

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

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**Qi Specification version 2.0 –  
Part 5: Communications Physical Layer**

**Spécification Qi version 2.0 –  
Partie 5 : Couche physique des communications**



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IEC 63563-5 has been prepared by technical area 15: Wireless Power Transfer, of IEC technical committee 100: Audio, video and multimedia systems and equipment. It is an International Standard.

It is based on *Qi Specification version 2.0, Communications Physical Layer* and was submitted as a Fast-Track document.

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

Draft	Report on voting
100/4250/FDIS	100/4280/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.

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This document was developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

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# Qi Specification

## *Communications Physical Layer*

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**Version 2.0**

**April 2023**

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## RELEASE HISTORY

Specification Version	Release Date	Description
v2.0	April 2023	Initial release of the v2.0 Qi Specification.

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# 1 General

The Wireless Power Consortium (WPC) is a worldwide organization that aims to develop and promote global standards for wireless power transfer in various application areas. A first application area comprises flat-surface devices such as mobile phones and chargers in the Baseline Power Profile (up to 5 W) and Extended Power Profile (above 5 W).

## 1.1 Structure of the Qi Specification

### General documents

- Introduction
- Glossary, Acronyms, and Symbols

### System description documents

- Mechanical, Thermal, and User Interface
- Power Delivery
- Communications Physical Layer
- Communications Protocol
- Foreign Object Detection
- NFC Tag Protection
- Authentication Protocol

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## 1.2 Scope

The *Communications Physical Layer* (this document) defines the low-level (physical layer and the data link layer) formats of data bits, data bytes, and data packets. In addition, it provides requirements and guidelines for load modulation and frequency-shift keying.

## 1.3 Compliance

All provisions in the *Qi Specification* are mandatory, unless specifically indicated as recommended, optional, note, example, or informative. Verbal expression of provisions in this Specification follow the rules provided in ISO/IEC Directives, Part 2.

**Table 1: Verbal forms for expressions of provisions**

Provision	Verbal form
requirement	“shall” or “shall not”
recommendation	“should” or “should not”
permission	“may” or “may not”
capability	“can” or “cannot”

## 1.4 References

For undated references, the most recently published document applies. The most recent WPC publications can be downloaded from <http://www.wirelesspowerconsortium.com>.

## 1.5 Conventions

### 1.5.1 Notation of numbers

- Real numbers use the digits 0 to 9, a decimal point, and optionally an exponential part.
- Integer numbers in decimal notation use the digits 0 to 9.
- Integer numbers in hexadecimal notation use the hexadecimal digits 0 to 9 and A to F, and are prefixed by "0x" unless explicitly indicated otherwise.
- Single bit values use the words ZERO and ONE.

### 1.5.2 Tolerances

Unless indicated otherwise, all numeric values in the *Qi Specification* are exactly as specified and do not have any implied tolerance.

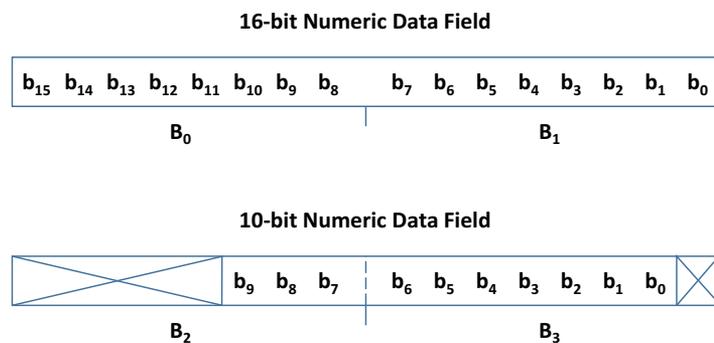
### 1.5.3 Fields in a data packet

A numeric value stored in a field of a data packet uses a big-endian format. Bits that are more significant are stored at a lower byte offset than bits that are less significant. [Table 2](#) and [Figure 1](#) provide examples of the interpretation of such fields.

