

# USB Power Delivery ENGINEERING CHANGE NOTICE

**Title: PPS Power Rule Clarifications**

**Applied to: USB Power Delivery Specification Revision 3.1**

**Version 1.1**

<b>Brief description of the functional changes proposed:</b>
Change the required current for optional APDO's to PDP/Prog Voltage. Disallow offering APDO's not defined in Table 10-8.

<b>Benefits as a result of the proposed changes:</b>
Clarification of existing requirements on PPS power rules. Reduce optionality in voltage offerings.

<b>An assessment of the impact to the existing revision and systems that currently conform to the USB specification:</b>
None

<b>An analysis of the hardware implications:</b>
Some systems may need to limit the max voltage offered in an APDO.

<b>An analysis of the software implications:</b>
Some systems may need to limit the max voltage offered in an APDO.

<b>An analysis of the compliance testing implications:</b>
Adjust power rule checking as described.

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## Actual Change Requested

### (a). Section 10.2, Page 681

#### From Text:

- Maximum current for Programmable Power Supply APDOs not defined in Table 10-7 **Shall** be RoundDown (x/Max Voltage) to the nearest 50mA.

#### To Text:

- If a 5V Prog, 9V Prog, 15V Prog or 20V Prog Programmable Power Supply APDO is advertised when not required by Table 10-7, then the maximum current **Shall** be RoundDown (x/Prog Voltage) to the nearest 50mA. When the PPS Power Limited bit is clear the Source Shall provide this current at Max Voltage.

### (b). Section 10.2.3.2, Page 686

#### From Text:

A Source that Advertises Programmable Power Supply APDOs other than the ones listed in Table 10-8 **Shall** Advertise additional APDO's with a maximum current of RoundDown (x/Max Voltage) to the nearest 50mA

#### To Text:

A Source **Shall Not** advertise a Programmable Power Supply APDO that does not follow the Minimum Voltage and Maximum Voltage defined in Table 10-8.

### (c). Section 10.2.3.2, Page 686, Table 10-7

#### From Text:

Table 10-1 SPR Programmable Power Supply PDOs and APDOs based on the PDP

PDP Rating (W)	5V fixed	9V fixed	15V fixed	20V fixed	5V Prog	9V Prog	15V Prog	20V Prog
$x < 15W$	$PDP/5^4$	-	-	-	$PDP/5^1$	-	-	-
15W	3A	-	-	-	3A	-	-	-
$15 < x < 27W$	$3A^3$	$PDP/9^4$	-	-	$3A^2$	$PDP/9^1$	-	-
27W	$3A^3$	3A	-	-	-	3A	-	-
$27 < x < 45W$	$3A^3$	$3A^3$	$PDP/15^4$	-	-	$3A^2$	$PDP/15^1$	-
45W	$3A^3$	$3A^3$	3A	-	-	-	3A	-
$45 < x < 60W$	$3A^3$	$3A^3$	$3A^3$	$PDP/20^4$	-	-	$3A^2$	$PDP/20^1$
60W	$3A^3$	$3A^3$	$3A^3$	$3A^3$	-	-	-	3A

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PDP Rating (W)	5V fixed	9V fixed	15V fixed	20V fixed	5V Prog	9V Prog	15V Prog	20V Prog
60 < x < 100W	3A <sup>3</sup>	3A <sup>3</sup>	3A <sup>3</sup>	PDP/20 <sup>4</sup>	-	-	-	PDP/20 <sup>2</sup>
100W	3A <sup>3</sup>	3A <sup>3</sup>	3A <sup>3</sup>	5A	-	-	-	5A

Notes:

1. The SPR PPS APDOs Maximum Current field **shall** advertise RoundDown (PDP/Prog Voltage) to the nearest 50mA.
2. The SPR PPS APDOs Maximum Current field **shall** advertise at least 3A, but **May** advertise up to RoundDown(PDP/Prog Voltage) to the nearest 50mA.
3. The Fixed PDOs Maximum Current field **shall** advertise at least 3A, but **May** advertise up to RoundUp (PDP/Voltage.) to the nearest 10mA. Requires a 5A cable if over 3A is advertised.
4. The Fixed PDOs Maximum Current field **shall** advertise either RoundDown (PDP/Voltage) or RoundUp (PDP/Voltage) to the nearest 10mA.

