

USB Power Delivery Software Framework(PSF) User Guide

Version 1.05

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1 Revision History

| REV | DATE | DESCRIPTION OF CHANGE |
|------|-----------|--|
| 0.92 | 11-Dec-19 | Initial Revision |
| 0.95 | 1-Jan-20 | Revised multiple sections to improve document flow |
| 1.00 | 26-Feb-20 | Updated document version to align with v1.00 release |
| 1.01 | 19-Mar-20 | Updated the document to align with recent PSF_Config header file updates where various PSF Configuration Options are moved to global configuration structure and Type C and Policy Engine Timeouts are moved inside PSF stack. |
| 1.02 | 7-Apr-20 | Sink functionality added. GotoMin support, Sink related configuration registers updated; MCHP_PSF_HOOK_DRIVE_DAC_I() added. |
| 1.03 | 21-Apr-20 | Added EN_SINK functionality. Updated comments for elements of PortCfgStatus Structure accordingly. |
| 1.04 | 19-Jun-20 | Added PB, PT and PPS features for source. PIO configurability updated to have only mandatory PIOs configurable as part of stack |
| 1.05 | 24-Jul-20 | Update for typos and sentence corrections in sections 1,7,9 and 10 |

2 Introduction

USB Power Delivery Software Framework (PSF) with USB-PD Port Controller [UPD350](#) is a full-featured, configurable USB Power Delivery(USB-PD) software stack that is compliant to the USB-PD 3.0 Specification. PSF is MCU-agnostic; a system designer may choose from a Microchip's wide catalog of MCU/SoCs to meet specific system requirements while optimizing cost and PCB space. Versatility is achieved through flexible configuration and hardware abstraction. Most major PD functions, like power roles and capabilities, data role and capabilities, product/vendor IDs, and control I/O configuration are achieved through a simple configuration header file..

This documents serves a user guide covering:

- PSF overview and high level architecture
- PSF stack directory structure
- Supported/Not supported features & messages
- It provides a high level configurable options
- Requirements for new platform integration
- Steps to integrate PSF

2.1 Feature Overview

Following are the key features of PSF:

- Compliant to USB Power Delivery 3.0 Specification Revision 1.2 and USB Type-C Specification Revision 1.3
- Multi-port support upto 4 ports.
- USB-PD Source-only or Sink-only port specific configurability
- FW update through CC support compliant to PD FW Update Specification Revision 1.0

Check [Supported/Non Supported PD Features](#) for full details on features supported by PSF.

2.2 References

- Microchip [UPD350](#) Datasheet
- USB Power Delivery 3.0 Specification Revision 1.2
- USB Type-C Specification Revision 1.3
- PD FW Update Specification Revision 1.0

2.3 Terms and Abbreviations

| Term | Definition |
|------------------------|--|
| USB-PD | USB Power Delivery |
| SPI | Serial Peripheral Interface bus - Full-duplex bus utilizing a single-master/multi-slave architecture. SPI is a 4-wire bus consisting of SPI CLK, SPI MOSI, SPI MISO and SPI SS |
| UPD350 | Microchip USB Type-C™ Power Delivery 3.0 Port Controller |
| Sink Role | USB Type-C Port which sinks power from its Port Partner |
| Source Role | USB Type-C Port which sources power to its Port Partner |
| USER_APPLICATION | The software platform that runs on SoC where the PSF is integrated |
| SoC | System on Chip |
| FW | Firmware |
| DFP | Downstream Facing Port |
| UFP | Upstream Facing Port |
| PDFU | Power Delivery Firmware update |
| PDO | Power Data Object |
| FRS | Fast Role Swap |
| PPS | Programmable Power Supply |
| PB | Power Balancing |
| PT | Power Throttling |

3 Legal Information

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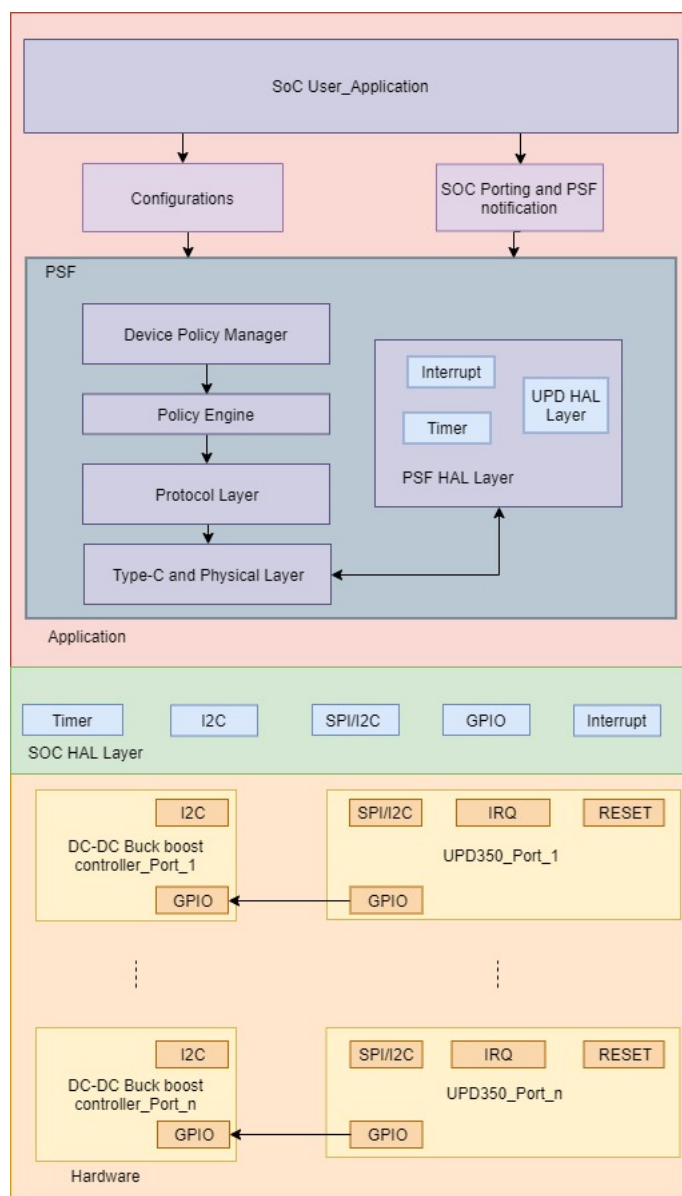
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4 PSF Architecture Overview

PSF is a layered Software framework that enables Power delivery support with any SoC interfaced to [UPD350](#). PSF also provides support for multiple ports, where each port could be configured in a manner independent of other ports. PSF also supports multiple compile time and run time configuration options to tailor the stack to the needs of USER_APPLICATION



SoC User Application:

- SoC User_Application interacts with PSF only through "Configuration (PSF_Config.h)" and "SoC Porting and PSF notification (PSF_APIHook.h)".

SoC HAL Layer:

- It has HAL drivers for modules required for PSF functionality like Timer, Interrupt, SPI/I2C Interface and GPIO.

Device Policy Manager:

The Device Policy Manager is responsible for the following,

- The DPM role is to maintain the Local Policy of the device.
- Controls the Source/Sink in the device.
- For a USB-PD Source, it monitors Source's present capabilities & in case of any change in the capability it triggers notification to Policy Engine.
- For a USB-PD Sink, it evaluates & respond to capability related requests from the Policy Engine for a given port.
- Controls the USB-C Port Control module for each Port.
- It interfaces with Policy Engine Port specifically informs Policy Engine Cable/Device detection as Source/Sink.
- Takes care of any VBUS or VCONN power fault

Policy Engine:

There is one Policy Engine instance per Port that interacts with the Device Policy Manager to implement present Local Policy for that Port.

- Policy Engine drives message sequences for various operations.
- It is responsible for establishing Explicit Contract by negotiating power based on Local Policy.

Protocol Layer:

- Protocol Layer handles message construction, transmission, & reception, reset operation, message error handling.
- It sends/receives messages through [UPD350](#) using SPI wrapper functions.
- It acts as an interface between Policy Engine & [UPD350](#).

Type-C Connector Management:

Type-C Management includes following operation as defined in the USB Type-C v1.3 specification,

- Source-to-Sink attach/detach detection
- Plug orientation/cable twist detection
- Initial power (Source-to-Sink) detection and enabling PD communication
- VBUS Detection & Type C Error Recovery Mechanism

Port Power Management:

Port power management as a Source/Sink for multiple ports supports,

- Configurable Fixed PDOs per port up to 100W
- Over current sense on ports

PSF HAL Layer:

Apart from the layers specified by USB-PD Specification for PSF, PSF has HAL layer to interact and access [UPD350](#) HW as well as for software functionality like software timer. Interrupt handles all the external interrupt from [UPD350](#) Silicon. Timer involves handling of all the active software timer's timeouts based on the interrupt from periodic hardware timer.

Hardware:

For driving variable VBUS voltages (i.e.: 5V, 9V, 15V, or 20V), an external DC-DC buck-boost controller is required. It can either be driven by [UPD350](#) PIOs or SoC's I2C controller. [UPD350](#) requires the SoC to control its SPI/I2C communication bus for interaction, IRQ and RESET lines.

5 Supported/Non Supported PD Features

List of supported and non supported USB-PD features by this release of PSF. Future releases may extend PSF feature set and the supported messages.

| Features | Supported/Not Supported |
|---------------------------------------|---|
| USB-PD Source only | Supported |
| USB-PD Sink only | Supported |
| Power negotiation up to 100 watts | Supported |
| PDFU support through CC | Support is available in PSF stack, but there is no sample application example |
| VCONN Power support | Supported |
| Extended message support via Chunking | Supported |
| Fixed PDOs | Supported |
| Dynamic Power Balancing | Supported |
| Power Throttling | Supported |
| PPS | Supported |
| FRS support | Not Supported |
| UVDM & USB Type-C Bridging | Not Supported |
| Dual-Role Power(DRP) | Not Supported |
| Dual-Role Data(DRD) | Not Supported |
| Alternate Mode | Not Supported |
| Unchunked Extended message | Not Supported |

6 Supported/Non Supported PD Messages

Control Messages

| USB-PD Control messages | Supported/Not Supported |
|-------------------------------------|-------------------------|
| GoodCRC | Supported |
| Accept | Supported |
| Reject | Supported |
| Ping | Supported |
| PS_RDY | Supported |
| Get_Source_Cap (For Sink Role only) | Supported |
| Get_Sink_Cap (For Source Role only) | Supported |
| VCONN_Swap | Supported |
| Wait | Supported |
| Soft_Reset | Supported |
| GotoMin | Supported |
| DR_SWAP | Not Supported |
| PR_SWAP | Not Supported |
| Get_Source_Cap_Extended | Not Supported |
| Get_Status | Supported |
| FR_Swap | Not Supported |
| Get_PPS_Status | Not Supported |
| Get_Country_Codes | Not Supported |

Data Messages

| USB-PD Data messages | Supported/Not Supported |
|--|-------------------------|
| Source_Capabilities (Source Role only) | Supported |
| Request | Supported |
| BIST | Supported |
| Sink_Capabilities (Sink Role only) | Supported |
| Battery_Status | Not Supported |
| Alert | Supported |
| Get_Country_Info | Not Supported |
| Vendor_Defined | Not Supported |

Extended Messages

| USB-PD Extended Message | Supported/Not Supported |
|--------------------------------|--------------------------------|
| Firmware_Update_Request | Supported |
| Firmware_Update_Response | Supported |
| Source_Capabilities_Extended | Not Supported |
| Status | Supported |
| Get_Battery_Cap | Not Supported |
| Get_Battery_Status | Not Supported |
| Battery_Capabilities | Not Supported |
| Manufacturer_Info | Not Supported |
| Security_Request | Not Supported |
| Security_Response | Not Supported |
| PPS_Status | Supported |
| Country_Info | Not Supported |
| Country_Codes | Not Supported |

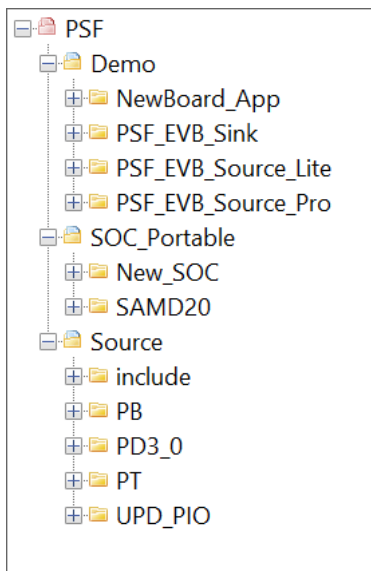
7 Directory Structure

PSF directory is organized as

- ../Demo - Contains all the power delivery application, PSF configuration files of Source Lite, Source Pro and Sink sample applications.
 - Source Lite - PSF Source only sample application with no add-on features
 - Source Pro - PSF Source sample application with value-add features such as Power Balancing, PPS, etc.
 - Sink - PSF Sink sample application
- ../SOC_Portable - Contains SoC specific integration, PSF APIs porting and drivers files
- ../Source - Contains PSF source and header file

PSF has two user configurable files to enable user various level of configurability and porting:

- PSF_Config.h -> To configure PSF to different PD features and functionality in a PSF integrated SOC platform
- PSF_APIHook.h -> To port and integrate to any new SoC platform



7.1 Source folder

This folder comprises of all the source files that implement the core USB PD functionality as defined in the USB-PD 3.0 specification.

The sub directory structure is as follows:

- ../PSF\Source\include - contains all the header files for PD3.0 functionality
- ../PSF\Source\PD3_0 - contains all the source file for PD3.0 functionality
- ../PSF\Source\PB - contains all the source and header files for Power Balancing functionality
- ../PSF\Source\PT - contains all the source and header files for Power Throttling functionality
- ../PSF\Source\UPD_PIO - contains all the source and header files for UPD PIO functionality

File descriptions of all the files present under include and PD3_0

| File Name | Application | File description |
|--|-----------------------------------|---|
| policy_manager.c policy_manager.h | Device Policy Manager (DPM) | Maintains DPM functionality |
| policy_engine.h policy_engine.c policy_engine_src.c policy_engine_snk.c | Policy Engine | <ul style="list-style-type: none"> policy_engine.c maintains PE functionality common to both Source & Sink whereas policy_engine_src.c and policy_engine_snk.c maintains functionality specific to Source and Sink respectively. policy_engine.h is single header file for all the PE related source files. |
| protocol_layer.c protocol_layer.h | Protocol Layer | APIs for Protocol layer functionality |
| typeC_control.c typeC_control.h | Type-C Connector Management | Type-C control functionality & connector management |
| pd_timer.c pd_timer.h | Timer management | Contains APIs to manage multiple Software Timers |
| upd_interrupts.c upd_interrupts.h | Interrupts Management | UPD350 Alert Interrupt management (port specific) |
| debug.h | Debug support | Debug interface support APIs file |
| upd_hw.c upd_hw.h | UPD350 Hardware | APIs to access for UPD350 Hardware GPIO, Registers, PIO override |
| int_globals.c int_globals.h | Internal globals | Maintains globals internal to PSF. |
| generic_defs.h | Generic Defines | contains generic defines for data types |
| timer_defs.h | Timer Defines | contains Type C and Policy Engine Timeout configurations |
| psf_stdinc.h | Standard include file | Standard include file for PSF |
| pd_main.c | PSF main source file | contains APIs to be called by User_Application |
| policy_engine_fwup.c policy_engine_fwup.h | Power Deliver Firmware update | Maintains PDFU functionality |
| portpower_control.c portpower_control.h | Port Power control | Maintains PSF default port power control support |
| pb_helper.c pb_mgr.c pb_mgr.h | Power Balancing | Maintains Power Balancing related APIs that are used to handle PPM events and helper functions needed for the same. |
| pt_mgr.c pt_mgr.h | Power Throttling | Maintains PT Functionality |
| upd350_pio_drivers.c upd350_pio_drivers.h | UPD350 PIO driver | Maintains UPD350 PIO Driver Functionality |
| ProjectVersion.h | PSF version | Maintains PSF release version |

7.2 SOC_Portable folder

SOC_Portable contains all the drivers porting files required for PSF functionality from SoC layer. It varies depending on the SoC and user application. The list of APIs required for PSF integration and porting is available as defines in PSF_APIHook.h at ..\PSF\SOC_Portable\New_SOC\PSF_APIHook.h.

