

USB PD CTS ENGINEERING CHANGE NOTIFICATION FORM

NOTICE: Any Company or Companies submitting a USB Power Delivery ECR proposal must be one of the following: a Promoter or Contributor of the USB 3.0 and 2.0 Specifications who have completed the USB Power Delivery addendum. If a group of Companies is submitting an ECR proposal, each company must be either a Promoter or Contributor of the USB 3.0 and 2.0 Specifications who have completed the USB Power Delivery addendum.

SPECIFICATION REVISIONS AND ADDENDA: At any point in time, there shall only be one current version of the USB PD CTS, termed the production version. At the same time, there may also be proposed revisions to the specification's design which are not yet approved and shall be held confidential as deemed necessary by the USB 3.0 and USB 2.0 Promoters and within the Group of Working Committee(s).

PROCEDURES FOR SUBMITTING PROPOSALS: Both members of the USB Implementers Forum as a whole and members of the USB 3.0 and USB 2.0 Promoters may submit requests to revise the USB PD CTS Specification. Such a request may be rejected or may result in a USB PD Engineering Change Notice (ECN), which is the official way USB specifications may be changed.

FORMAT OF PROPOSAL: The originator of a request to alter the USB PD CTS Specification may do so by posting this to the USB Power Delivery Compliance working group for review. Once the proposal has been reviewed by the working group it will be passed to the USB 3.0 and 2.0 Promoters for approval to publish.

RESUBMISSION AND APPEAL: The originator of a request that was not approved can redraft the original request. Rewritten proposal will be treated as a new proposal and will be evaluated using the procedures described above. The originator of a request that was not approved can also submit an appeal to the USB 3.0 and 2.0 Promoters. The appeal must be made in writing and addressed to the Secretary of the USB Implementers Forum.

ABOUT THE ENGINEERING CHANGE REQUEST FORM:

The Purpose of this Engineering Change Request Form is to expedite the review process of the proposal by providing explanations, background information, and examples of the proposed changes at a high level. This form serves as an executive summary to the actual proposal.

STEPS ON HOW TO SUBMIT A USB PD ENGINEERING CHANGE REQUEST:

- 1) Please fill out the Engineering Change Request Form on the following pages completely:
 - a) Detail the names and contact details for each of the ECR contributors
 - b) Update the ECR Title
 - c) Give a minimum of 2-3 sentences for each description on the form outlining the background to the ECR
- 2) For each section/table/figure to be updated:
 - a) Detail the section number, starting page and figure/table number to be updated as appropriate.
 - b) Detail existing text under "From Text"
 - c) Detail changed text under "To Text"
- 3) Save the file as "USB PD CTS 1.0 R 1" followed by the ECR Title as per step 1)b)
- 4) Post the ECR in the USB PD CTS Documents section under "ECR | New ECRs".
 - a) This ECR will then be reviewed by the Power Delivery Compliance Working Group.
 - b) Revisions to the ECR originating from the review should be submitted as document revision of the original ECR using "Add new document".

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Company: Apple Mailstop: _____

Address: _____

City: _____ State/Province: _____

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City: _____ State/Province: _____

Country: _____ Zip/Postal Code: _____

Phone: _____ FAX: _____

Name: _____ Email: _____

Company: _____ Mailstop: _____

Address: _____

City: _____ State/Province: _____

Country: _____ Zip/Postal Code: _____

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USB PD CTS ENGINEERING CHANGE NOTIFICATION FORM

Title: TEST.PD.PS.SNK.1

Applied to: USB PD CTS Q1, 2026 RC

Brief description of the functional changes proposed:
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Update PDO transition test per USB PD 3.2 v1.2 definition(Section 4.5).

Benefits as a result of the proposed changes:
--

Sink DUT voltage/current transition operation tested per the latest spec definition.
--

An assessment of the impact to the existing revision and systems that currently conform to the USB specification:
--

None

An analysis of the hardware implications:
--

None

An analysis of the software implications:
--

None

An analysis of the compliance testing implications:
--

Tester to update the corresponding tests per the ECR updates.

An analysis of the Vendor Info File (VIF) implications:
--

None

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Actual Change Requested

TEST.PD.PS.SNK.1

From Text:

TEST.PD.PS.SNK.1 PDO Transitions As Sink

Description: The Tester verifies that the UUT responds correctly to a new *Source_Capabilities* Messages.

