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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Semiconductor devices – Semiconductor devices for wireless power transfer and charging –
Part 1: General requirements and specifications

Dispositifs à semiconducteurs – Dispositifs à semiconducteurs pour le transfert de puissance et la charge sans fil –
Partie 1: Exigences et spécifications générales

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SEMICONDUCTOR DEVICES – SEMICONDUCTOR DEVICES FOR WIRELESS POWER TRANSFER AND CHARGING –

Part 1: General requirements and specifications

FOREWORD

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Draft	Report on voting
47/2706/FDIS	47/2723/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.

A list of all the parts in the IEC 63244 series, published under the general title *Semiconductor devices – Semiconductor devices for wireless power transfer and charging*, 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 "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- withdrawn,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.

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INTRODUCTION

The IEC 63244 series is planned to comprise the following parts:

- IEC 63244-1: Semiconductor devices – Semiconductor devices for wireless power transfer and charging – Part 1: General requirements and specifications
- IEC 63244-2: Semiconductor devices – Semiconductor devices for wireless power transfer and charging – Part 2: Far-field based wireless power transfer – Electromagnetic-wave based wireless power transfer
- IEC 63244-3-1: Semiconductor devices – Semiconductor devices for wireless power transfer and charging – Part 3-1: Near-field based wireless power transfer – Magnetic-field based wireless power transfer
- IEC 63244-3-2: Semiconductor devices – Semiconductor devices for wireless power transfer and charging – Part 3-2: Near-field based wireless power transfer – Electric-field based wireless power transfer

The standardization bodies for wireless power transfer and charging technologies is as follow:

1) Wireless power consortium (WPC): Wireless power consortium covers MF WPT technology such as inductive WPT and magnetic resonance WPT. WPC has Qi certification process to ensure the safety and quality.
2) AirFuel alliance: AirFuel alliance covers NF WPT technology such as resonant mode of magnetic-field based wireless power transfer. And also, AirFuel alliance is working on FF WPT technology such as electromagnetic-wave based wireless power transfer. AirFuel alliance has Rezence certification process for resonant mode of MF WPT to ensure the safety and quality. AirFuel alliance was formed by the merge of Alliance for Wireless Power (A4WP) and Power Matters Alliance (PMA) in 2015.

SEMICONDUCTOR DEVICES – SEMICONDUCTOR DEVICES FOR WIRELESS POWER TRANSFER AND CHARGING –

Part 1: General requirements and specifications

1 Scope

This part of IEC 63244 provides general requirements and specifications of the semiconductor devices for the performance and reliability evaluations of wireless power transfer and charging systems. For the performance evaluations, this part covers various characterization parameters and symbols, general system diagrams, and test setups and test conditions.

This document also describes classifications of the wireless power transfer technologies.

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 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 + 12 h cycle)*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60749-10, *Semiconductor devices – Mechanical and climatic test methods – Part 10: Mechanical shock*

IEC 61967-2, *Integrated circuits – Measurement of electromagnetic emissions, 150 kHz to 1 GHz – Part 2: Measurement of radiated emissions – TEM cell and wideband TEM cell method*

IEC 61967-4, *Integrated circuits – Measurement of electromagnetic emissions – Part 4: Measurement of conducted emissions – 1 Ω /150 Ω direct coupling method*

IEC 61967-8, *Integrated circuits – Measurement of electromagnetic emissions – Part 8: Measurement of radiated emissions – IC stripline method*

IEC 62132-2, *Integrated circuits – Measurement of electromagnetic immunity – Part 2: Measurement of radiated immunity – TEM cell and wideband TEM cell method*

IEC 62132-4, *Integrated circuits – Measurement of electromagnetic immunity 150 kHz to 1 GHz – Part 4: Direct RF power injection method*

IEC 62132-8, *Integrated circuits – Measurement of electromagnetic immunity – Part 8: Measurement of radiated immunity – IC stripline method*

IEC 62262, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

IEC 62969-2:2018, *Semiconductor devices – Semiconductor interface for automotive vehicles – Part 2: Efficiency evaluation methods of wireless power transmission using resonance for automotive vehicles sensors*

IEC CISPR 11, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*

3 Terms, definitions and symbols

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

NOTE The following terms and definitions are classified into general terminology, terminology for near-field based wireless power transfer, and terminology for far-field based wireless power transfer.

3.1 Terms and definitions

3.1.1 General terminology

3.1.1.1
wireless energy transfer
WET
transfer of electrical, optical, acoustic and other type of energies from a source to an electrical load via electric and/or magnetic fields, electromagnetic waves, acoustic waves, etc.

3.1.1.2
wireless power transfer
WPT
transfer of electrical energy from a power source to an electrical load via electric and/or magnetic fields or electromagnetic waves

Note 1 to entry: The alternative term “wireless power transmission” is also often used in technical documents.

3.1.1.3
power receiver
PRx
device receiving electrical power from a transmitting device or transmitting devices

Note 1 to entry: The alternative term “power receiving unit (PRU)” is also often used in technical documents. And also, “secondary device” is used in CISPR 11.