7.3 Demo folder

Demo folder contains PSF sample applications specific to the boards. It contains:

- project files
- Application and board specific files and documents
- PSF_Config header file.
- Boot time configuration file specific to sample application.
- I2C DC DC Controller specific files

With these files the user can build and exercise an application on the PSF evaluation platform or other custom-designed hardware platform. PD functionality can be configured with the "PSF_Config.h" header file located at "..\Demo\NewBoard_App\PSF_Config.h". This file is used to configure the PD application to meet specific system requirements and feature-set. In Boot time configuration file, user must write a function to initialize all the needed configuration parameters.

8 PSF Configuration Options

PSF has a range of compile time and runtime configuration options for the various USB-PD features and other special features.












This release of PSF allows configuration of the following:

- Number of ports
- Power Role - Source only or Sink only
- Data Role - DFP or UFP
- Port Power control management
- Source & Sink PDOs
- Power Balancing parameters
- Configuration of PT Banks and Power values
- [UPD350](#) PIO Configuration
- Compile time Code & Data RAM inclusion/exclusion based on USB-PD Specification Revision & Power Role.

All this configurable options are present in PSF_Config.h. header file of PSF. PSF_Config.h shall be customized as per the PD application and included as part of User Application Directory. It is recommended to include this file path as one of preprocessor include paths. The template of PSF_Config.h for new demo application is available at `..\PSF\Demo\NewBoard_App\`

8.1 Include/Exclude Features

Macros

| | Name | Description |
|---|--|--|
|  | INCLUDE_PD_3_0 | USB-PD V3.0 support code inclusion. |
|  | INCLUDE_PD_SOURCE | Source support code inclusion. |
|  | INCLUDE_PD_SINK | Sink support code inclusion. |
|  | INCLUDE_VCONN_SWAP_SUPPORT | VCONN Support code inclusion. |
|  | INCLUDE_POWER_FAULT_HANDLING | Power Fault Handling code inclusion. |
|  | INCLUDE_UPD_PIO_OVERRIDE_SUPPORT | PIO Override Feature code inclusion. |
|  | INCLUDE_POWER_MANAGEMENT_CTRL | Power Management Control Support code inclusion. |
|  | INCLUDE_PDFU | PD Firmware update code inclusion. |
|  | INCLUDE_POWER_BALANCING | Power Balancing support code inclusion. |
|  | INCLUDE_POWER_THROTTLING | Power Throttling support code inclusion. |
|  | INCLUDE_PD_SOURCE_PPS | PPS support code inclusion. |

Description

This parameter is used to configure USB-PD features that is to be included or excluded in stack. User can choose to include/exclude any of the listed features based on the functional requirements. Based on this definition, part of code will be included/excluded for compilation process. This can be used effectively to reduce PSF code size if specific features aren't required.

8.1.1 INCLUDE_PD_3_0

C

```
#define INCLUDE_PD_3_0 1
```

Description

Setting the INCLUDE_PD_3_0 as 1, enables PSF to include USB Power delivery 3.0 specification features(collision avoidance and extended message support via chunking) along with PD 2.0 features at the compile. User can set this define to 0 to reduce code size, if none of the PD enabled ports require PD 3.0 specific features.

Remarks

Recommended default value is '1'.

Example

```
#define INCLUDE_PD_3_0 1(Include USB PD 3.0 specific features to PSF)
#define INCLUDE_PD_3_0 0(Exclude USB PD 3.0 specific features from PSF)
```

8.1.2 INCLUDE_PD_SOURCE

C

```
#define INCLUDE_PD_SOURCE 1
```

Description

Setting the INCLUDE_PD_SOURCE as 1 enables PSF to include the USB PD Source functionality at compile time. User can set this define to 0 to reduce code size if none of the PD enabled ports in the system are configured for Source operation.

Remarks

Recommended default value is '1' for Source Application.

Example

```
#define INCLUDE_PD_SOURCE 1(Include USB PD Source functionality in PSF)
#define INCLUDE_PD_SOURCE 0(Exclude USB PD Source functionality from PSF)
```

8.1.3 INCLUDE_PD_SINK

C

```
#define INCLUDE_PD_SINK 1
```

Description

Setting the INCLUDE_PD_SINK as 1 enables PSF to include USB PD Sink functionality at the compile time. User can set this define to 0 to reduce code size if none of the PD enabled ports are configured for Sink operation.

Remarks

Recommended default value is '1' for Sink Application.

Example

```
#define INCLUDE_PD_SINK 1(Include USB PD Sink functionality in PSF)
#define INCLUDE_PD_SINK 0(Exclude USB PD Sink functionality from PSF)
```

8.1.4 INCLUDE_VCONN_SWAP_SUPPORT

C

```
#define INCLUDE_VCONN_SWAP_SUPPORT 1
```

Description

Setting the INCLUDE_VCONN_SWAP_SUPPORT as 1 enables PSF to include the VCONN Swap functionality at the compile time. User can set this define to 0 to reduce code size if none of the PD enabled ports requires VCONN Swap functionality.

Remarks

Recommended default value is 1. For Source Operation, it is mandatory to define this macro as '1'. When [INCLUDE_PD_SOURCE](#) is defined as '1', define this macro as '1'.

Example

```
#define INCLUDE_VCONN_SWAP_SUPPORT 1(Include VCONN Swap functionality in PSF)
#define INCLUDE_VCONN_SWAP_SUPPORT 0(Exclude VCONN Swap functionality from PSF)
```

8.1.5 INCLUDE_POWER_FAULT_HANDLING

C

```
#define INCLUDE_POWER_FAULT_HANDLING 1
```

Description

Setting the INCLUDE_POWER_FAULT_HANDLING as 1 enables PSF to handle power faults (Source and Sink over voltage, Source OCS, Sink under voltage) as per Power Delivery specification Rev3.0 as applicable. User can set this define to 0 to reduce code size if PSF based power fault handling is not required.

Remarks

Recommended default value is 1.

Example

```
#define INCLUDE_POWER_FAULT_HANDLING 1(Include Power Fault handling to PSF)
#define INCLUDE_POWER_FAULT_HANDLING 0(Exclude Power Fault handling from PSF )
```

8.1.6 INCLUDE_UPD_PIO_OVERRIDE_SUPPORT

C

```
#define INCLUDE_UPD_PIO_OVERRIDE_SUPPORT 1
```

Description

PIO override is [UPD350](#) specific feature which changes the state of a PIO without software intervention. PSF uses this feature to disable EN_VBUS(in case of source operation) or EN_SINK(in case of sink operation) instantly on detection of a Power Fault Condition. Setting the INCLUDE_UPD_PIO_OVERRIDE_SUPPORT as 1 enables this feature. User can set this define to 0 to reduce code size of PSF if PIO override based power faulting is not required.

Remarks

To use this feature, EN_VBUS or EN_SINK and FAULT_IN Pin of the system should be [UPD350](#) PIOs. It is also confined to [INCLUDE_POWER_FAULT_HANDLING](#) define, thus [INCLUDE_POWER_FAULT_HANDLING](#) should be declared as 1 for INCLUDE_UPD_PIO_OVERRIDE_SUPPORT define to be effective. Recommended default value is 1 if [UPD350](#) PIOs are

used for EN_VBUS, EN_SINK and FAULT_IN.

Example

```
#define INCLUDE_UPD_PIO_OVERRIDE_SUPPORT    1(Include UPD350 PIO Override support for Power
                                             fault to PSF)
#define INCLUDE_UPD_PIO_OVERRIDE_SUPPORT    0(Exclude UPD350 PIO Override support for Power
                                             fault from PSF)
```

8.1.7 INCLUDE_POWER_MANAGEMENT_CTRL

C

```
#define INCLUDE_POWER_MANAGEMENT_CTRL 1
```

Description

Setting the INCLUDE_POWER_MANAGEMENT_CTRL as 1 enables PSF to include the functionality that puts the [UPD350](#) into low power mode if [UPD350](#) is inactive for [CONFIG_PORT_UPD_IDLE_TIMEOUT_MS](#) time and PSF notifies the same via the call back [MCHP_PSF_NOTIFY_CALL_BACK](#). User can set this define to 0 to reduce code size of the PSF if low power mode operation of [UPD350](#) is not required for the application.

Remarks

Recommended default value is 1.

Example

```
#define INCLUDE_POWER_MANAGEMENT_CTRL    1(Include power management feature)
#define INCLUDE_POWER_MANAGEMENT_CTRL    0(Exclude power management feature)
```

8.1.8 INCLUDE_PDFU

C

```
#define INCLUDE_PDFU 0
```

Description

Setting the INCLUDE_PDFU as 1 includes the state machine code for PD Firmware Update feature as per USB Power Delivery FW Update Specification v1.0. User can set this define to 0 to reduce code size if the PSF application doesnot use Firmware update feature.

Remarks

Recommended default value is 0 unless Firmware update feature is used. It is mandatory to have [INCLUDE_PD_3_0](#) is defined as '1' when INCLUDE_PDFU is '1'.

Example

```
#define INCLUDE_PDFU    1(Include PDFU feature)
#define INCLUDE_PDFU    0(Exclude PDFU feature)
```

8.1.9 INCLUDE_POWER_BALANCING

C

```
#define INCLUDE_POWER_BALANCING 1
```

Description

Setting the INCLUDE_POWER_BALANCING as 1 enables PSF to include the PD Power Balancing functionality at compile time. User can set this define to 0 to reduce code size if none of the PD enabled Source ports in the system require Power

Balancing functionality.

Remarks

Recommended default value is 1. For INCLUDE_POWER_BALANCING to be 1, [INCLUDE_PD_SOURCE](#) shall be set to 1.

Example

```
#define INCLUDE_POWER_BALANCING 1(Include Power Balancing functionality in PSF)
#define INCLUDE_POWER_BALANCING 0(Exclude Power Balancing functionality from PSF)
```

8.1.10 INCLUDE_POWER_THROTTLING

C

```
#define INCLUDE_POWER_THROTTLING 1
```

Description

Setting the INCLUDE_POWER_THROTTLING as 1 enables PSF to include the Power Throttling(PT) feature at compile time. User can set this define to 0 to reduce code size if none of the Source ports in the system require PT functionality.

Remarks

Recommended default value is 1. For INCLUDE_POWER_THROTTLING to be 1, [INCLUDE_PD_SOURCE](#) shall be set to 1.

Example

```
#define INCLUDE_POWER_THROTTLING 1(Include PT functionality in PSF)
#define INCLUDE_POWER_THROTTLING 0(Exclude PT functionality from PSF)
```

8.1.11 INCLUDE_PD_SOURCE_PPS

C

```
#define INCLUDE_PD_SOURCE_PPS 1
```

Description

Setting the INCLUDE_PD_SOURCE_PPS as 1 enables PSF to include the Source Programmable Power Supply(PPS) feature at compile time. User can set this define to 0 to reduce code size if none of the Source ports in the system require PPS functionality.

Remarks



Recommended default value is 1. For INCLUDE_PD_SOURCE_PPS to be 1, [INCLUDE_PD_SOURCE](#) and [INCLUDE_PD_3_0](#) shall be set to 1.

Example

```
#define INCLUDE_PD_SOURCE_PPS 1(Include Source PPS functionality in PSF)
#define INCLUDE_PD_SOURCE_PPS 0(Exclude Source PPS functionality from PSF)
```

8.2 System Level Configuration

Macros

| | Name | Description |
|---|--|---|
|  | CONFIG_PD_PORT_COUNT | Power Delivery Enabled ports count. |
|  | CONFIG_DEFINE_UPD350_HW_INTF_SEL | HW Communication interface between SOC and UPD350 . |

Description

This section explain PSF configurability available at overall system level.

8.2.1 CONFIG_PD_PORT_COUNT

C

```
#define CONFIG_PD_PORT_COUNT 2
```

Description

CONFIG_PD_PORT_COUNT defines the number of Power delivery enabled ports. The maximum number of ports PSF can support is '4'.

Remarks

The max and min value for CONFIG_PD_PORT_COUNT is '4' and '1' respectively. PSF refers the Port number in the call backs as 0 to (CONFIG_PD_PORT_COUNT - 1). The default value is 2 and it can be defined based on the user application. For each port defined by this macro approximately 500Bytes of Data RAM is consumed.

Example

```
#define CONFIG_PD_PORT_COUNT 2 (Number of PD ports enabled in PSF Stack is 2)
```

8.2.2 CONFIG_DEFINE_UPD350_HW_INTF_SEL

C

```
#define CONFIG_DEFINE_UPD350_HW_INTF_SEL CONFIG_UPD350_SPI
```

Description

CONFIG_DEFINE_UPD350_HW_INTF_SEL defines the Hardware interface for communication between the SOC and [UPD350](#). It can take either CONFIG_UPD350_SPI or CONFIG_UPD350_I2C as input value.

CONFIG_UPD350_SPI - SPI is the communication interface between SOC and [UPD350](#). SPI interface is supported by [UPD350](#) B and D parts alone.

CONFIG_UPD350_I2C - I2C is the communication interface between SOC and [UPD350](#). I2C interface is supported by [UPD350](#) A and C parts alone.

Remarks

CONFIG_DEFINE_UPD350_HW_INTF_SEL should be defined based on [UPD350](#) silicon part used for the application. All the ports in a system should use either I2C supported or SPI supported [UPD350](#) part. Using mixed interfaces for individual ports is not supported (i.e.: SPI for Port 1 and I2C for Port 2).

If the target for PSF is a UPD301C device, SPI must always be selected. I2C is not an option for UPD301C due to the physical bonding of the UPD301C.

Example





```
#define CONFIG_DEFINE_UPD350_HW_INTF_SEL CONFIG_UPD350_SPI
#define CONFIG_DEFINE_UPD350_HW_INTF_SEL CONFIG_UPD350_I2C
```

8.3 Configuration and Status Registers


Macros

| | Name | Description |
|---|--|---------------------------------------|
|  | INCLUDE_CFG_STRUCT_MEMORY_PAD_REGION | INCLUDE_CFG_STRUCT_MEMORY_PAD_REGION. |

Structures

| | Name | Description |
|---|--------------------------------------|--|
|  | _GlobalCfgStatusData | This structure contains the system level, Port specific configurations and Status parameters of PSF for Type C, PD, PB, PT and PPS parameters. gasCfgStatusData is the defined variable of this structure. |
|  | _PortCfgStatus | This structure contains port specific Type C and PD configuration and status parameters. sPerPortData is referred from _GlobalCfgStatusData . |
|  | _PBPortCfgStatus | This structure contains port specific Power Balancing Configuration parameters. sPBPerPortData is referred from _GlobalCfgStatusData . |
|  | _PPSPortCfgStatus | This structure contains port specific status parameters. sPPSPerPortData is referred from _GlobalCfgStatusData . |

Variables

| | Name | Description |
|---|----------------------------------|---|
|  | gasCfgStatusData | This is an instance of _GlobalCfgStatusData . |

Description

Configuration and Status registers help users to control the operation of the PSF ports and to know the run time status information of the ports defined in [CONFIG_PD_PORT_COUNT](#).