## To Text:

Table 10-2 Maximum Current for SPR Programmable Power Supply PDOs and APDOs based on the PDP

PDP Rating (W)	5V fixed	9V fixed	15V fixed	20V fixed	5V Prog <sup>5</sup>	9V Prog <sup>5</sup>	15V Prog <sup>5</sup>	20V Prog <sup>5</sup>
x < 15W	PDP/5 <sup>4</sup>	-	-	-	PDP/5 <sup>1</sup>	-	-	-
15W	3A	-	-	-	3A	-	-	-
15 < x < 27W	3A <sup>3</sup>	PDP/9 <sup>4</sup>	-	-	3A <sup>2</sup>	PDP/9 <sup>1</sup>	-	-
27W	3A <sup>3</sup>	3A	-	-	-	3A	-	-
27 < x < 45W	3A <sup>3</sup>	3A <sup>3</sup>	PDP/15 <sup>4</sup>	-	-	3A <sup>2</sup>	PDP/15 <sup>1</sup>	-
45W	3A <sup>3</sup>	3A <sup>3</sup>	3A	-	-	-	3A	-
45 < x < 60W	3A <sup>3</sup>	3A <sup>3</sup>	3A <sup>3</sup>	PDP/20 <sup>4</sup>	-	-	3A <sup>2</sup>	PDP/20 <sup>1</sup>
60W	3A <sup>3</sup>	3A <sup>3</sup>	3A <sup>3</sup>	3A <sup>3</sup>	-	-	-	3A
60 < x < 100W	3A <sup>3</sup>	3A <sup>3</sup>	3A <sup>3</sup>	PDP/20 <sup>4</sup>	-	-	-	PDP/20 <sup>2</sup>
100W	3A <sup>3</sup>	3A <sup>3</sup>	3A <sup>3</sup>	5A	-	-	-	5A

Notes:

1. The SPR PPS APDOs Maximum Current field **shall** advertise RoundDown (PDP/Prog Voltage) to the nearest 50mA.
2. The SPR PPS APDOs Maximum Current field **shall** advertise at least 3A, but **May** advertise up to RoundDown(PDP/Prog Voltage) to the nearest 50mA.
3. The Fixed PDOs Maximum Current field **shall** advertise at least 3A, but **May** advertise up to RoundUp (PDP/Voltage.) to the nearest 10mA. Requires a 5A cable if over 3A is advertised.
4. The Fixed PDOs Maximum Current field **shall** advertise either RoundDown (PDP/Voltage) or RoundUp (PDP/Voltage) to the nearest 10mA.
5. Applies to APDOs regardless of value of the PPS Power Limited bit.

## (d). Section 10.2.3.2, Page 686, Table 10-7

## From Text:

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## 10.1.1.1.1 Examples of the use of SPR Programmable Power Supplies

The following examples illustrate what a power adapter that Advertises a particular PDP Rating *May* offer:

1. PDP 15W
  - 5V @ 3A and 5V Prog @ 3A is the baseline.
2. PDP 25W
  - 5V @ 3A, 9V @ 2.8A, 5V Prog @ 3A and 9V Prog @ 2.8A is the baseline.
  - 5V @ 3A, 9V @ 2.8A, 5V Prog @ >3A up to 5A and 9V Prog @ 2.8A (with a 5A cable)
3. PDP 27W
  - 5V @ 3A, 9V @ 3A, 9V Prog @ 3A is the baseline.
  - 5V @ 3A, 9V @ 3A, 5V Prog @ 3A and 9V Prog @ 3A can offer 5V Prog, but it is covered by the 9V Prog.
  - 5V @ 3A, 9V @ 3A, 5V Prog @ >3A up to 5A and 9V Prog @ 3A (with a 5A cable)
4. PDP 36W
  - 5V @ 3A, 9V @ 3A, 15 @ 2.4A, 9V Prog @ 3 A and 15V Prog @ 2.4A is the baseline.
  - 5V @ 3A, 9V @ 3A, 15 @ 2.4A, 5V Prog @ >3A up to 5A, 9V Prog @ >3A up to 4A and 15V Prog @ 2.4A (with a 5A cable)

The first example is a simple single output Voltage supply. Both the Fixed and Programmable outputs supply 3A.

The second example illustrates that there are multiple ways to meet the requirements. The first sub-bullet is the power that the power rules require. The second sub-bullet illustrates that the power supply can offer more power at a particular Voltage so long as it does not violate the power rules. In this case it offers 25W at both 5V and 9V.

The third example illustrates that there are multiple ways a 27W PDP Rated power adapter can be implemented and meet the power rules. The first sub-bullet shows that the 9V Prog @ 3A fully covers the 5V Prog @3A range so it is not necessary to Advertise both. The second and third sub-bullets illustrate that the power adapter can Advertise lower Voltages at higher currents than required so long as the power does not exceed the PDP.

The fourth example illustrates as the PDP Rating goes higher there are more possible combinations that meet the power rules. Although there are multiple ways to meet the power rules, while operating on SPR Mode no more than a combination of seven SPR PDOs and APDOs can be offered. While operating in EPR Mode, in addition to the seven SPR PDOs and APDOs, no more than 6 additional EPR PDOs may be offered.

