PD IEC TR 63239:2020

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Radio frequency beam wireless power transfer (WPT) for mobile devices

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CONTENTS

FOREWORD 3
1 Scope 5
2 Normative references 5
3 Terms and definitions 5
4 Introduction to RF beam WPT 5
4.1 Overview of the RF beam WPT type 5
4.2 Requirements for RF beam WPT 6
4.2.1 General 6
4.2.2 Power transfer system design of RF beam WPT 7
4.2.3 Available candidate frequencies of RF beam WPT 8
4.2.4 Operating principle of omnidirectional RF beam WPT 8
4.2.5 Operating principle of directional RF beam WPT 9
4.3 Operating scenario of RF beam WPT 11
4.3.1 Possible requirement for RF beam WPT 11
4.3.2 Operating scenario of omnidirectional RF beam WPT 12
4.3.3 Operating scenario of directional RF beam WPT 12
5 Trends in standards, regulations, and technologies related to RF beam WPT 14
5.1 Trends in standards related to RF beam WPT 14
5.2 Trends in regulations related to RF beam WPT 15
5.3 Trends in global products related to RF beam WPT 19
6 Summary 22

Figure 1 – TX and RX structures of RF beam WPT 7
Figure 2 – Beam pattern diagram of omnidirectional RF beam WPT 8
Figure 3 – Example of high-output omnidirectional RF beam WPT in the space 9
Figure 4 – Beam pattern diagram of directional RF beam WPT 9
Figure 5 – Electromagnetic wave transmission/reception at each pattern antenna of directional RF beam WPT 10
Figure 6 – Direction RF beam WPT (a) description on delay generation at each pattern antenna (b) delay adjustment method to transmit desired signals 10
Figure 7 – Example of beam pattern formation by the delay and direction adjustment of the transmission signals of each antenna 11
Figure 8 – Expected operating scenario of omnidirectional RF beam WPT 12
Figure 9 – Expected operating scenario sequence of directional RF beam WPT – Pilot signal transmission from the single RX in case of an obstacle 13
Figure 10 – Expected operating scenario sequence of directional RF beam WPT – Directional WPT to the single RX in case of an obstacle 13
Figure 11 – Expected operating scenario sequence of directional RF beam WPT – Directional WPT from multiple TXs to multiple RXs in case of an obstacle 14

Table 1 – Overview of the RF beam WPT type 6
Table 2 – Characteristics of candidate frequencies for RF beam WPT 8
Table 3 – Activities of domestic/overseas standardization organizations related to RF beam WPT 15
Table 4 – Major recommendations and regulations of standardization organizations related to WPT for mobile devices 16

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RADIO FREQUENCY BEAM WIRELESS POWER TRANSFER (WPT) FOR MOBILE DEVICES

FOREWORD

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IEC TR 63239, which is a Technical Report, has been prepared by technical area 15: Wireless power transfer, of IEC technical committee TC 100: Audio, video and multimedia systems and equipment.

The text of this Technical Report is based on the following documents:

Draft TR	Report on voting
100/3212/DTR	100/3317/RVDTR

Full information on the voting for the approval of this Technical Report 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.

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- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
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RADIO FREQUENCY BEAM WIRELESS POWER TRANSFER (WPT) FOR MOBILE DEVICES

1 Scope

This Technical Report presents the surveyed technologies, product development trends, international standards, and regulation trends of RF beam WPT. This report can be used for the research and analysis of projects that apply small-output remote WPT to mobile devices, such as smartphones, Internet of Things (IoT) devices, and ultra-small sensors.

2 Normative references

There are no normative references in this document.

3 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
IoT
Internet of Things
service-based facilities to provide advanced services by connecting the various things of the physical world and the virtual world based on information communication technology

Note 1 to entry: Infrastructure computing devices for realizing ubiquitous space are embedded in environments and things to make them intelligent and to expand the machine-to-machine (M2M) concept, which is capable of intelligent communication between humans and things or between things to the internet.

Note 2 to entry: The concept has evolved into a concept that interacts with all the information of reality and the virtual world as well as things. The major technologies of IoT include sensing technology, wired and wireless communication and network infrastructure technology, IoT interface technology, and service technology through IoT.

3.2
Wi-Fi
Wireless-Fidelity
certification mark provided to products compatible with the regulations determined by the wireless LAN (WLAN) specifications (IEEE 802.11b) using 2,4 GHz

Note 1 to entry: Among the products manufactured in accordance with these specifications, the ones that passed the test of the Wireless Ethernet Compatibility Alliance (WECA), a group founded by wireless-network-related companies, can have this mark.

4 Introduction to RF beam WPT

4.1 Overview of the RF beam WPT type

RF beam WPT performs remote WPT using omnidirectional or directional antenna beam patterns. This type is divided into the omnidirectional type, in which electromagnetic waves are radiated in all directions to achieve constant radiation intensity in any direction, and the directional type, in which radio waves are transmitted in a certain direction. Table 1 shows the Overview of the RF beam WPT type.

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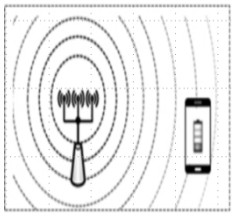
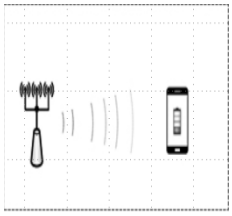
Table 1 – Overview of the RF beam WPT type

	Electromagnetic waves	
	Omnidirectional	**Directional**
Representative figure		
Operating principle	Electromagnetic wave radiation	
Electric field intensity	Pt (Pt: transmitting power)	Pt X Gt (Gt: Antenna Gain by beamforming)
Efficiency	Small in proportion to Gt compared to directional RF beam WPT	Large in proportion to Gt compared to omnidirectional RF beam WPT
Transfer distance	Long distance (up to ~m)	Long distance (transfer up to the ~m unit is possible if Line of Sight (LOS) is secured)
Mobility	Possible	Possible
Safety	There are issues on human safety. Human body protection should be considered.	There are issues on human safety. Human body protection should be considered.
Used frequency	RF (Hundred MHz, Several GHz)	RF (Hundred MHz, Several GHz)
Standardization trend	No standard	No standard

4.2 Requirements for RF beam WPT

4.2.1 General

RF beam WPT radiates electromagnetic waves and is significantly different from the two following two non-beam types in the operating principle for transferring power. The magnetic induction and magnetic resonance types use non-radiation WPT and transfer power between TX(Transmitter) and RX(Receiver) in close proximity using the magnetic lines of force and resonance generated by alternating current (AC). On the other hand, RF beam WPT can transfer power by radiating electromagnetic waves through an antenna as in wireless communication. TX transmits the power of an electromagnetic wave oscillator using a directional antenna while RX receives microwaves using an antenna and converts it to a direct current (DC) power source through a rectifier to obtain power.

While RF beam WPT has a benefit in the charging distance because it enables remote charging for multiple devices at the same time, it may affect the human body and exhibits very low power efficiency. The recent technology achieved the power efficiency of very low power at the distance of several meters, but studies to verify and avoid its effects on human health are considered essential for the commercialization of RF beam WPT in the future. It is important to note that the beam WPT needs to arrange conditions for sharing the frequency with existing radio stations because it has the property of radiating the beam into space and transmitting power. In this Subclause 4.2, the system design of the RF beam type, candidate frequencies, and the operating principles of the omnidirectional and directional RF beam types are discussed.

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