8.3.1 _GlobalCfgStatusData Structure

C

```

struct _GlobalCfgStatusData {
    UINT8  u8MinorVersion;
    UINT8  u8MajorVersion;
    UINT8  u8HWVersion;
    UINT8  u8SiVersion;
    UINT8  u8aManfString[8];
    UINT8  u8PSFMajorVersion;
    UINT8  u8PSFMinorVersion;
    UINT8  u8PwrThrottleCfg;
    UINT8  u8aReserved3;
    UINT16 u16ProductID;
    UINT16 u16VendorID;
    UINT16 u16ProductTypeVDO;
    UINT16 u16ProductVDO;
    UINT16 u16CertStatVDO;
    UINT16 u16IDHeaderVDO;
    PORT_CFG_STATUS sPerPortData[CONFIG_PD_PORT_COUNT];
    UINT16 u16SharedPwrCapacityIn250mW;
    UINT8  u8PBEnableSelect;
    UINT8  u8aReserved6;
    UINT16 u16SystemPowerBankAIn250mW;
    UINT16 u16MinPowerBankAIn250mW;
    UINT16 u16SystemPowerBankBIn250mW;
    UINT16 u16MinPowerBankBIn250mW;
    UINT16 u16SystemPowerBankCIn250mW;

```



```

UINT16 u16MinPowerBankCIn250mW;
PB_PORT_CFG_STATUS sPBPerPortData[CONFIG_PD_PORT_COUNT];
PPS_PORT_CFG_STATUS sPPSPerPortData[CONFIG_PD_PORT_COUNT];
UINT8 u8ReservedPadBytes[16];
};

```

Description

This structure contains global configuration and status parameters that are either Integer Datatypes, Bit-Mapped bytes or another structure.

1. Members that are Integer data types:

| Name | Size in Bytes | R/W Config time | R/W Run time | Description |
|-------------------|---------------|-----------------|--------------|--|
| u8MinorVersion | 1 | R/W | R | Defines Structure Minor Version |
| u8MajorVersion | 1 | R/W | R | Defines Structure Major Version |
| u8HWVersion | 1 | R/W | R | Defines Hardware Version |
| u8SiVersion | 1 | R/W | R | Defines Silicon Version |
| u8aManfString[8] | 1 | R/W | R | Defines Manufacturer String |
| u8PSFMajorVersion | 1 | R/W | R | Defines PSF Stack Major Version |
| u8PSFMinorVersion | 1 | R/W | R | Defines PSF Stack Minor Version |
| u16ProductID | 2 | R/W | R | <ul style="list-style-type: none"> Defines the Product Identifier Value. It is used by the PD Firmware Update state machine during Enumeration phase. This information is shared with the PDFU initiator as part of GET_FW_ID command's response. User definition of this macro is mandatory when INCLUDE_PDFU is defined as 1. It should always be two byte wide. |
| u16VendorID | 2 | R/W | R | <ul style="list-style-type: none"> Defines the Vendor Identifier Value. It is used by the PD Firmware Update state machine during Enumeration phase. This information is shared with the PDFU initiator as part of GET_FW_ID command's response. User definition of this macro is mandatory when INCLUDE_PDFU is defined as 1. It should always be two byte wide. |
| u16ProductTypeVDO | 2 | R/W | R | Defines Product Type VDO |
| u16ProductVDO | 2 | R/W | R | Defines Product VDO |
| u16CertStatVDO | 2 | R/W | R | Defines Cert Stat VDO |
| u16IDHeaderVDO | 2 | R/W | R | Defines ID Header VDO |

| | | | | |
|----------------------------|---|-----|---|--|
| u16SystemPowerBankAIn250mW | 2 | R/W | R | <ul style="list-style-type: none"> Defines the Total System Power of Bank A. Each unit is 0.25W Sample values are, <ol style="list-style-type: none"> 0x0001 = 0.25W 0x01E0 = 120W 0x0320 = 200W A setting of 0x0000 and 0x0321-0xFFFF is invalid. This variable is used only when either of <u>INCLUDE_POWER_BALANCING</u> or <u>INCLUDE_POWER_THROTTLING</u> is set to '1'. |
| u16MinPowerBankAIn250mW | 2 | R/W | R | <ul style="list-style-type: none"> Defines the Guaranteed minimum Power of Bank A. Each unit is 0.25W Sample values are, <ol style="list-style-type: none"> 0x0001 = 0.25W 0x003C = 15W 0x0190 = 100W A setting of 0x0000 and 0x0191-0xFFFF is invalid. This variable is used only when either of <u>INCLUDE_POWER_BALANCING</u> or <u>INCLUDE_POWER_THROTTLING</u> is set to '1'. |
| u16SystemPowerBankBIn250mW | 2 | R/W | R | <ul style="list-style-type: none"> Defines the Total System Power of Bank B. Each unit is 0.25W Sample values are, <ol style="list-style-type: none"> 0x0001 = 0.25W 0x01E0 = 120W 0x0320 = 200W A setting of 0x0000 and 0x0321-0xFFFF is invalid. This variable is used only when either of <u>INCLUDE_POWER_BALANCING</u> or <u>INCLUDE_POWER_THROTTLING</u> is set to '1'. |
| u16MinPowerBankBIn250mW | 2 | R/W | R | <ul style="list-style-type: none"> Defines the Guaranteed minimum Power of Bank B. Each unit is 0.25W Sample values are, <ol style="list-style-type: none"> 0x0001 = 0.25W 0x003C = 15W 0x0190 = 100W A setting of 0x0000 and 0x0191-0xFFFF is invalid. This variable is used only when either of <u>INCLUDE_POWER_BALANCING</u> or <u>INCLUDE_POWER_THROTTLING</u> is set to '1'. |

| | | | | |
|-----------------------------|----|-----|---|---|
| u16SystemPowerBankCIn250mW | 2 | R/W | R | <ul style="list-style-type: none"> Defines the Total System Power of Bank C. Each unit is 0.25W Sample values are, <ol style="list-style-type: none"> 0x0001 = 0.25W 0x01E0 = 120W 0x0320 = 200W A setting of 0x0000 and 0x0321-0xFFFF is invalid. This variable is used only when either of <code>INCLUDE_POWER_BALANCING</code> or <code>INCLUDE_POWER_THROTTLING</code> is set to '1'. |
| u16MinPowerBankCIn250mW | 2 | R/W | R | <ul style="list-style-type: none"> Defines the Guaranteed minimum Power of Bank C. Each unit is 0.25W Sample values are, <ol style="list-style-type: none"> 0x0001 = 0.25W 0x003C = 15W 0x0190 = 100W A setting of 0x0000 and 0x0191-0xFFFF is invalid. This variable is used only when either of <code>INCLUDE_POWER_BALANCING</code> or <code>INCLUDE_POWER_THROTTLING</code> is set to '1'. |
| u16SharedPwrCapacityIn250mW | 2 | R | R | <ul style="list-style-type: none"> Defines the currently available shared power capacity from which power is allocated to ports that are not yet in a valid negotiated contract. The shared power capacity is dynamically adjusted as ports are connected and disconnected. Each unit is 0.25W Sample values are, <ol style="list-style-type: none"> 0x0001 = 0.25W 0x003C = 15W 0x0190 = 100W This variable is used only when either of <code>INCLUDE_POWER_BALANCING</code> or <code>INCLUDE_POWER_THROTTLING</code> is set to '1'. |
| u8aReserved3 | 1 | | | Reserved |
| u8aReserved6 | 1 | | | Reserved |
| u8aReserved7[3] | 3 | | | Reserved |
| u8aReserved8[3] | 3 | | | Reserved |
| u16Reserved2 | 2 | | | Reserved |
| u8ReservedPadBytes[16] | 16 | | | <ul style="list-style-type: none"> Reserved bytes included based on configuration macro <code>INCLUDE_CFG_STRUCT_MEMORY_PAD_REGION</code> |

2. Members that are Bit-Mapped bytes:

a. u8PBEnableSelect:

u8PBEnableSelect defines PB Enable/Disable for the system and also the Power Balancing algorithm. It's size is 1 byte.

| Bit | R/W Config time | R/W Run time | Description |
|-----|-----------------|--------------|---|
| 3:0 | R/W | R | Selection of Power Balancing Algorithm <ul style="list-style-type: none"> • 0000 = First Come First Serve • 0001 = Last Plugged Gets Priority • 0010-1111 = Reserved |
| 4 | R/W | R | Power balancing Enable/Disable for the system <ul style="list-style-type: none"> • 0 = PD Balancing is disabled • 1 = PD Balancing is enabled |
| 7:5 | | | Reserved |

b. u8PwrThrottleCfg:

u8PwrThrottleCfg defines the Power Throttle Enable/Disable configuration and currently selected Power Bank. It's size is 1 byte.

| Bit | R/W Config time | R/W Run time | Description |
|-----|-----------------|--------------|--|
| 0 | R/W | R | Power Throttle Enable/Disable for the system <ul style="list-style-type: none"> • 0 = Disable Power Throttling • 1 = Enable Power Throttling |
| 2:1 | R/W | R/W | Selection of Power Throttling Bank <ul style="list-style-type: none"> • 00 = Bank A • 01 = Bank B • 10 = Bank C • 11 = Shutdown mode |
| 7:3 | | | Reserved |

3. Members that are another structures:

| Structure | Description |
|-----------------|--|
| sPerPortData | Includes Type C and PD parameters of a port, say default Source PDOs, default Sink PDOs, currently negotiated voltage and current values, under voltage and over voltage threshold values, etc., Tag for this structure is <u>_PortCfgStatus</u> . |
| sPPSPerPortData | Includes PPS parameters of a port, say PPS Enable/Disable option and list of Augmented PDOs supported. Tag for this structure is <u>_PPSPortCfgStatus</u> . |
| sPBPerPortData | Includes Power Balancing parameters of a port, say maximum power and maximum current. Tag for this structure is <u>_PBPortCfgStatus</u> . |

Remarks

None

8.3.2 _PortCfgStatus Structure

C

```
struct _PortCfgStatus {
    UINT32 u32CfgData;
    UINT32 u32aSourcePDO[7];
    UINT32 u32aSinkPDO[7];
    UINT32 u32aNewPDO[7];
    UINT32 u32aAdvertisedPDO[7];
    UINT32 u32aPartnerPDO[7];
    UINT32 u32RDO;
    UINT32 u32PortConnectStatus;
    UINT32 u32PortStatusChange;
    UINT32 u32PortIOStatus;
    UINT32 u32ClientRequest;
    UINT16 u16AllocatedPowerIn250mW;
    UINT16 u16NegoVoltageInmV;
    UINT16 u16NegoCurrentInmA;
    UINT16 u16MaxSrcPrtCurrentIn10mA;
    UINT16 u16PortIntrMask;
    UINT16 u16PowerGoodTimerInms;
    UINT16 u16FeatureSelect;
    UINT16 u16Reserved1;
    UINT16 u16aMinPDOPreferredCurInmA[7];
    UINT16 u16SnkMaxOperatingCurInmA;
    UINT16 u16SnkMinOperatingCurInmA;
    UINT16 u16DAC_I_MaxOutVoltInmV;
    UINT16 u16DAC_I_MinOutVoltInmV;
    UINT16 u16DAC_I_CurrentInd_MaxInA;
    UINT8 u8SourcePDOCnt;
    UINT8 u8SinkPDOCnt;
    UINT8 u8NewPDOCnt;
    UINT8 u8AdvertisedPDOCnt;
    UINT8 u8PartnerPDOCnt;
    UINT8 u8SinkConfigSel;
    UINT8 u8FaultInDebounceInms;
    UINT8 u8OCSThresholdPercentage;
    UINT8 u8OVThresholdPercentage;
    UINT8 u8UVThresholdPercentage;
    UINT8 u8VCONNOCSDebounceInms;
    UINT8 u8VBUSMaxFaultCnt;
    UINT8 u8VCONNMaxFaultCnt;
    UINT8 u8Pio_FAULT_IN;
    UINT8 u8Mode_FAULT_IN;
    UINT8 u8aReserved1;
    UINT8 u8Pio_EN_VBUS;
    UINT8 u8Mode_EN_VBUS;
    UINT8 u8aReserved2[2];
    UINT8 u8Pio_EN_SINK;
    UINT8 u8Mode_EN_SINK;
    UINT8 u8DAC_I_Direction;
    UINT8 u8Reserved3;
    UINT8 u8ReservedPortPadBytes[32];
};
```

Description

This structure contains global configuration and status parameters that are either Integer Datatypes, Bit-Mapped bytes or another structure.

1. Members that are Integer data types:

| Name | Size in Bytes | R/W Config time | R/W Run time | Description |
|--------------------------|---------------|-----------------|--------------|---|
| u32aSourcePDO[7] | 28 | R/W | R | <ul style="list-style-type: none"> Source Capabilities array holding maximum of 7 Data Objects including Fixed PDOs and PPS APDOs. This array should be used only for Source Operation. |
| u32aSinkPDO[7] | 28 | R/W | R | <ul style="list-style-type: none"> Upto 7 fixed Sink PDOs where Voltage is specified in mV and Current is specified in mA. This array should be used only when the port is configured as Sink. |
| u32aNewPDO[7] | 28 | R/W | R/W | <ul style="list-style-type: none"> New Source Capabilities array holding maximum of 7 Data Objects including Fixed PDOs and PPS APDOs. This array is common for Source and Sink. It is valid only when Bit 0 of u32ClientRequest is set to 1. |
| u32aAdvertisedPDO[7] | 28 | R | R | <ul style="list-style-type: none"> Upto 7 PDOs that are advertised to Port Partner. During run time, this array holds the value of current u32aNewPDO[7] if Bit 0 of u32ClientRequest is enabled else holds the value of current u32aSourcePDO[7] |
| u32aPartnerPDO[7] | 28 | R | R | <ul style="list-style-type: none"> Upto 7 fixed Partner PDOs where Voltage is specified in mV and Current is specified in mA This array is common for Source and Sink. |
| u32RDO | 4 | R | R | <ul style="list-style-type: none"> Complete raw RDO Data as sent to the port partner when acting as Sink and Complete raw RDO Data as requested by connected port partner when acting as Source. Will be blank if no RDO has been issued/received. This variable is common for Source and Sink. |
| u16AllocatedPowerIn250mW | 2 | R | R | <ul style="list-style-type: none"> Allocated Power for the Port PD contract in 0.25W steps |
| u16NegoVoltageInmV | 2 | R | R | <ul style="list-style-type: none"> Negotiated Voltage in mV steps. When acting as Source and in Fixed power supply contract, it holds the value of bits 19:10 of PDO in mV. When acting as Source and in Programmable Power Supply contract, it holds the value of bits 19:9 of RDO in mV. When acting as Sink, it holds the value of bits 19:10 of PDO in mV. This variable is common for both Source and Sink. |
| u16NegoCurrentInmA | 2 | R | R | <ul style="list-style-type: none"> Negotiated Current in mA steps. When acting as Source and in Fixed power supply contract, it holds the value of bits 9:0 of PDO in mV. When acting as Source and in Programmable Power Supply contract, it holds the value of bits 6:0 of RDO in mV. When acting as Sink, it holds the value of bits 9:0 of PDO in mV. This variable is common for both Source and Sink. |

