

USB Power Delivery ENGINEERING CHANGE NOTICE

Title: EPR Entry flow

**Applied to: USB Power Delivery Specification Revision 3.1
Version 1.6**

Brief description of the functional changes proposed:
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<p>To enter EPR, both sink and source partner need to ensure that the entire system is EPR capable. Similar to what is done for power above 60W, Source needs to verify that cable is EPR cable before it can enter the EPR mode. EPR sources are by definition above 60W so they already have checked cable capability before entering any SPR contract above 60W. Cable EPR capable bit is static. This ECR proposes to give ability to the Source to reuse cable info it previously read when entering the EPR mode. This allows Sources to turn Vconn OFF if not needed. Vconn can be sourced VBUS to check cable info, during first explicit contract.</p>

Benefits as a result of the proposed changes:
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<p>As for sources proposing more than 3A, there is no need to have a separate Vconn from VBUS. Information from cable remains same during the explicit contract which always starts at 5V. The ECR may save cost of dedicated VCONN power supply for EPR process.</p>

An assessment of the impact to the existing revision and systems that currently conform to the USB specification:
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<p>No impact</p>

An analysis of the hardware implications:
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<p>Save cost (area + BOM) for power bricks</p>
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An analysis of the software implications:
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<p>No impact</p>

An analysis of the compliance testing implications:
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<p>CTS needs to be updated</p>

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Actual Change Requested

(a). Section 1.6, Table 1-1 “Terms and Abbreviations”, P.47

From Text:

EPR PDO	<ul style="list-style-type: none">• Fixed PDO that offers more than 20V.• AVS APDO whose Maximum Voltage is up to 48V and no more than 240W.
...	
EPR Source	A Source that supports both SPR Mode and EPR Mode.

To Text

Default Contract	[USB Type-C 2.2] current operation.
...	
EPR PDO	<ul style="list-style-type: none">• Fixed PDO that offers either 28V, 36V or 48V.• AVS APDO whose Maximum Voltage the highest voltage in the EPR_Source_Capabilities and no more than 240W.
...	
EPR Source	A Source that supports both SPR Mode and EPR Mode and is able to supply more than 100W.

(b). Section 2.1 “Introduction”, P.57

New Text:

2.1 Introduction

In USB Power Delivery, pairs of directly Attached ports negotiate Voltage, current and/or direction of power flow over the USB cable, using the USB Type-C® connector’s CC wire as the communications channel. The mechanisms used, operate independently of other USB methods used to negotiate power.

USB Power Delivery also acts as a side-band channel enabling communications with the cable assembly connecting the ports. Modes are associated with a Standard or Vendor ID (SVID). Power Delivery Structured VDM Messages can be used to discover supported SVIDs and Modes and then to enter and exit Modes as required. Multiple Active Modes can also be in operation at the same time.

2.1.1 Power Delivery Source Operational Contracts

A PD Source will be in one of three Contracts:

- Default Contract which it enters immediately following a connect where the Source provides 5V and advertises the amount of current it can deliver using the Rp value as defined in [USB Type-C 2.2].
- Implicit Contract which immediately follows a PR Swap or FR Swap. The PD Source provides 5V and advertises the amount of current it can deliver using the Rp value as defined in [USB Type-C 2.2].

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- Explicit Contract is the state of the Source after any PD power negotiation consisting of the Source sending a **Source_Capabilities** Message, the Sink responding with a **Request** Message, the Source acknowledging the request with an **Accept** Message and finally the Source sends a **PS_Ready** Message when the Source is ready to deliver the requested power.

