PSF Sink Demo Read Me

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REV	DATE	DESCRIPTION OF CHANGE
1.02	8-Apr-2020	Initial version of Sink Demo
1.03	21-Apr-20	Updated EN_SINK functionality for v1.03 release.
1.04	26-May-20	Updated document version to align with v1.04 release
1.05	24-Jul-20	Updated document version to align with v1.05 release
1.06	12-Aug-20	Updated document version to align with v1.06 release

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Software License Agreement

Terms and Abbreviations

Term	Definition
PSF	Universal Serial Bus Power Delivery Software Framework
EVB	Evaluation Board
PD	Power Delivery
IDE	Integrated Development Environment
PDO	Power Data Object
PM-PD	Power Module-USB Power Delivery
LED	Light Emitting Diode
GPIO	General Purpose Input Output

Introduction

Microchip's USB Power Delivery Software Framework (PSF) is a configurable USB PD solution that is compliant to USB-PD 3.0 specification.

PSF Sink application support basic USB-PD sink functionality with two modes. They are Higher wattage at higher voltage (Mode A) and Higher wattage at lower voltage (Mode B).

This document is intended to guide a user on setting up the PSF-EVB to work properly with Sink version of PSF along with a demonstration of a PD device attached to the PSF-EVB.

Prerequisites

Hardware:

1) Microchip PSF Evaluation Board (PSF-EVB)

