# USB Power Delivery ENGINEERING CHANGE NOTICE

## Title: PPS PS_RDY
## Applied to: USB Power Delivery Specification Revision 3.0 Version 1.1

| **Brief description of the functional changes proposed:** |
|---|
| Makes a distinction between small and large PPS voltage changes. Requested changes of less than or equal to +/-0.5V are considered small changes, while requests for changes greater than +/- 0.5V are considered large changes.<br>The meaning of PS_RDY is clarified when sent in response to a request of an APDO. |

| **Benefits as a result of the proposed changes:** |
|---|
| This ECN ensures a reliable PS_RDY response for both voltage and current transitions with an exception in the case of obstructing $V_{BUS}$, like keeping $V_{BUS}$ at a certain (battery) voltage or pushing current into a Source. In both cases, protections provide a safe way out. |

| **An assessment of the impact to the existing revision and systems that currently conform to the USB specification:** |
|---|
| Sinks that depend on PS_RDY to know when vPpsNew has been reached, may have a problem in case of an expected voltage increase when in current limit. |

| **An analysis of the hardware implications:** |
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| **An analysis of the software implications:** |
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| |

| **An analysis of the compliance testing implications:** |
|---|
| Tests for PPS mode need to make the distinction between small and large voltage steps when checking transition timing. |

# Actual Change Requested

## (a). Section 7.1.4.3, Page 221

## From Text:

### 7.1.4.3 Programmable Power Supply Voltage Transitions

The Programmable Power Supply (PPS) ***Shall*** transition $V_{BUS}$ over the defined voltage range in a controlled manner. The Output Voltage value in the Programmable RDO defines the nominal value of the PPS output voltage after completing a voltage change and ***Shall*** settle within the limits defined by ***vPpsNew*** by ***tPpsSrcTransition***. Any undershoot or overshoot beyond ***vPpsNew*** ***Shall Not*** exceed ***vPpsValid*** at any time. The PPS output voltage ***May*** change in a step-wise or linear manner and the slew rate of either type of change ***Shall Not*** exceed ***vPpsSlewPos*** for voltage increases or ***vPpsSlewNeg*** for voltage decreases. The nominal requested voltage of all linear voltage changes ***Shall*** equate to an integer number of LSB changes. An LSB change of the PPS output voltage is defined as ***vPpsStep***. A PPS ***Shall*** be able to supply the negotiated current level as it change its output voltage to the requested level. All PPS voltage increases ***Shall*** result in a voltage that is greater than the previous PPS output voltage. Likewise, all PPS voltage decreases ***Shall*** result in a voltage that is less than the previous PPS output voltage.

Figure 7-4 and Figure 7-5 below show the output voltage behavior of a Programmable Power Supply in response to positive and negative voltage change requests while operating with a PPS. The parameters ***vPpsMinVoltage*** and ***vPpsMaxVoltage*** define the lower and upper limits of the PPS range respectively. ***vPpsMinVoltage*** corresponds to Minimum Voltage field in the PPS APDO and ***vPpsMaxVoltage*** corresponds to Maximum Voltage field in the PPS APDO. If the Sink negotiates for a new PPS APDO, then the transition between the two PPS APDOs ***Shall*** occur as described in Section 7.3.18.

## To Text:

### 7.1.4.3 Programmable Power Supply Voltage Transitions

The Programmable Power Supply (PPS) ***Shall*** transition $V_{BUS}$ over the defined voltage range in a controlled manner. The Output Voltage value in the Programmable RDO defines the nominal value of the PPS output voltage after completing a voltage change and ***Shall*** settle within the limits defined by ***vPpsNew*** by ***tPpsSrcTransSmall~~ition~~*** for steps smaller than or equal to ***vPpsSmallStep***, or else, within the limits defined by ***vPpsNew*** by ***tPpsSrcTransLarge~~Settle~~***, but only in case the Programmable Power Supply is not in CL mode. Any ~~undershoot or~~ overshoot beyond ***vPpsNew*** ***Shall Not*** exceed ***vPpsValid*** at any time. Any undershoot beyond ***vPpsNew Shall Not*** exceed ***vPpsValid*** for currents not resulting in CL mode. The PPS output voltage ***May*** change in a step-wise or linear manner and the slew rate of either type of change ***Shall Not*** exceed ***vPpsSlewPos*** for voltage increases or ***vPpsSlewNeg*** for voltage decreases. The nominal requested voltage of all linear voltage changes ***Shall*** equate to an integer number of LSB changes. An LSB change of the PPS output voltage is defined as ***vPpsStep***. A PPS ***Shall*** be able to supply the negotiated current level as it changes its output voltage to the requested level. All PPS voltage increases ***Shall*** result in a voltage that is greater than the previous PPS output voltage. Likewise, all PPS voltage decreases ***Shall*** result in a voltage that is less than the previous PPS output voltage.

Since a Sink can draw current up to the negotiated APDO current level in case of a voltage step, the voltage might not increase to the requested level due to the power supply operating in CL mode. Likewise, since a Sink can have a battery connected to $V_{BUS}$, the voltage might not decrease to the requested level due to the battery voltage being higher than the output voltage set-point the Source is transitioning to. Were the Source to rely on checking the voltage on $V_{BUS,}$ in either case, to determine when its power supply is ready a ***PS_RDY*** would never be sent.

When the PPS voltage steps up or down, a ***PS_RDY*** Message ***Shall*** be sent within:

- ***tPpsSrcTransLarge*** after the last bit of the ***GoodCRC*** Message following the ***Accept*** Message for steps larger than ***vPpsSmallStep***

- ***tPpsSrcTransSmall*** after the last bit of the ***GoodCRC*** Message following the ***Accept*** Message for steps less than or equal to ***vPpsSmallStep*** provided that either the voltage on $V_{BUS}$ has reached ***vPpsNew*** or the power supply is in CL mode.

When ***vPpsNew*** is lower than the battery voltage, or the Source's primary power is cut off the Sink ***Shall*** immediately disconnect its battery from $V_{BUS}$. In these situations the output current could reverse polarity and the Sink is not allowed to source current (see Sections 7.2.1 and 7.2.9).

Figure 7-4 and Figure 7-5 below show the output voltage behavior of a Programmable Power Supply in response to positive and negative voltage change requests while operating with a PPS. The parameters ***vPpsMinVoltage*** and ***vPpsMaxVoltage*** define the lower and upper limits of the PPS range respectively. ***vPpsMinVoltage*** corresponds to Minimum Voltage field in the PPS APDO and ***vPpsMaxVoltage*** corresponds to Maximum Voltage field in the PPS APDO. If the Sink negotiates for a new PPS APDO, then the transition between the two PPS APDOs ***Shall*** occur as described in Section 7.3.18.