A Source in the Default Contract will remain in this Contract until:

- The Sink is disconnected
- The Source and Sink negotiate an Explicit Contract

A Source in an Implicit Contract will remain in this Contract until:

- The Sink is disconnected
- The Source and Sink negotiate an Explicit Contract

A Source in an Explicit Contract:

- Will remain in an Explicit Contract during and after a renegotiation of its contract.
- It will exit the Explicit Contract when
 - Disconnected from the Sink where it will restart in Default state when reconnected to the Sink
 - Following a Hard Reset where it will restart as if it were disconnected then reconnected to the Sink.
 - Following a PR Swap or FR Swap where it will enter an Implicit Contract

2.1.2 Power Delivery Contracts

Any Contract negotiated using this specification, supersedes any and all previous power contracts established whether from standard [\[USB 2.0\]](#), [\[USB 3.2\]](#), [\[USB4\]](#), [\[USB Type-C 2.2\]](#) or [\[USBBC 1.2\]](#) mechanisms. While in Power Delivery Mode there will be a Contract in place (either Explicit or Implicit) determining the power level available and the direction of that power. The Port Pair remains in Power Delivery Mode until the Port Pair is Detached, there is a Hard Reset, or the Source removes power (except during a Power Role Swap or Fast Role Swap when the initial Source removes power to enable the new Source to apply power).

(c). Section 6.4.1.2.2.7 “EPR Mode Capable”, P.135

From Text:

The EPR Mode Capable bit is used to indicate whether the Source is capable of supplying more than 100W at this time. When the Source’s ability to supply more than 100W changes, it **Shall** send a new **Source_Capabilities** Message with the updated EPR Mode Capable bit.

Note: When this bit is set, the Source **Shall Not** offer to or supply more than 100W unless the cable and the Sink also report that they are also designed for safe operation at power levels greater than 100W and the EPR Mode has been entered successfully.

To Text

The EPR Mode Capable bit is a static bit that **Shall** be set if the Source is designed to supply more than 100W and operate in EPR Mode.

When this bit is set, an EPR Source:

- Operating in SPR Mode **Shall** only send an **EPR_Source_Capabilities** Message in response to a **EPR_Get_Source_Cap** Message
- **May** only enter EPR Mode when the Cable and the Sink also report that they are EPR capable.

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(d). Section 6.4.4.3.1.6.5 “EPR Mode Capable”, P.164

From Text:

Shall only be set when the cable is specifically designed for safe operation when carrying up to 50 volts at 5 amps.

To Text:

A static bit which *Shall* only be set when the cable is specifically designed for safe operation when carrying up to 50 volts at 5 amps.

(e). Section 6.4.4.3.1.7.5 “EPR Mode Capable”, P.167

From Text:

Shall only be set when the cable is specifically designed for safe operation when carrying up to 50 volts at 5 amps.

To Text:

A static bit which *Shall* only be set when the cable is specifically designed for safe operation when carrying up to 50 volts at 5 amps.

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(f). Section 6.4.10.1 “Process to enter EPR Mode”, P.186

From Text:

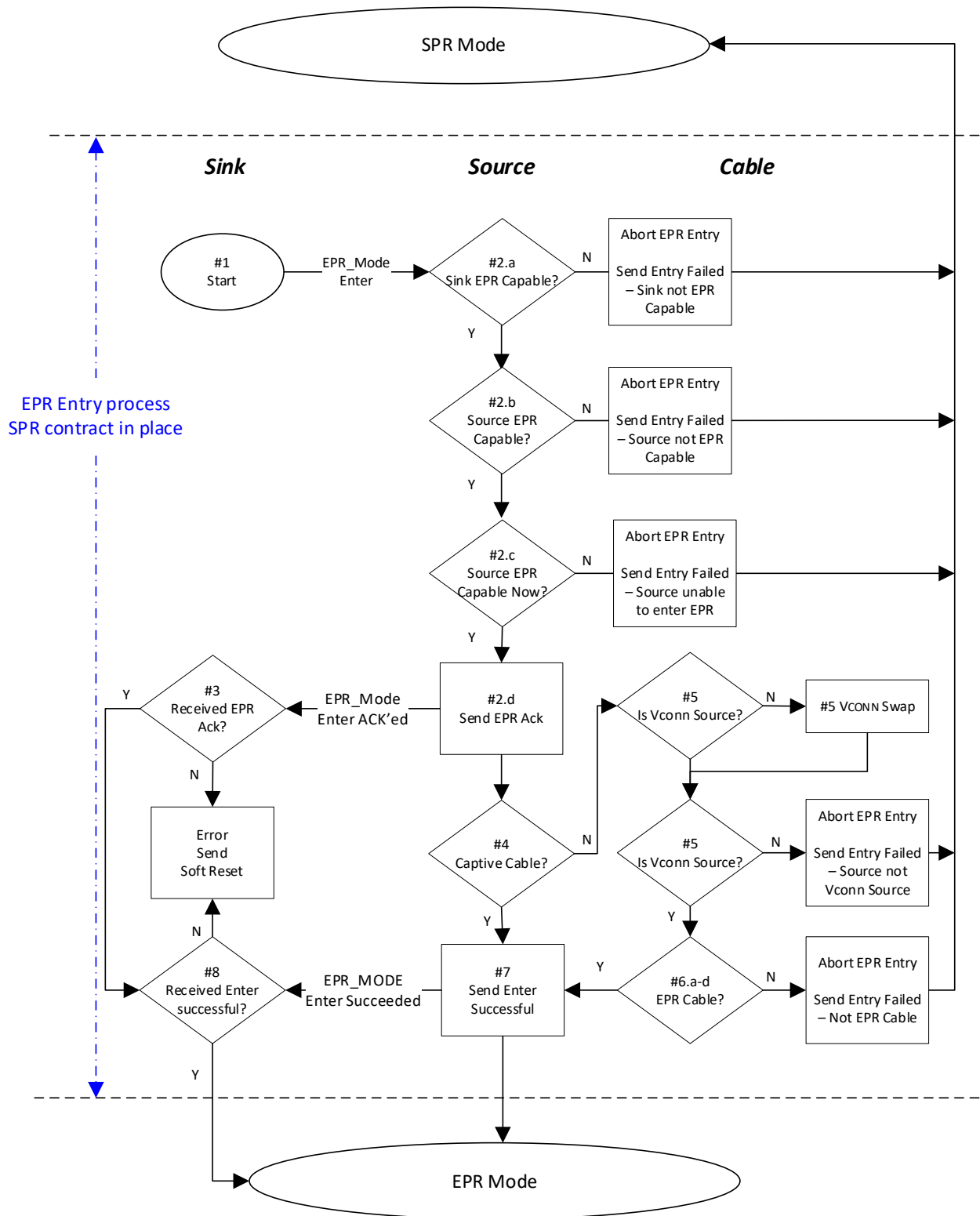
For port partners to successfully enter EPR mode, a number of conditions must be met prior to initiating the entry process:

- A Sink **Shall Not** be Connected to the Source through a Charge Through VPD (CT-VPD).
- The Source and Sink **Shall** be in an SPR Explicit Contract.
- The EPR Mode capable bit **Shall** have been set in the 5V fixed PDO in the last **Source_Capabilities** Message the Sink received.
- The EPR Mode capable bit **Shall** have been set in the RDO in the last **Request** Message received by the Source.

The EPR Mode entry process is a non-interruptible multi-message sequence. An illustration of this sequence is shown in Figure 6-34. Note that Figure 6-34 is not **Normative** but is illustrative only.

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Figure 6-1 Illustration of process to enter EPR Mode



The entry process **shall** follow these steps in order:

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1. The Sink **Shall** send the **EPR_Mode** Message with the Action field set to 1 (Enter) and the Data field set to its Operational PDP. If the EPR Source receives an **EPR_Mode** message with the Action field not set to Enter it **Shall** initiate a Soft Reset.
2. The Source **Shall** do the following:
 - a. Verify the EPR Mode Capable bit was set in the most recent RDO. If not set, the Source **Shall** do the following:
 - i. Send an **EPR_Mode** Message with the Action field set to 4 (“Enter Failed”) and the Data field set to 3 (“EPR Mode Capable bit not set in the RDO”).
 - ii. Abort the EPR Mode entry process and remain in the existing SPR Explicit Contract.
 - b. Verify the EPR Mode Capable bit was set in the most recent 5V fixed PDO. If not set, the Source **Shall** do the following:
 - i. Send an **EPR_Mode** Message with the Action field set to 4 (“Enter Failed”) and the Data field set to 5 (“EPR Mode Capable bit not set in the fixed 5V PDO”).
 - ii. Abort the EPR Mode entry process and remain in the existing SPR Explicit Contract.
 - c. Verify the Source is still able to support EPR Mode. If not, the Source **Shall** do the following:
 - i. Send an **EPR_Mode** Message with the Action field set to 4 (“Enter Failed”) and Data field set to 4 (“Unable at this time”).
 - ii. Abort the EPR Mode entry process and remain in the existing SPR Explicit Contract
 - d. Send an **EPR_Mode** Message with the Action field set to 2 (“Enter Acknowledged”).
3. If the Sink receives any Message, other than an **EPR_Mode** Message with the Action Field set to 2, the Sink **Shall** initiate a Soft Reset.
4. If the Source has a captive cable, it **Shall** go directly to Step 7.
5. If the Source is not the VCONN Source, it **Shall** send a **VCONN_Swap** Message
 - a. If the Source fails to become the VCONN Source, it **Shall**:
 - i. send an **EPR_Mode** message with the Action field set to 4 (Enter Failed) and the Data field set to 2 (not VCONN source).
 - ii. Abort the EPR Mode entry process and remain in the existing SPR Explicit Contract.
6. The Source **Shall** use the **Discover Identity** Command to read the cable’s e-Marker and verify the following:
 - a. Cable VDO - Maximum V_{BUS} Voltage field is 11b (50V)
 - b. Cable VDO - V_{BUS} Current Handling Capability field is 10b (5A)
 - c. Cable VDO - EPR Mode Capable field is 1b (EPR Mode Capable)
 - d. If the cable fails to respond to the **Discover Identity** Command or is not EPR capable, the Source **Shall** do the following:
 - i. Send an **EPR_Mode** Message with the Action field set to 4 (“Enter Failed”) and the Data field to 1 (“Cable not EPR capable”).
 - ii. Abort the EPR Mode entry process and remain in the existing SPR Explicit Contract.
7. The Source **Shall** send the **EPR_Mode** message with the Action field set to 3 (“Enter Succeeded”) and **Shall** enter EPR Mode.
8. If the Sink receives an **EPR_Mode** Message with the Action field set to 3 (“Enter Succeeded”) it **Shall** enter EPR Mode, otherwise it **Shall** initiate a Soft Reset.

If the EPR Mode entry process has not been aborted or does not complete within **tEnterEPR** of the last bit of the **GoodCRC** Message sent in response to the **EPR_Mode** Message with the Action field set to 1 (“Enter”), the Sink **Shall** initiate a Soft Reset.

To Text:

For port partners to successfully enter EPR mode, a number of conditions must be met prior to initiating the entry process:

- The EPR Source **Shall** have done one of the following:
 - Discover the cable prior to entering its first Explicit Contract
 - Alternatively, within **tEPRSourceCableDiscovery** of entry into the first Explicit Contract
 - If it is the VCONN Source, discover the cable
 - If not the VCONN Source, do a VCONN Swap then discover the cable
- A Sink **Shall Not** be Connected to the Source through a Charge Through VPD (CT-VPD).
- The Source and Sink **Shall** be in an SPR Explicit Contract.