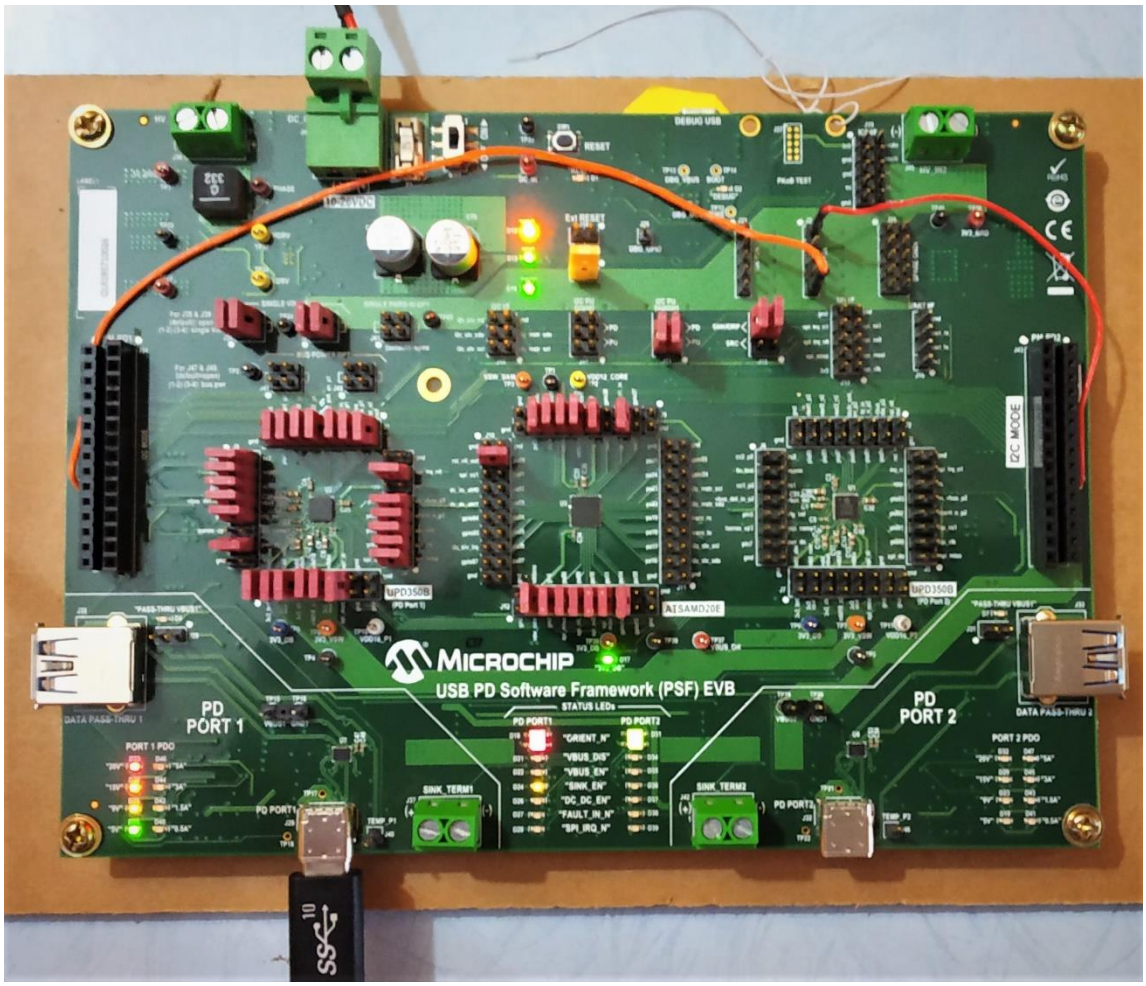

Figure 4.1 Microchip PSF Evaluation Board

2) Power Adapter with 24V, with 3A to 6.25A output rating

Figure 4.2 Power Adapter with 24V, 6.25A output capacity

3) USB-C to USB-C cable

4) Atmel ICE Debugger kit

Figure 4.3 Atmel-ICE Debugger Kit

5) USB Power Delivery capable Phones or Laptops

Setting up the PSF-EVB board for "PSF_EVB_Sink"

1. Ensure the following jumpers are connected in PSF-EVB before proceeding to next step. An image of PSF-EVB with all the required jumper connections highlighted is shown in Figure 5.1

Jumper	**Pins**

J38	1-2, 3-4
J39	1-2, 3-4
J21	1-3, 2-4
J15	3-5, 2-6
J1	1-2 3-4 5-6 7-8
J4	1-2 3-4 5-6 7-8 9-10 13-14
J5	1-2 3-4 5-6 7-8 9-10 13-14
J8	1-2 3-4 5-6 7-8 9-10 11-12
J9	5-6 9-10 11-12 13-14 15-16 17-18
J10	3-4