Test Specific Tester Behavior:

Test Conditions:

	Consumer Only, C/P, DRP	Provider Only, P/C
<i>Rev2Snk</i>	✓	
<i>Rev3ChkdSnk</i>	✓	

Test Procedures:

1. The Tester runs a bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a *Get_Sink_Cap* Message to the UUT.
3. The check fails if the UUT does not send *Sink_Capabilities* Message. [TEST.PD.PS.SNK.1#1]
4. The Tester sends a new *Source_Capabilities* Message emulating a 240W source PPS for PD3 or 100W source for PD2 as per power rules.
 - a. The first PDO is defined as:
 - i. B29 (Dual-Role Power) set to 1b.
 - ii. B28 (USB Suspend Supported) set to 0b.
 - iii. B27 (Unconstrained Power) set to 0b.
 - iv. B26 (USB Communications Capable) set to 0b.
 - v. B25 (Dual-Role Data) set to 0b.
 - vi. B24 (PD3, Unchunked Extended Message Supported) set to 0b.
 - vii. B23 (EPR Mode Capable) to 1b when in PD3, to 0b in PD2
 - viii. B22 (Reserved) set to 0b.
 - ix. B21...20 (Peak Current) set to 00b.
 - x. B19...10 (Voltage) set to 5V.
 - xi. B9...0 (Maximum Current) set to 3000mA.
 - b. Other PDOs fit with power rules:
 - i. PDO2: 9V 3A
 - ii. PDO3: 15V 3A
 - iii. PDO4: 20V 5A
 - iv. if in PD3:
 1. APDO1 AVS: 9 to 15V 3A and 15 to 20V 5A
 2. APDO2 PPS: 5 to 21V 5A
5. The check fails if the UUT does not responds with a *Request* Message. [TEST.PD.PS.SNK.1#2]
6. The Tester checks if requested PDO is within the range of VIF Sink PDOs.[TEST.PD.PS.SNK.1#12]
 - a. For the Fixed, Variable or SPR_AVS *Request* Message, the check fails if either of the following is true:
 - i. Voltage in the RDO is not in the Sink Fixed or Variable range PDOs list or within the range of Variable Supply in VIF Sink PDOs
 - ii. Operating current in the RDO is greater than the operating current of any of the PDOs identified from 6.a.i
 - b. For the Battery *Request* Message, the check fails if either of the following is true:
 - i. Voltage in the RDO is not in the Battery Supply PDOs list in VIF Sink PDOs
 - ii. Operating power in the RDO is greater than the operating power of any of the PDOs identified from step 6.b.i

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- c. For PPS *Request* Message, the check fails if either of the following is true:
 - i. Voltage in the RDO is not within the voltage range of SPR PPS APDOs in VIF Sink PDOs
 - ii. Operating current of the RDO is greater than the operating current of any of the PDOs identified from step 6.c.i
7. The Tester checks if requested PDP is greater than PD_Power_as_Snk [TEST.PD.PS.SNK.1#13]
8. The Tester intentionally sends a *Wait* Message. The test fails if another *Request* Message is received within min of *tSinkReuquest*. This is measured when the EOP of a *Wait* Message has been received. [TEST.PD.PS.SNK.1#17]
9. If the UUT does not resend the *Request* Message within *tCtsInfinite* second, then the Tester resends the *Source_Capabilities* as per step 4. The test fails if the *Request* Message is not resent by the UUT or if the UUT does not respond with the *Request* Message to *Source_Capabilities* Message resent by the Tester. [TEST.PD.PS.SNK.1#18]
10. The Tester sends an *Accept* Message.
 - a. If a new PDO has been requested and the transition involves increasing the voltage:
 - i. After a total of *tSrcTransition* min, check that current drawn by the UUT does not exceed *iSnkStdby* max. [TEST.PD.PS.SNK.1#3]
 - ii. Wait a nominal *tSrcTransition* from the *GoodCRC* Message and then change V_{BUS} voltage requested to the new value and/or be prepared to supply more or less current within *tSrcTransition* max plus *tSrcReady* max as appropriate.
 - iii. As soon as the voltage on V_{BUS} has stopped changing, check that current drawn by the UUT does not exceed *iSnkStdby* max. [TEST.PD.PS.SNK.1#4]
 - b. If a new PDO with no change in the voltage or no new PDO is requested,
After *tSrcTransition* max + *tSrcReady* max (315ms) time period check that the current drawn from V_{BUS} does not exceed the previously contracted current. [TEST.PD.PS.SNK.1#5]
11. The Tester sends a *PS_RDY* Message to the UUT.
12. The Tester performs the following check [TEST.PD.PS.SNK.1#6]
 - a. For Fixed PDO:
The Tester checks that the current drawn by the UUT does not exceed the level specified in the current PDO over the next 5 seconds.
 - b. For PPS PDO:
N/A
13. If VIF field *EPR_Supported_As_Snk* is Yes and the UUT sends the *EPR_Mode* Message with action field set to 1(Enter), the Tester sends *EPR_Mode* Message with the Data field set to 4(not able to enter EPR now). The check fails if the UUT does not respond with SoftReset Message [TEST.PD.PS.SNK.1#16]
14. If VIF field *EPR_Supported_As_Snk* is No and the UUT sends the *EPR_Mode* Message with the Action field set to 1(Enter), the test fails. [TEST.PD.PS.SNK.1#15]
15. The Tester sends another new *Source_Capabilities* Message with single PDO
 - a. The PDO:
 - i. B31...30 (Fixed Supply) set to 00b.
 - ii. B29 (Dual-Role Power) set to 0b.
 - iii. B28 (USB Suspend Supported) set to 0b.
 - iv. B27 (Unconstrained Power) set to 0b.
 - v. B26 (USB Communications Capable) set to 0b.
 - vi. B25 (Dual-Role Data) set to 0b.
 - vii. B24 (PD3, Unchunked Extended Message Supported) set to 0b.
 - viii. B23 (EPR Mode Capable) to 1b when in PD3, and 0b when in PD2
 - ix. B22 (Reserved) set to 0b.
 - x. B21...20 (Peak Current) set to 00b.
 - xi. B19...10 (Voltage) set to 5V.
 - xii. B9...0 (Maximum Current) set to 0mA.
16. The check fails if the UUT does not respond with a *Request* Message [TEST.PD.PS.SNK.1#7]
17. The Tester sends an *Accept* Message.