**Table 2: Example of fields in a data packet**

	$b_7$	$b_6$	$b_5$	$b_4$	$b_3$	$b_2$	$b_1$	$b_0$	
$B_0$	16-bit Numeric Data Field								
$B_1$									(lsb)
$B_2$	Other Field					(msb)			
$B_3$	10-bit Numeric Data Field						(lsb)		Field

**Figure 1. Examples of fields in a data packet**



### 1.5.4 Notation of text strings

Text strings consist of a sequence of printable ASCII characters (i.e. in the range of 0x20 to 0x7E) enclosed in double quotes ("). Text strings are stored in fields of data structures with the first character of the string at the lowest byte offset, and are padded with ASCII NUL (0x00) characters to the end of the field where necessary.

**EXAMPLE:** The text string "WPC" is stored in a six-byte fields as the sequence of characters 'W', 'P', 'C', NUL, NUL, and NUL. The text string "M:4D3A" is stored in a six-byte field as the sequence 'M', ':', '4', 'D', '3', and 'A'.

### 1.5.5 Short-hand notation for data packets

In many instances, the *Qi Specification* refers to a data packet using the following shorthand notation:

<MNEMONIC>/<modifier>

In this notation, <MNEMONIC> refers to the data packet's mnemonic defined in the *Qi Specification, Communications Protocol*, and <modifier> refers to a particular value in a field of the data packet. The definitions of the data packets in the *Qi Specification, Communications Protocol*, list the meanings of the modifiers.

For example, EPT/cc refers to an End Power Transfer data packet having its End Power Transfer code field set to 0x01.

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## 1.6 Power Profiles

A Power Profile determines the level of compatibility between a Power Transmitter and a Power Receiver. [Table 3](#) defines the available Power Profiles.

- *BPP PTx*: A Baseline Power Profile Power Transmitter.
- *EPP5 PTx*: An Extended Power Profile Power Transmitter having a restricted power transfer capability, i.e.  $P_L^{(pot)} = 5 \text{ W}$ .
- *EPP PTx*: An Extended Power Profile Power Transmitter.
- *BPP PRx*: A Baseline Power Profile Power Receiver.
- *EPP PRx*: An Extended Power Profile Power Receiver.

**Table 3: Capabilities included in a Power Profile**

Feature	BPP PTx	EPP5 PTx	EPP PTx	BPP PRx	EPP PRx
Ax or Bx design	Yes	Yes	No	N/A	N/A
MP-Ax or MP-Bx design	No	No	Yes	N/A	N/A
Baseline Protocol	Yes	Yes	Yes	Yes	Yes
Extended Protocol	No	Yes	Yes	No	Yes
Authentication	N/A	Optional	Yes	N/A	Optional

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## 2 Load Modulation

This section defines both the physical layer and the data link layer of the Power Receiver to Power Transmitter communications interface.

The Power Receiver communicates to the Power Transmitter using backscatter modulation. For this purpose, the Power Receiver modulates the amount of power that it draws from the Power Signal. The Power Transmitter detects this as a modulation of the current through and/or voltage across the Primary Cell. In other words, the Power Receiver and Power Transmitter use an amplitude modulated Power Signal to provide a Power Receiver to Power Transmitter communications channel.

### 2.1 Modulation scheme

The Power Receiver shall modulate the amount of power that it draws from the Power Signal, such that the Primary Cell current and/or Primary Cell voltage assume two states, namely a HI state and a LO state.<sup>1</sup> A state is characterized in that the amplitude is constant within a certain variation  $\Delta$  for at least  $t_s$  ms. If the Power Receiver is properly aligned to the Primary Cell of a type A10 or MP-A1 Power Transmitter, and for all appropriate loads, at least one of the following three conditions shall apply:<sup>2</sup>

- The difference of the amplitude of the Primary Cell current in the HI and LO state is at least 15 mA.
- The difference of the Primary Cell current in the HI and LO state is at least 15 mA. The Primary Cell current is measured at instants in time that correspond to one quarter of the cycle of the control signal driving the half-bridge inverter.<sup>3</sup>
- The difference of the amplitude of the Primary Cell voltage in the HI and LO state is at least 200 mV.

