WIRELESS POWER

CONSORTIUM

Qi Specification

Mechanical, Thermal, and User Interface

Version 1.3

January 2021

COPYRIGHT

© 2021 by the Wireless Power Consortium, Inc. All rights reserved.

The *Qi Specification, Mechanical, Thermal, and User Interface*, is published by the Wireless Power Consortium and has been prepared by the members of the Wireless Power Consortium. Reproduction in whole or in part is prohibited without express and prior written permission of the Wireless Power Consortium.

may not otherwise be disclosed in any form to any person or organization without express and prior written permission of the Wireless Power Consortium.

DISCLAIMER

The information contained herein is believed to be accurate as of the date of publication, but is provided "as is" and may contain errors. The Wireless Power Consortium makes no warranty, express or implied, with respect to this document and its contents, including any warranty of title, ownership, merchantability, or fitness for a particular use or purpose. Neither the Wireless Power Consortium, nor any member of the Wireless Power Consortium will be liable for errors in this document or for any damages, including indirect or consequential, from use of or reliance on the accuracy of this document. For any further explanation of the contents of this document, or in case of any perceived inconsistency or ambiguity of interpretation, contact: info@wirelesspowerconsortium.com.

RELEASE HISTORY

Specification Version	Release Date	Description
1.3	January 2021	Initial release of this document.

Table of Contents

1 General 4
1.1 Structure of the Qi Specification. 4
1.2 Scope 5
1.3 Compliance. 5
1.4 References. 5
1.5 Conventions 6
1.5.1 Notation of numbers 6
1.5.2 Tolerances 6
1.5.3 Fields in a data packet 6
1.5.4 Notation of text strings 7
1.5.5 Short-hand notation for data packets 7
1.6 Power Profiles. 8

2 Power Receiver design requirements 9

3 Mechanical design guidelines (Informative). 10
3.1 Power Transmitter Product 10
3.2 Power Receiver Product 10
3.3 Power Transmitter Product Alignment Aid. 11
3.4 Power Receiver Product Alignment Aid 11

4 Interface Surface temperature rise 12

5 User Interface requirements 13
5.1 User interaction with a Power Transmitter Product. 13
5.2 User interaction with a Power Receiver Product. 14

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/RFID Card Protection
- Authentication Protocol

Reference design documents

- Power Transmitter Reference Designs
- Power Receiver Design Examples

Compliance testing documents

- Power Transmitter Test Tools
- Power Receiver Test Tools
- Power Transmitter Compliance Tests
- Power Receiver Compliance Tests

NOTE: The compliance testing documents are restricted and require signing in to the WPC members' website. All other specification documents are available for download on both the WPC public website and the WPC website for members.

1.2 Scope

The *Qi Specification, Mechanical, Thermal, and User Interface* (this document) identifies basic physical design requirements and guidelines for Power Transmitter and Power Receiver Products, including product and system dimensions, alignment of the products, surface temperature rise, and indications to the user.

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. In addition, the *Qi Specification* references documents listed below. Documents marked here with an asterisk (*) are restricted and require signing in to the WPC website for members.

- Product Registration Procedure Web page*
- Qi Product Registration Manual, Logo Licensee/Manufacturer*
- Qi Product Registration Manual, Authorized Test Lab*
- Power Receiver Manufacturer Codes,* Wireless Power Consortium
- The International System of Units (SI), Bureau International des Poids et Mesures
- Verbal forms for expressions of provisions, International Electotechnical Commission

For regulatory information about product safety, emissions, energy efficiency, and use of the frequency spectrum, visit the regulatory environment page of the WPC members’ website.

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.

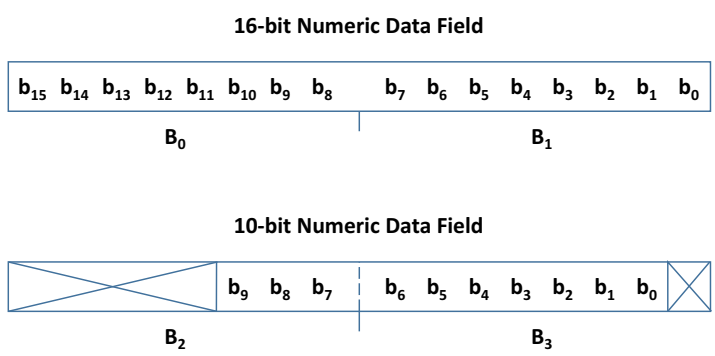
1.5.3 Fields in a data packet

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	(msb) 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.

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. $P_{\mathrm{L}}^{(\mathrm{pot})}$ = 5 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.

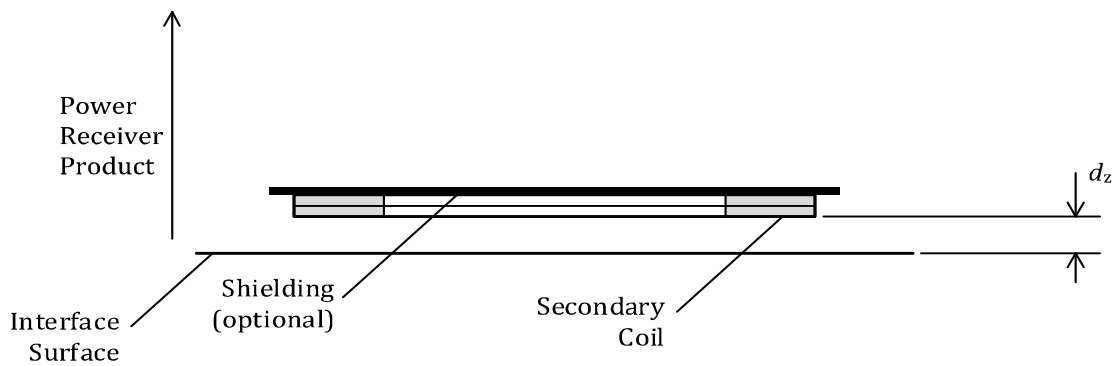
Table 3: Capabilities included in a Power Profile

Feature	BPP PTx	EPP5 PTx	EPP PTx	BPP PRx	EPP PRx
A*x* or B*x* design	Yes	Yes	No	N/A	N/A
MP-A*x* or MP-B*x* 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

2 Power Receiver design requirements

A Power Receiver design shall include a Secondary Coil and an Interface Surface (see Figure 2). The distance from the Secondary Coil to the Interface Surface of the Power Receiver Product shall not exceed d_z = 2.5 mm across the bottom face of the Secondary Coil.