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- i. After a total of $t_{SrcTransition}$ min, check that current drawn by the UUT does not exceed $p_{SnkSusp}$ max. [TEST.PD.PS.SNK.1#10]
 - ii. The Tester sends a PS_RDY Message to the UUT.
18. The Tester shall continue to monitor current/power for $t_{CtsInfinite}$. [TEST.PD.PS.SNK.1#11]

To Text:

TEST.PD.PS.SNK.1 PDO Transitions As Sink

Description: The Tester verifies that the UUT responds correctly to a new $Source_Capabilities$ Messages.

Test Specific Tester Behavior:

Test Conditions:

	Consumer Only, C/P, DRP	Provider Only, P/C
<i>Rev2Snk</i>	✓	
<i>Rev3ChkdSnk</i>	✓	

Test Procedures:

1. The Tester runs a bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a Get_Sink_Cap Message to the UUT.
3. The check fails if the UUT does not send $Sink_Capabilities$ Message. [TEST.PD.PS.SNK.1#1]
4. In PD3 mode, the Tester sends a $Get_Sink_Cap_Extended$ Message to the UUT, the check fails if the UUT does not send a $Sink_Capabilities_Extended$ Message. [TEST.PD.PS.SNK.1#19]
5. The Tester sends a new $Source_Capabilities$ Message emulating a 240W source PPS for PD3 or 100W source for PD2 as per power rules.
 - a. The first PDO is defined as:
 - i. B29 (Dual-Role Power) set to 1b.
 - ii. B28 (USB Suspend Supported) set to 0b.
 - iii. B27 (Unconstrained Power) set to 0b.
 - iv. B26 (USB Communications Capable) set to 0b.
 - v. B25 (Dual-Role Data) set to 0b.
 - vi. B24 (PD3, Unchunked Extended Message Supported) set to 0b.
 - vii. B23 (EPR Mode Capable) to 1b when in PD3, to 0b in PD2
 - viii. B22 (Reserved) set to 0b.
 - ix. B21...20 (Peak Current) set to 00b.
 - x. B19...10 (Voltage) set to 5V.
 - xi. B9...0 (Maximum Current) set to 3000mA.
 - b. Other PDOs fit with power rules:
 - i. PDO2: 9V 3A
 - ii. PDO3: 15V 3A
 - iii. PDO4: 20V 5A
 - iv. if in PD3:
 1. APDO1 AVS: 9 to 15V 3A and 15 to 20V 5A
 2. APDO2 PPS: 5 to 21V 5A
6. The check fails if the UUT does not **respond** with a $Request$ Message. [TEST.PD.PS.SNK.1#2]
7. The Tester checks if requested PDO is within the range of VIF Sink **Capabilities Extended PDP**. [TEST.PD.PS.SNK.1#12]
 - a. For the Fixed or Variable $Request$ Message, the check fails if:
 - i. B19...10 (Operating Current) x Voltage of the PDO in the corresponding Object Position is greater than VIF field $Snk_SPR_Maximum$ PDP
 - b. For the Battery $Request$ Message, the check fails if either of the following is true:

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- i. B19...10 (Operating Power) is greater than VIF field Snk_SPR_Maximum PDP
 - c. For the PPS *Request* Message, the check fails if either of the following is true:
 - i. Snk_PPS_Charging_Supported = N and PPS Request is sent
 - ii. B20...9 (Output Voltage) x B6...0 (Operating Current) is greater than VIF field Snk_SPR_Maximum PDP
 - d. For the SPR_AVIS, the check fails if either of the following is true:
 - i. Snk_AVIS_Supported = N and SPR_AVIS Request is sent
 - ii. B20...9 (Output Voltage) x B6...0 (Operating Current) is greater than VIF field Snk_SPR_Maximum PDP
- ~~8. The Tester checks if requested PDP is greater than PD_Power as Snk [TEST.PD.PS.SNK.1#13]~~
- 9. The Tester intentionally sends a *Wait* Message. The test fails if another *Request* Message is received within min of *tSinkRequest*. This is measured when the EOP of GoodCRC Message acknowledging the *Wait* Message has been received. [TEST.PD.PS.SNK.1#17]
- 10. If the UUT does not resend the *Request* Message within *tCtsInfinite* second, then the Tester resends the *Source_Capabilities* as per step 5. The test fails if the *Request* Message is not resent by the UUT or if the UUT does not respond with the *Request* Message to *Source_Capabilities* Message resent by the Tester. [TEST.PD.PS.SNK.1#18]
- 11. The Tester sends an *Accept* Message.
- 12. If a new PDO has been requested and the transition involves increasing the voltage:
 - a. If the transition is to a Fixed Supply PDO, or to an AVS APDO with a voltage change greater than vSmallStep:
 - i. After a total of *tSnkStdbyn* from the EOP of GoodCRC Message acknowledging the *Accept* message, check that current drawn by the UUT does not exceed *iSnkStdby* max. [TEST.PD.PS.SNK.1#3]
 - ii. Wait a nominal *tSrcTransition* from the *GoodCRC* Message and then change V_{BUS} voltage to the new requested value. For Fixed Supply PDO transitions, the Tester completes the voltage change and sends *PS_RDY* before *tSrcTransReq* expires. For AVS APDO transitions, the Tester shall complete the voltage change before *tAvsSrcTransLarge* expires.
 - iii. As soon as the voltage on V_{BUS} has reached V_{NEW}, check that current drawn by the UUT does not exceed *iSnkStdby* max until *PS_RDY* is sent. [TEST.PD.PS.SNK.1#4]
 - b. If the transition is to an AVS APDO with a voltage change less than or equal to vSmallStep:
 - i. The Tester shall immediately begin changing V_{BUS} voltage after the GoodCRC Message acknowledging the *Accept* message. The tester shall complete the voltage transition and send *PS_RDY* before *tSrcTransSmall* expires.
 - ii. If the newly negotiated current is less than the previously contracted current, after *tSnkNewPower* from the EOP of GoodCRC acknowledging the *Accept* Message, check that the current drawn by the UUT does not exceed the newly negotiated current(I_{NEW}). [TEST.PD.PS.SNK.1#20]
 - iii. If the newly negotiated current is unchanged or increased, check that the current drawn by the UUT does not exceed the previously contracted current during the transition after the EOP of GoodCRC acknowledging the *Accept* Message until the *PS_RDY* is sent by the Tester. [TEST.PD.PS.SNK.1#21]
 - c. If the transition is to a PPS APDO while in CV mode:
 - i. The Tester shall immediately begin changing V_{BUS} voltage after the GoodCRC Message acknowledging the *Accept* message. The Tester shall complete the voltage change and send *PS_RDY* before *tPpsSrcTransSmall* max for voltage changes less than or equal to vPpsSmallStep, or *tPpsSrcTransLarge* max for voltage changes greater than vPpsSmallStep.
 - ii. Check that the current drawn by the UUT does not exceed the max contracted current during and after the transition. [TEST.PD.PS.SNK.1#22]
- 13. If a new PDO has been requested and the transition involves unchanged or decreased voltage, or no new PDO is requested:
 - a. If the newly negotiated current is unchanged or increased

