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TECHNICAL REPORT

colour inside

Consideration of energy efficiency in wireless power transfer technology

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

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

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FOREWORD

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IEC TR 63231, which is a technical report, has been prepared by TA15: 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:

Enquiry draft	Report on voting
100/3186/DTR	100/3262/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.

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

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CONSIDERATION OF ENERGY EFFICIENCY IN WIRELESS POWER TRANSFER TECHNOLOGY

1 Scope

This Technical Report (TR) describes the technical background of current energy efficiency efforts related to wireless power transfer (WPT) technology and commercially available products related to related to audio, video and multimedia systems and equipment. This Technical Report examines use cases, standardization efforts of other standards development organizations (SDOs) and known national regulations. This document concludes with observations and recommendations for the potential future technical standards development activities within the scope of TC 100.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

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 Terms and definitions

3.1.1
WPT Tx
wireless power transfer transmitter
device that transmits power to the receiver

Note 1 to entry: Examples of WPT Tx are charging pads, which are portable, car-mounted, or furniture-mounted.

3.1.2
WPT Rx
wireless power transfer receiver
device that receives power from the transmitter, which is a charging pad

Note 1 to entry: Examples of Rx are smartphones, laptops, smartwatches.

3.2 Abbreviated terms

WPT	wireless power transfer
DTBC	device to be charged

4 Overview of the WPT system

4.1 General

Clause 4 describes an overview of WPT systems, which include WPT technologies, applications and coupling methods.

4.2 Magnetic induction WPT systems

An alternating electric current flowing through a coil (source) generates a magnetic field that acts on a receiver coil to produce a current within it, and thus electric power is transferred between the source and device-to-be-charged (DTBC) coils.

Tight magnetic coupling between the two coils helps achieve high transfer efficiency. Because the electric power transfer distance is short, typically measured in the mm range, the WPT by the electromagnetic induction is often called noncontact power transfer, or tightly-coupled WPT.

4.3 Magnetic resonance WPT systems

Magnetic resonance is a special case of electromagnetic induction where resonant coils are used such that higher efficiencies can be supported for a given coupling factor (k) in configurations designed for low (much less than 1,0) coupling factor. The magnetic resonance method utilizes a source consisting of a coil and series capacitor as a resonator, with a corresponding sink element consisting also of a coil and series capacitor as a tuned resonator. Electric power is transferred through the electromagnetic resonance between the source and DTBC coils. By matching the resonance frequency of the source coil and the DTBC coil in a high Q factor regime, electric power is transferred over a long distance (mm to m) even where magnetic coupling (k) between two coils is low.

The magnetic resonance approach is referred to interchangeably as magnetic resonant coupling, highly resonant magnetic induction, or loosely coupled WPT.

4.4 Microwave (RF) used in WPT systems

Power transfer via radio waves can be made more directional, allowing longer-distance power beaming, with shorter wavelengths of electromagnetic radiation, typically in the microwave range.

Power beaming by microwaves has the difficulty that, for most space applications, the required aperture sizes are very large owing to diffraction limiting antenna directionality.

In 2013, inventor Hatem Zeine demonstrated how wireless power transmission using phased array antennas can deliver electrical power up to 30 feet away. It uses the same radio frequencies as Wi-Fi.

In 2015, researchers at the University of Washington introduced power over Wi-Fi, which trickle-charges batteries and powered battery-free cameras and temperature sensors using transmissions from Wi-Fi routers. Wi-Fi signals were shown to power battery-free temperature and camera sensors at ranges of up to 20 feet. It was also shown that Wi-Fi can be used to wirelessly trickle-charge nickel–metal hydride and lithium-ion coin-cell batteries at distances of up to 28 feet.

4.5 Capacitive wireless power transfer (CPT)

Research efforts are being published in capacitive WPT, which uses an electric field to transfer power (in contrast with the magnetic field in 4.2 and 4.3, or coupled electro-magnetic fields in 4.4).

5 WPT product use cases

5.1 General

In order to consider energy efficiency measurements in WPT, the current scope of commercially available products needs to be explored. The products described in this clause are presented as use cases for energy efficiency considerations. A typical configuration of a commercially available system consists of a transmission or charging pad and a device with a receiver.