## (b). Section 7.1.8.1, Page 227

### From Text:

After a voltage transition of a Programmable Power Supply is complete (i.e. after ***tPpsSrcTransition***) and during static load conditions the Source output voltage ***Shall*** remain within the ***vPpsNew*** limits. The range defined by ***vPpsNew*** accounts for DC regulation accuracy, line regulation, load regulation and output ripple. After a voltage transition is complete (i.e. after ***tPpsSrcTransition***) and during transient load conditions the Source output voltage ***Shall Not*** go beyond the range specified by ***vPpsValid***. The amount of time the Source output voltage can be in the band between ***vPpsNew*** and ***vPpsValid*** ***Shall Not*** exceed ***tPpsTransient***.

### To Text:

After a voltage transition of a Programmable Power Supply is complete (i.e. after ***tPpsSrcTransSmall*** or ***tPpsSrcTransLarge***) and during static load conditions the Source output voltage ***Shall*** remain within the ***vPpsNew*** limits. The range defined by ***vPpsNew*** accounts for DC regulation accuracy, line regulation, load regulation and output ripple. After a voltage transition is complete (i.e. after ***tPpsSrcTransSmall*** or ***tPpsSrcTransLarge***) and during transient load conditions the Source output voltage ***Shall Not*** go beyond the range specified by ***vPpsValid***. The amount of time the Source output voltage can be in the band between ***vPpsNew*** and ***vPpsValid*** ***Shall Not*** exceed ***tPpsTransient***.

## (c). Section 7.3.16, Page 270

### From Text:

#### 7.3.16 Increasing the Programmable Power Supply Voltage

The interaction of the System Policy, Device Policy, and power supply that ***Shall*** be followed when increasing the voltage is shown in Figure 7-30. The sequence that ***Shall*** be followed is described in Table 7-16. The timing parameters that ***Shall*** be followed are listed in Table 7-19 and Table 7-20. Note in this figure, the Sink has previously sent a ***Request*** Message to the Source.

Figure 7-30 Transition Diagram for Increasing the Programmable Power Supply Voltage

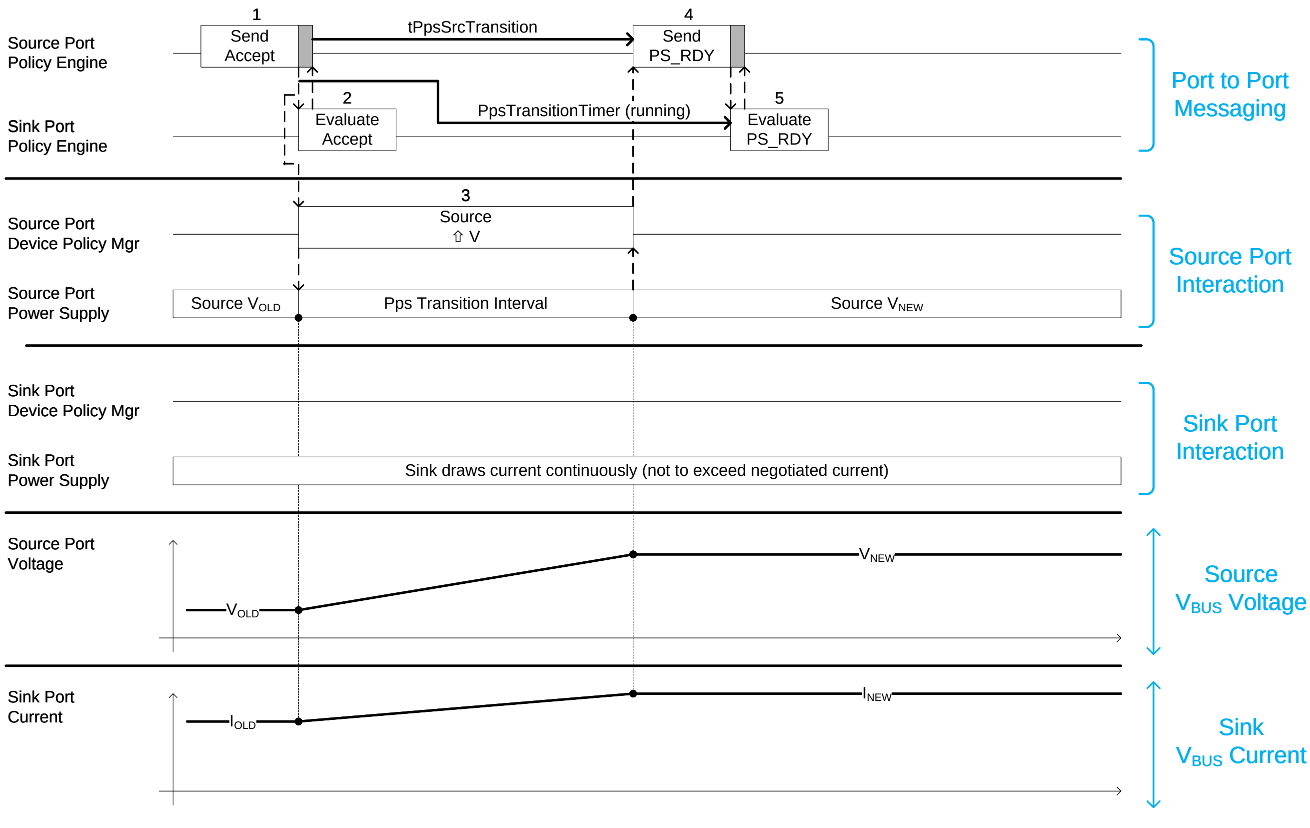


Table 7-16 Sequence Description for Increasing the Programmable Power Supply Voltage

| Step | Source Port | Sink Port |
|---|---|---|
| 1 | Policy Engine sends the ***Accept*** Message to the Sink. | Policy Engine receives the ***Accept*** Message and starts the ***PSTransitionTimer***. |
| 2 | Protocol Layer receives the ***GoodCRC*** Message from the Sink. The Policy Engine tells the Device Policy Manager to instruct the power supply to increase its output voltage. | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine. Policy Engine then evaluates the ***Accept*** Message. |
| 3 | After sending the ***Accept*** Message, the Programmable Power Supply starts to increase its output voltage. The Programmable Power Supply new voltage ***Shall*** be reached by ***tPpsSrcTransition***. The power supply informs the Device Policy Manager that it is has reached the new level. The power supply status is passed to the Policy Engine. | |
| 4 | The Policy Engine sends the ***PS_RDY*** Message to the Sink. | The Policy Engine receives the ***PS_RDY*** Message from the Source. |
| 5 | Protocol Layer receives the ***GoodCRC*** Message from the Sink. | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine then evaluates the ***PS_RDY*** Message from the Source and tells the Device Policy Manager that the Programmable Power Supply is operating at the new voltage. |

## To Text:

### 7.3.16 Increasing the Programmable Power Supply Voltage

The interaction of the System Policy, Device Policy, and power supply that ***Shall*** be followed when increasing the voltage is shown in Figure 7-30. The sequence that ***Shall*** be followed is described in Table 7-16. The timing parameters that ***Shall*** be followed are listed in Table 7-22 and Table 7-23. Note in this figure, the Sink has previously sent a ***Request*** Message to the Source.

