

USB PD ENGINEERING CHANGE NOTICE FORM

Title: Power Rules

Applied to: USB PD Revision 2.0 V1.1, 7 May 2015

Brief description of the functional changes:
Replace Appendix A (Profiles) by new chapter 10 on Power Rules

Benefits as a result of the changes:
Improved interoperability between Power Sources and Power Sinks, increased re-usability of Power Sources. Reduced user confusion due to incompatibilities.

An assessment of the impact to the existing revision and systems that currently conform to the USB specification:
Many existing Power Sources will not comply with the new rules. The rules set a long term direction

An analysis of the hardware implications:
Existing hardware designs are likely to need updating. New designs are expected to apply to new rules.

An analysis of the software implications:
None

An analysis of the compliance testing implications:
Compliance tests to the new rules will be required. Waivers will be needed for existing designs and designs “in flight”.

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Actual Change

(a) Add new definition in Section 1.6

PD Power (PDP)	The output power of a Source, as specified by the manufacturer and expressed in Fixed Supply PDOs as defined in Section 10.
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(b). From Appendix A (page 483):

A. Power Profiles

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(entire section)

To Text/Table (and location):

A. Power Profiles

This section is deprecated in favor of Section 10

(c). Add new Section 10

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10 Power Rules

10.1 Introduction

The flexibility of power provision on USB Type-C is expected to lead to adapter re-use and the increasingly widespread provision of USB power outlets in domestic and public places and in transport of all kinds. Environmental considerations could result in unbundled adapters. Rules are needed to avoid incompatibility between the Sources and the Sinks they are used to power, in order to avoid user confusion and to meet user expectations. This section specifies a set of rules that Sources and Sinks shall follow. These rules provide a simple and consistent user experience.

10.2 Source Power Rules

10.2.1 Source Power Rule Considerations

The Source power rules are designed to:

- Ensure the PD Power (PDP) of an adapter specified in watts explicitly defines the voltages and currents at each voltage the adapter supports
- Ensure that adapters with a large PDP are always capable of providing the power to devices designed for use with adapters with a smaller PDP
- Enable an ecosystem of adapters that are interoperable with the devices in the ecosystem.

The considerations that lead to the Source power rules are based are summarized in Table 10-1.

Table 10-1 Considerations for Sources

Considerations	Rationale	Consequence
Simple to identify capability	A user going into an electronics retailer should know what they need	Cannot have a complex identification scheme
Higher power Sources are a superset of smaller ones	Bigger is always better in user's eyes – don't want a degradation in performance	Higher power Sources do everything smaller ones do
Unambiguous Source definitions	Sources with the same power rating but different VI combinations might not interoperate	To avoid user confusion, any given power rating has a single definition
A range of power ratings	Users and companies will want freedom to pick appropriate Source ratings	Fixed profiles at specific power levels don't provide adequate flexibility, e.g. profiles as defined in [USBPD 2.0]
5V@3A USB Type-C Source is defined by [USB Type-C 1.2]	5V@3A USB Type-C Source is considered	All > 15W adapters must support 5V@3A or superset consideration is violated
Maximize 3A cable utilization	3A cables will be ubiquitous	Increase to maximum voltage (20V) before increasing current beyond 3A
Optimize voltage rail count	More rails are a higher burden for Sources, particularly in terms of testing	5V is a basic USB requirement. 20V provides the maximum capability.
Some Sources are not able to provide significant power	Some small Battery operated Sources e.g. mobile devices, are able to provide more power directly from their Battery than from a regulated 5V supply	In addition to the minimal 5V advertisement are able to advertise more power from their Battery
Some Sources share power between multiple Ports (Hubs)	Hubs have to be supported	See Section 10.2.4

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10.2.2 Normative Voltages and Currents

The voltages and currents a Source with a PDP of x Watts shall support are as defined in Table 10-2.