| | | | | |
|------------------------------|----|-----|---|---|
| u16MaxSrcPrtCurrentIn10mA | 2 | R/W | R | <ul style="list-style-type: none"> Maximum allowable current for ports in 10mA steps Sample values this variable can take are, <ol style="list-style-type: none"> 0x0032 = 0.5A 0x012C = 3A 0x01F4 = 5A Note : Values above 5A (0x01F5 - 0x0FFF) are not supported |
| u16SnkMaxOperatingCurlnmA | 2 | R/W | R | <ul style="list-style-type: none"> Maximum allowable current or system's maximum operating current in terms of mA. This variable is applicable only when acting as Sink. |
| u16aMinPDOPreferedCurlnmA[7] | 14 | R/W | R | <ul style="list-style-type: none"> Preferred minimum current range for the PDO by which the Sink may select without setting Capability Mismatch Bit with highest current preferred. This array is applicable only for Sink Operation. |
| u16SnkMinOperatingCurlnmA | 2 | R/W | R | <ul style="list-style-type: none"> Minimum current required by the sink hardware to be operational. This variable is applicable only for Sink Operation. When a Gotomin message is issued by source, sink reduces its operating current to the value provided in this variable. |
| u16DAC_I_MaxOutVltlnmV | 2 | R/W | R | <ul style="list-style-type: none"> Defines the maximum voltage on DAC_I with a maximum of 2.5V in terms of mV This is applicable only for Sink operation. |
| u16DAC_I_MinOutVltlnmV | 2 | R/W | R | <ul style="list-style-type: none"> Defines the minimum voltage on DAC_I with a minimum of 0V in terms of mV This is applicable only for Sink operation. |

| | | | | |
|----------------------------|---|-----|-----|---|
| u16DAC_I_CurrentInd_MaxInA | 2 | R/W | R | <ul style="list-style-type: none"> Defines which current in terms of mA corresponding to maximum output voltage It can take either 3A or 5A value. If it is 5A and maximum output voltage is 2.5V and if direction mentioned in u8DAC_I_Direction is High Amperage - Max Voltage, then <ol style="list-style-type: none"> 0.5A > DAC_I = 0.25V 1.5A > DAC_I = 0.75V 2.0A > DAC_I = 1V 3.0A > DAC_I = 1.5V 4.0A > DAC_I = 2.0V 5.0A > DAC_I = 2.5V If it is 3A and maximum output voltage is 2.5V, then <ol style="list-style-type: none"> 0.5A > DAC_I = 0.42V 1.5A > DAC_I = 1.25V 2.0A > DAC_I = 1.67V 3.0A > DAC_I = 2.5V 4.0A > DAC_I = 2.5V 5.0A > DAC_I = 2.5V This is applicable only for Sink operation. |
| u16PowerGoodTimerInms | 2 | R/W | R | <ul style="list-style-type: none"> After an automatic fault recovery, u16PowerGoodTimerInms is run to determine whether power remains in a good state for the duration of the timer, then the Fault Counter is reset. If another fault occurs before the Power Good Timer expires, then the Fault Counter is incremented. For power Source, it is the time a power source must consistently provide power without a fault to determine the power is good and a fault condition does not exist. For power Sink, it is the time after the sink established a contract and its consistently drawing power from VBUS without a power fault to determine that power is good and a fault condition does not exist. |
| u8SourcePDOCnt | 1 | R/W | R | <ul style="list-style-type: none"> Number of Default Source PDOs supported. This variable is applicable only when the port is configured as Source. |
| u8SinkPDOCnt | 1 | R/W | R | <ul style="list-style-type: none"> Number of Default Sink PDOs supported. This variable is applicable only when the port is configured as Sink. |
| u8NewPDOCnt | 1 | R/W | R/W | <ul style="list-style-type: none"> Number of New PDOs Supported. This variable is common for both Source and Sink. It is valid only when Bit 0 of u32ClientRequest is set to 1. |
| u8AdvertisedPDOCnt | 1 | R | R | <ul style="list-style-type: none"> Number of PDOs advertised to port partner. |

| | | | | |
|--------------------------|---|-----|---|--|
| u8PartnerPDOCnt | 1 | R | R | <ul style="list-style-type: none"> Number of PDOs received from port partner. This variable is common for Source and Sink. |
| u8SinkConfigSel | 1 | R/W | R | <ul style="list-style-type: none"> BIT[1:0] - Sink Selection mode for operation. <ol style="list-style-type: none"> '0x00' Mode A: Prefer Higher Voltage and Wattage '0x01' Mode B: Prefer Lower Voltage and Wattage BIT2 - No USB Suspend Flag <ol style="list-style-type: none"> '1':Set the flag to '1' in RDO request '0':Set the flag to '0' in RDO request BIT3 - GiveBackFlag <ol style="list-style-type: none"> '1':Set the flag to '1' in RDO request enabling GotoMin feature Set the flag to '0' in RDO request disabling GotoMin Feature |
| u8FaultInDebounceInms | 1 | R/W | R | <ul style="list-style-type: none"> Debounce timer value in terms of milliseconds for VBUS overcurrent fault conditions before reacting and entering fault recovery routine. It is applicable only for OCS detection via FAULT_IN configured UPD350 pin. |
| u8OCSThresholdPercentage | 1 | R/W | R | <ul style="list-style-type: none"> OCS Threshold. Reserved for future use. This variable is not currently used by PSF. |
| u8OVThresholdPercentage | 1 | R/W | R | <ul style="list-style-type: none"> Percentage of PDO voltage to be considered as Over Voltage for that PDO. As per PD specification, desired range for fixed PDO voltage is (0.95 * PDO Voltage) to (1.05 * PDO Voltage), So u8OVThresholdPercentage should be greater than the desired range. If 115% of the PDO voltage has to be considered as overvoltage for that PDO voltage, then define u8OVThresholdPercentage as 115. It is mandatory to define u8OVThresholdPercentage when INCLUDE_POWER_FAULT_HANDLING is defined as '1'. |
| u8UVThresholdPercentage | 1 | R/W | R | <ul style="list-style-type: none"> Percentage of PDO voltage to be considered as under Voltage for that PDO. As per PD specification, desired range for fixed PDO voltage is (0.95 * PDO Voltage) to (1.05 * PDO Voltage), So u8UVThresholdPercentage should be less than the desired range. If 85% of the PDO voltage has to be considered as under voltage for that PDO voltage, then define u8UVThresholdPercentage as 85. u8UVThresholdPercentage must be defined when INCLUDE_POWER_FAULT_HANDLING is defined as '1'. As an exceptional case this factor is not considered for VSafe5V. |

| | | | | |
|------------------------|---|-----|---|--|
| u8VCONNOCSDebounceInms | 1 | R/W | R | <ul style="list-style-type: none"> Debounce timer value in terms of milliseconds for VCONN overcurrent fault conditions before reacting and entering fault recovery routine. |
| u8VBUSMaxFaultCnt | 1 | R/W | R | <ul style="list-style-type: none"> The maximum number of back-to-back VBUS faults allowed before permanent shut down of the port. A back-to-back fault is a second fault which occurs within the u16PowerGoodTimerInms after a port is automatically reenabled from a previous fault condition. During port shutdown due to over current fault, the device removes its CC termination and wait for port partner to get detached physically from the port to resume its normal operation. |
| u8VCONNMaxFaultCnt | 1 | R/W | R | <ul style="list-style-type: none"> The maximum number of back-to-back VCONN faults allowed before it permanently disables the VCONN. A back-to-back fault is a second fault which occurs within the u16PowerGoodTimerInms after a port is automatically reenabled from a previous fault condition. If VCONN is disabled due to over current VCONN power fault, VCONN will be enabled only after a physical detach and reattach. |
| u8Pio_EN_VBUS | 1 | R/W | R | <ul style="list-style-type: none"> Defines the UPD350 PIO number used for EN_VBUS pin functionality for the Port. This variable is applicable only for source operation. EN_VBUS is to enable VBUS drive out of DC/DC controller. EN_VBUS pin connects to a load switch device such as a power FET or load switch IC. It is driven as per u8Mode_EN_VBUS configuration mode whenever stack requires VBUS to driven high as well as low. The range of valid values is 0 to 15 which correspond to UPD350 PIO0 to PIO15. To disable the pin functionality from the stack, the user can define a value of 0xFF. It is applicable only for Source operation only. By defining INCLUDE_UPD_PIO_OVERRIDE_SUPPORT as '1', The PIO Override feature of the UPD350 shall be utilized in this pin to ensure that fast and autonomous action is taken by the UPD350 in a fault condition. |
| u8Mode_EN_VBUS | 1 | R/W | R | <ul style="list-style-type: none"> Defines the PIO mode of the UPD350 PIO EN_VBUS defined in u8Pio_EN_VBUS. This variable is applicable only for source operation. It takes values only from enum eUPD_OUTPUT_PIN_MODES_TYPE. |
| u8Pio_FAULT_IN | 1 | R/W | R | <ul style="list-style-type: none"> Defines the UPD PIO used as FAULT_IN pin. FAULT_IN pin detects over current fault or under/over voltage fault from external sensing device based on its configuration u8Mode_FAULT_IN. It can take values only from 0 to 15 and to disable the pin functionality from stack, user can define it as 0xFF. It is applicable only when INCLUDE_POWER_FAULT_HANDLING defined as '1'. |

| | | | | |
|----------------------------|----|-----|---|---|
| u8Mode_FAULT_IN | 1 | R/W | R | <ul style="list-style-type: none"> Defines the PIO mode of the UPD350 PIO FAULT_IN defined in u8Pio_FAULT_IN. It takes only values from enum eFAULT_IN_MODE_TYPE. |
| u8Pio_EN_SINK | 1 | R/W | R | <ul style="list-style-type: none"> Defines the UPD350 PIO number used for EN_SINK pin. This is applicable only for Sink operation. This pin is asserted in the following conditions: <ol style="list-style-type: none"> If the source supports Power delivery, the PD negotiated current should be greater than or equal to the current mentioned under u16SnkMinOperatingCurlnmA variable. If the source does not support Power delivery and is Type-C only, the Rp value in source partner should be greater than or equal to the current mentioned under u16SnkMinOperatingCurlnmA variable. This pin is de-asserted during a hard reset, a power fault recovery or a detach. The range of valid values is 0 to 15 which correspond to UPD350 PIO0 to PIO15. By defining INCLUDE_UPD_PIO_OVERRIDE_SUPPORT as '1', The PIO Override feature of the UPD350 shall be utilized in this pin to ensure that fast and autonomous action is taken by the UPD350 in a fault condition. |
| u8Mode_EN_SINK | 1 | R/W | R | <ul style="list-style-type: none"> Defines the PIO mode for EN_SINK pin This is applicable only for Sink operation. It takes values only from enum eUPD_OUTPUT_PIN_MODES_TYPE. |
| u8DAC_I_Direction | 1 | R/W | R | <ul style="list-style-type: none"> Specifies the direction of DAC_I to allow user invert direction of DAC_I if required <ol style="list-style-type: none"> 0 - High Amperage - Max Voltage 1- High Amperage - Min Voltage This is applicable only for Sink operation. |
| u16Reserved1 | 2 | | | Reserved |
| u8aReserved1 | 1 | | | Reserved |
| u8aReserved2[2] | 2 | | | Reserved |
| u8Reserved3 | 1 | | | Reserved |
| u8ReservedPortPadBytes[32] | 32 | | | <ul style="list-style-type: none"> Reserved bytes included based on configuration macro INCLUDE_CFG_STRUCT_MEMORY_PAD_REGION |

2. Members that are Bit-Mapped bytes:

a. u32CfgData:

u32CfgData variable holds the Port Configuration Data. It's size is 4 bytes.

| Bit | R/W Config time | R/W Run time | Description |
|-------|-----------------|--------------|--|
| 2:0 | RW | R | Port Power Role <ul style="list-style-type: none"> '000' Sink '001' Source |
| 4:3 | RW | R | Rp Selection <ul style="list-style-type: none"> '00' Disabled '01' USB Power '10' 1.5A '11' 3.0A |
| 5 | RW | R | Port Enable/Disable <ul style="list-style-type: none"> '0' Disabled '1' Enabled |
| 8:6 | RW | R | USB Data <ul style="list-style-type: none"> '000' No Data '001' USB2 '010' USB3.1 Gen1 '011' USB3.1 Gen2 |
| 9 | RW | R | VCONN OCS Enable <ul style="list-style-type: none"> '0' Disable '1' Enable |
| 32:10 | | | Reserved |

b. u32PortConnectStatus: u32PortConnectStatus variable holds the connection status of the port. It's size is 4 bytes.

| Bit | R/W Config time | R/W Run time | Description |
|-----|-----------------|--------------|--|
| 0 | R | R | Attached <ul style="list-style-type: none"> '0' Detached '1' Attached |
| 1 | R | R | Orientation <ul style="list-style-type: none"> '0' Unflipped - Port Partner attached in CC1 pin '1' Flipped - Port Partner attached in CC2 pin |
| 2 | R | R | Data Role <ul style="list-style-type: none"> '0' UFP '1' DFP |
| 3 | R | R | Power Role <ul style="list-style-type: none"> '0' Sink '1' Source |

| | | | |
|----|---|---|--|
| 4 | R | R | VCONN Status <ul style="list-style-type: none"> '0' Disabled '1' Enabled |
| 5 | R | R | Cable Reduced Source Capabilities <ul style="list-style-type: none"> '0' Attached USB-C cable supports the locally-defined Source PDOs '1' Attached USB-C cable does not support the locally defined Source PDOs |
| 6 | R | R | Reduced Source Capabilities <ul style="list-style-type: none"> '0' The advertised PDOs are equivalent to the default configured values '1' The advertised PDOs have been reduced from default configured values |
| 7 | R | R | Source Capability Mismatch <ul style="list-style-type: none"> '0' De-asserted by Source port when there is capability mismatch with sink partner '1' Asserted by Source port when sink port indicates capability mismatch in RDO |
| 8 | R | R | As Source PD Contract Good <ul style="list-style-type: none"> '0' As Source: USB-C Connection Only (No Request Made Yet) '1' As Source; USB PD connection established, Power request has been made, accepted and PS_RDY message sent. This bit will always remain 0 when acting as sink. |
| 9 | R | R | As Source RDO Accepted <ul style="list-style-type: none"> '0' As Source: No RDO Accept message has been sent to last Request made by attached Sink or no Request has yet been made during connection. '1' As Source: RDO Accept message has been sent to last Request made by attached Sink This bit will always remain 0 when acting as sink |
| 10 | R | R | As Source RDO Rejected <ul style="list-style-type: none"> '0' As source; No RDO reject message has been sent to last request made by attached Sink or no Request has yet been made during connection '1' As Source: RDO Reject message has been sent to last Request made by attached Sink This bit will always remain 0 when acting as Sink |
| 11 | R | R | As Sink Last Request Accept <ul style="list-style-type: none"> '0' As Sink: Last RDO Request was not Accepted or no request has yet been made. '1' As Sink: Last RDO Request was Accepted This bit will always remain 0 when acting as a source. |
| 12 | R | R | As Sink Last Request Reject <ul style="list-style-type: none"> '0' As Sink: Last RDO Request was not Rejected or no request has yet been made. '1' As Sink: Last RDO Request was Rejected This bit will always remain 0 when acting as a source. |
| 13 | R | R | As Sink Last Request PS_RDY <ul style="list-style-type: none"> '0' As Sink: PS_RDY not yet received for last RDO request '1' As Sink: PS_RDY received for last RDO request This bit will always remain 0 when acting as a source. |

| | | | |
|-------|---|---|---|
| 14 | R | R | Sink Capability Mismatch <ul style="list-style-type: none"> '0' De-asserted by the Sink Port when there is no capability mismatch '1' Asserted by Sink Port when no Source capability was found |
| 16:15 | R | R | Rp Value detected by Sink <ul style="list-style-type: none"> '00' Disabled '01' USB Power '10' 1.5A '11' 3.0A |
| 31:17 | | | Reserved |

c. **u32PortIOStatus**: u32PortIOStatus variable holds the IO status of the port. It's size is 4 bytes.