**Figure 7-30 Transition Diagram for Increasing the Programmable Power Supply Voltage**

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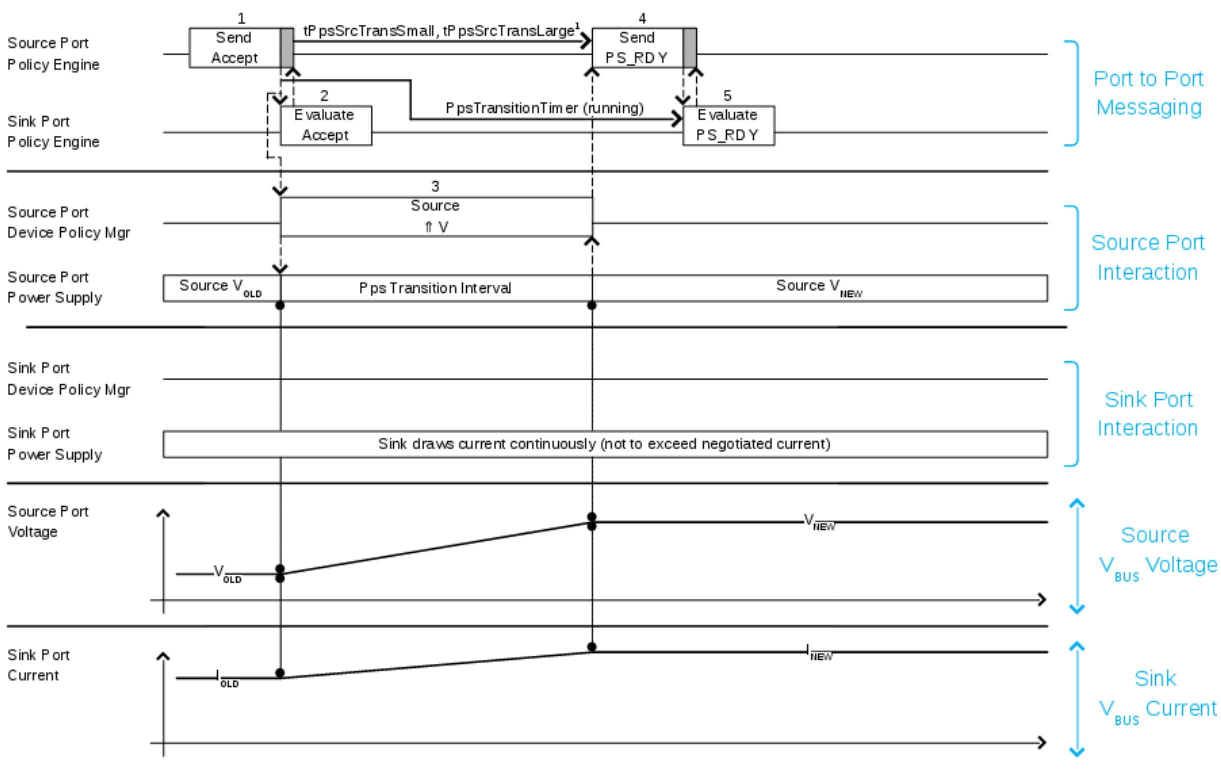



¹ tPpsSrcTransLarge for steps > vPpsSmallStep else tPpsSrcTransSmall

**Table 7-16 Sequence Description for Increasing the Programmable Power Supply Voltage**

| Step | Source Port | Sink Port |
|---|---|---|
| 1 | Policy Engine sends the ***Accept*** Message to the Sink. | Policy Engine receives the ***Accept*** Message and starts the ***PSTransitionTimer***. |
| 2 | Protocol Layer receives the ***GoodCRC*** Message from the Sink. The Policy Engine tells the Device Policy Manager to instruct the power supply to increase its output voltage. | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine. Policy Engine then evaluates the ***Accept*** Message. |

| Step | Source Port | Sink Port |
|---|---|---|
| 3 | After sending the ***Accept*** Message, the Programmable Power Supply starts to increase its output voltage. The Programmable Power Supply new voltage set-point ***Shall*** be reached by ***tPpsSrcTransLarge*** for steps larger than ***vPpsSmallStep*** or ***tPpsSrcTransSmall~~ition~~*** otherwise. The power supply informs the Device Policy Manager that it ~~is~~ has reached the new set-point and whether Vbus is at the corresponding new level, or if the supply is operating in CL mode. The power supply status is passed to the Policy Engine. | |
| 4 | The Policy Engine sends the ***PS_RDY*** Message to the Sink. | The Policy Engine receives the ***PS_RDY*** Message from the Source. |
| 5 | Protocol Layer receives the ***GoodCRC*** Message from the Sink. | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine then evaluates the ***PS_RDY*** Message from the Source and tells the Device Policy Manager that the Programmable Power Supply is operating at the new voltage set-point. |

## (d). Section 7.3.17, Page 272

## From Text:

### 7.3.17 Decreasing the Programmable Power Supply Voltage

The interaction of the System Policy, Device Policy, and power supply that ***Shall*** be followed when decreasing the voltage is shown in Figure 7-31. The sequence that ***Shall*** be followed is described in Table 7-17. The timing parameters that ***Shall*** be followed are listed in Table 7-19 and Table 7-20. Note in this figure, the Sink has previously sent a ***Request*** Message to the Source.

