BS EN 62827-1:2016

BSI Standards Publication

Wireless Power Transfer — Management

Part 1: Common Components

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee EPL/100, Audio, video and multimedia systems and equipment.

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Published by BSI Standards Limited 2017

ISBN 978 0 580 87350 8
ICS 29.240.99; 35.240.99

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2017.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 62827-1

November 2016

ICS 29.240.99; 35.240.99

English Version

Wireless Power Transfer - Management - Part 1: Common Components (IEC 62827-1:2016)

Transfert de puissance sans fil - Gestion - Partie 1: Composants communs (IEC 62827-1:2016)

Drahtlose Energieübertragung - Management - Teil 1: Gemeinsame Komponenten (IEC 62827-1:2016)

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Ref. No. EN 62827-1:2016 E

European foreword

The text of document 100/2451/CDV, future edition 1 of IEC 62827-1, prepared by Technical Area 15 “Wireless power transfer” of IEC/TC 100 “Audio, video and multimedia systems and equipment” was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62827-1:2016.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2017-05-18
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2019-11-18

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WIRELESS POWER TRANSFER – MANAGEMENT –

Part 1: Common components

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The text of this standard is based on the following documents:

CDV	Report on voting
100/2451/CDV	100/2538/RVC

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

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

A list of all parts in the IEC 62827 series, published under the general title *Wireless power transfer – Management*, can be found on the IEC website.

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

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INTRODUCTION

The IEC 62827 (Wireless power transfer – Management) series provides the management protocol for a wireless power transfer system in which power sources can deliver power to receivers at a distance. IEC 62827 consists of the following parts:

– Part 1: Common components
– Part 2: Multiple devices control management
– Part 3: Multiple sources control management

Part 1 of IEC 62827 defines the definition and functionality for a wireless power transfer system.

Part 2 of IEC 62827 specifies the management protocol of wireless power transfer for multiple devices.

Part 3 of IEC 62827 specifies the management protocol of wireless power transfer for multiple sources.

WIRELESS POWER TRANSFER – MANAGEMENT –

Part 1: Common components

1 Scope

This part of IEC 62827 specifies common components of management for multiple sources and devices in a wireless power transfer system, and justifies various functions for wireless power transfer.

This part of IEC 62827 defines the reference models for possible configurations of a wireless power transfer system. The models are specified in additional parts in more detail.

NOTE This standard is applied to a wireless power transfer system for audio, video and multimedia equipment.

2 Terms, definitions and abbreviations

2.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1.1
wireless power receiver
device which receives electric power wirelessly

Note 1 to entry: There are two types of wireless power receivers. One is a wireless power receiver with battery. The other is a wireless power receiver without battery, such as speakers and displays.

2.1.2
wireless power source
transmitter which delivers electric power to power receiver wirelessly

2.1.3
wireless power transfer
transfer of electric power without the physical contact of electrodes

2.1.4
wireless data communication zone
area that includes wireless power sources or wireless power receivers, and enables data communication without physical contact

Note 1 to entry: A wireless data communication zone includes a wireless power transfer zone.

Note 2 to entry: A wireless data communication zone can be a union of multiple wireless data communication zones managed by multiple wireless power sources.

2.1.5
wireless power transfer zone
area that includes wireless power sources or wireless power receivers, and enables power transfer without physical contact

Note 1 to entry: A wireless power transfer zone can be a union of multiple wireless power transfer zones managed by multiple wireless power sources.

2.1.6
wireless power management system
management system that is capable of transferring wireless power from either one or multiple power sources to either one or multiple power devices with wireless communication

Note 1 to entry: In case that areas or regions, where both data and power can be transferred, are emphasized, the term “wireless power transfer network” may be used.