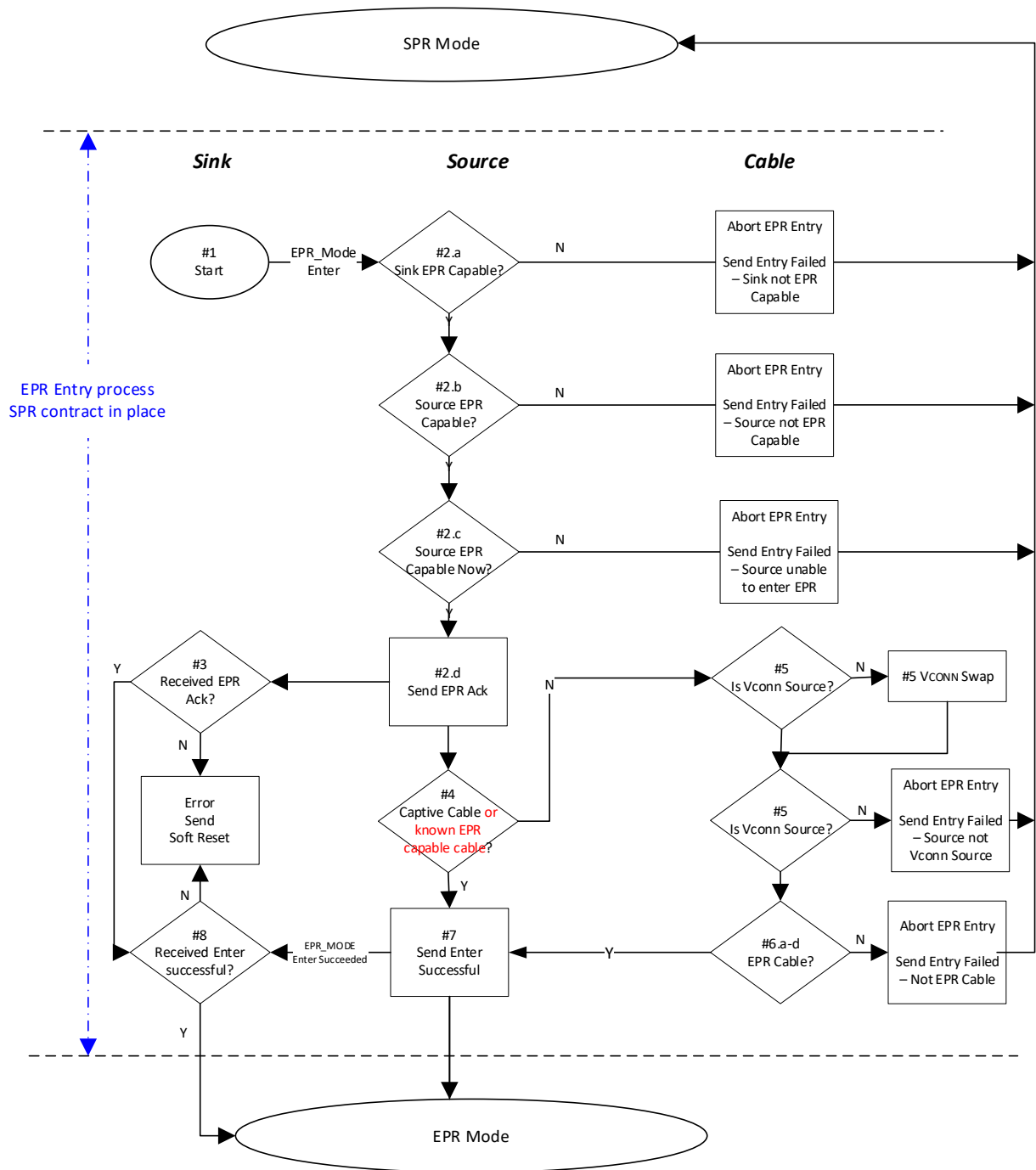
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- The EPR Mode capable bit *Shall* **be** set in the 5V fixed PDO.
- The EPR Mode capable bit *Shall* have been set in the RDO in the last *Request* Message received by the Source.
- **The EPR Mode capable bit *Shall* be set in the Cable Plug VDO**

The EPR Mode entry process is a non-interruptible multi-message sequence. An illustration of this sequence is shown in Figure 6-34. Note that Figure 6-34 is not *Normative* but is illustrative only.