**Figure 7-31 Transition Diagram for Decreasing the Programmable Power Supply Voltage**

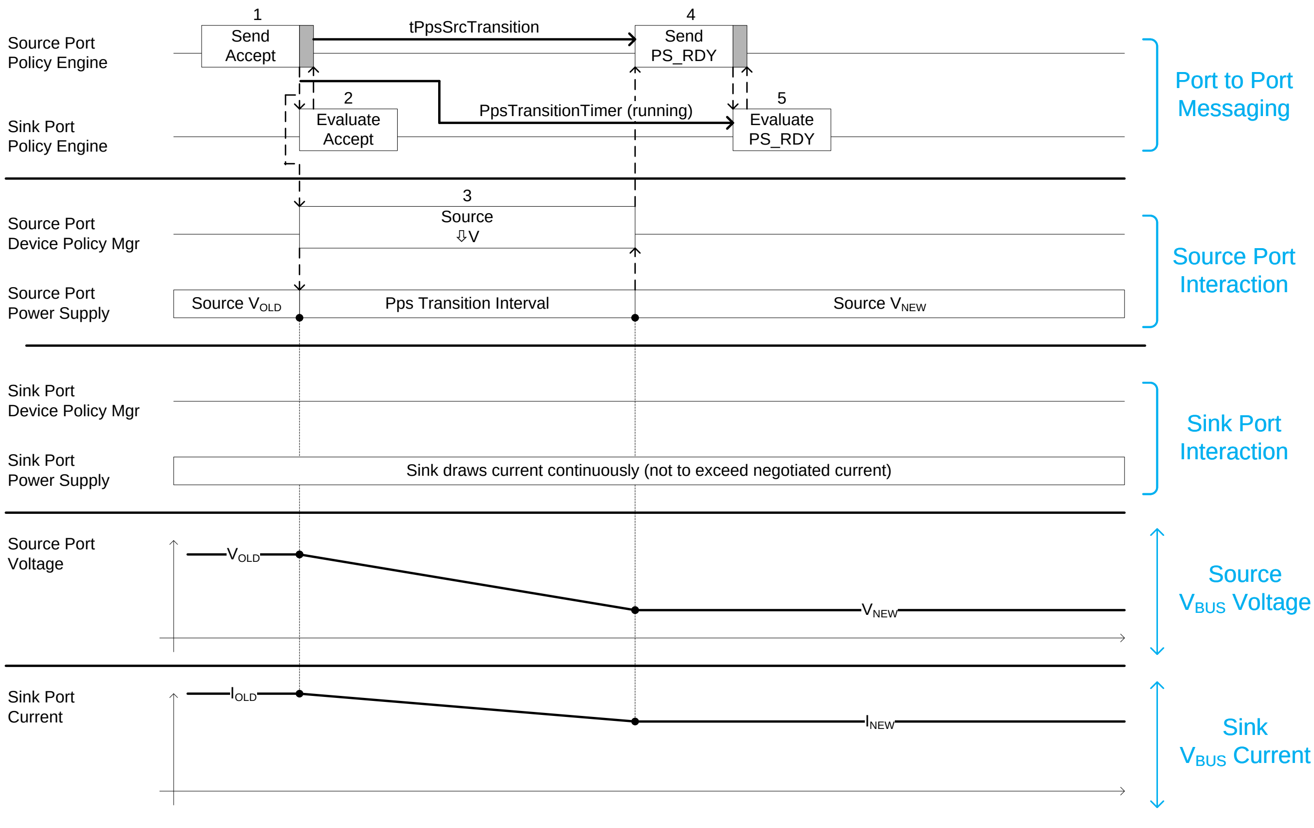



**Table 7-17 Sequence Description for Decreasing the Programmable Power Supply Voltage**

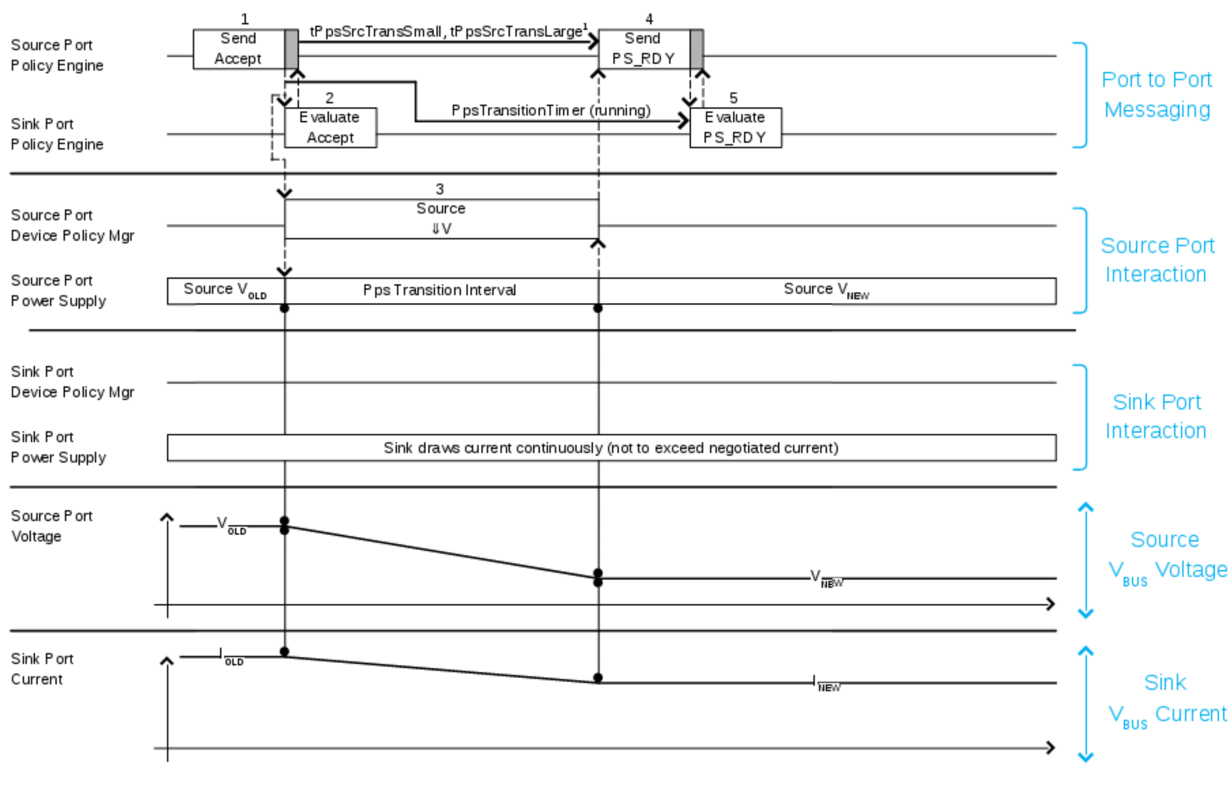
| Step | Source Port | Sink Port |
|---|---|---|
| 1 | Policy Engine sends the ***Accept*** Message to the Sink. | Policy Engine receives the ***Accept*** Message and starts the ***PSTransitionTimer***. |
| 2 | Protocol Layer receives the ***GoodCRC*** Message from the Sink. The Policy Engine tells the Device Policy Manager to instruct the power supply to decrease its output voltage. | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine. Policy Engine then evaluates the ***Accept*** Message. |
| 3 | After sending the ***Accept*** Message, the Programmable Power Supply starts to decrease its output voltage. The Programmable Power Supply new voltage ***Shall*** be reached by ***tPpsSrcTransition***. The power supply informs the Device Policy Manager that it is has reached the new level. The power supply status is passed to the Policy Engine. | |
| 4 | The Policy Engine sends the ***PS_RDY*** Message to the Sink. | The Policy Engine receives the ***PS_RDY*** Message from the Source. |
| 5 | Protocol Layer receives the ***GoodCRC*** Message from the Sink. | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine then evaluates the ***PS_RDY*** Message from the Source and tells the Device Policy Manager that the Programmable Power Supply is operating at the new voltage. |