2.1.7
wireless power management system
<source> wireless power source which can transfer power to a number of WPMS devices (WPMS-Ds) or relay transmitters (WPMS-Rs)

2.1.8
wireless power management system
<device> wireless power receiver which can receive power from the WPMS sources (WPMS-Ss) or relay transmitters (WPMS-Rs)

2.1.9
wireless power management system
<repeater> wireless power relay transmitter which can transfer electric power from one or multiple source(s) to one or multiple device(s)

Note 1 to entry: To relay electric power wirelessly, it performs a source (WPMS-S) and a device (WPMS-D) at a time.

2.2 Abbreviations

WPT	Wireless Power Transfer
WDCZ	Wireless Data Communication Zone
WPTZ	Wireless Power Transfer Zone
WPTN	Wireless Power Transfer Network
WPMS	Wireless Power Management System
WPMS-S	Wireless Power Management System – Source
WPMS-R	Wireless Power Management System – Repeater
WPMS-D	Wireless Power Management System – Device

3 Overview

WPMS is the management system of WPT for multiple WPMS-Ss and WPMS-Ds. Conventional charging via a cable is inconvenient to users. WPT is a technology that eliminates a conventional charging method via a wired cable. It utilizes the characteristics of electromagnetic coupling to deliver power at a distance. WPMS aims to provide consumers of various mobile devices an option to be able to fully utilize WPT that delivers power wirelessly. To break away from conventional 1:1 wireless charging (1:1 WPT), WPMS will be managing power transfer for multiple WPMS-Ss and WPMS-Ds (M:N WPT) simultaneously.

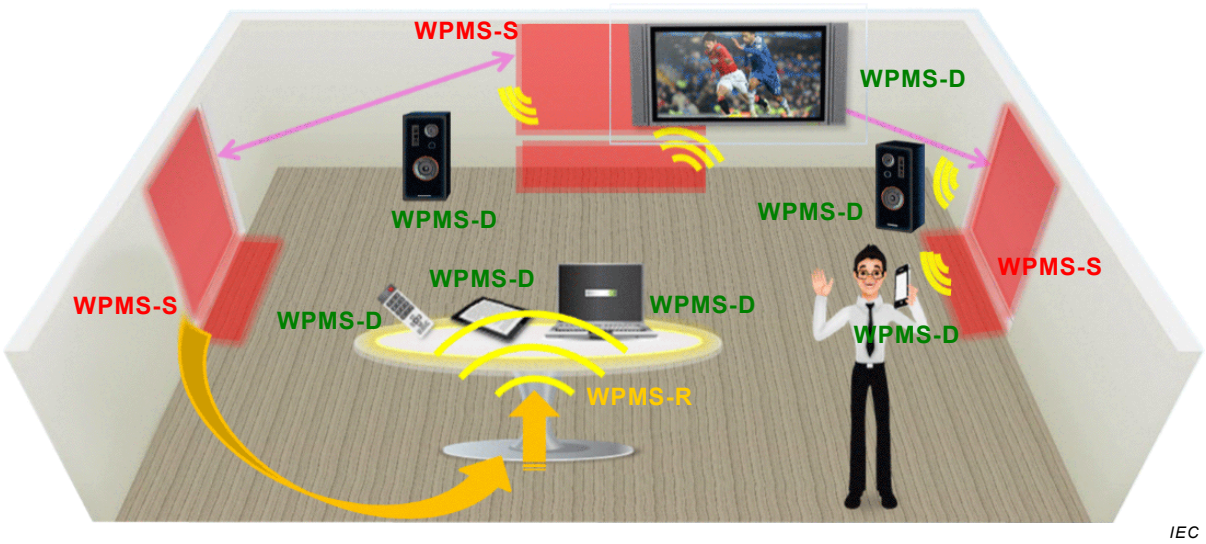

Figure 1 – Concept of a wireless power management system

In Figure 1, there are three sources which have repeaters or several devices such as a TV, a remote control, a tablet PC, a smartphone, a notebook computer and wireless speakers in their own WPTZ.

The WPMS technology can be applied to the various fields, including the following.

- Mobile terminals: Charging services can be provided to mobile terminals any time and anywhere.
- Home appliances: The use of WPMS technology can offer the benefits of minimal wiring and choice of furniture arrangements, while eliminating the disorder and inconvenience of conventional cable charging.

