: This current is used to provide minimum power for waking up a PRU signaling module and MCU, and to initiate communication.

**3.2.1.7**
 $I_{\text{TX\_SHORT\_BEACON}}$ 

RMS current into the PTU resonator while in the PTU power save state

Note 1 to entry: This current is used to detect the PTU impedance change caused by the placement of an object in the charge area.

**3.2.1.8**
 $I_{\text{TX\_START}}$ 

RMS current into the PTU resonator that provides minimum power for waking up a PRU signaling module and MCU

Note 1 to entry: This current is also used to initiate communication and registration.

**3.2.1.9**
 $P_{\text{IN}}$ 

DC power into the PTU