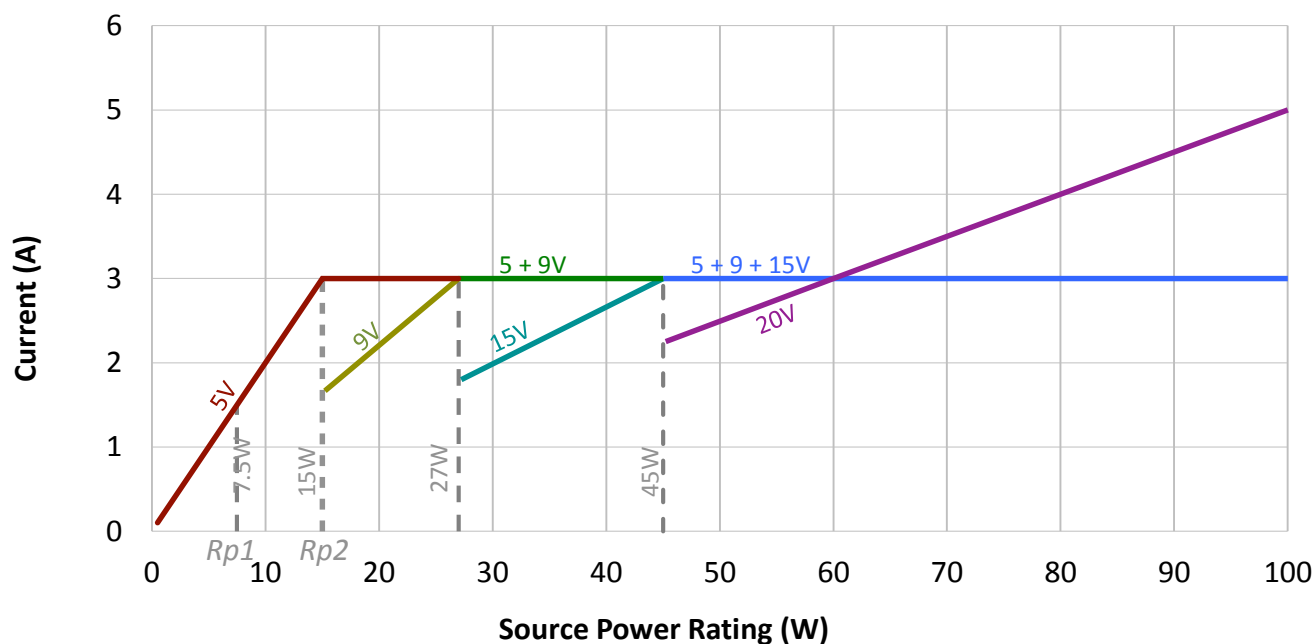
Table 10-2 Normative Voltages and Currents

PDP (W)	Current at 5V (A)	Current at 9V (A)	Current at 15V (A)	Current at 20V (A)
$0.5 \leq x \leq 15$	$x \div 5$			
$15 < x \leq 27$	3	$x \div 9$		
$27 < x \leq 45$	3	3	$x \div 15$	
$45 < x \leq 60$	3	3	3	$x \div 20$
$60 < x \leq 100$	3	3	3	$x \div 20^1$

¹ Requires a 5A cable.

Figure 10-1 illustrates the maximum current and power rails that a Source shall support at each voltage for a given PDP.

Figure 10-1 Source Power Rule Illustration



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Figure 10 2 shows an example of an adapter with a rating at 50W. The adapter is required to support 20V at 2.5A, 15V at 3A, 9V at 3A and 5V at 3A.