4 Reference models

4.1 General

This clause describes the reference models offering possible configurations of WPMS-S(s), WPMS-R(s) and WPMS-D(s).

4.2 WPT of one source to one device (1:1)

In a 1:1 WPT model, a WPTN consists of a single WPMS-S and a single WPMS-D, as shown in Figure 2.

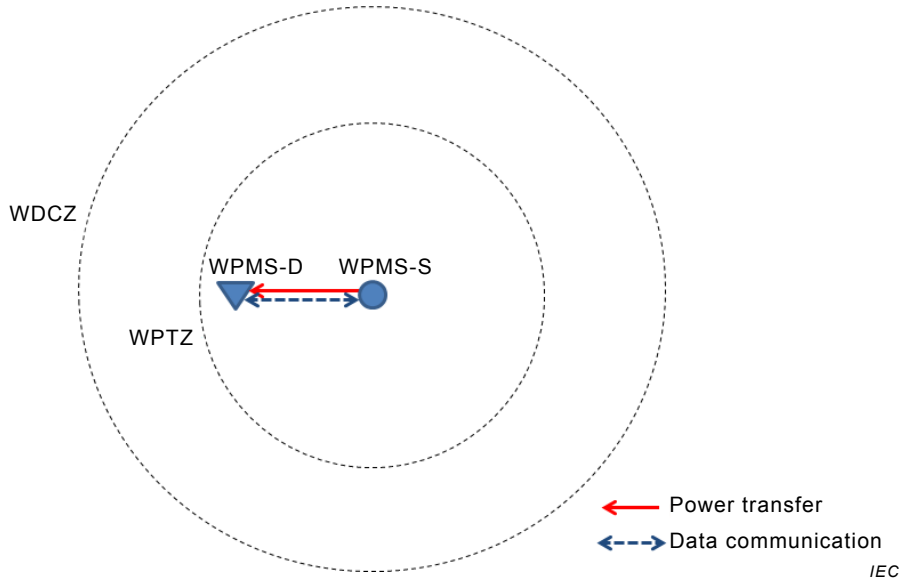

Figure 2 – Structure of 1:1 wireless power transfer network

The WPMS-S receives the charging status data of the WPMS-D in the WDCZ, and forms the WPTN based on that information. Then, the WPMS-S wirelessly transfers power to the WPMS-D in the WPTN.

A WPMS-S can manage only a WPMS-D in the WPTZ and transfer electric power to the WPMS-D at a distance. This signifies that one WPMS-D belongs to only one WPTZ.

4.3 WPT of one source to many devices (1:N)

In a 1:N WPT model, a WPTN consists of single WPMS-S and multiple WPMS-Ds, as shown in Figure 3.