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- i. After $t_{SrcTransReq}$ max time period (before PS_RDY is sent), check that the current drawn from V_{BUS} does not exceed the previously contracted current. [TEST.PD.PS.SNK.1#5]
 - b. If the newly negotiated current is decreased
 - i. After $t_{SnkNewPower}$ from the EOP of GoodCRC acknowledging the Accept Message, check that the current drawn by the UUT does not exceed the newly negotiated current (I_{NEW}). [TEST.PD.PS.SNK.1#23]
 - ii. After $t_{SrcTransReq}$ max time period, check that the current drawn from V_{BUS} does not exceed the newly negotiated current (I_{NEW}). [TEST.PD.PS.SNK.1#24]
14. The Tester sends a PS_RDY Message to the UUT.
15. The Tester checks that the current drawn by the UUT does not exceed the level specified in the current PDO over the next 5 seconds. [TEST.PD.PS.SNK.1#6]
16. If VIF field $EPR_Supported_As_Snk$ is Yes and the UUT sends the EPR_Mode Message with action field set to 1(Enter), the Tester sends EPR_Mode Message with the Action field set to 4 (Enter Failed) and the Data field set to 4(Source unable to enter EPR Mode). The check fails if the UUT does not respond with SoftReset Message [TEST.PD.PS.SNK.1#16]
17. If VIF field $EPR_Supported_As_Snk$ is No and the UUT sends the EPR_Mode Message with the Action field set to 1(Enter), the test fails. [TEST.PD.PS.SNK.1#15]
18. The Tester sends another new ~~Source Capabilities~~ Message with single PDO
 - a. The PDO:
 - i. B31...30 (Fixed Supply) set to 00b.
 - ii. B29 (Dual Role Power) set to 0b.
 - iii. B28 (USB Suspend Supported) set to 0b.
 - iv. B27 (Unconstrained Power) set to 0b.
 - v. B26 (USB Communications Capable) set to 0b.
 - vi. B25 (Dual Role Data) set to 0b.
 - vii. B24 (PD3, Unchunked Extended Message Supported) set to 0b.
 - viii. B23 (EPR Mode Capable) to 1b when in PD3, and 0b when in PD2
 - ix. B22 (Reserved) set to 0b.
 - x. B21...20 (Peak Current) set to 00b.
 - xi. B19...10 (Voltage) set to 5V.
 - xii. B9...0 (Maximum Current) set to 0mA.
19. The check fails if the UUT does not respond with a ~~Request~~ Message [TEST.PD.PS.SNK.1#7]
20. The Tester sends an ~~Accept~~ Message:
 - i. After a total of $t_{SrcTransition}$ min from the GoodCRC Message acknowledging the Accept Message, check that current/power drawn by the UUT does not exceed $p_{SnkSusp}$ max. [TEST.PD.PS.SNK.1#10]
 - ii. The Tester sends a PS_RDY Message to the UUT.
21. The Tester shall continue to monitor current/power for $t_{CtsInfinite}$. [TEST.PD.PS.SNK.1#11]