## To Text:

### 7.3.17 Decreasing the Programmable Power Supply Voltage

The interaction of the System Policy, Device Policy, and power supply that ***Shall*** be followed when decreasing the voltage is shown in Figure 7-31. The sequence that ***Shall*** be followed is described in Table 7-17. The timing parameters that ***Shall*** be followed are listed in Table 7-22 and Table 7-23. Note in this figure, the Sink has previously sent a ***Request*** Message to the Source.

**Figure 7-31 Transition Diagram for Decreasing the Programmable Power Supply Voltage**




¹ tPpsSrcTransLarge for steps > vPpsSmallStep else tPpsSrcTransSmall

**Table 7-17 Sequence Description for Decreasing the Programmable Power Supply Voltage**

| Step | Source Port | Sink Port |
|---|---|---|
| 1 | Policy Engine sends the ***Accept*** Message to the Sink. | Policy Engine receives the ***Accept*** Message and starts the ***PSTransitionTimer***. |
| 2 | Protocol Layer receives the ***GoodCRC*** Message from the Sink. The Policy Engine tells the Device Policy Manager to instruct the power supply to decrease its output voltage. | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine. Policy Engine then evaluates the ***Accept*** Message. |
| 3 | After sending the ***Accept*** Message, the Programmable Power Supply starts to decrease its output voltage. The Programmable Power Supply new voltage set-point (corresponding to ***vPpsNew***) ***Shall*** be reached by ***tPpsSrcTransLarge*** for steps larger than ***vPpsSmallStep*** or else by ***tPpsSrcTransSmall~~ition~~***. The power supply informs the Device Policy Manager that it is has reached the new set-point and whether Vbus is at the corresponding new level, or if the supply is operating in CL mode. The power supply status is passed to the Policy Engine. | |

| Step | Source Port | Sink Port |
|---|---|---|
| 4 | The Policy Engine sends the ***PS_RDY*** Message to the Sink. | The Policy Engine receives the ***PS_RDY*** Message from the Source. |
| 5 | Protocol Layer receives the ***GoodCRC*** Message from the Sink. | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine then evaluates the ***PS_RDY*** Message from the Source and tells the Device Policy Manager that the Programmable Power Supply is operating at the new voltage set-point (corresponding to ***vPpsNew***). |

## (e). Section 7.3.18, Page 274, Table 7-18

## From Text:

**Table 7-18 Sequence Description for Changing the Source PDO or APDO**

| Step | Source Port | Sink Port |
|---|---|---|
| 1 | Policy Engine sends the ***Accept*** Message to the Sink. | Policy Engine receives the ***Accept*** Message and starts the ***PSTransitionTimer***. |
| 2 | Protocol Layer receives the ***GoodCRC*** Message from the Sink. The Policy Engine tells the Device Policy Manager to instruct the power supply to change to the new Source PDO or APDO. | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine. Policy Engine then evaluates the ***Accept*** Message. |
| 3 | After sending the ***Accept*** Message, the Source starts to change to the new PDO or APDO. The Source transition to the new PDO or APDO $V_{BUS}$ voltage ***Shall*** be completed by ***tSrcTransition***. The power supply informs the Device Policy Manager that the transition to the new PDO or APDO is complete. The power supply status is passed to the Policy Engine. | |
| 4 | The Policy Engine sends the ***PS_RDY*** Message to the Sink. | The Policy Engine receives the ***PS_RDY*** Message from the Source. |
| 5 | Protocol Layer receives the ***GoodCRC*** Message from the Sink. | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine then evaluates the ***PS_RDY*** Message from the Source and tells the Device Policy Manager that the Source is operating at the new PDO or APDO. |

## To Text:

**Table 7-18 Sequence Description for Changing the Source PDO or APDO**

| Step | Source Port | Sink Port |
|---|---|---|
| 1 | Policy Engine sends the ***Accept*** Message to the Sink. | Policy Engine receives the ***Accept*** Message and starts the ***PSTransitionTimer***. |
| 2 | Protocol Layer receives the ***GoodCRC*** Message from the Sink. The Policy Engine tells the Device Policy Manager to instruct the power supply to change to the new Source PDO or APDO. | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine. Policy Engine then evaluates the ***Accept*** Message. |

| Step | Source Port | Sink Port |
|---|---|---|
| 3 | ~~After sending the ***Accept*** Message, the Source starts to change to the new PDO or APDO. The Source transition to the new PDO or APDO $V_{BUS}$ voltage ***Shall*** be completed by ***tSrcTransition***. The power supply informs the Device Policy Manager that the transition to the new PDO or APDO is complete. The power supply status is passed to the Policy Engine.~~ | Policy Engine tells the Device Policy Manager to instruct the power supply to reduce power consumption to ***pSnkStdby*** within ***tSnkStdby*** (t1); t1 ***Shall*** complete before ***tSrcTransition***. The Sink ***Shall Not*** violate transient load behavior defined in Section 7.2.6 while transitioning to and operating at the new power level. |
| 4 | ***tSrcTransition*** after the ***GoodCRC*** Message was received the Source starts to change to the new PDO or APDO. The Source ***Shall*** be ready to operate at the new power level within ***tSrcReady*** (t2). The power supply informs the Device Policy Manager that it is ready to operate at the new power level. The power supply status is passed to the Policy Engine. | |
| 5 | The Policy Engine sends the ***PS_RDY*** Message to the Sink. | The Policy Engine receives the ***PS_RDY*** Message from the Source. |
| 6 | Protocol Layer receives the ***GoodCRC*** Message from the Sink. | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine then evaluates the ***PS_RDY*** Message from the Source and tells the Device Policy Manager that the Source is operating at the new PDO or APDO. |
| 7 | | The Sink ***May*** begin operating at the new power level any time after evaluation of the ***PS_RDY*** Message. This time duration is indeterminate. |
| 8 | | The Sink ***Shall Not*** violate the transient load behavior defined in Section 7.2.6 while transitioning to and operating at the new power level. The time duration (t3) depends on the magnitude of the load change. |