3.1.1.4
power transmitter
PTx
device sending electrical power to a receiving device or receiving devices

Note 1 to entry: The alternative term “power transmitting unit (PTU)” is also often used in technical documents. And also, “primary device” is used in CISPR 11.

3.1.2 Terminology for near-field based wireless power transfer

3.1.2.1
power receiving coil
power receiving coiled inductor that is induced by a time-varying magnetic field from a power transmitting coil(s)

Note 1 to entry: The alternative term “the secondary coil” is also often used in technical documents. And also, the alternative term “receiving resonator coil” is also used in IEC 62969-2.

3.1.2.2
power transmitting coil
power transmitting coiled inductor that induces a voltage across a power receiving coil(s)

Note 1 to entry: The alternative term “the primary coil” is also often used in technical documents. And also, the alternative term “transmitting resonator coil” is also used in IEC 62969-2.

3.1.2.3
near-field based wireless power transfer
NF WPT
wireless electrical power transfer from a power transmitter(s) to a power receiver(s) that is(are) located within an induced magnetic or electric field

3.1.2.4
magnetic-field based wireless power transfer
MF WPT
wireless electrical power transfer from a power transmitter(s) to a power receiver(s) that is(are) located within an induced magnetic field

3.1.2.5
non-resonant mode of magnetic-field based wireless power transfer
wireless electrical power transfer between power transmitting coiled inductor(s) and power receiving coiled inductor(s) using an induced magnetic field without a resonance

Note 1 to entry: The alternative term “inductive wireless power transfer” is also often used in technical documents.

3.1.2.6
resonant mode of magnetic-field based wireless power transfer
wireless electrical power transfer between power transmitting coiled inductor(s) and power receiving coiled inductor(s) using an induced magnetic-field with a resonance

Note 1 to entry: Four coiled inductors system has one source coiled inductor, two resonated coiled inductors and one load coiled inductor. Two coiled inductors system has only two resonated coiled inductors.

Note 2 to entry: The alternative term “magnetic resonance wireless power transfer” is also often used in technical documents.

3.1.2.7
electric-field based wireless power transfer
EF WPT
wireless electrical power transfer from a power transmitter(s) to a power receiver(s) that is(are) located within an induced electric field

Note 1 to entry: The alternative term “capacitive coupling wireless power transfer” is also often used in technical documents.

3.1.2.8
resonant frequency
f_R
specific resonated frequency determined by inductance of the coiled inductor and capacitance of matching capacitor in the resonant mode of magnetic-field based wireless power transfer

Note 1 to entry: AirFuel uses 6,78 MHz ± 15 kHz as a resonant frequency.

3.1.2.9
coupling coefficient
k
coefficient that indicates the degree of magnetic coupling between two coils

Note 1 to entry: The alternative term "coupling factor" is also often used in technical documents and the coupling coefficient is greater or equal to 0 and less than 1.

3.1.2.10
critically coupled distance
optimum distance between a power transmitting coil(s) and a power receiving coil(s) where maximum wireless power transfer is obtained

3.1.2.11
loosely coupled distance
distance longer than the critically coupled distance where less magnetic coupling is obtained because a magnetic flux from a power transmitting coil(s) is not fully reached to a receiving coil(s)

3.1.2.12
over coupled distance
distance closer than the critically coupled distance where less magnetic coupling is obtained because a formation of magnetic flux is hindered by the effect of anti-resonance

3.1.2.13
tightly coupled system
MF WPT system having a coupling coefficient of about 1 by using a magnetic core inside the power transmitting and receiving coils

3.1.2.14
proximity range of magnetic-field based wireless power transfer
wireless power transfer range of MF WPT that has the distance of less than 10 mm between a power transmitter(s) and a power receiver(s)

3.1.2.15
effective range of magnetic-field based wireless power transfer
wireless power transfer range of MF WPT that having the distance of less than or equal to the size of receiving coil diameter between a power transmitter(s) and a power receiver(s)

3.1.3 Terminology for far-field based wireless power transfer

3.1.3.1
power transmitting antenna
metal conductor(s) transmitting electrical power via electromagnetic wave propagating through the air

3.1.3.2
power receiving antenna
metal conductor(s) receiving electrical power from a power transmitting antenna via electromagnetic wave propagating through the air

3.1.3.3
electromagnetic-wave based wireless power transfer
EMW WPT
wireless electrical power transfer from a power transmitting antenna(s) to a power receiving antenna(s) using an electromagnetic-wave radiation

3.1.3.4
far-field based wireless power transfer
FF WPT
electrical power transfer from a PTx to a PRx using a radiative electromagnetic wave

3.1.3.5
power transmission frequency
f_{PT}
frequency at which the wireless power is transmitted and received

Note 1 to entry: The alternative term “fundamental, center or operating frequency” is also often used in technical documents.

3.1.3.6
short range of electromagnetic-wave based wireless power transfer
power transmission distance up to 5 meters from a power transmitter(s) to a power receiver(s)

3.1.3.7
medium range of electromagnetic-wave based wireless power transfer
power transmission distance up to 10 meters from a power transmitter(s) to a power receiver(s)

Note 1 to entry: The alternative term “locally” is also used in CISPR 11.