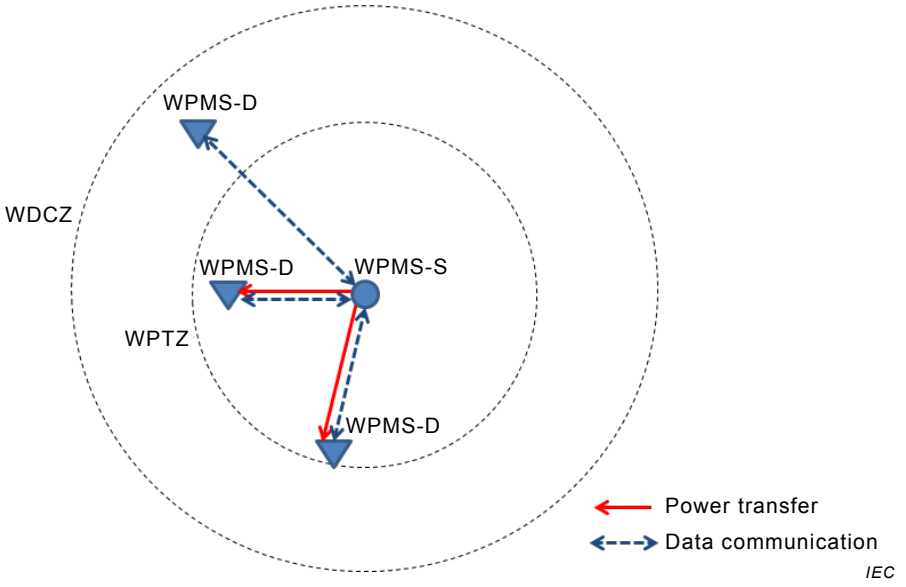

Figure 3 – Structure of a 1:N wireless power transfer network

The WPMS-S collects the charging status data of multiple WPMS-Ds in the WDCZ, and forms the WPTN based on this information. Then, the WPMS-S wirelessly transfers power to WPMS-Ds in the WPTN. A WPMS-D located outside a WPTZ is not included in the WPTN.

A WPMS-S manages multiple WPMS-Ds in the WDCZ and transfers electric power to the WPMS-Ds in the WPTZ remotely. WPMS-Ds can belong to only one WPTZ at the same time.

4.4 A WPT of many sources to many devices (M:N)

In a M:N WPT model, a WPTN consists of multiple WPMS-Ss and multiple WPMS-Ds, as shown in Figure 4.

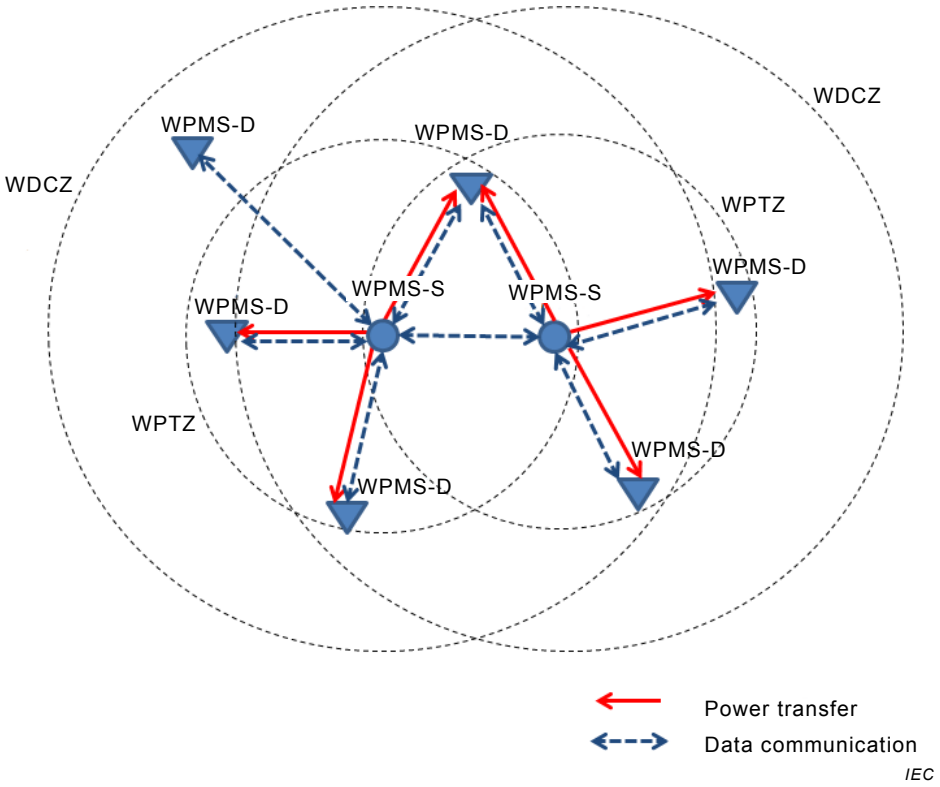

Figure 4 – Structure of a M:N wireless power transfer network

Figure 4 shows that a WPMS-D can belong to multiple WPTZs which are managed by multiple WPMS-Ss simultaneously. In this scenario one WPTZ can be a union of multiple WPTZs.