## (f). New Section 7.3.19

## From Text:

not present

## To Text:

### 7.3.19 Increasing the Programmable Power Supply Current

The interaction of the System Policy, Device Policy, and power supply that ***Shall*** be followed when increasing the current limit in the same APDO, not exceeding the maximum for that APDO and without changing the requested voltage is shown in Figure 7-33. The sequence that ***Shall*** be followed is described in Table 7-19. The timing parameters that ***Shall*** be followed are listed in Table 7-22 and Table 7-23. Note in this figure, the Sink has previously sent a ***Request*** Message to the Source.

The Sink ***May*** draw current equal to the increasing Current Limit of the Source before it has received the ***PS_RDY*** Message for the new request.

**Figure 7-33 Transition Diagram for increasing the Current in PPS mode**

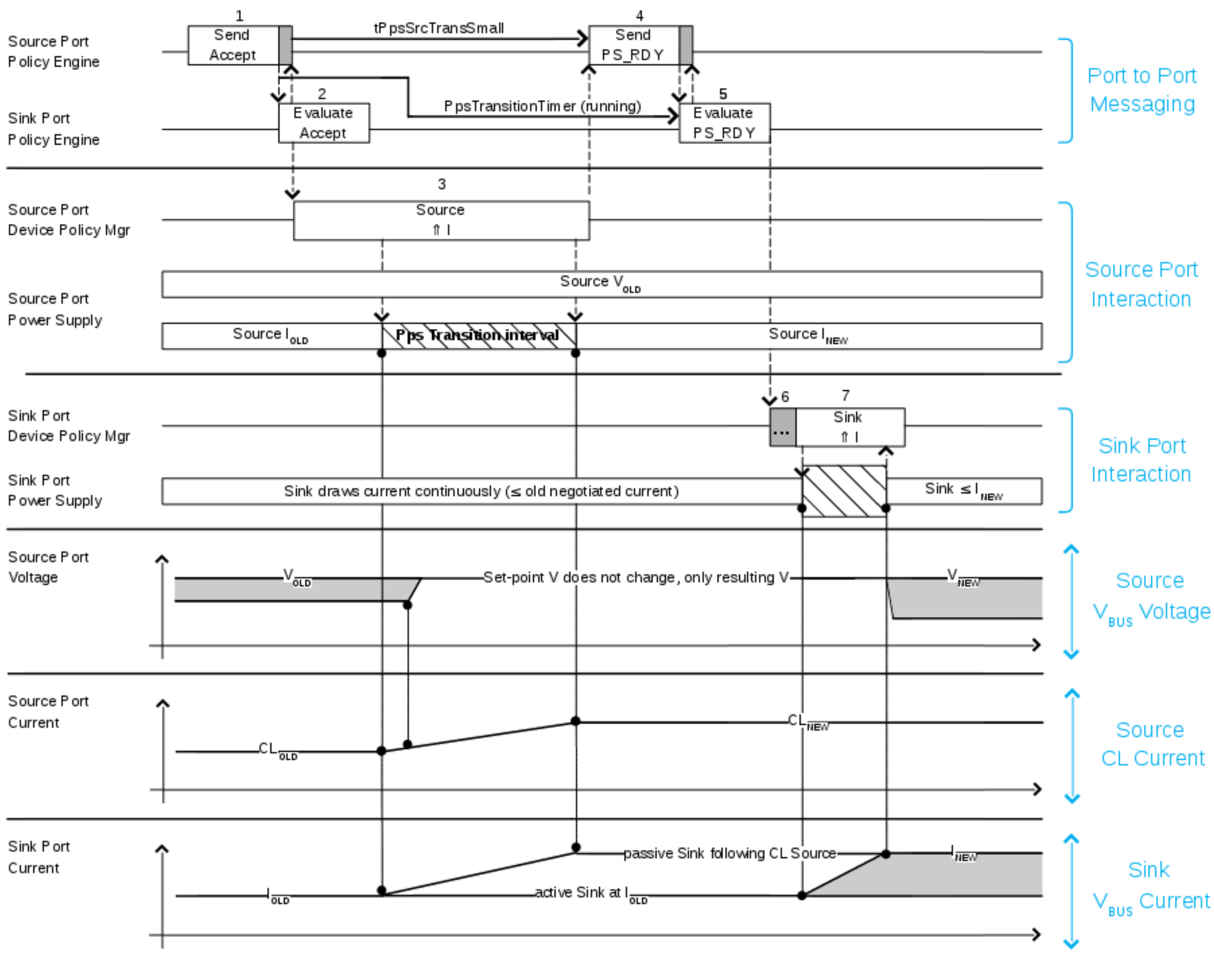



**Table 7-19 Sequence Description for increasing the Current in PPS mode**

| Step | Source Port | Sink Port |
|---|---|---|
| 1 | Policy Engine sends the ***Accept*** Message to the Sink. | Policy Engine receives the ***Accept*** Message and starts the ***PSTransitionTimer***. |
| 2 | Protocol Layer receives the ***GoodCRC*** Message from the Sink. The Policy Engine tells the Device Policy Manager to instruct the power supply to increase its set-point for the current limit. | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine then evaluates the ***Accept*** Message. |
| 3 | The Power Supply increases its Current Limit set-point to the new requested value. | The Sink draws current according to the increased Current Limit of the Source. |
| 4 | The Policy Engine waits ***tPpsSrcTransSmall*** then sends the ***PS_RDY*** Message to the Sink. | Policy Engine receives the ***PS_RDY*** Message. |
| 5 | Policy Engine receives the ***GoodCRC*** Message from the Sink. | Protocol Layer sends the ***GoodCRC*** Message to the Source. |
| 6 | | Policy Engine evaluates the ***PS_RDY*** Message and tells the Device Policy Manager it can increase the current up to the requested value without the Source going into CL mode. |
| 7 | | The Sink increases its current. |

## (g). New Section 7.3.20

### From Text:

not present

### To Text:

#### 7.3.20 Decreasing the Programmable Power Supply Current

The interaction of the System Policy, Device Policy, and power supply that ***Shall*** be followed when decreasing the current limit in the same APDO, not exceeding the minimum for that APDO and without changing the requested voltage is shown in Figure 7-34. The sequence that ***Shall*** be followed is described in Table 7-20. The timing parameters that ***Shall*** be followed are listed in Table 7-22 and Table 7-23. Note in this figure, the Sink has previously sent a ***Request*** Message to the Source.