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Figure 6-2 Illustration of process to enter EPR Mode



The entry process **shall** follow these steps in order:

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1. The Sink **Shall** send the **EPR_Mode** Message with the Action field set to 1 (Enter) and the Data field set to its Operational PDP. If the EPR Source receives an **EPR_Mode** message with the Action field not set to Enter it **Shall** initiate a Soft Reset.
2. The Source **Shall** do the following:
 - a. Verify the EPR Mode Capable bit was set in the most recent RDO. If not set, the Source **Shall** do the following:
 - i. Send an **EPR_Mode** Message with the Action field set to 4 (“Enter Failed”) and the Data field set to 3 (“EPR Mode Capable bit not set in the RDO”).
 - ii. Abort the EPR Mode entry process and remain in the existing SPR Explicit Contract.
 - b. Verify the EPR Mode Capable bit was set in the most recent 5V fixed PDO. If not set, the Source **Shall** do the following:
 - i. Send an **EPR_Mode** Message with the Action field set to 4 (“Enter Failed”) and the Data field set to 5 (“EPR Mode Capable bit not set in the fixed 5V PDO”).
 - ii. Abort the EPR Mode entry process and remain in the existing SPR Explicit Contract.
 - c. Verify the Source is still able to support EPR Mode. If not, the Source **Shall** do the following:
 - i. Send an **EPR_Mode** Message with the Action field set to 4 (“Enter Failed”) and Data field set to 4 (“Unable at this time”).
 - ii. Abort the EPR Mode entry process and remain in the existing SPR Explicit Contract
 - d. Send an **EPR_Mode** Message with the Action field set to 2 (“Enter Acknowledged”).
3. If the Sink receives any Message, other than an **EPR_Mode** Message with the Action Field set to 2, the Sink **Shall** initiate a Soft Reset.
4. If the Source has a captive cable, **or the Source has already determined it is connected to an EPR Capable cable,** it **Shall** go directly to Step 7.
5. If the Source is not the VCONN Source, it **Shall** send a **VCONN_Swap** Message
 - a. If the Source fails to become the VCONN Source, it **Shall**:
 - i. send an **EPR_Mode** message with the Action field set to 4 (Enter Failed) and the Data field set to 2 (not VCONN source).
 - ii. Abort the EPR Mode entry process and remain in the existing SPR Explicit Contract.
6. The Source **Shall** use the **Discover Identity** Command to read the cable’s e-Marker and verify the following:
 - a. Cable VDO - Maximum V_{BUS} Voltage field is 11b (50V)
 - b. Cable VDO - V_{BUS} Current Handling Capability field is 10b (5A)
 - c. Cable VDO - EPR Mode Capable field is 1b (EPR Mode Capable)
 - d. If the cable fails to respond to the **Discover Identity** Command or is not EPR capable, the Source **Shall** do the following:
 - i. Send an **EPR_Mode** Message with the Action field set to 4 (“Enter Failed”) and the Data field to 1 (“Cable not EPR capable”).
 - ii. Abort the EPR Mode entry process and remain in the existing SPR Explicit Contract.
7. The Source **Shall** send the **EPR_Mode** message with the Action field set to 3 (“Enter Succeeded”) and **Shall** enter EPR Mode.
8. If the Sink receives an **EPR_Mode** Message with the Action field set to 3 (“Enter Succeeded”) it **Shall** enter EPR Mode, otherwise it **Shall** initiate a Soft Reset.

If the EPR Mode entry process has not been aborted or does not complete within **tEnterEPR** of the last bit of the **GoodCRC** Message sent in response to the **EPR_Mode** Message with the Action field set to 1 (“Enter”), the Sink **Shall** initiate a Soft Reset.

(f). Section 6.6.21.4 “tEPRSourceCableDiscovery”, P.229

New Text:

After Port Partners are Attached or after a Hard Reset or after a Power Role Swap or after a Fast Role Swap a Source **Shall discover the Cable Plug within **tEPRSourceCableDiscovery** of entering the first Explicit Contract.**

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The Source *Shall* send the **Discover_Identity REQ** Command, to the Cable Plug, within ***tEPRSourceCableDiscovery*** of receiving the **GoodCRC** Message acknowledging the **PS_RDY** Message as part of the Explicit Contract negotiation.

Note: if the Source is not the VCONN Source, ***tEPRSourceCableDiscovery***, will also include the time needed for the VCONN Swap.

(h). Section 6.6.22, Table 6-68, “Time Values”, P.230

New Text:

Parameter	Value (min)	Value (nom)	Value (max)	Unit s	Reference

<i>tEPRSourceCableDiscovery</i>			2	s	Section Error! Reference source not found.