Figure 2. Secondary Coil assembly



3 Mechanical design guidelines (Informative)

3.1 Power Transmitter Product

For the best user experience with respect to wireless power transfer, it is recommended that:

- The Power Transmitter Product Interface Surface extends higher than its surroundings, or has a size of at least 107 mm × 177 mm for the Baseline Power Profile.

For the Extended Power Profile, the recommended Power Transmitter Product Interface Surface dimensions is at least 439 × 329 mm^2.

- The Power Transmitter Product Interface Surface is marked to indicate the location of its Active Area(s)—e.g. by means of the logo or other visual marking, lighting, etc.
- In the case of stand-alone Power Transmitter Products, the Active Area is centered within the Power Transmitter Product Interface Surface.

3.2 Power Receiver Product

The overall shape and size of a Power Receiver Product is dictated by its primary application. For example, cell phones, headsets, and digital (still) cameras, all have substantially different form factors. For the best user experience with respect to wireless power transfer, it is recommended that the mechanical design of a Power Receiver Product follows the guidelines listed below to the extent possible in relation to the primary application of the Power Receiver Product:

- The Power Receiver Product X, Y dimensions do not exceed 107 mm × 177 mm for the Baseline Power Profile.

For the Extended Power Profile, Power Receiver Product X, Y dimensions do not exceed 439 × 329 mm^2.

- The Power Receiver Product Interface Surface is flat.
- The Power Receiver Product Interface Surface is marked to indicate the location of its Active Area, e.g. by means of the logo or other visual marking.
- The location of the Active Area is centered within the Power Receiver Product Interface Surface.

3.3 Power Transmitter Product Alignment Aid

In order to ensure proper coupling between a Power Transmitter Product and a Power Receiver Product, it is recommended that the Power Transmitter Product employs one or more of the following Alignment Aids:

- A movable Active Area.
- A fixed visual marking of the Active Area on Interface Surface.
- Lighting that guides the user to align the Power Receiver Product.
- An audible signal that indicates when alignment is achieved.
- Tactile feedback that indicates when alignment is achieved.

3.4 Power Receiver Product Alignment Aid

In order to ensure proper coupling between a Power Transmitter Product and a Power Receiver Product, it is recommended that the Power Receiver Product employs one or more of the following Alignment Aids:

- An audible signal when alignment is achieved.
- Tactile feedback that indicates when alignment is achieved.
- A visual Response; e.g. a screen lighting up within 200 ms to indicate that power is received.
- An indication of wireless charging.

4 Interface Surface temperature rise

The Power Transmitter Product shall limit the top surface temperature of the thermal Test Power Receiver (TPR-THERMAL-5W or TPR-THERMAL-15W, defined in Compliance Testing) to at most 12 °C above the ambient temperature, while the Test Power Receiver is operating at its desired Control Point for 1 hour in an environment that is shielded against spurious thermal contributions due to air flow, radiation, etc. It is recommended that the Power Transmitter Product limits the Interface Surface temperature to at most 5 °C above the ambient temperature, while powering the Test Power Receiver for 1 hour.

5 User Interface requirements

A user will typically interface with both a Power Transmitter Product and a Power Receiver Product. The goal is to provide clear feedback[1] to a user.

5.1 User interaction with a Power Transmitter Product

A Power Transmitter Product should indicate the following conditions to a user:

- Indication to a user within 0.5 seconds that a Power Receiver Product or object is placed on the Power Transmitter Product.
- Indication to a user whether power transfer or charging is in progress or not.
- Indication to a user whether power transfer or charging is complete.
- Indication to a user in case of an error of fault (in stand-by, at the initiation of, during or at the completion of power transfer or charging).
- (Extended Power Profile only) Whether power transfer or charging occurs at a reduced rate.

  NOTE: A Power Transmitter should indicate this condition if it has denied a Specific Request for Guaranteed Load Power (Request = 0x01).

A Power Transmitter Product should indicate the following condition to a user:

- Indication to a user if a Foreign Object has been detected.

A Power Transmitter Product that is able to support multiple Power Receiver Products at the same time should indicate each of the above conditions for each supported Power Receiver Product.

A Power Transmitter Product that can take input power from a USB Micro-B or Micro-AB receptacle should indicate to the user if the requested amount of power potentially cannot be provided to a Power Receiver Product. In particular, this indication

- should be activated prior to the start of power transfer to a Power Receiver Product, preferably when the Power Transmitter Product is switched on;
- should be activated during power transfer to a Power Receiver Product, if the Power Transmitter Product cannot provide the requested amount of power; and
- once activated, should remain active until the Power Transmitter Product leaves the *power transfer* phase.

[1] Audible, visible, or tactile indication

5.2 User interaction with a Power Receiver Product

A Power Receiver Product should indicate the following conditions to users:

- Successful reception of the Power Signal within 3 seconds after being placed on a Power Transmitter Product.
- End of reception of the Power Signal.