WPMS-Ss collect the charging status data and location of WPMS-Ds in their WDCZs. Based on this information, each WPMS-S forms a WPTN which includes the WPMS-S, and finally sets up a WPTN which is a union of the individual WPTNs. Then, the WPMS-Ss communicate with each other to transfer electric power to WPMS-Ds in their WPTZs, including the intersection of the WPTZs. Each WPMS-D can receive wireless power from the WPMS-Ss in the WPTN.

This M:N WPT reference model covers M:1 wireless power transfer which consists of multiple WMPS-Ss and one WPMS-D. The WPMS-D is located in the WPTN managed by only one WPMS-S or in the intersection of the WPTNs managed by multiple WPMS-Ss. When the WPMS-D moves to other WPTNs, the power management is updated accordingly.

4.5 WPMS with WPMS-Rs

A WPMS can include WPMS-Rs. If a WPMS-R has both WPMS-S and WPMS-D functions, the WPMS-R is subject to time division processing and the reference model is a combination of 4.3 and 4.4. As shown in Figure 5 and Figure 6, WPMS-S and WPMS-D functions within the WPMS-R are periodically exchanged or replaced. Figure 5 shows that the WPMS-R operates as a power receiver like the WMPS-D. Each WPMS-D can receive wireless power from WPMS-Ss or WPMS-Rs in the WPTN. Figure 5 is based on the same model as Figure 3.

Figure 6 shows that the WPMS-R operates as a power transmitter like a WMPS-S. Figure 6 is based on the same model as Figure 4. WPMS-Rs which are managed by WPMS-Ss can extend the WPTN.

Therefore, the reference model of WPT with repeaters is a special case and a combination of other models, namely Figure 3 and Figure 4.