J12	3-4 5-6 7-8 9-10 11-12 13-14 15-16

Table 5.1 PSF-EVB Jumper Connections

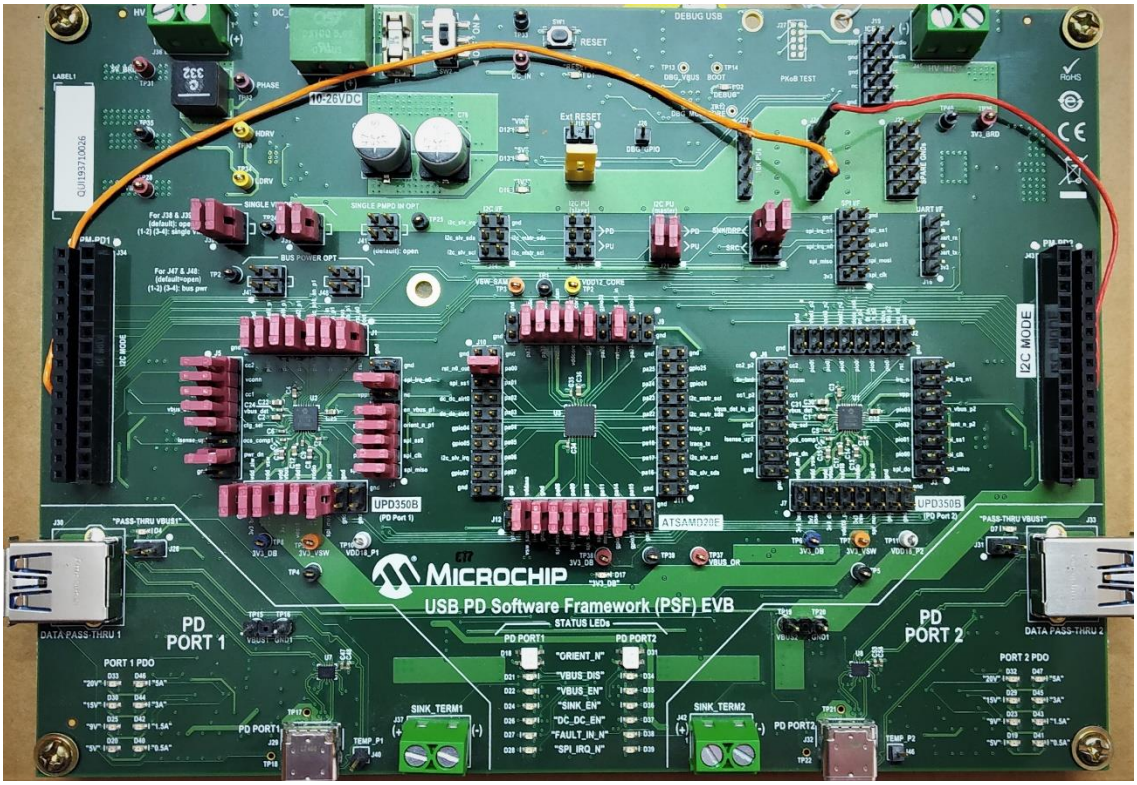

Figure 5.1 PSF-EVB with jumper connections

2. Connect power adapter to J49 of the PSF-EVB

3. Connect one end of Atmel ICE to PC using USB Micro-B cable and the other end to J19 of PSF-EVB. A dot(encircled in image) will be present in Atmel ICE Adapter board which gives an indication that this pin should be connected to 3v3 of J19. The right way to connect is,