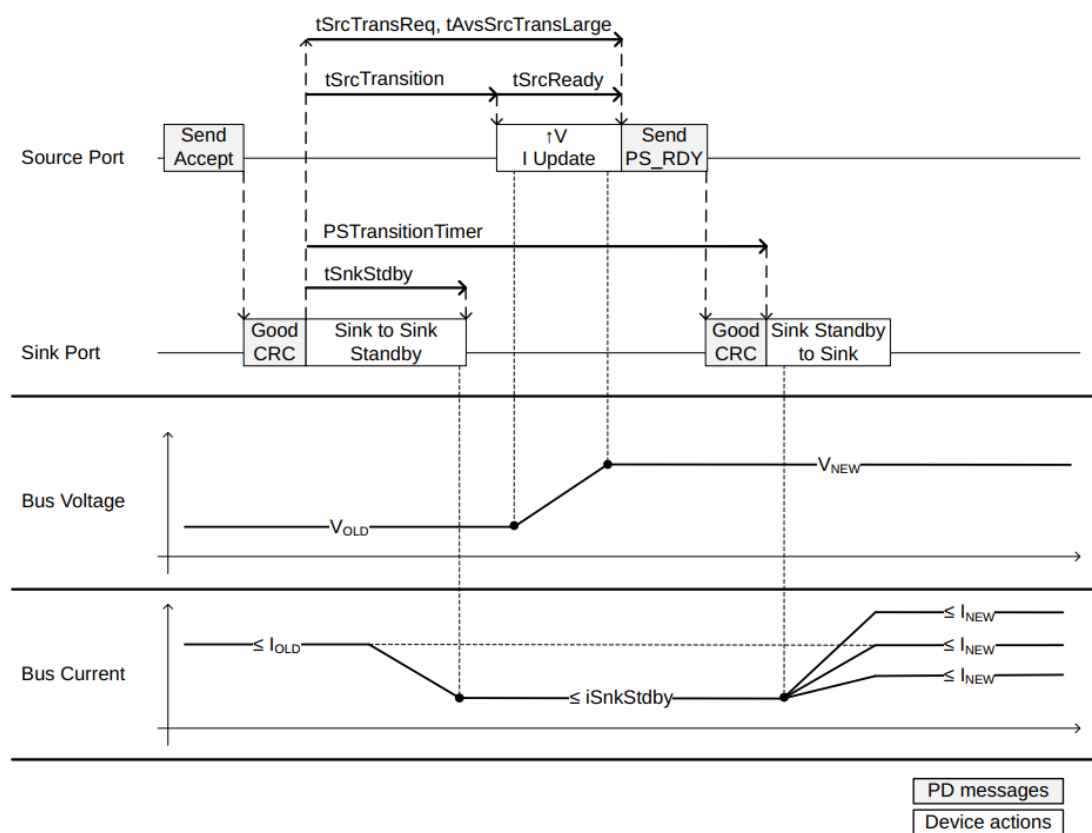
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Background Info:

Key Normative Rule (Section 6.7.1, p.201)

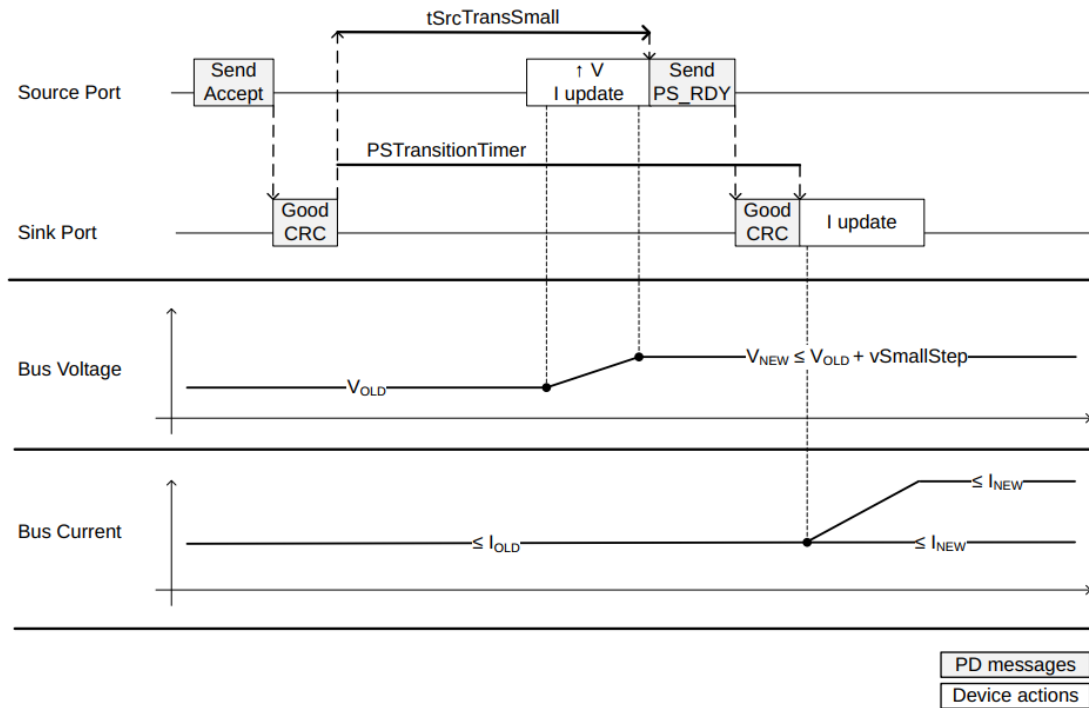
An unrecognized or unsupported Message (except for a Structured VDM), received in the **PE_SNK_Ready** or **PE_SRC_Ready** states, **Shall Not** cause a **Soft_Reset** Message to be generated but instead a **Reject** Message **Shall** be generated.