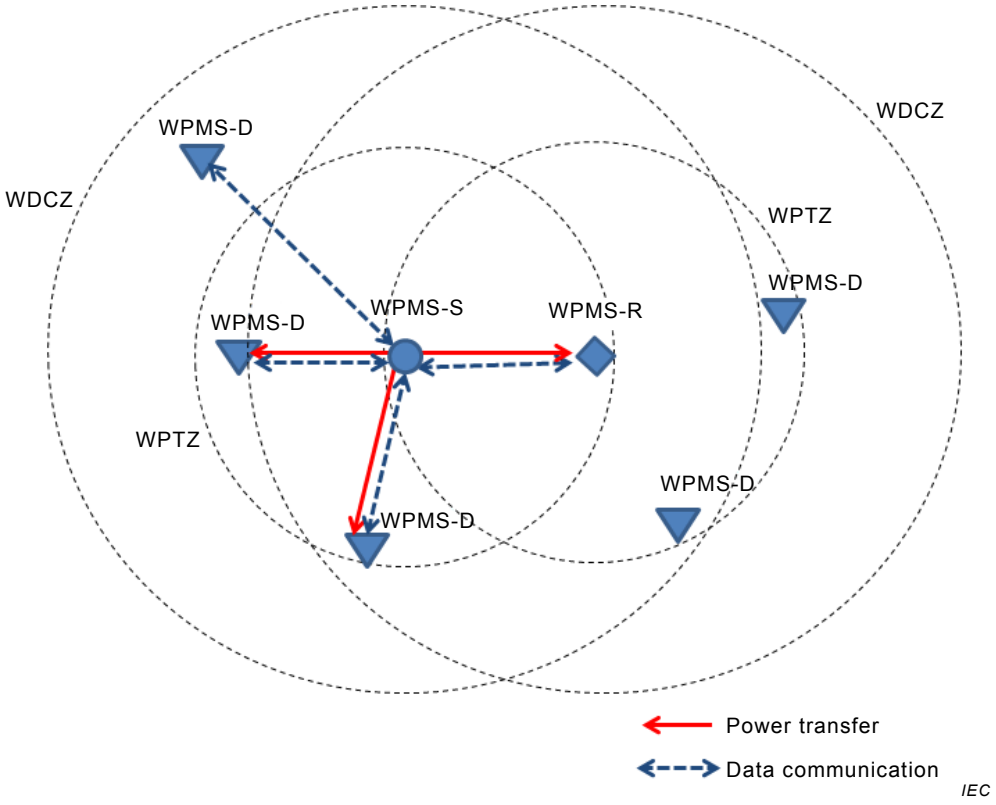

Figure 5 – WPMS-R as power receiver

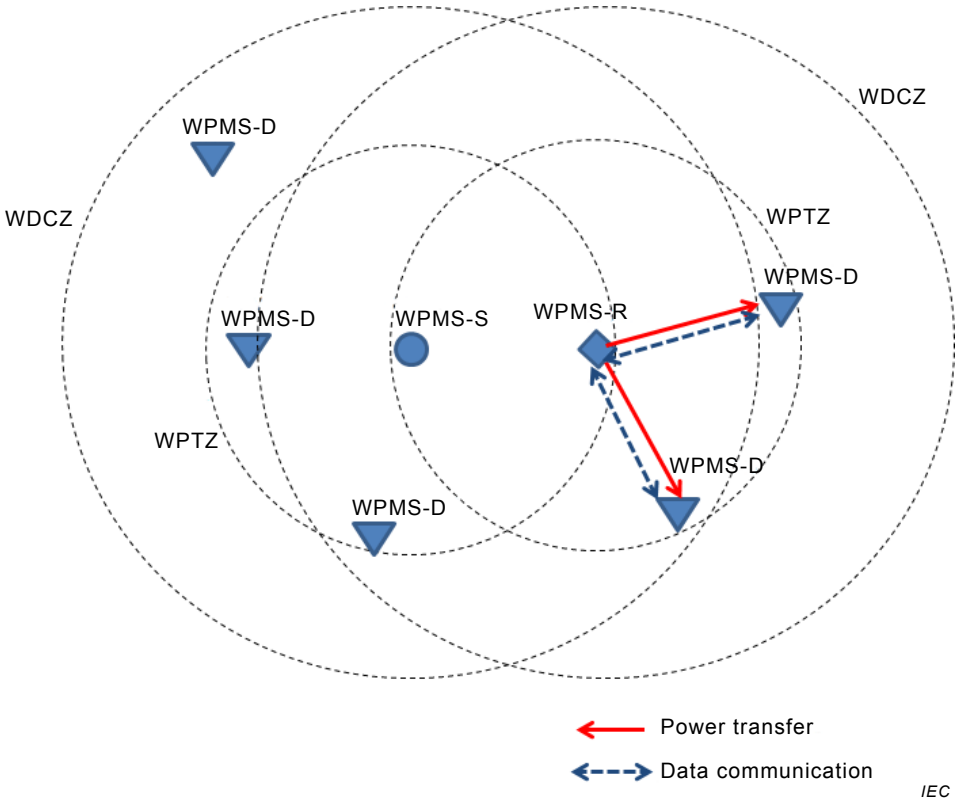

Figure 6 – WPMS-R as power transmitter

5 Components in WPMS-S and WPMS-D

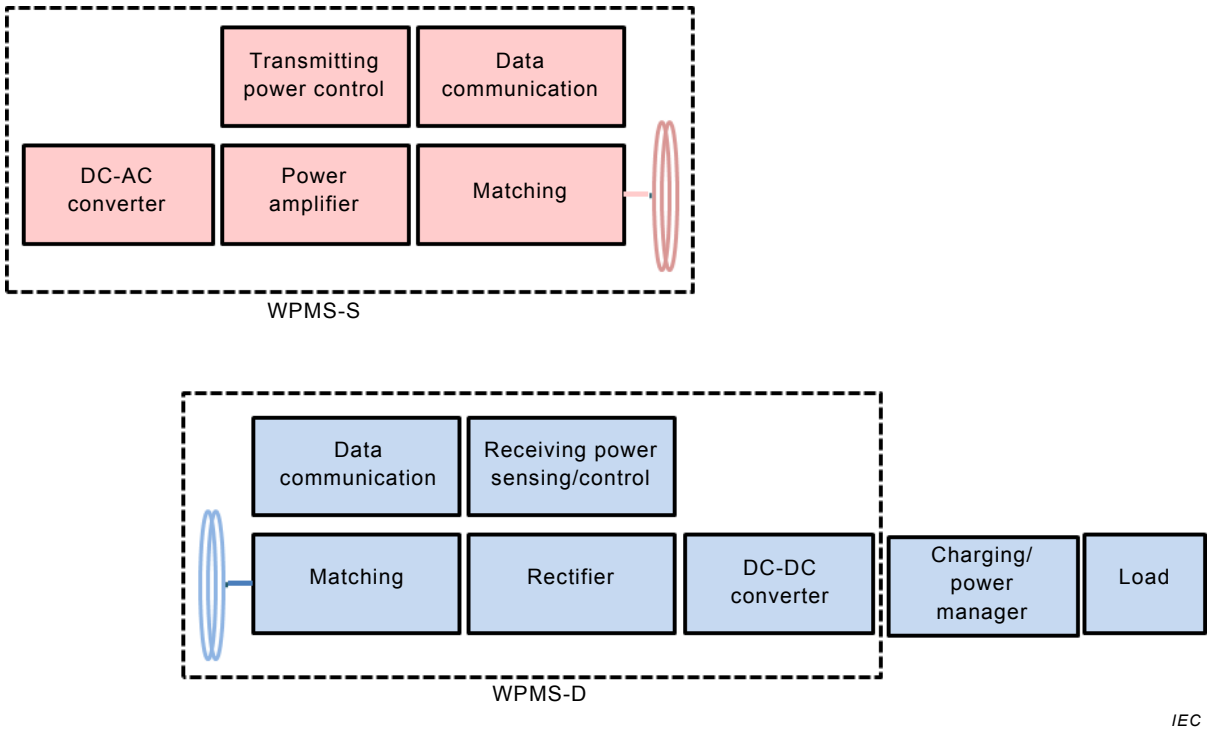

Figure 7 – Components of WPMS-S and WPMS-D in WPMS

Figure 7 shows an example of the WPMS consisting of WPMS-S and WPMS-D. The WPMS-S includes a DC-AC converter, a power amplifier, a transmitting power control block, a data communication block, and a wireless power transmitting resonant antenna. The DC-AC converter converts the DC signal to an AC signal. The power amplifier is a type of RF power amplifier used to convert a low-power AC signal into a larger signal of significant power. The power amplifier is connected to the resonant antenna with an impedance matching block. The most important reason that justifies the presence of an impedance matching block in WPMS is to maximize the power transfer efficiency from WPMS-S to WPMS-D. Monitoring power transfer information from WPMS-S to WPMS-D is one of the most important steps in the charging process. The data communication block enables an exchange of the real-time power information between WPMS-S and WPMS-D. This block is used to control the transmitting power. The WPMS-D includes a wireless power receiving resonant antenna, a rectifier, a DC-DC converter, a charging/power manager block, receiving power sensing/controlling block, and the data communication block. The rectifier harvests energy from the RF/AC signal and provides the required energy to the entire system. The rectifier converts the RF/AC signal from WPMS-S to a DC voltage. As incident RF/AC power varies, the generated DC voltage fluctuates as well. The DC-DC converter is implemented to provide stable power supply to power management blocks such as charging/power manager. The receiving power sensing block detects the receiving power level of a rectifier. The data communication block transfers real-time power monitoring data to the WPMS-S.

6 Functionalities

In order to design a management protocol that can construct reliable and efficient WPMSs for multiple sources and receivers, it is classified into two operations. The two operations consist of multiple WPMS-Ds control management (1:N WPT), IEC 62827-2 and multiple WPMS-Ss control management (M:N WPT), IEC 62827-3. Also procedures in the control management are categorized into five distinctive functions. They are initialization, authentication and association, general charging management, termination and abnormal status management.

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