Figure 10-2 Source Power Rule Example

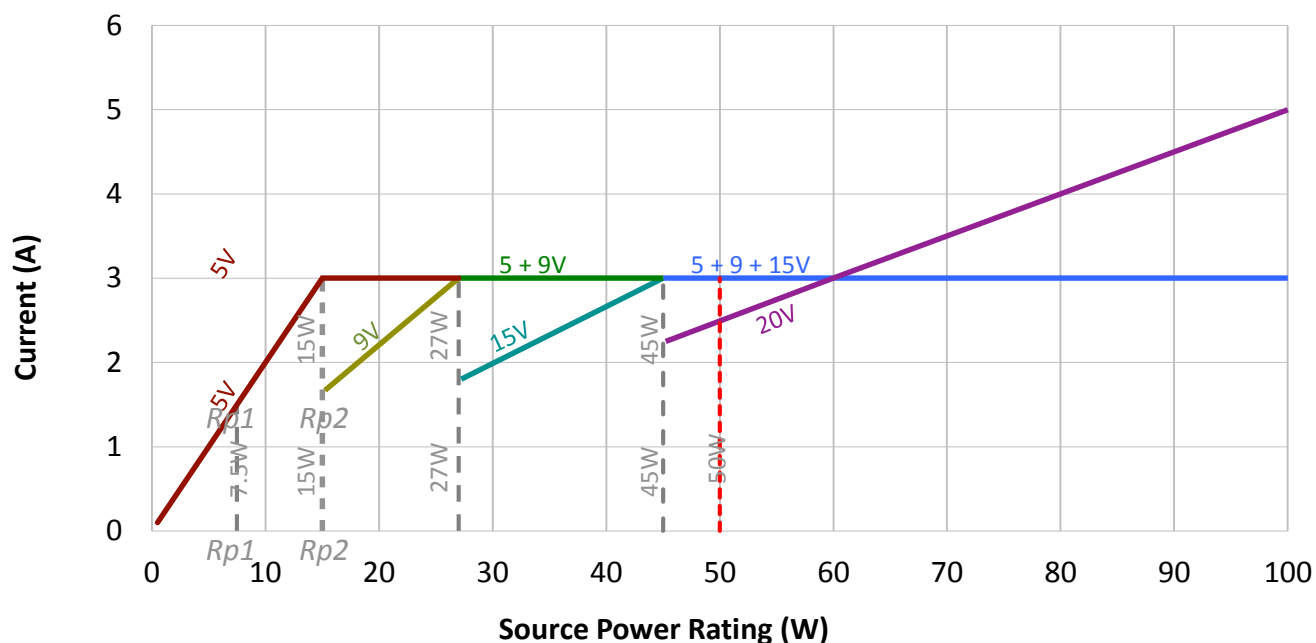


Table 10 3, Table 10 4, Table 10 5 and Table 10 6 show the Fixed Supply PDOs that shall be supported for each of the **Normative** voltages defined in Table 10 2.

Table 10-3 Fixed Supply PDO – Source 5V

Bit(s)	Description						
B31..30	Fixed supply						
B29	Dual-Role Power						
B28	USB Suspend Supported						
B27	Externally Powered						
B26	USB Communications Capable						
B25	Dual-Role Data						
B24..22	Reserved – shall be set to zero.						
B21..20	Peak Current						
B19..10	5V						
B9..0	<table border="1"> <tr> <th>PDP (x)</th><th>Current (A)</th></tr> <tr> <td>$0.5 \leq x \leq 15$</td><td>$x \div 5$</td></tr> <tr> <td>$15 < x \leq 100$</td><td>3</td></tr> </table>	PDP (x)	Current (A)	$0.5 \leq x \leq 15$	$x \div 5$	$15 < x \leq 100$	3
PDP (x)	Current (A)						
$0.5 \leq x \leq 15$	$x \div 5$						
$15 < x \leq 100$	3						

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Table 10-4 Fixed Supply PDO – Source 9V

Bit(s)	Description								
B31..30	Fixed Supply								
B29..22	Reserved – shall be set to zero.								
B21..20	Peak Current								
B19..10	9V								
B9..0	<table> <tr> <th>PDP (x)</th><th>Current (A)</th></tr> <tr> <td>$0.5 \leq x \leq 15$</td><td>PDO not required</td></tr> <tr> <td>$15 < x \leq 27$</td><td>$x \div 9$</td></tr> <tr> <td>$27 < x \leq 100$</td><td>3</td></tr> </table>	PDP (x)	Current (A)	$0.5 \leq x \leq 15$	PDO not required	$15 < x \leq 27$	$x \div 9$	$27 < x \leq 100$	3
PDP (x)	Current (A)								
$0.5 \leq x \leq 15$	PDO not required								
$15 < x \leq 27$	$x \div 9$								
$27 < x \leq 100$	3								