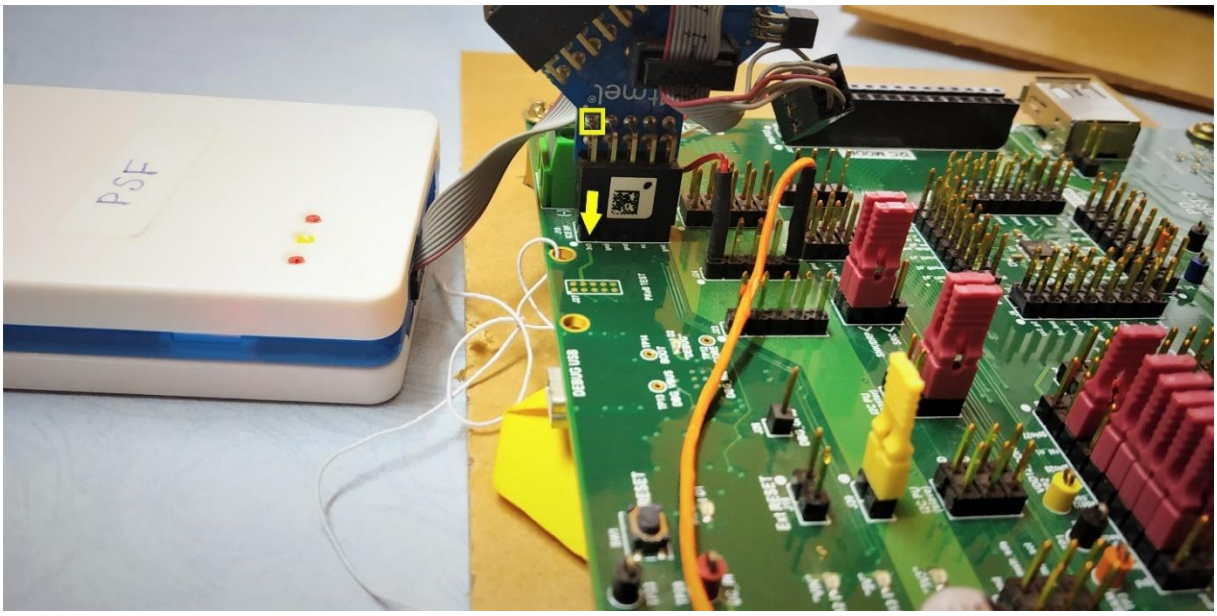

Figure 5.2 Connecting Atmel-ICE Debugger to J19

4. The whole connection looks like,

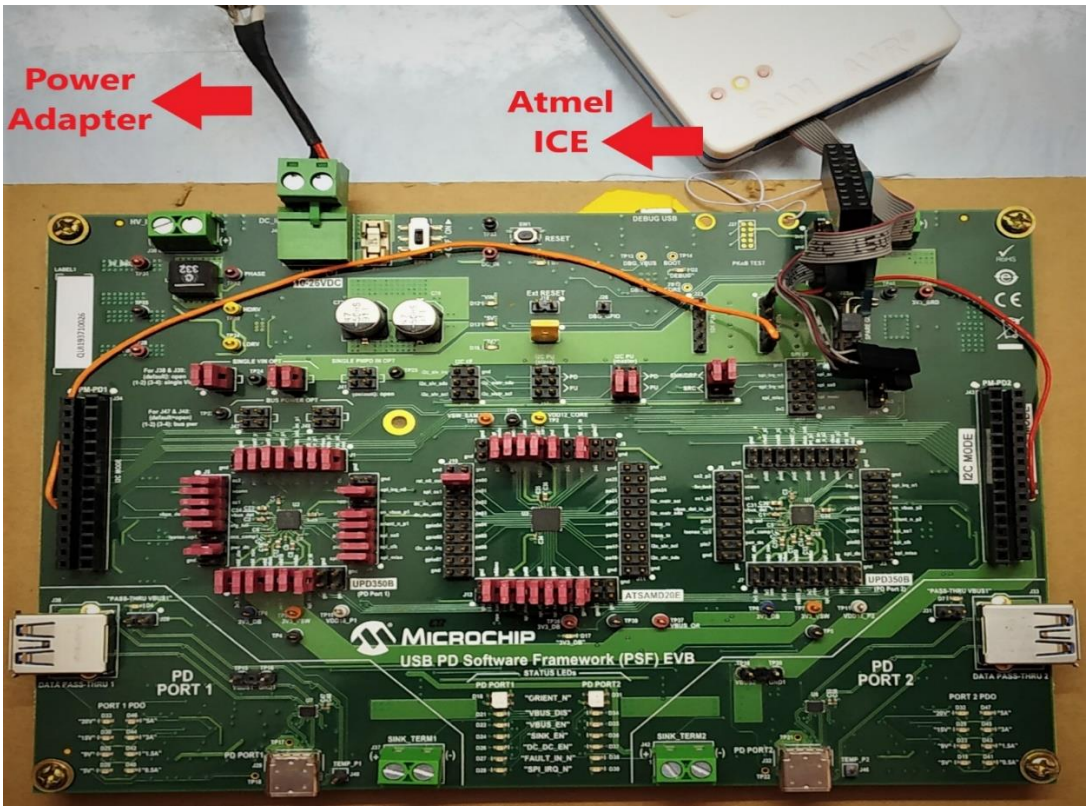

Figure 5.3 PSF-EVB Full Setup

Running the demo

Refer Getting Started with PSF document for the detailed steps on setting up the build environment, building the Sink PSF project and programming the hex file in the PSF-EVB.

Refer Appendix 8.2 of Getting Started with PSF to change any SAMD20 Harmony configuration. Refer 10.2.9 Boot time Configuration of PSF User Guide to change any configuration parameters.