| Bit | R/W Config time | R/W Run time | Description |
|-----|-----------------------|--------------------|---|
| 0 | R | R | EN_DC_DC Status <ul style="list-style-type: none"> '1' Asserted '0' De-asserted |
| 1 | R | R | VSEL0 Status <ul style="list-style-type: none"> '1' Asserted '0' De-asserted |
| 2 | R | R | VSEL1 Status <ul style="list-style-type: none"> '1' Asserted '0' De-asserted |
| 3 | R | R | VSEL2 Status <ul style="list-style-type: none"> '1' Asserted '0' De-asserted |
| 4 | R | R | EN_VBUS Status <ul style="list-style-type: none"> '1' Asserted '0' De-asserted |
| 5 | R | R | VBUS_DIS Status <ul style="list-style-type: none"> '1' Asserted '0' De-asserted |
| 6 | R | R | EN_SINK Status <ul style="list-style-type: none"> '1' Asserted '0' De-asserted |
| 7 | R | R | 1.5_IND Status <ul style="list-style-type: none"> '1' Asserted '0' De-asserted |
| 8 | R | R | 3.0_IND Status <ul style="list-style-type: none"> '1' Asserted '0' De-asserted |

| | | | |
|-------|---|---|---|
| 9 | R | R | PS_RDY Received <ul style="list-style-type: none"> '1' Asserted '0' De-asserted |
| 10 | R | R | Capability Mismatch <ul style="list-style-type: none"> '1' Asserted '0' De-asserted |
| 31:11 | | | Reserved |

d. u32PortStatusChange: u32PortStatusChange variable defines the port connection status change bits. It's size is 4 bytes.

| Bit | R/W Config time | R/W Run time | Description |
|-----|-----------------------|--------------------|---|
| 0 | R | R | Attach Event <ul style="list-style-type: none"> '0' Since the last read of this register, PSF has not experienced a USB-C attach '1' Since the last read of this register, PSF has experienced a USB-C attach |
| 1 | R | R | Detach Event <ul style="list-style-type: none"> '0' Since the last read of this register, PSF has not experienced a USB-C detach '1' Since the last read of this register, PSF has experienced a USB-C detach |
| 2 | R | R | As Source New Request <ul style="list-style-type: none"> '0' As Source, since the last read of this register, PSF has not received any new PDO request from attached port partner '1' As Source: Received a new PDO request the attached Sink port partner, As Sink: Received an updated set of Source capabilities form the attached Source port partner |
| 3 | R | R | As Sink New PDOs Received <ul style="list-style-type: none"> '0' As Sink: Since the last read of this register, PSF has not received any changed source capabilities '1' As Sink: Received an updated set of Source capabilities form the attached Source port partner |
| 4 | R | R | As Sink New Request Sent <ul style="list-style-type: none"> '0' As Sink: Since the last read of this register, PSF has not sent any additional Sink RDOs '1' As Sink: Since the last read of this register, PSF has issued a new Sink RDO to the attached Source, This bit will always remain 0 when acting as a source |
| 5 | R | R | As Sink Last Request Accept <ul style="list-style-type: none"> '0' As Sink: Since the last read of this register, PSF has not received any new Request Accept messages from the attached Source '1' As Sink: Since the last read of this register, PSF has received a new Request Accept from the attached Source |
| 6 | R | R | As Sink Last Request Reject <ul style="list-style-type: none"> '0' As Sink: Since the last read of this register, PSF has not received any new Request Reject messages from the attached Source '1' As Sink: Since the last read of this register, PSF has received a new Request Reject message from the attached Source |

| | | | |
|-------|---|---|--|
| 7 | R | R | As Sink Last Sink PS Rdy <ul style="list-style-type: none"> '0' As Sink: Since the last read of this register, PSF has not received any PS_RDY messages from the attached Source '1' As Sink: Since the last read of this register, PSF has received a PS_RDY message from the attached Source |
| 8 | R | R | Hard Reset Event <ul style="list-style-type: none"> '0' Since the last read of this register, PSF has not experienced a USB PD Hard Reset '1' Since the last read of this register, PSF has experienced a USB PD Hard Reset |
| 9 | R | R | Pin Reset Event <ul style="list-style-type: none"> '0' Since the last read of this register, PSF has not been reset via POR or pin '1' Since the last read of this register, PSF has been reset via POR or pin |
| 10 | R | R | VBUS Fault <ul style="list-style-type: none"> '0' Since the last read of this register, no VBUS faults have been detected '1' Since the last read of this register, 1 or more VBUS faults have been detected |
| 11 | R | R | VCONN Fault <ul style="list-style-type: none"> '0' Since the last read of this register, no VCONN faults have been detected '1' Since the last read of this register, 1 or more VCONN faults have been detected |
| 31:12 | | | Reserved |

e. u32ClientRequest: u32ClientRequest variable defines the client request mask bits. It's size is 1 byte. Application can make use of this variable to request PSF to handle the mentioned client requests. Except VBUS Power Fault Request, all the other requests cannot coexist i.e Only one client request could be handled by PSF at a given time. So, it is recommended that the application could raise a single request at a time i.e set only one of the bits in this variable.

In case PSF is busy, it cannot handle any of the client requests. In this case, the u32ClientRequest variable would be cleared and eMCHP_PSF_BUSY notification would be posted by PSF, so that the application initiate the request again by setting the respective bit in this variable. If the request is accepted and processed, a response notification would be posted by PSF as mentioned in the below table.

| Bit | R/W Config time | R/W Run time | Description |
|-----|-----------------|--------------|--|
| 0 | R/W | R/W | Renegotiation Request <ul style="list-style-type: none"> '0' PSF has not received any renegotiation request. '1' PSF has received a renegotiation request. <p>Before initiating the request, user has to fill the Source capabilities in u32aNewPDO array and the PDO count in u8NewPDOCnt. Once the request is processed by PSF, u32aNewPDO array and u8NewPDOCnt would be cleared and eMCHP_PSF_PD_CONTRACT_NEGOTIATED notification would be posted.</p> |
| 1 | R/W | R/W | Get Sink capabilities Request <ul style="list-style-type: none"> '0' PSF has not received any request for getting the sink capabilities. '1' PSF has received a request for getting the sink capabilities. <p>Once the request is processed by PSF, eMCHP_PSF_SINK_CAPS_RCVD or eMCHP_PSF_SINK_CAPS_NOT_RCVD notification would be posted depending on the Sink partner's response to Get_Sink_Caps message. User can read the received sink capabilities from u32aPartnerPDO array.</p> |

| | | | |
|------|-----|-----|---|
| 2 | R/W | R/W | Get Sink capabilities Extended Request <ul style="list-style-type: none"> '0' PSF has not received any request for getting the extended sink capabilities. '1' PSF has received a request for getting the extended sink capabilities. |
| 3 | R/W | R/W | Handle VBUS Power Fault Over voltage Request <ul style="list-style-type: none"> Set this bit to request PSF to process externally detected over voltage VBUS fault. |
| 4 | R/W | R/W | Handle VBUS Power Fault Over current Request <ul style="list-style-type: none"> Set this bit to request PSF to process externally detected over current VBUS power fault or to inform PSF that Current Limit mode is entered by external DC-DC controller. |
| 5 | R/W | R/W | Handle VBUS Power Fault Over current exit Request <ul style="list-style-type: none"> Set this bit to inform PSF that externally detected over current VBUS power fault condition is exited or Constant Voltage mode is entered by external DC-DC controller. |
| 31:6 | | | Reserved |

f. **u16PortIntrMask**: u16PortIntrMask variable defines the port interrupt mask bits. It's size is 2 bytes.

| Bit | R/W Config time | R/W Run time | Description |
|-----|-----------------|--------------|--|
| 0 | RC | RC | Attach Event Mask <ul style="list-style-type: none"> '0' Do not mask interrupt pin toggle on changes to this event. '1' Mask this event from generating interrupt pin toggle. |
| 1 | RC | RC | Detach Event Mask <ul style="list-style-type: none"> '0' Do not mask interrupt pin toggle on changes to this event. '1' Mask this event from generating interrupt pin toggle. |
| 2 | RC | RC | As Source New Request Mask <ul style="list-style-type: none"> '0' Do not mask interrupt pin toggle on changes to this event. '1' Mask this event from generating interrupt pin toggle. |
| 3 | RC | RC | As Sink New PDOs Received Mask <ul style="list-style-type: none"> '0' Do not mask interrupt pin toggle on changes to this event. '1' Mask this event from generating interrupt pin toggle. |
| 4 | RC | RC | As Sink New Request Sent Mask <ul style="list-style-type: none"> '0' Do not mask interrupt pin toggle on changes to this event. '1' Mask this event from generating interrupt pin toggle. |
| 5 | RC | RC | As Sink Last Request Accept Mask <ul style="list-style-type: none"> '0' Do not mask interrupt pin toggle on changes to this event. '1' Mask this event from generating interrupt pin toggle. |
| 6 | RC | RC | As Sink Last Request Reject Mask <ul style="list-style-type: none"> '0' Do not mask interrupt pin toggle on changes to this event. '1' Mask this event from generating interrupt pin toggle. |
| 7 | RC | RC | As Sink Last Sink PS RDY Mask <ul style="list-style-type: none"> '0' Do not mask interrupt pin toggle on changes to this event. '1' Mask this event from generating interrupt pin toggle. |

| | | | |
|-------|----|----|---|
| 8 | RC | RC | Hard Reset Event Mask <ul style="list-style-type: none"> '0' Do not mask interrupt pin toggle on changes to this event. '1' Mask this event from generating interrupt pin toggle. |
| 9 | RC | RC | Pin Reset Mask <ul style="list-style-type: none"> '0' Do not mask interrupt pin toggle on changes to this event. '1' Mask this event from generating interrupt pin toggle. |
| 10 | RC | RC | VBUS Fault Mask <ul style="list-style-type: none"> '0' Do not mask interrupt pin toggle on changes to this event. '1' Mask this event from generating interrupt pin toggle. |
| 11 | RC | RC | VCONN Fault Mask <ul style="list-style-type: none"> '0' Do not mask interrupt pin toggle on changes to this event. '1' Mask this event from generating interrupt pin toggle. |
| 15:12 | | | Reserved |

g. u16FeatureSelect: u16FeatureSelect variable defines the enable/disable of various PSF features. It's size is 2 bytes.

| Bit | R/W Config time | R/W Run time | Description |
|------|-----------------|--------------|--|
| 0 | R/W | R | Power Balancing Enable/Disable <ul style="list-style-type: none"> '0' Disable. '1' Enable. This bit is applicable only for source operation. |
| 15:1 | | | Reserved |

Remarks

None

8.3.3 _PBPortCfgStatus Structure

C

```

struct _PBPortCfgStatus {
    UINT16 u16MaxPrtPwrBankAIn250mW;
    UINT16 u16MaxPrtPwrBankBIn250mW;
    UINT16 u16MaxPrtPwrBankCIn250mW;
    UINT8 u8PortPriority;
    UINT8 u8aReserved4;
};

```

Description

This structure contains global configuration and status parameters that are either Integer Datatypes, Bit-Mapped bytes or another structure. This structure is used only when either of the macros `INCLUDE_POWER_BALANCING` or `INCLUDE_POWER_THROTTLING` is set to '1'.

1. Members that are Integer data types:

| Name | Size in Bytes | R/W Config time | R/W Run time | Description |
|--------------------------|---------------|-----------------|--------------|--|
| u16MaxPrtPwrBankAIn250mW | 2 | R/W | R | <ul style="list-style-type: none"> Maximum Port Power Bank A in 0.25W steps. Unit/LSB = 0.25W Sample values this variable can take are, <ol style="list-style-type: none"> 0x0001 = 0.25W 0x00F0 = 60W 0x0190 = 100W Note : A setting of 0x0000 and 0x191-0xFFFF is invalid. |
| u16MaxPrtPwrBankBIn250mW | 2 | R/W | R | <ul style="list-style-type: none"> Maximum Port Power Bank B in 0.25W steps. Unit/LSB = 0.25W Sample values this variable can take are, <ol style="list-style-type: none"> 0x0001 = 0.25W 0x00F0 = 60W 0x0190 = 100W Note : A setting of 0x0000 and 0x191-0xFFFF is invalid. |
| u16MaxPrtPwrBankCIn250mW | 2 | R/W | R | <ul style="list-style-type: none"> Maximum Port Power Bank A in 0.25W steps. Unit/LSB = 0.25W Sample values this variable can take are, <ol style="list-style-type: none"> 0x0001 = 0.25W 0x00F0 = 60W 0x0190 = 100W Note : A setting of 0x0000 and 0x191-0xFFFF is invalid. |
| u8PortPriority | 1 | R/W | R | <ul style="list-style-type: none"> Selects the port priority 000b is the highest priority |
| u8aReserved4 | 1 | | | Reserved |

Remarks

None

8.3.4 _PPSPortCfgStatus Structure

C

```

struct _PPSPortCfgStatus {
    UINT32 u32PartnerAlert;
    UINT8 u8aPartnerStatus[6];
    UINT8 u8aReserved5[2];
};

```

Description

This structure contains the following status parameters that are either Integer Datatypes or Bit-Mapped bytes. This structure is used only when `INCLUDE_PD_SOURCE_PPS` is set to '1'.

1. Members that are Integer Datatypes:

| Name | Size in Bytes | R/W Config time | R/W Run time | Description |
|---------------------|---------------|-----------------|--------------|---|
| u32PartnerAlert | 4 | R | R | <ul style="list-style-type: none"> Complete Alert information received from Partner, Will be blank if no Alert has been received. This variable is common for Source and Sink. |
| u8aPartnerStatus[6] | 6 | R | R | <ul style="list-style-type: none"> Store the Status information received from Port Partner. This array would hold a valid value if eMCHP_PSF_SINK_STATUS_RCVD notification is posted. It would be 0 when eMCHP_PSF_SINK_STATUS_NOT_RCVD notification is posted. |
| u8aReserved5[2] | 2 | | | Reserved |

Remarks

None

8.3.5 gasCfgStatusData Variable

C

```
GLOBAL_CFG_STATUS_DATA gasCfgStatusData;
```

Description

gasCfgStatusData is the global structure which defines the overall system level configuration and status parameters of PSF. This structure contains the system level and port specific Configuration and Status parameters of PSF including Type C, PD, PB, PT and PPS parameters.