3.1.3.8
locally
within close proximity and distances of up to 10 meters

3.1.3.9
long range of electromagnetic-wave based wireless power transfer
power transmission distance more than 10 meters from a power transmitter(s) to a power receiver(s)

3.2 Symbols and abbreviated terms

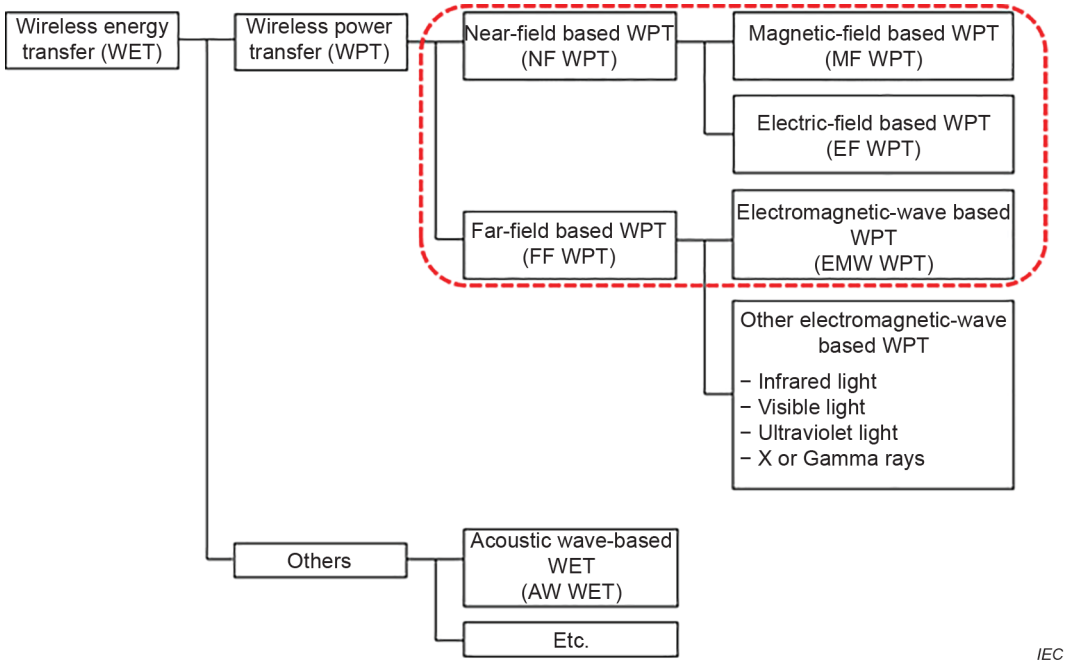
The following letter symbols and abbreviations are listed as shown in Table 1.

Table 1 – Letter symbols and abbreviated terms

Terms	Letter symbols	Abbreviated terms
General terms and parameters related to wireless power transfer		
wireless energy transfer	-	WET
wireless power transfer	-	WPT
power receiver	-	PRx
power receiving unit	-	PRU
power transmitter	-	PTx
power transmitting unit	-	PTU
Terms and parameters related to near-field based wireless power transfer		
magnetic-field based wireless power transfer	-	MF WPT
electric-field based wireless power transfer	-	EF WPT
near-field based wireless power transfer	-	NF WPT
resonant frequency	f_R	-
coupling coefficient or coupling factor	k	-
Terms and parameters related far-field based wireless power transfer		
electromagnetic-wave based wireless power transfer	-	EMW WPT
far-field based wireless power transfer	-	FF WPT
power transmission frequency	f_{PT}	-

4 Classification

The WET technology is classified as shown in Figure 1. An energy can be transmitted wirelessly through electric and/or magnetic fields, electromagnetic waves, acoustic waves, etc. And also, field regions for electromagnetically short antennas are shown in Figure A.1 of Annex A.



NOTE The red dashed rectangular line indicates commercialized WPT technologies.

Figure 1 – Classification of WET technologies

The examples of blank specifications shall be listed as shown in the Table 2. Products with respect to power consumption level, wireless power transfer methods and wireless power transfer distance shall be listed in the table.

Table 2 – Example of blank specifications: classification of wireless power transfer methods and distance according to products and power consumption

Products	Power consumption	Wireless power transfer methods and distance				
		MF WPT		EMW WPT		
		Proximity range (≤ 10 mm)	Effective range (≤ size of receiving coil diameter)	Short range (≤ 5 m)	Medium range (≤ 10 m)	Long range (10 m ≤)
Low power sensors **Low power wireless communications (BLE)**	≤ 10 mW					
Medium power sensors **Medium power wireless communications (Zigbee)**	≤ 500 mW					
Wireless headset or earphone	≤ 1 W					
Smart phone	≤ 5 W to 10 W					
Tablet PC	≤ 15 W					
Laptop PC	≤ 50W					
Low power home appliances and lights	≤ 100 W					