1. Ensure all the jumpers are in place and Power on the PSF-EVB.
2. Program the hex file by following the steps mentioned in section 8 of Getting Started with PSF
3. Connect a PD Source device to Port 1 of PSF-EVB using a USB-C to USB-C cable.
4. The image demonstrates a scenario where a HP Elite book laptop has been connected to Port 1.

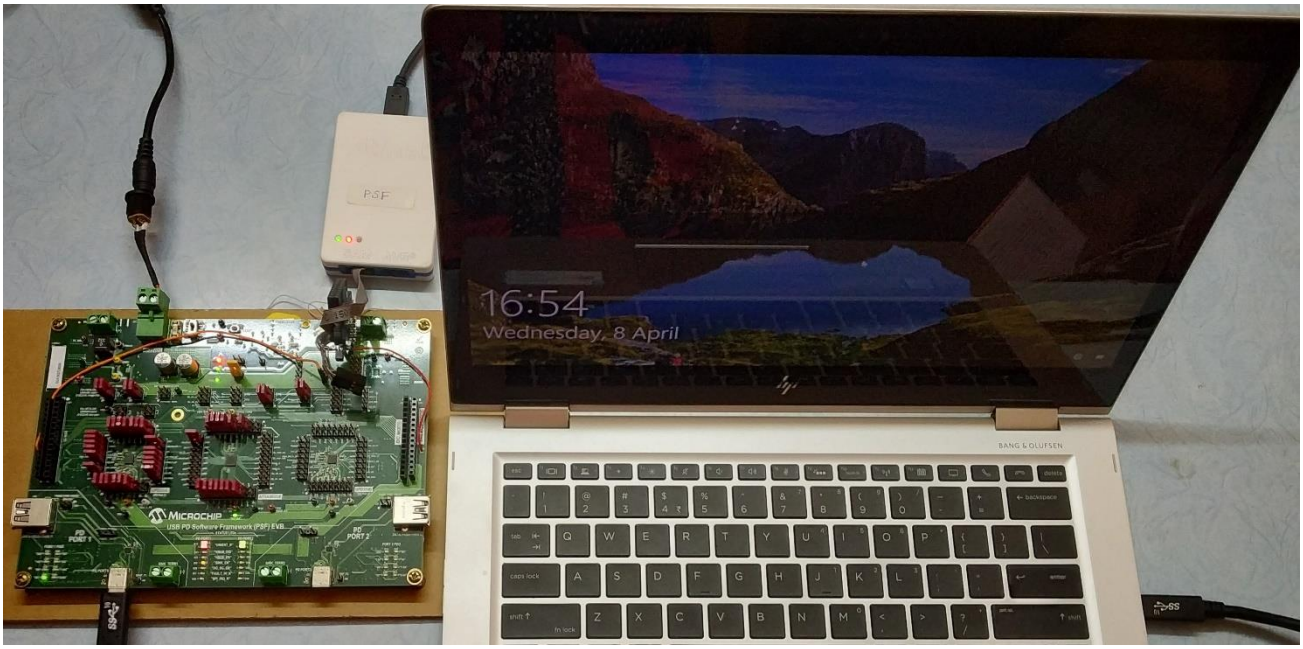

Figure 6.1 A PD source connected to port 1

Expected Results