It is mandatory that the user has to initialize the configuration parameters for the PSF stack to function properly. This can be done through [MCHP_PSF_HOOK_BOOT_TIME_CONFIG](#) which initializes the parameters defined in gasCfgStatusData during compile time. For accessing the configuration registers and reading the status registers at run time, an I2C slave interface shall be used by the user application.

Remarks

None

8.3.6 INCLUDE_CFG_STRUCT_MEMORY_PAD_REGION

C

```
#define INCLUDE_CFG_STRUCT_MEMORY_PAD_REGION 0
```

Description

INCLUDE_CFG_STRUCT_MEMORY_PAD_REGION will define the reserved bytes in the config and status register structure, so that expansion of structure members in future can be handled without change in the address of the existing member elements.

Remarks

The default value is 0 and it can be defined to 1 based on the user application needs.

Example



```
#define INCLUDE_CFG_STRUCT_MEMORY_PAD_REGION 0
```

8.4 DC-DC Buck Boost Controller Configuration

The section explains the option to configure DC-DC control. Except EN_VBUS, EN_SINK and FAULT_IN pins that has to be mandatorily controlled by [UPD350](#), all other PIO pins are left configurable to the user

8.4.1 Power Control GPIO Enumeration constants

Enumerations

| | Name | Description |
|---|--|---|
|  | eFAULT_IN_MODE_TYPE | UPD350 Fault_IN GPIO mode enum. |
|  | eUPD_OUTPUT_PIN_MODES_TYPE | UPD350 GPIO Output mode enum. |

Description

This section describes the enumeration constants provided by PSF for configuring the various Port Power Control parameters such as Mode and PIO number of EN_VBUS pin.

8.4.1.1 eFAULT_IN_MODE_TYPE Enumeration

C

```
typedef enum {
    eFAULT_IN_ACTIVE_LOW = 0x20U,
    eFAULT_IN_ACTIVE_HIGH = 0x10U,
    eFAULT_IN_ACTIVE_LOW_PU = 0xA0U,
    eFAULT_IN_ACTIVE_HIGH_PD = 0x50U
} eFAULT_IN_MODE_TYPE;
```

Description

eFAULT_IN_MODE_TYPE enum defines the various combination modes applicable for [UPD350](#) GPIO in input mode.

Members

| Members | Description |
|----------------------------------|--|
| eFAULT_IN_ACTIVE_LOW = 0x20U | Active low input signal |
| eFAULT_IN_ACTIVE_HIGH = 0x10U | Active high input signal |
| eFAULT_IN_ACTIVE_LOW_PU = 0xA0U | Active low signal with internal pull up |
| eFAULT_IN_ACTIVE_HIGH_PD = 0x50U | Active high signal with internal pull down |

Remarks

None

8.4.1.2 eUPD_OUTPUT_PIN_MODES_TYPE Enumeration

C

```
typedef enum {
    ePUSH_PULL_ACTIVE_HIGH = 0x0CU,
    ePUSH_PULL_ACTIVE_LOW = 0x04U,
}
```

```
eOPEN_DRAIN_ACTIVE_HIGH = 0x08U,
eOPEN_DRAIN_ACTIVE_LOW = 0x00U,
eOPEN_DRAIN_ACTIVE_HIGH_PU = 0x88U,
eOPEN_DRAIN_ACTIVE_LOW_PU = 0x80U
} eUPD_OUTPUT_PIN_MODES_TYPE;
```

Description

eUPD_OUTPUT_PIN_MODES_TYPE enum defines the various combination modes applicable for [UPD350](#) GPIO in output mode. This is applicable only for EN_SINK and EN_VBUS unctinality.

Members

| Members | Description |
|------------------------------------|--|
| ePUSH_PULL_ACTIVE_HIGH = 0x0CU | Active High output signal |
| ePUSH_PULL_ACTIVE_LOW = 0x04U | Active low output signal |
| eOPEN_DRAIN_ACTIVE_HIGH = 0x08U | Active High Open Drain output signal |
| eOPEN_DRAIN_ACTIVE_LOW = 0x00U | Active Low Open Drain output signal |
| eOPEN_DRAIN_ACTIVE_HIGH_PU = 0x88U | Active High Open Drain output signal with internal pull up |
| eOPEN_DRAIN_ACTIVE_LOW_PU = 0x80U | Active Low Open Drain output signal with internal pull up |

Remarks

None

8.5 MCU Idle Timeout Configuration

Macros

| | Name | Description |
|---|---|--|
|  | CONFIG_PORT_UPD_IDLE_TIMEOUT_MS | UPD350 Idle Timeout value in milliseconds. |

8.5.1 CONFIG_PORT_UPD_IDLE_TIMEOUT_MS

C

```
#define CONFIG_PORT_UPD_IDLE_TIMEOUT_MS MILLISECONDS_TO_TICKS(15000)
```

Description

CONFIG_PORT_UPD_IDLE_TIMEOUT_MS is the idle time after which [UPD350](#) is put to low power mode by the power management control if there is no activity or interrupt in [UPD350](#).

Remarks

It shall be expressed in MILLISECONDS_TO_TICKS define. CONFIG_PORT_UPD_IDLE_TIMEOUT_MS is valid only if [INCLUDE_POWER_MANAGEMENT_CTRL](#) set as 1. By default, this define is set to to 15seconds.

Example

```
#define CONFIG_PORT_UPD_IDLE_TIMEOUT_MS MILLISECONDS_TO_TICKS(15000) (Timeout is 15 seconds)
```

8.6 Debug Hook Configuration

Macros

| | Name | Description |
|---|---------------------------------------|---|
|  | CONFIG_HOOK_DEBUG_MSG | Print status messages from PSF stack through UART interface |

8.6.1 CONFIG_HOOK_DEBUG_MSG

C

```
#define CONFIG_HOOK_DEBUG_MSG 0
```

Description

Setting CONFIG_HOOK_DEBUG_MSG to 1, prints status messages from PSF stack through UART interface.

Remarks

The following hook APIs should be defined with appropriate UART functions to view status messages from PSF stack.

1. [MCHP_PSF_HOOK_DEBUG_INIT\(\)](#)
2. [MCHP_PSF_HOOK_PRINT_CHAR](#)(byData)
3. [MCHP_PSF_HOOK_PRINT_INTEGER](#)(dwWriteInt, byWidth)
4. [MCHP_PSF_HOOK_PRINT_TRACE](#)(pbyMessage)










None.

Example

```
#define CONFIG_HOOK_DEBUG_MSG 0
#define CONFIG_HOOK_DEBUG_MSG 1
```

8.7 PDFU Configuration

Macros

| | Name | Description |
|---|--|--|
|  | CONFIG_PDFU_SUPPORTED | Power Delivery Firmware Update Supported field. |
|  | CONFIG_PDFU_VIA_USBDP_SUPPORTED | Power Delivery Firmware Update Supported via USB config. |
|  | CONFIG_MAX_FIRMWARE_IMAGESIZE | Maximum Firmware image size. |
|  | CONFIG_RECONFIG_PHASE_WAITTIME | Reconfig phase wait time value. |
|  | CONFIG_TRANSFER_PHASE_WAITTIME | Transfer phase wait time value. |
|  | CONFIG_UPDATABLE_IMAGEBANK_INDEX | Index of Updatable image. |
|  | CONFIG_VALIDATION_PHASE_WAITTIME | Validation phase wait time value. |
|  | CONFIG_HWMAJOR_VERSION | Hardware Major Version. |
|  | CONFIG_HWMINOR_VERSION | Hardware Minor Version. |

Description

This section explains the configurable options available for PDFU.

8.7.1 CONFIG_PDFU_SUPPORTED

C

```
#define CONFIG_PDFU_SUPPORTED 1
```

Description

CONFIG_PDFU_SUPPORTED is set to '0' if firmware is not updatable during Run time. Otherwise shall be set to 1. It is used by the PD Firmware Update state-machine during Enumeration phase. This information is shared with the PDFU Initiator as part of GET_FW_ID command's response.

Remarks

The user definition of this macro is mandatory when [INCLUDE_PDFU](#) is '1'. By default, it is defined as '1'.

Example

```
#define CONFIG_PDFU_SUPPORTED 1
```

8.7.2 CONFIG_PDFU_VIA_USBDPD_SUPPORTED

C

```
#define CONFIG_PDFU_VIA_USBDPD_SUPPORTED 1
```

Description

CONFIG_PDFU_VIA_USBDPD_SUPPORTED Set to '1' to indicate support for PDFU via USB PD Firmware Update flow. Otherwise shall be set to '0'. It is used by the PD Firmware Update state-machine during Enumeration phase. This information is shared with the PDFU Initiator as part of GET_FW_ID command's response.

Remarks

The user definition of this macro is mandatory when [INCLUDE_PDFU](#) is '1'. The default value is '1'.

Example

```
#define CONFIG_PDFU_VIA_USBDPD_SUPPORTED 1
```

8.7.3 CONFIG_MAX_FIRMWARE_IMAGESIZE

C

```
#define CONFIG_MAX_FIRMWARE_IMAGESIZE 0x8800UL
```

Description

CONFIG_MAX_FIRMWARE_IMAGESIZE defines the ROM size allocated for the Updatable application. PDFU Initiator shall flash entire size during every re-flash operation. Flashing lesser or more than this Size results in error response.

Remarks

Choose Firmware Image size in such a way that integral multiple of 256. The definition of this function is mandatory when [INCLUDE_PDFU](#) is '1' and shall expressed in terms of bytes. By default, the value is 0x8800UL(34KB).

Example

```
#define CONFIG_MAX_FIRMWARE_IMAGESIZE 0x9800UL (38*1024 bytes for 38KB Updatable application).
```


8.7.4 CONFIG_RECONFIG_PHASE_WAITTIME

C

```
#define CONFIG_RECONFIG_PHASE_WAITTIME 0x00u
```

Description

CONFIG_RECONFIG_PHASE_WAITTIME specifies the Wait time required for the Reconfigure state, i.e. the PDFU_Initiate request processing takes "Wait time" millisecond, and next request can be issued by the PDFU_Initiator after the specified wait time. This information is shared with the PDFU Initiator as part of PDFU_INITIATE command's response.

Remarks

The user definition of this macro is mandatory when `INCLUDE_PDFU` is '1'. It can have values from 0x00 to 0xFF. By default, it is defined as '0x00'.

Example

```
#define CONFIG_RECONFIG_PHASE_WAITTIME 0x03u //3ms wait time required
```

8.7.5 CONFIG_TRANSFER_PHASE_WAITTIME

C

```
#define CONFIG_TRANSFER_PHASE_WAITTIME 0x64u
```

Description

CONFIG_TRANSFER_PHASE_WAITTIME Species the Wait time required during the Transfer state, i.e. the PDFU Data request processing takes "Wait time" millisecond, and next PDFU_DATA request to be issued by the initiator after the specified wait time. This information is shared with the PDFU Initiator as part of PDFU_DATA command's response.

Remarks

The user definition of this macro is mandatory when `INCLUDE_PDFU` is '1'. It can have values from 0x00 to 0xFF. By default, it is defined as '0x03'.

Example

```
#define CONFIG_TRANSFER_PHASE_WAITTIME 0x03u //3ms required for processing PDFU_DATA request
```

8.7.6 CONFIG_UPDATABLE_IMAGEBANK_INDEX

C

```
#define CONFIG_UPDATABLE_IMAGEBANK_INDEX 0x03u
```

Description

CONFIG_UPDATABLE_IMAGEBANK_INDEX specifies the Image bank index for which firmware upgrade is requested (or) in other words it corresponds to the image bank index of the Updatable application as mentioned by Architecture 2 of PD FW Update Specification.

This information is used during the Reconfiguration phase to determine what application is currently executing and whether application switching to Fixed Application is required or not.

Remarks

The user definition of this macro is mandatory when `INCLUDE_PDFU` is '1'. By default, this macro is defined as 0x03.

Example

```
#define CONFIG_UPDATABLE_IMAGEBANK_INDEX    0x03u (3 image banks are available)
```

8.7.7 CONFIG_VALIDATION_PHASE_WAITTIME

C

```
#define CONFIG_VALIDATION_PHASE_WAITTIME 0x03u
```

Description

CONFIG_VALIDATION_PHASE_WAITTIME specifies the wait time macro for the validation state, i.e. the PDFU_Validate command's processing takes "Wait time" millisecond, and next request can be issued by the Initiator after the specified wait time.

Remarks

The user definition of this macro is mandatory when [INCLUDE_PDFU](#) is '1'. It can have values from 0x00 to 0xFF. By default, it is defined as '0x03'.

Example

```
#define CONFIG_VALIDATION_PHASE_WAITTIME    0x03u
```

8.7.8 CONFIG_HWMAJOR_VERSION

C

```
#define CONFIG_HWMAJOR_VERSION
```

Description

CONFIG_HWMAJOR_VERSION defines Hardware Major Version details of the product. It is used by the PD Firmware Update state-machine during Enumeration phase. This information is shared with the PDFU Initiator as part of GET_FW_ID command's response.

Remarks

This is a 4-bit entity. (Valid values are 0x0 to 0xF). The user definition of this macro is mandatory when [INCLUDE_PDFU](#) is defined as '1'.

Example

```
#define CONFIG_HWMAJOR_VERSION    0x1
```

8.7.9 CONFIG_HWMINOR_VERSION

C

```
#define CONFIG_HWMINOR_VERSION
```

Description

[CONFIG_HWMAJOR_VERSION](#) defines Hardware Minor Version details of the product. It is used by the PD Firmware Update state-machine during Enumeration phase. This information is shared with the PDFU Initiator as part of GET_FW_ID command's response.

Remarks

This is a 4-bit entity. (Valid values are 0x0 to 0xF). The user definition of this macro is mandatory when [INCLUDE_PDFU](#) is defined as '1'.

Example

```
#define CONFIG_HWMINOR_VERSION    0x0
```

9 System level integration of PSF

As PSF is hardware agnostic, it can be integrated to many Microchip SoC platforms. This topic provides details on

- Hardware and Software requirements for system level integration of PSF
- Steps for integrating PSF with an existing application or system
- APIs to be implemented for integrating PSF
- Notification callback from PSF

All the APIs required for PSF porting and integration are available in PSF_APIHooks.h header file. It is recommended to include this PSF_APIHooks.h file path as one of preprocessor include path. The template of PSF_APIHooks.h for new SoC integration is available under ..\PSF\SOC_Portable\New_SOC.

9.1 Hardware Requirements

This section describes the hardware requirements of the SoC for running PSF.

9.1.1 UPD350

The UPD350 is a companion Power Delivery Port Controller that provides cable plug orientation and detection for a USB Type-C receptacle. It implements baseband communication with a partner Type-C device on the opposite side of the cable.

The UPD350 communicates to an external SoC using the integrated I2C/SPI interface. One UPD350 per port is required to achieve USB-PD functionality in each port.