**Figure 7-34 Transition Diagram for decreasing the Current in PPS mode**

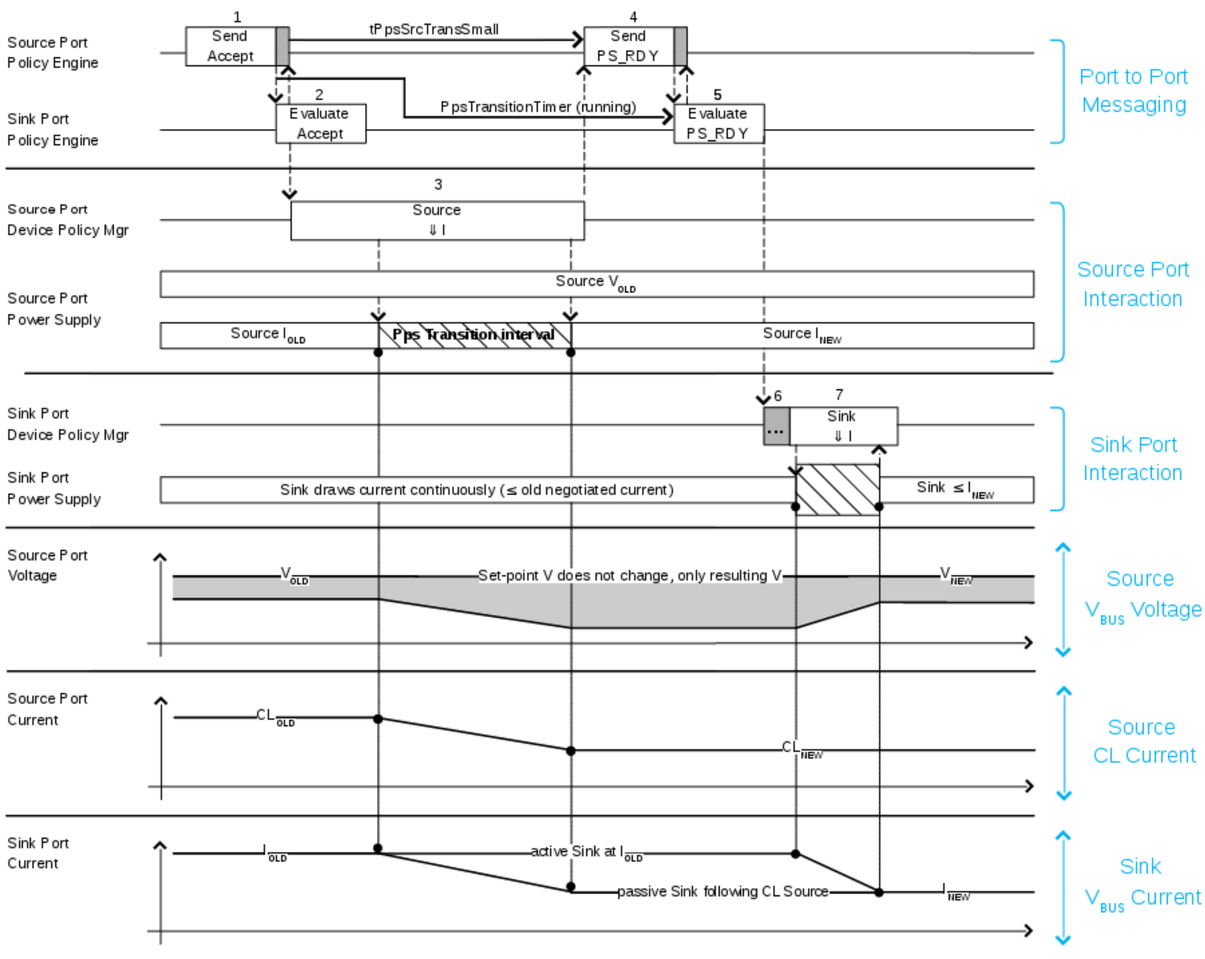



**Table 7-20 Sequence Description for decreasing the Current in PPS mode**

| Step | Source Port | Sink Port |
|---|---|---|
| 1 | Policy Engine sends the ***Accept*** Message to the Sink. | Policy Engine receives the ***Accept*** Message and starts the ***PSTransitionTimer***. |
| 2 | Protocol Layer receives the ***GoodCRC*** Message from the Sink. The Policy Engine tells the Device Policy Manager to instruct the power supply to decrease its set-point for the current limit. | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine then evaluates the ***Accept*** Message and instructs the Sink to reduce its current to below the new negotiated current level. |
| 3 | The Power Supply decreases its Current Limit set-point to the new negotiated value. | The Sink reduces its current to less than the new negotiated current to prevent the $V_{BUS}$ voltage reducing. |
| 4 | The Policy Engine waits ***tPpsSrcTransSmall*** then sends the ***PS_RDY*** Message to the Sink. | |
| 5 | Policy Engine receives the ***GoodCRC*** Message from the Sink. | Policy Engine receives the ***PS_RDY*** Message. |
| 6 | | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine evaluates the ***PS_RDY*** Message. |
| 7 | | The Sink is allowed to draw $I_{NEW}$ but must be aware the voltage on $V_{BUS}$ can drop doing so. |

## (h). New Section 7.3.21

### From Text:

not present

### To Text:

#### 7.3.21 Same Request Programmable Power Supply

The interaction of the System Policy, Device Policy, and power supply that ***Shall*** be followed when the Sink requests the same voltage and current levels as the present negotiated levels for voltage and current is shown in Figure 7-34. The sequence that ***Shall*** be followed is described in Table 7-20. The timing parameters that ***Shall*** be followed are listed in Table 7-22 and Table 7-23. Note in this figure, the Sink has previously sent a ***Request*** Message to the Source.