1. Once the hex file is programmed, the SPI_IRQ_N LEDs in port1 flash and then turn off.

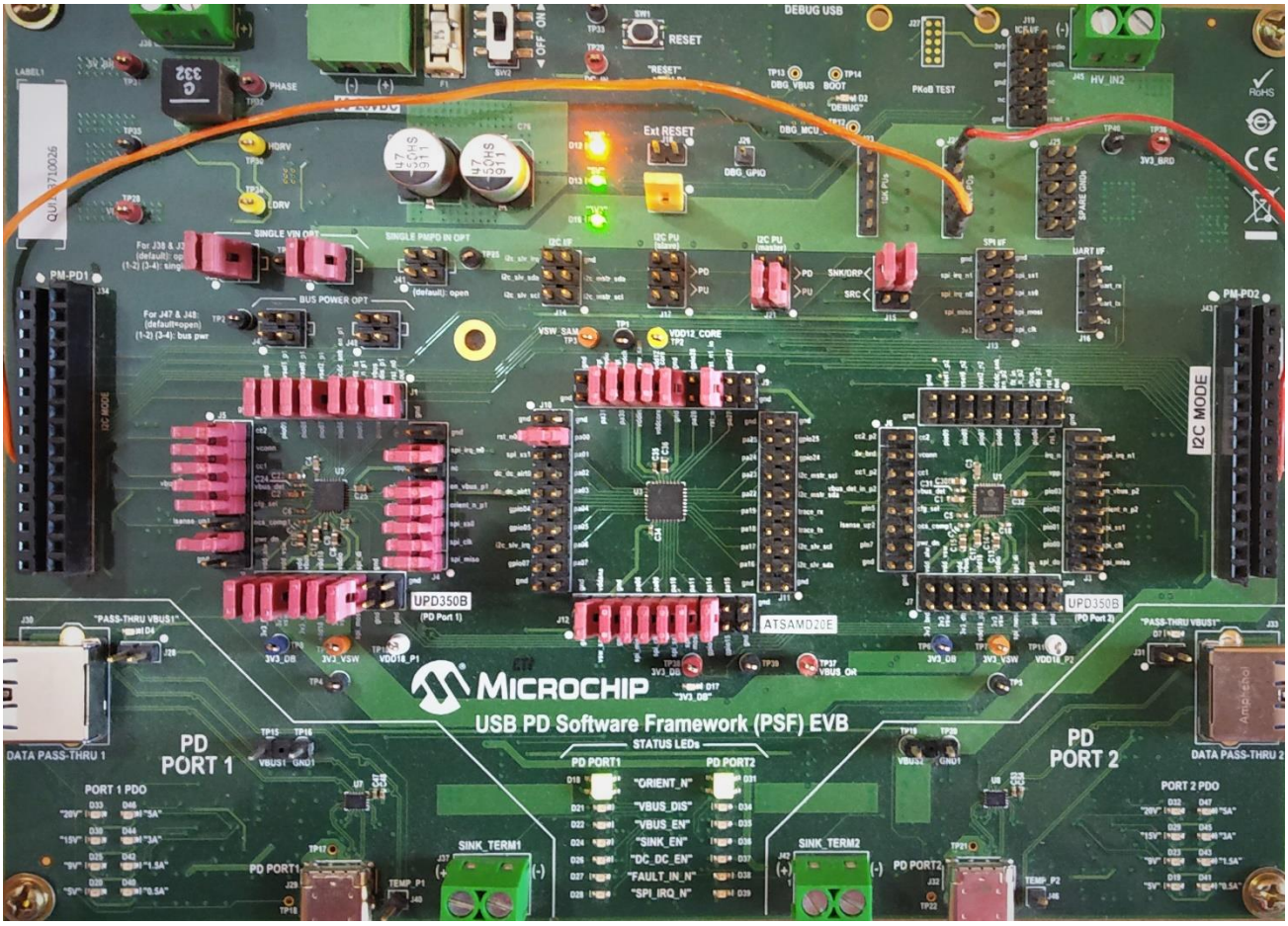

Figure 7.1 Status LEDs after power on

2. Once the Source PD Device is attached to a PD port, the device gives out 5V followed by Source capabilities.

3. PSF request for suitable PDO from source capability based on the configuration. PD negotiation take place if the source accepts the request and sources the requested power.