PSF supports the following versions of UPD350 SKUs

| Device | Hardware communication Interface |
|----------|----------------------------------|
| UPD350-A | I2C |
| UPD350-B | SPI |
| UPD350-C | I2C |
| UPD350-D | SPI |

PSF requires the following hardware support from SoC to control UPD350:

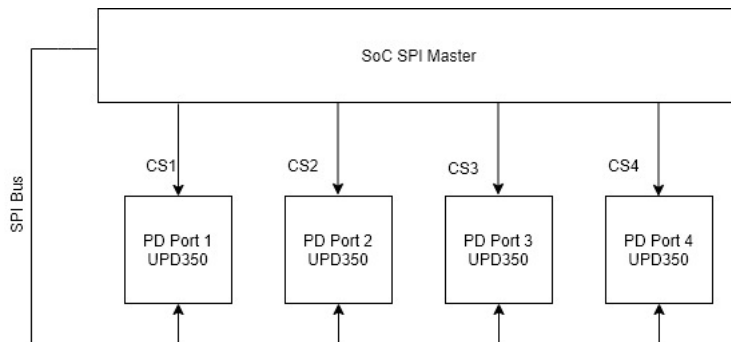
- Hardware communication interface either I2C or SPI to interact with UPD350
- PIOs for each port's UPD350 to detect IRQ alert
- PIO to reset the UPD350s

9.1.1.1 Hardware Communication Interface

SoC shall use either SPI or I2C interface of [UPD350](#) to access all the on-chip Control and Status Registers.

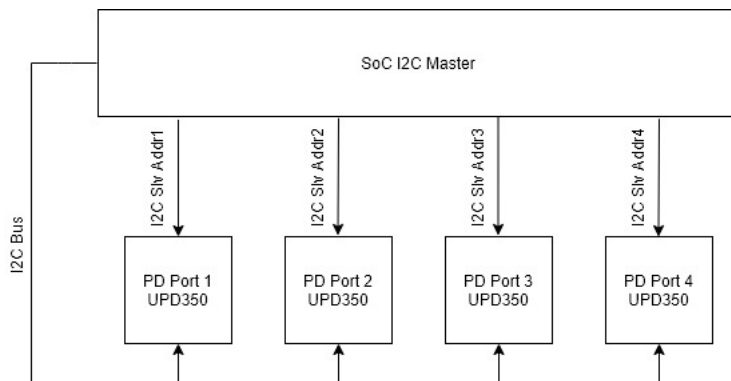
SPI Master:

The SoC needs to have a SPI master interface that can interact with the UPD350B/D SPI slave interfaces at SPI clock speeds up to 25 MHz. In addition to this, the SoC should also have a dedicated SPI Chip Select (CS) line for each UPD350B/D in the system.



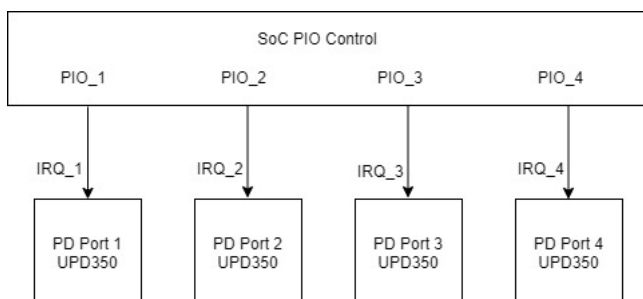
I2C Master:

SOC needs to have an I2C Master interface for interacting with the UPD350A/C in the system. The UPD350A/C's I2C slave interface supports Standard mode(100 kbps), Fast Mode(400 kbps) and Fast Mode Plus(1 Mbps) speeds. Each PD port having a [UPD350](#) is identified by unique I2C slave address.



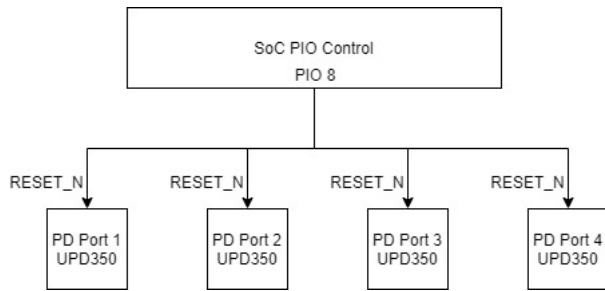
9.1.1.2 PIOs for UPD350 IRQs

A PIO specific to each port's [UPD350](#) is required for [UPD350](#) IRQ interrupt detection. IRQ_N of [UPD350](#) is an active low signal. Thus, SoC 's User_Application shall configure the PIO for active low interrupt detection. And it shall inform PSF about the occurrence of interrupts through APIs provided; for PSF to service the interrupt.



9.1.1.3 PIO for UPD350 Reset

PSF needs a dedicated PIO from SoC to reset the UPD350s. It is recommended to use a single PIO for all the UPD350s in the system. It is connected to RESET_N of [UPD350](#), an active low signal.



9.1.2 Hardware Timer

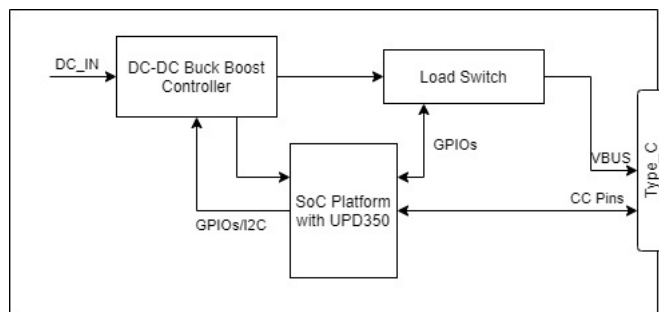
A Hardware timer with a minimum resolution of 1ms is required synchronizing the various state machines of PSF. PSF creates multiple software instance of this hardware timer. SoC User_Application shall inform PSF about the occurrence of every Timer interrupt through APIs provided.

Note: PSF is tested with hardware timer resolution of 1ms for two port source configuration.

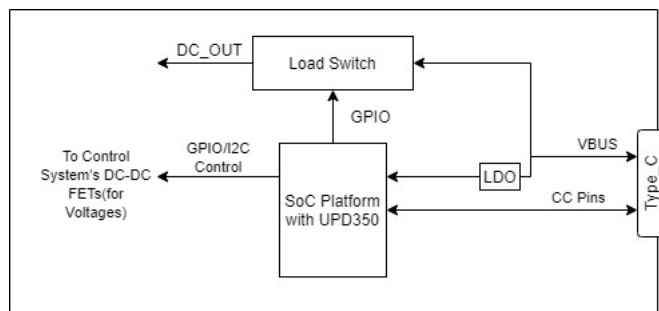
9.1.3 DC-DC Buck Boost Controller

A [UPD350](#) is PD controller that negotiates a PD contract. It does not provide the PD voltage for the ports. The [UPD350](#) employs a DC-DC buck boost controller for this purpose. The DC-DC controller can be controlled from the [UPD350](#) using PIOs or I2C.

For Source-only port, the setup would be as follows,



For Sink-Only port, the set up would be as follows,



Note: The PSF evaluation and development platform includes a Microchip MCP19119 Buck converter. This Buck converter is digitally enhanced and capable of supporting a number of control schemes through firmware modification. By default, it is configured for a basic GPIO based control scheme.

9.2 Software Requirements

This section lists the software requirements for PSF integration. This guide helps to determine whether PSF integration is possible with the available memory constraints in SoC.

9.2.1 Memory Requirement

- **32-bit**

In a 32-bit SoC environment, the code size for the sample applications is below

| Sample | Functionality | Code Size | Data Size |
|-------------|------------------------|-------------|------------|
| Source Lite | Basic Source - 2 Port | 31897 Byte | 1540 Bytes |
| Source Pro | 2 Port Source + PB +PT | 35135 Bytes | 1648 Bytes |
| Source Pro | 2 Port Source +PPS | 33717 Bytes | 1588 Bytes |
| Sink | 1 Port Sink | 30269 Bytes | 928 Bytes |

Any additional port will increase total Data RAM size requirement by approximately 500 Bytes.

- **16-bit**

TBD

- **8-bit**

TBD

9.2.2 Multi-Port Support

PSF supports maximum of 4 ports.

Note: The tested PSF configuration is 2 port source configuration with SPI interface.

9.2.3 Endianness

PSF supports and has been tested on little endian SOC.

9.3 Steps to integrate PSF

Steps to integrate to new SoC platform:

1. Select a compatible SoC based on [Hardware Requirements](#) and [Software Requirements](#)
2. Generate required SoC drivers. Port the mandatory APIs specified in [APIs to be implemented by the User application](#) in PSF_APIHooks header file.
3. Integrate PSF APIs listed in [APIs to be called by the User Application](#) the drivers of the new SoC.. These APIs will also be available in PSF_APIHooks header file.
4. Choose a PD functionality for the application (for example, Source only operation, Sink only operation) and configure the PSF_Config.h file with the help of section [PSF Configuration Options](#).

10 APIs Implementation required for SW integration

This section provides the list of APIs needed for integrating PSF with an existing application or a new SoC.

These APIs can be categorized further as:

- APIs to be implemented by the SoC User_Application
- APIs to be called by the SoC User_Application

10.1 Data types




| Pre-processor definitions | Data types |
|---------------------------|----------------|
| TRUE | 1 |
| FALSE | 0 |
| BOOL | unsigned char |
| UINT8 | unsigned char |
| UINT16 | unsigned short |
| UINT32 | unsigned long |
| INT8 | char |
| INT16 | short |
| INT32 | long |
| CHAR | char |
| UCHAR | unsigned char |

10.2 APIs to be implemented by the User Application

This section lists out APIs that to be implemented by User for PSF functionality. Implement all the APIs mentioned as mandatory in the remarks.

10.2.1 UPD350 Hardware Interface Configurations

Macros

| | Name | Description |
|---|--|---|
|  | <code>MCHP_PSF_HOOK_UPDHW_INTF_INIT</code> | Initialize the hardware interface(SPI/I2C) used for communicating with UPD350 part. |
|  | <code>MCHP_PSF_HOOK_UPD_READ</code> | Initiates a read transfer to UPD350 via I2C/SPI |
|  | <code>MCHP_PSF_HOOK_UPD_WRITE</code> | Initiates a write transfer to UPD350 via I2C/SPI |

10.2.1.1 MCHP_PSF_HOOK_UPDHW_INTF_INIT

C

```
#define MCHP_PSF_HOOK_UPDHW_INTF_INIT 0
```

Description

PSF requires a Hardware interface from SOC(either SPI or I2C) to communicate with [UPD350](#). [UPD350](#) supports either I2C or SPI interface depending on [UPD350](#) part used. [UPD350](#) A and C supports I2C interface and [UPD350](#) B and D part supports SPI interface. This Hook is to initialize the SOC's Hardware interface for communication. It is called during initialization of PSF. Define relevant function that has no arguments but a return type UINT8 that indicates whether initialization is successful.

Preconditions

Use SPI interface for part [UPD350](#) B and D. Use I2C interface for part [UPD350](#) A and C.

Returns

UINT8 - Return TRUE if initialization was successful or else return FALSE. If hardware interface initialization(SPI/I2C) fails and the API returns FALSE, all the PD ports are disabled by PSF by default.

Remarks

User definition of this Hook function is mandatory.

Example

```
#define MCHP_PSF_HOOK_UPDHW_INTF_INIT()      hw_spi_init()
UINT8 hw_spi_init(void);
UINT8 hw_spi_init(void)
{
    //Intialise SOC's SPI master
    //Return TRUE if initialisation is successful else FALSE
}
#define MCHP_PSF_HOOK_UPDHW_INTF_INIT()      hw_i2c_init()
UINT8 hw_i2c_init(void);
UINT8 hw_i2c_init(void)
{
    //Initialise SOC's I2C master
    //Return TRUE if initialisation is successful else FALSE
}
```

10.2.1.2 MCHP_PSF_HOOK_UPD_READ

C

```
#define MCHP_PSF_HOOK_UPD_READ(u8PortNum,pu8WriteBuf,u8WriteLen,pu8ReadBuf, u8ReadLen) 0
```

Description

This hook is called to read to [UPD350](#) registers with respect to the port. Its definition is confined

CONFIG_DEFINE_UPD350_HW_INTF_SEL definition for SPI/I2C selection. Define relevant function that has UINT8, UINT8*, UINT8, UINT8*, UINT8 arguments with UINT8 return type.

Preconditions

None.

Parameters

| Parameters | Description |
|-------------|---|
| u8PortNum | Port number of the device. It takes value between 0 to (<u>CONFIG_PD_PORT_COUNT</u> -1). |
| pu8WriteBuf | PSF shall pass the pointer to the buffer which has the data to be written on the SPI/I2C Hardware bus before read. It contains the Register address to be read. Data type of the pointer buffer must be UINT8*. |
| u8WriteLen | PSF shall pass the Number of bytes to be written on the SPI/I2C Hardware bus. Data type of this parameter must be UINT8. |
| pu8ReadBuf | PSF will pass the pointer to the buffer where data read from the SPI/I2C bus to be stored. Data type of the pointer buffer must be UINT8*. |
| u8ReadLen | PSF will pass the number of bytes to be read on the SPI/I2C bus. Data type of this parameter must be UINT8. |

Returns

UINT8 - Return TRUE if read was successful or else return FALSE.

Remarks

User definition of this Hook function is mandatory.

Example

```
#define MCHP_PSF_HOOK_UPD_READ(u8PortNum,pu8WriteBuf,u8WriteLen,pu8ReadBuf,u8ReadLen)
    SPI_Read (u8PortNum,pu8WriteBuf,u8WriteLen,pu8ReadBuf,u8ReadLen)
void SPI_Read (UINT8 u8PortNum, UINT8 *pu8WriteBuffer, UINT8 u8Writelength,
               UINT8 *pu8ReadBuffer, UINT8 u8Readlength);
void SPI_Read (UINT8 u8PortNum, UINT8 *pu8WriteBuffer, UINT8 u8Writelength,
               UINT8 *pu8ReadBuffer, UINT16 u8Readlength)
{
    for(UINT8 u8Txcount = 0; u8Txcount < u16Writelength; u8Txcount++)
    {
        //Write data bytes to SPI bus
    }
    for(UINT8 u8Rxcount = 0; u8Rxcount< u8Readlength; u8Rxcount++)
    {
        //Read data from SPI bus
    }
    // Return TRUE if the read is successful; else FALSE
}
#define MCHP_PSF_HOOK_UPD_READ(u8PortNum,pu8WriteBuf,u8WriteLen,pu8ReadBuf,u8ReadLen)
    I2C_Read(u8PortNum,pu8WriteBuf,u8WriteLen,pu8ReadBuf,u8ReadLen)

void I2C_Read (UINT8 u8PortNum, UINT8 *pu8WriteBuffer, UINT8 u8Writelength,
               UINT8 *pu8ReadBuffer, UINT16 u8Readlength);
void I2C_Read (UINT8 u8PortNum, UINT8 *pu8WriteBuffer, UINT8 u8Writelength,
               UINT8 *pu8ReadBuffer, UINT16 u8Readlength)
{
    //Select I2C address for the UPD350 I2C slave using u8PortNum
    for(UINT8 u8Txcount = 0; u8Txcount < u16Writelength; u8Txcount++)
    {
        //Write data bytes to I2C bus
    }
    for(UINT8 u8Rxcount = 0; u8Rxcount< u8Readlength; u8Rxcount++)
    {
        //Read data from I2C bus
    }
    // Return TRUE if the read is successful else return FALSE
}
```

10.2.1.3 MCHP_PSF_HOOK_UPD_WRITE

C

```
#define MCHP_PSF_HOOK_UPD_WRITE(u8PortNum,pu8WriteBuf,u8WriteLen) 0
```

Description

This hook is called to write to [UPD350](#) registers specific to the port. Its definition is confined to [CONFIG_DEFINE_UPD350_HW_INTF_SEL](#) definition for SPI or I2C selection. Define relevant function that has UINT8, UINT8*, UINT8 arguments with a return type UINT8.