Figure 7-34 Transition Diagram for no change in Current or Voltage in PPS mode

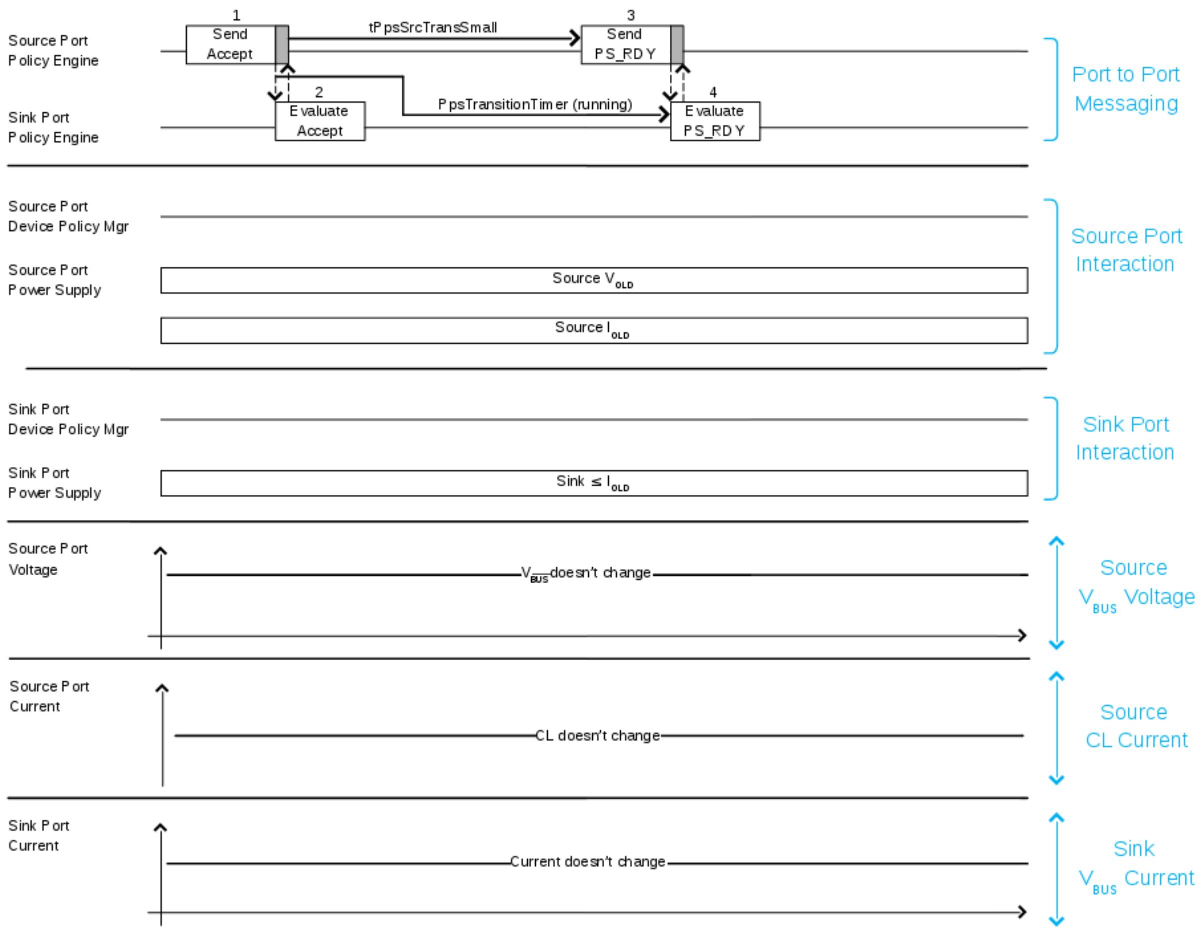



Table 7-20 Sequence Description for no change in Current or Voltage in PPS mode

| Step | Source Port | Sink Port |
|---|---|---|
| 1 | Policy Engine sends the ***Accept*** Message to the Sink. | Policy Engine receives the ***Accept*** Message and starts the ***PSTransitionTimer***. |
| 2 | Protocol Layer receives the ***GoodCRC*** Message from the Sink. | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine then evaluates the ***Accept*** Message. |
| 3 | The Policy Engine then sends the ***PS_RDY*** Message to the Sink within ***tPpsSrcTranSmall***. | Policy Engine receives the ***PS_RDY*** Message. |
| 4 | Policy Engine receives the ***GoodCRC*** Message from the Sink.<br>Note: the decision that no power transition is required could be made either by the Device Policy Manager or the power supply depending on implementation. | Protocol Layer sends the ***GoodCRC*** Message to the Source. Policy Engine evaluates the ***PS_RDY*** Message. |

## (i). Section 7.4.1, Page 276, Table 7-19

## From Text:

**Table 7-19 Source Electrical Parameters**

| Parameter | Description | MIN | TYP | MAX | UNITS | Reference |
|---|---|---|---|---|---|---|
| ***tPpsSrcTransition*** | The time the Programmable Power Supply ***Shall*** transition between requested voltages. | 0 | | 25 | ms | Section 7.3 |
| ***tPpsTransient*** | The maximum time for the Programmable power Supply to be between vPpsNew and vPpsValid in response to a load transient | | | 5 | ms | Section 7.1.8.1 |
| Note 1: The Source ***Shall*** charge and discharge the total bulk capacitance to meet the transition time requirements. | | | | | | |

## To Text:

**Table 7-22 Source Electrical Parameters**

| Parameter | Description | MIN | TYP | MAX | UNITS | Reference |
|---|---|---|---|---|---|---|
| ***tPpsSrcTransLarge*** | The time the Programmable Power Supply's set-point ***Shall*** transition between requested voltages for steps larger than ***vPpsSmallStep***. | 0 | | 275 | ms | Section 7.3.16, 7.3.17 |
| ***tPpsSrcTransSmall~~ition~~*** | The time the Programmable Power Supply's set-point ***Shall*** transition between requested voltages for steps less than or equal to ***vPpsSmallStep***. | 0 | | 25 | ms | Section 7.3.16, 7.3.17 |
| ***tPpsTransient*** | The maximum time for the Programmable Power Supply to be between ***vPpsNew*** and ***vPpsValid*** in response to a load transient not resulting in CL mode. ~~exceeding the negotiated maximum current~~ | | | 5 | ms | Section 7.1.8.1 |
| ***vPpsSmallStep*** | PPS step size defined as small step | -500 | | 500 | mV | Section 7.1.4.3 |
| Note 1: The Source ***Shall*** charge and discharge the total bulk capacitance to meet the transition time requirements. | | | | | | |