## To Text:

## 10.1.1.1.2 Examples of the use of SPR Programmable Power Supplies

The following examples illustrate what a power adapter that Advertises a particular PDP Rating *May* offer:

1. PDP 15W
  - 5V @ 3A and 5V Prog @ 3A is the baseline.
2. PDP 25W
  - 5V @ 3A, 9V @ 2.8A, 5V Prog @ 3A and 9V Prog @ 2.8A is the baseline.
  - 5V @ 3A, 9V @ 2.8A, 5V Prog @ >3A up to 5A and 9V Prog @ 2.8A (with a 5A cable)
3. PDP 27W
  - 5V @ 3A, 9V @ 3A, 9V Prog @ 3A is the baseline.
  - 5V @ 3A, 9V @ 3A, 5V Prog @ 3A and 9V Prog @ 3A can offer 5V Prog, but it is covered by the 9V Prog.
  - 5V @ 3A, 9V @ 3A, 5V Prog @ >3A up to 5A and 9V Prog @ 3A (with a 5A cable)
4. PDP 36W
  - 5V @ 3A, 9V @ 3A, 15 @ 2.4A, 9V Prog @ 3 A and 15V Prog @ 2.4A is the baseline.

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- 5V @ 3A, 9V @ 3A, 15 @ 2.4A, 5V Prog @ >3A up to 5A, 9V Prog @ >3A up to 4A and 15V Prog @ 2.4A (with a 5A cable)

## 5. PDP 50W

- 5V @ 3A, 9V @ 3A, 15 @ 3A, 20V @ 2.5A, 15V Prog @ 3A, and 20V Prog @ 2.5A is the baseline.

The first example is a simple single output Voltage supply. Both the Fixed and Programmable outputs supply 3A.

The second example illustrates that there are multiple ways to meet the requirements. The first sub-bullet is the power that the power rules require. The second sub-bullet illustrates that the power supply can offer more power at a particular Voltage so long as it does not violate the power rules. In this case it offers 25W at both 5V and 9V.

The third example illustrates that there are multiple ways a 27W PDP Rated power adapter can be implemented and meet the power rules. The first sub-bullet shows that the 9V Prog @ 3A fully covers the 5V Prog @ 3A range so it is not necessary to Advertise both. The second and third sub-bullets illustrate that the power adapter can Advertise lower Voltages at higher currents than required so long as the power does not exceed the PDP.

The fourth example illustrates as the PDP Rating goes higher there are more possible combinations that meet the power rules. Although there are multiple ways to meet the power rules, while operating on SPR Mode no more than a combination of seven SPR PDOs and APDOs can be offered. While operating in EPR Mode, in addition to the seven SPR PDOs and APDOs, no more than 6 additional EPR PDOs may be offered.

The fifth example shows that the 15V Prog @ 3A fully covers the 9V Prog @ 3A range so it is not necessary to advertise both.

## (e). Section 10.3.2, Page 691, Table 10-7

### From Text:

#### 10.3.2 Normative Sink Rules

Sinks designed to use Sources with a PDP Rating of x W **Shall**:

- Either operate or charge from Sources that have a PDP Rating  $\geq$  x W.
- Either operate, charge or indicate a capability mismatch (see Section 6.4.2.3) from Sources that have a PDP Rating  $<$  x W and  $\geq$  0.5W.

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

### To Text:

#### 10.3.2 Normative Sink Rules

Sinks designed to use Sources with a PDP Rating of x W **Shall**:

- Either operate or charge from Sources that have a PDP Rating  $\geq$  x W.
  - A sink Shall operate or charge from Sources that have a PDP Rating  $\geq$  x W that offer only the voltages and currents listed in Table 10-2.
    - For example, a 45W source may not offer 20V.
- Either operate, charge or indicate a capability mismatch (see Section 6.4.2.3) from Sources that have a PDP Rating  $<$  x W and  $\geq$  0.5W.

A Sink optimized for a Source with **Optional** Voltages and currents or power as described in Section 10.2.3 with a PDP Rating of x W **Shall** provide a similar user experience when powered from a Source with a PDP Rating of  $\geq$  x W that supplies only the **Normative** Voltages and currents as

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specified in Section 10.2.2. For example, a 60W source might not offer 9V Prog or 15V Prog since 20V Prog is a suitable substitute for both (as shown in Table 10-7).

**For Reference only (no changes):**

**Table 10-8 SPR Programmable Power Supply Voltage Ranges**

	Fixed Nominal Voltage			
	5V Prog	9V Prog	15V Prog	20V Prog
Maximum Voltage	5.9V	11V	16V	21V
Minimum Voltage	3.3V	3.3V	3.3V	3.3V