4. Once an explicit power contract negotiation is in place, the PSF gets enough power for charging. PDO status LEDs will turn ON indicating the negotiated voltage as shown in Figure 7.2

PDO	**Status LED**
5V	Port 1 – D20
9V	Port 1 – D25
15V	Port 1 – D30

20V	Port 1 – D33

Table 7.1 PDO Status LEDs

Example with Port 1: If 5V is negotiated by the device, LED in the D20 of Port 1 PDO will glow. If 9V is negotiated, then LEDs in D20 and D25 will glow. In case of 15V, LEDs in D20, D25 and D30 will glow. If 20V is negotiated, all the LEDs will glow.

5. The DAC indicator will indicate the implicit/negotiated current capability of the attached source partner. In PSF EVB, J10.8 is the pin corresponding to DAC indicator. The table below relates the negotiated current with DAC indicator pin's output voltage.

S.No	Negotiated Current	DAC Indicator's output
1.	Less than 0.5A	0 V
2.	Greater than 0.5A but less than or equal to 1.5A	0.25 V
3.	Greater than 1.5A but less than or equal to 2A	0.75 V
4.	Greater than 2A but less than or equal to 3A	1 V
5.	Greater than 3A but less than or equal to 4A	1.5 V
6.	Greater than 4A but less than or equal to 5A	2 V
7.	Greater than 5A	2.5 V

Table 7.2 DAC indicator

In our case, HP Elite book is capable of sourcing 5V@3A. Therefore, J10.8 in PSF EVB, which is the DAC indicator pin, will be driven with 1V.

6. Three GPIO indicators are designed to indicate the status of sink operation.

S.No	GPIO Indicator	Pin number in PSF EVB	Role
1.	1.5A indicator	J10.6	Asserts when current capability/negotiated is 1.5A or more.
2.	3A indicator	J12.18	Asserts when current capability/negotiated is 1.5A or more.
3.	Capability mismatch indicator	J10.12	Asserts when PD negotiation is complete and there was a capability mismatch with the selection.

Table 7.3 GPIO indicators

Since, our source partner, HP Elite book sources 5V@3A, it is a perfect match. So, 3A indicator, PD Negotiation indicator will go high in our case. 1.5A indicator and capability mismatch indicator GPIOs will remain low.

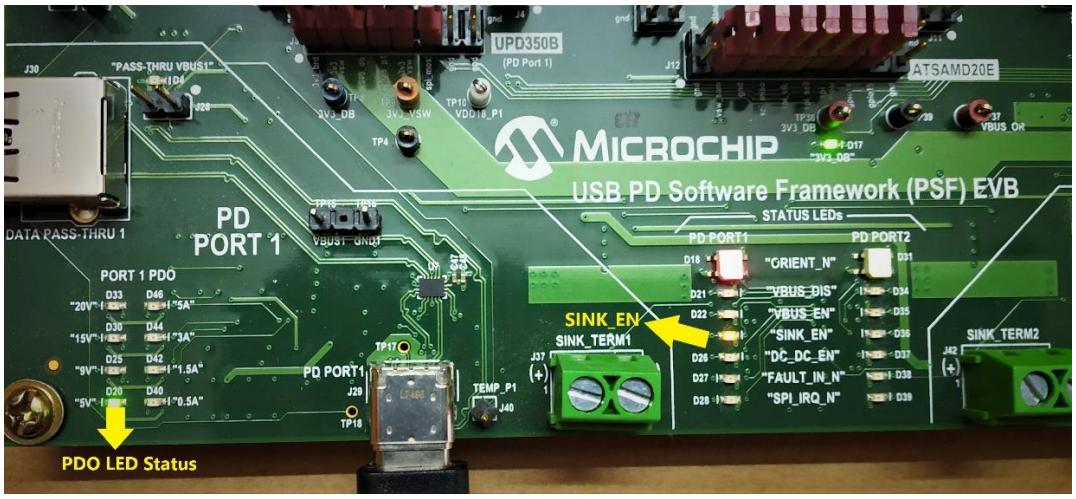

Figure 7.2 PDO Status LEDs after source attach