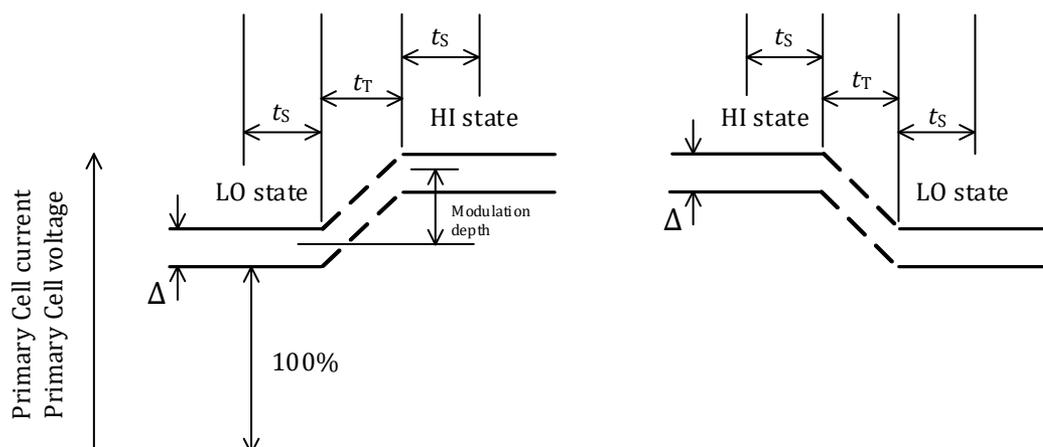
During a transition, the Primary Cell current and Primary Cell voltage are undefined. See [Figure 2](#) and [Table 4](#).

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<sup>1</sup> The HI and LO states do not correspond to fixed Primary Cell current and/or Primary Cell voltage levels.

<sup>2</sup> The design requirements of the Mobile Device determine both the range of lateral displacements that constitute proper alignment and the range of loading conditions on its Power Receiver.

<sup>3</sup> The start of the cycle corresponds the closing of the top switch in the half-bridge inverter.

**Figure 2. Amplitude modulation of the Power Signal****Table 4: Amplitude modulation of the Power Signal**

Parameter	Symbol	Value	Unit
Maximum transition time	$t_r$	100	$\mu\text{s}$
Minimum stable time	$t_s$	150	$\mu\text{s}$
Current amplitude variation	$\Delta$	8	mA
Voltage amplitude variation	$\Delta$	110	mV

## 2.2 Bit encoding scheme

The Power Receiver shall use a differential bi-phase encoding scheme to modulate data bits onto the Power Signal. For this purpose, the Power Receiver shall align each data bit to a full period  $t_{CLK}$  of an internal clock signal, such that the start of a data bit coincides with the rising edge of the clock signal. This internal clock signal shall have a frequency  $f_{CLK} = (2 \pm 4\%) \text{ kHz}$ .

**NOTE:** A ripple on the Power Receiver’s load yields a ripple on the Power Transmitter’s current. As a result, such a ripple can lead to bit errors in the Power Transmitter. The number of bit errors can be particularly high if this ripple has a frequency that is close to the modulation frequency  $f_{CLK}$ .

The Receiver shall encode a ONE bit using two transitions in the Power Signal, such that the first transition coincides with the rising edge of the clock signal and the second transition coincides with the falling edge of the clock signal. The Receiver shall encode a ZERO bit using a single transition in the Power Signal, which coincides with the rising edge of the clock signal.

**Figure 3. Example of a differential bi-phase encoding scheme**