Table 10-5 Fixed Supply PDO – Source 15V

Bit(s)	Description								
B31..30	Fixed Supply								
B29..22	Reserved – shall be set to zero.								
B21..20	Peak Current								
B19..10	15V								
B9..0	<table> <tr> <th>PDP (x)</th><th>Current (A)</th></tr> <tr> <td>$0.5 \leq x \leq 27$</td><td>PDO not required</td></tr> <tr> <td>$27 < x \leq 45$</td><td>$x \div 15$</td></tr> <tr> <td>$45 < x \leq 100$</td><td>3</td></tr> </table>	PDP (x)	Current (A)	$0.5 \leq x \leq 27$	PDO not required	$27 < x \leq 45$	$x \div 15$	$45 < x \leq 100$	3
PDP (x)	Current (A)								
$0.5 \leq x \leq 27$	PDO not required								
$27 < x \leq 45$	$x \div 15$								
$45 < x \leq 100$	3								

Table 10-6 Fixed Supply PDO – Source 20V

Bit(s)	Description						
B31..30	Fixed Supply						
B29..22	Reserved – shall be set to zero.						
B21..20	Peak Current						
B19..10	20V						
B9..0	<table> <tr> <th>PDP (x)</th><th>Current (A)</th></tr> <tr> <td>$0.5 \leq x \leq 45$</td><td>PDO not required</td></tr> <tr> <td>$45 < x \leq 100$</td><td>$x \div 20$</td></tr> </table>	PDP (x)	Current (A)	$0.5 \leq x \leq 45$	PDO not required	$45 < x \leq 100$	$x \div 20$
PDP (x)	Current (A)						
$0.5 \leq x \leq 45$	PDO not required						
$45 < x \leq 100$	$x \div 20$						

More current may be offered in the PDOs when **Optional** voltages/currents are supported and a 5A cable is being used (see Section 10.2.3).

10.2.3 Optional Voltages/Currents

In addition to the voltages and currents specified in Section 10.2.2 a Source that is optimized for use with a specific Sink or a specific class of Sinks may **Optionally** supply additional voltages and increased currents. When **Optional** voltages and increased currents are provided, the following requirements shall apply:

- The Source shall be able to meet its PDP at the **Normative** voltages and currents as specified in Section 10.2.2, regardless of whether it meets its PDP at an **Optional** additional voltage or current.
- The **Optional** voltages and currents shall not deliver more power than the PDP.

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10.2.4 Power sharing between ports

The Source power rules defined in Section 10.2.2 and Section 10.2.3 shall apply independently to each port on a system with multiple ports.

10.3 Sink Power Rules

10.3.1 Sink Power Rule Considerations

The Sink power rules are designed to ensure the best possible user experience when a given Sink used with a compliant Source of arbitrary Output Power Rating that only supplies the **Normative** voltages and currents.

The Sink Power Rules are based on the following considerations:

- Low power Sources (e.g., 5V) are expected to be very common and will be used with Sinks designed for a higher PDP.
- Optimizing the user experience when Sources with a high PDP are used with low power Sinks.
- Preventing Sinks that only function well (or at all) when using **Optional** voltages and currents.

10.3.2 Normative Sink Rules

Sinks designed for Sources with a PDP of x W shall:

- Provide the same user experience when powered from Sources that have a PDP $\geq x$ W.
- Either operate, charge or indicate a capability mismatch (see Section 6.4.2.3) from Sources that have a PDP $< x$ W and ≥ 0.5 W.

A Sink optimized for a Source with **Optional** voltages and currents as described in Section 10.2.2 and Section 10.2.3 with a PDP of x W shall provide the same user experience when powered from a Source with a PDP of $\geq x$ W that supplies only the **Normative** voltages and currents as specified in Section 10.2.2 and Section 10.2.3.