Figure 4.16. Transition Diagram for Large-step voltage increase (Fixed or AVS > vSmallStep)



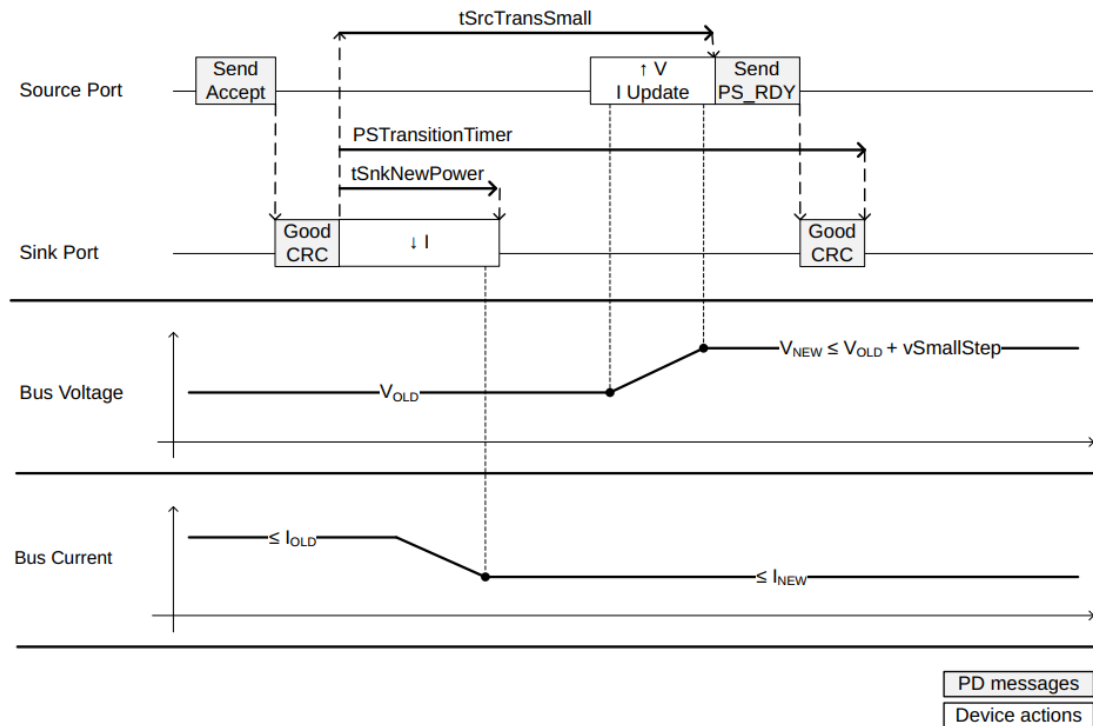
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Figure 4.17. Transition Diagram for Small-step voltage increase ($AVS \leq v_{SmallStep}$), current unchanged or increased



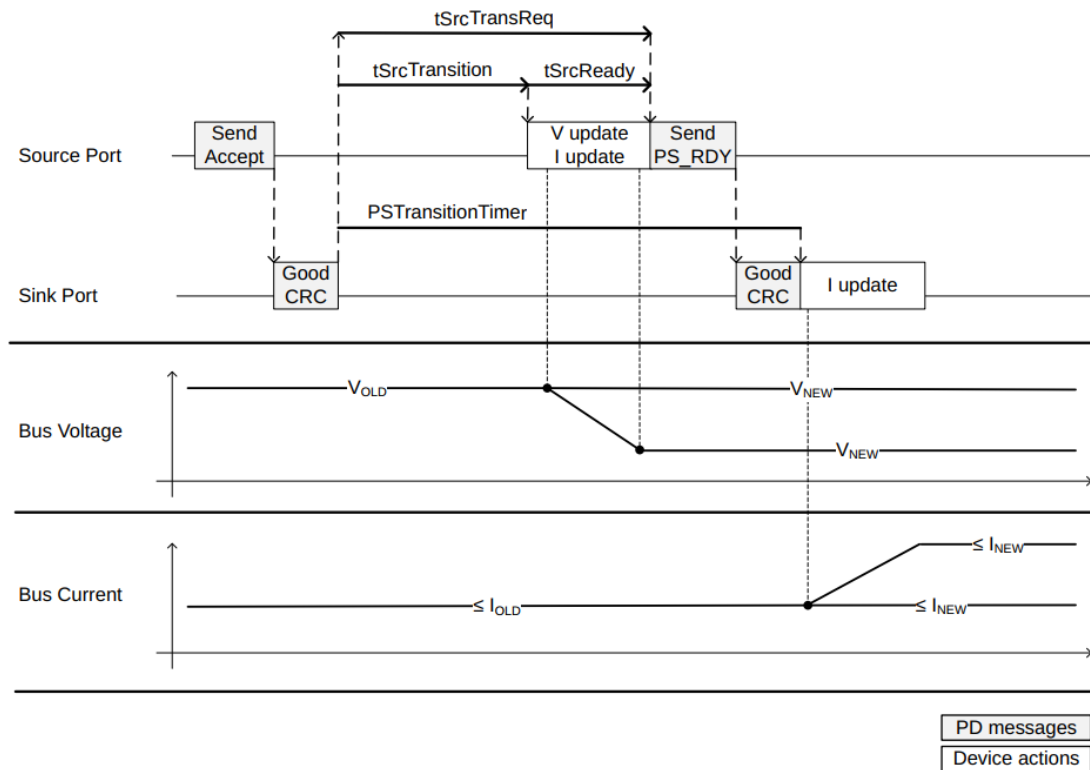
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Figure 4.18. Transition Diagram for Small-step voltage increase ($AVS \leq v_{SmallStep}$), current decreased



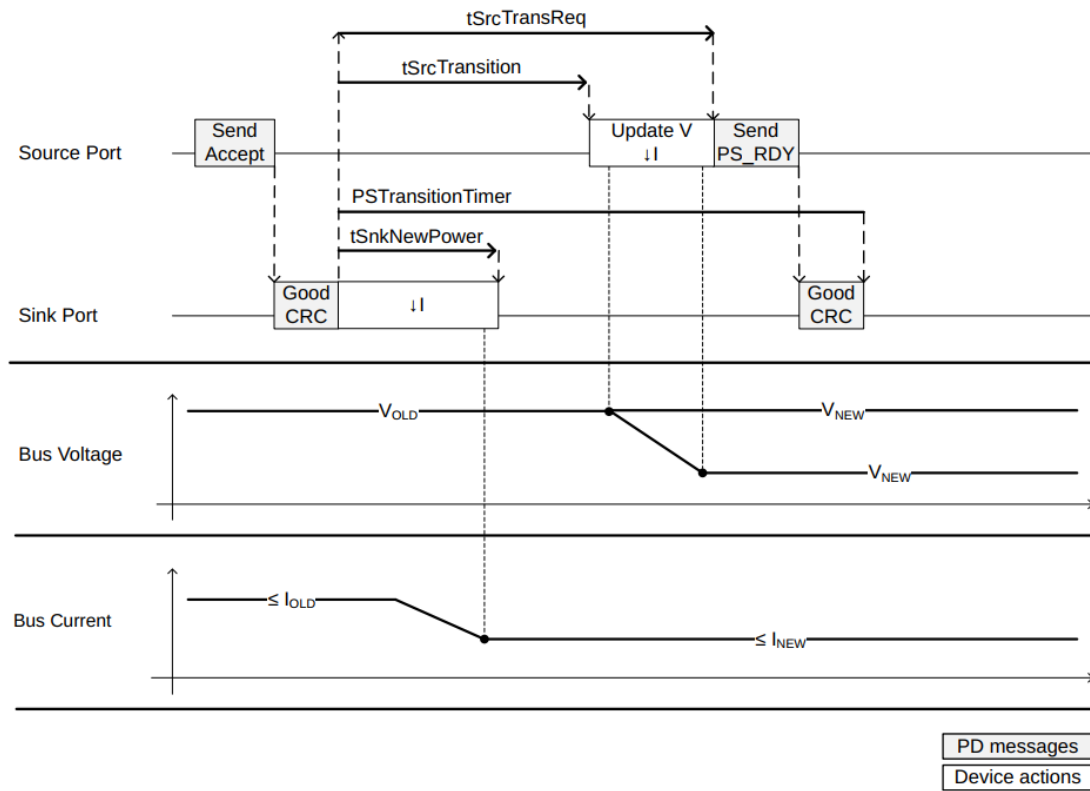
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Figure 4.19. Transition Diagram for voltage unchanged or decreased with current unchanged or increased



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Figure 4.20. Transition Diagram for voltage unchanged or decreased with current decreased



tAvsSrcTransLarge	0		700	ms	The time the AVS set-point Shall transition between requested voltages for steps larger than vAvsSmallStep .
tAvsSrcTransSmall	0		50	ms	The time the AVS set-point Shall transition between requested voltages for steps smaller than vAvsSmallStep .