Preconditions

None.

Parameters

| Parameters | Description |
|-------------|--|
| u8PortNum | Port number of the device. It takes value between 0 to (CONFIG_PD_PORT_COUNT -1). |
| pu8WriteBuf | PSF shall pass the pointer to the buffer which has the data to be written on the SPI/I2C Hardware bus. Data type of the pointer buffer must be UINT8*. |
| u8WriteLen | PSF shall pass the Number of bytes to be written on the SPI/I2C Hardware bus. Data type of this parameter must be UINT8. |

Returns

UINT8 - Return TRUE if write was successful or else return FALSE.

Remarks




User definition of this Hook function is mandatory

Example

```
#define MCHP_PSF_HOOK_UPD_WRITE(u8PortNum,pu8WriteBuf,u8WriteLen)
    SPI_Write (u8PortNum,pu8WriteBuf,u8WriteLen)
UINT8 SPI_Write(UINT8 u8PortNum, UINT8 *pu8WriteBuffer, UINT8 u8Writelength);
UINT8 SPI_Write(UINT8 u8PortNum, UINT8 *pu8WriteBuffer, UINT8 u8Writelength)
{
    for(UINT8 u8Txcount = 0; u8Txcount < u16Writelength; u8Txcount++)
    {
        //Write data bytes to SPI bus
    }
    // Return TRUE if the write is successful; else FALSE
}
#define MCHP_PSF_HOOK_UPD_WRITE(u8PortNum,pu8WriteBuf,u8WriteLen)
    I2C_Write (u8PortNum,pu8WriteBuf,u8WriteLen)
UINT8 I2C_Write(UINT8 u8PortNum, UINT8 *pu8WriteBuffer, UINT8 u8Writelength);
UINT8 I2C_Write(UINT8 u8PortNum, UINT8 *pu8WriteBuffer, UINT8 u8Writelength)
{
    // Select I2C address for the UPD350 I2C slave using u8PortNum
    for(UINT8 u8Txcount = 0; u8Txcount < u16Writelength; u8Txcount++)
    {
        //Write data bytes to I2C bus
    }
    // Return TRUE if the write is successful; else FALSE
}
```

10.2.2 PD Timer Configuration

Macros

| | Name | Description |
|---|---|---|
|  | MCHP_PSF_PDTIMER_INTERRUPT_RATE | PD Timer Interrupt Rate |
|  | MCHP_PSF_HOOK_HW_PDTIMER_INIT | Hook to Initialize and start the hardware timer module. |
|  | MCHP_PSF_CONFIG_16BIT_PDTIMER_COUNTER | Config 16-bit PD Timer Counter |

10.2.2.1 MCHP_PSF_PDTIMER_INTERRUPT_RATE

C

```
#define MCHP_PSF_PDTIMER_INTERRUPT_RATE 1000
```

Description

MCHP_PSF_PDTIMER_INTERRUPT_RATE defines the frequency of interrupt set in the hardware timer dedicated for PSF. In other words, it is the resolution of the hardware timer. It can be configured depending on the resolution of the hardware timer available.

Remarks

Resolution of the hardware timer has to be at least 1ms. Tested resolution values of hardware timer is 1ms.(Corresponding MCHP_PSF_PDTIMER_INTERRUPT_RATE value is 1000).

Example

```
#define MCHP_PSF_PDTIMER_INTERRUPT_RATE 1000
(1000 interrupts per second, with interrupt interval or resolution of 1ms)
```

10.2.2.2 MCHP_PSF_HOOK_HW_PDTIMER_INIT

C

```
#define MCHP_PSF_HOOK_HW_PDTIMER_INIT 0
```

Description

PSF requires a single dedicated hardware timer module for its functionality. This Hook initializes and starts the hardware timer module for [MCHP_PSF_PDTIMER_INTERRUPT_RATE](#) interrupt frequency. To inform PSF about the occurrence of hardware timer interrupt API [MchpPSF_PDTimerHandler](#) should be called by the SOC layer on every timer interrupt. Define relevant function that has no argument with UINT8 return type.

Preconditions

None.

Returns

UINT8 - Returns TRUE if initialization is successful else FALSE. If Timer initialization fails and the API returns FALSE, all the PD ports are disabled by PSF by default.

Remarks

User definition of this Hook function is mandatory

Example

```
#define MCHP_PSF_HOOK_HW_PDTIMER_INIT() Timer_Init()
UINT8 Timer_Init(void);
UINT8 Timer_Init(void)
{
    //Initialize and start the SOC timer module for MCHP_PSF_PDTIMER_INTERRUPT_RATE
```

```

//interrupt frequency & register MchpPSF_PDTimerHandler as callback
//Return TRUE if Timer initialisation is successful else return FALSE
}

```

10.2.2.3 MCHP_PSF_CONFIG_16BIT_PDTIMER_COUNTER

C

```
#define MCHP_PSF_CONFIG_16BIT_PDTIMER_COUNTER 0
```

Description

MCHP_PSF_CONFIG_16BIT_PDTIMER_COUNTER can be defined as either 1 or 0 to set the timeout counter in PSF to unsigned 16bit or unsigned 32bit correspondingly. When set as 1, maximum timeout that can be set will be 65535 ticks.(Ticks = Resolution of the Hardware timer used). When set as 0 , maximum timeout that can be set will be 4294967296 ticks. Default value of MCHP_PSF_CONFIG_16BIT_PDTIMER_COUNTER is set as 1. With Hardware timer resolution set as 1ms , PSF will be capable of handling timeouts upto 65.535 Seconds.

Remarks

None

Example


```

#define MCHP_PSF_CONFIG_16BIT_PDTIMER_COUNTER 1 (Sets timeout variable inside the PSF as
unsigned 16bit)
#define MCHP_PSF_CONFIG_16BIT_PDTIMER_COUNTER 0 (Sets timeout variable inside the PSF as
unsigned 32bit)

```

10.2.3 SoC Interrupt Enable/Disable

Macros

| | Name | Description |
|---|--|--------------------------------|
|  | MCHP_PSF_HOOK_ENABLE_GLOBAL_INTERRUPT | Enables the global interrupt. |
|  | MCHP_PSF_HOOK_DISABLE_GLOBAL_INTERRUPT | Disables the global interrupt. |

10.2.3.1 MCHP_PSF_HOOK_ENABLE_GLOBAL_INTERRUPT

C

```
#define MCHP_PSF_HOOK_ENABLE_GLOBAL_INTERRUPT
```

Description

This hook is called when PSF exits from critical section. It must provide an implementation to enable the interrupts globally. This function must be very short, otherwise response time to the interrupt may be delayed and cause timing issues/conflicts. Define relevant function that has no arguments without return type.

Preconditions

None.

Returns

None.

Remarks

User definition of this Hook function is mandatory

Example

```

#define MCHP_PSF_HOOK_ENABLE_GLOBAL_INTERRUPT()    CRITICAL_SECTION_EXIT()
void CRITICAL_SECTION_EXIT(void) ;

```

```
void CRITICAL_SECTION_EXIT()
{
    //Enable global interrupts
}
```

10.2.3.2 MCHP_PSF_HOOK_DISABLE_GLOBAL_INTERRUPT

C

```
#define MCHP_PSF_HOOK_DISABLE_GLOBAL_INTERRUPT
```

Description

This hook is called when PSF enters into a critical section. It must provide an implementation to disable the interrupts globally. This hook implementation must be very short, otherwise response time may be delayed and cause timing issues/conflicts. Define relevant function that has no arguments without return type.

Preconditions

None.

Returns

None.

Remarks



User definition of this Hook function is mandatory

Example

```
#define MCHP_PSF_HOOK_DISABLE_GLOBAL_INTERRUPT() CRITICAL_SECTION_ENTER()
void CRITICAL_SECTION_ENTER(void);
void CRITICAL_SECTION_ENTER()
{
    //Disable SOC's global interrupts
}
```

10.2.4 Memory Compare and Copy

Macros

| | Name | Description |
|---|--------------------------------------|---|
|  | MCHP_PSF_HOOK_MEMCMP | Compare two memory regions |
|  | MCHP_PSF_HOOK_MEMCPY | Copies one memory area to another memory area |

Description

Memory compare and copy functionalities are given as hooks for user implementation because some compilers have inbuilt library functions that does this operation in minimum machine cycle. This hooks provide options to use those functions for better performance.

10.2.4.1 MCHP_PSF_HOOK_MEMCMP

C

```
#define MCHP_PSF_HOOK_MEMCMP(pObj1, pObj2, iLength) 0
```

Description

This function is called to compare two memory regions pau8Obj1, pau8Obj2 with specified length u8Length. User must define this hook based on compiler of SOC.

Preconditions

None.

Parameters

| Parameters | Description |
|------------|---|
| pObj1 | This is the pointer to block of Memory region 1 |
| pObj2 | This is the pointer to block of Memory region 2 |
| iLength | This is the number of bytes to be compared. |

Returns

Return 0 if two memory regions are same else return number of bytes did not match.

Remarks

User definition of this Hook function is mandatory

Example

```
#define MCHP_PSF_HOOK_MEMCMP(pObj1, pObj2, iLength) memcmp(pObj1, pObj2, iLength)
//This hook definition can be compiler defined or user defined.
```

10.2.4.2 MCHP_PSF_HOOK_MEMCPY

C

```
#define MCHP_PSF_HOOK_MEMCPY(pDest, pSrc, iLen) 0
```

Description

This function is called to copy iLen bytes from pSrc memory area to pDest memory area. User must define this function based on compiler of SOC. The memory areas must not overlap.

Preconditions

None.

Parameters

| Parameters | Description |
|------------|---|
| pDest | This is the pointer to block of destination memory region |
| pSrc | This is the pointer to block of source memory region |
| iLen | This is the number of bytes to be copied. |

Returns

Returns a pointer to pDest.

Remarks


User definition of this Hook function is mandatory


Example

```
#define MCHP_PSF_HOOK_MEMCPY(pDest, pSrc, iLen) memcpy(pDest, pSrc, iLen)
//This hook definition can be compiler defined or user defined.
```

10.2.5 Structure Packing

Macros

| | Name | Description |
|---|-------------------------------------|--|
|  | <u>MCHP_PSF_STRUCT_PACKED_START</u> | Structure packing to align the bytes in data memory based on the compiler. |

| | | |
|---|-----------------------------------|--|
|  | <u>MCHP_PSF_STRUCT_PACKED_END</u> | Structure packing to align the bytes in data memory based on the compiler. |
|---|-----------------------------------|--|

10.2.5.1 MCHP_PSF_STRUCT_PACKED_START

C

```
#define MCHP_PSF_STRUCT_PACKED_START
```

Description

Generally packed structures will be used to save space & align the bytes in data memory based on the compiler. If this pre-processor is defined, then all the PSF's "C" structures will be replaced with this keyword for compilation. If this pre-processor is not defined, then it will be default compilation rules based on the compiler.

Remarks

Need to be packed always based on type of SOC.

Example

```
#define MCHP_PSF_STRUCT_PACKED_START __attribute__((packed))
```

10.2.5.2 MCHP_PSF_STRUCT_PACKED_END

C

```
#define MCHP_PSF_STRUCT_PACKED_END
```

Description

Generally packed structures will be used to save space & align the bytes in data memory based on the compiler. If this pre-processor is defined, then all the PSF's "C" structures will be replaced with this keyword for compilation. If this pre-processor is not defined, then it will be default compilation rules based on the compiler.

Remarks





Need to be packed always based on type of SOC.

Example

```
#define CONFIG_STRUCT_PACKED_END _Pragma("pack( )")
```

10.2.6 Port Power Control

Macros

| | Name | Description |
|---|---|---|
|  | <u>MCHP_PSF_HOOK_HW_PORTPWR_INIT</u> | Initializes all the hardware modules related to port power functionality especially DC-DC buck boost controller and load switch. Additionally, in case of sink functionality, this hook may be defined with APIs to initialize a DAC. |
|  | <u>MCHP_PSF_HOOK_PORTPWR_DRIVE_VBUS</u> | Drives the VBUS for given voltage, current |
|  | <u>MCHP_PSF_HOOK_PORTPWR_CONFIG_SINK_HW</u> | Enables or disables sink hardware circuitry and configures it to sinks the VBUS voltage for a given port based on the sink requested voltage and current. |
|  | <u>MCHP_PSF_HOOK_DRIVE_DAC_I</u> | Indicates the implicit/explicit current capability of attached source partner. |

10.2.6.1 MCHP_PSF_HOOK_HW_PORTPWR_INIT

C

```
#define MCHP_PSF_HOOK_HW_PORTPWR_INIT(u8PortNum)
```

Description

This hook is to initialize the hardware modules related to port power functionality. Implementation of this function depends on the type of DC-DC buck boost controller, load switch or DAC used. Define relevant function with return type as UINT8.

Preconditions

API implementation must make sure the Port Power(VBUS) of all ports must be set to 0V.

Parameters

| Parameters | Description |
|------------|--|
| u8PortNum | Port number of the device. It takes value between 0 to (CONFIG_PD_PORT_COUNT-1). |

Returns

None.

Remarks

User definition of this Hook function is mandatory. A DAC may initialized under this hook if PSF is configured as SINK.

Example

```
#define MCHP_PSF_HOOK_HW_PORTPWR_INIT(u8PortNum)    hw_portpower_init(u8PortNum)
void hw_portpower_init(void);
void hw_portpower_init(void)
{
    //Initializes the hardware modules related to port power functionality
}
```

10.2.6.2 MCHP_PSF_HOOK_PORTPWR_DRIVE_VBUS

C

```
#define MCHP_PSF_HOOK_PORTPWR_DRIVE_VBUS(u8PortNum,u16VBUSVolatge,u16Current) \
```

Description

If the user chose to implement their own DC-DC buck booster control, this hook must be implemented to drive VBUS as per the parameter passed based on voltage and current. It can also be used to modify the default option. Implementation of this function depends on the type of DC-DC buck boost controller and load switch used. Define relevant function that has UINT8,UINT16, UINT16 arguments without return type.

Preconditions

It is applicable only for Source operation.

Parameters

| Parameters | Description |
|----------------|--|
| u8PortNum | Port number of the device. It takes value between 0 to (CONFIG_PD_PORT_COUNT-1). |
| u16VBUSVolatge | VBUS Voltage level to be driven in VBUS expressed in terms of milliVolts. |
| u16Current | VBUS current level in terms of mA. |

Returns

None.

Remarks

User definition of this Hook function is mandatory.

Example

```
#define MCHP_PSF_HOOK_PORTPWR_DRIVE_VBUS(u8PortNum, u16VBUSVolatge, u16Current)
    hw_portpower_driveVBUS(u8PortNum, u16VBUSVolatge, u16Current)
void hw_portpower_driveVBUS(UINT8 u8PortNum, UINT16 u16VBUSVolatge, UINT16 u16Current);
void hw_portpower_driveVBUS(UINT8 u8PortNum, UINT16 u16VBUSVolatge, UINT16 u16Current)
{
    // Configure DC-DC buck boost control to drive u16VBUSVolatge & u16Current in VBUS
}
```

10.2.6.3 MCHP_PSF_HOOK_PORTPWR_CONFIG_SINK_HW

C

```
#define MCHP_PSF_HOOK_PORTPWR_CONFIG_SINK_HW(u8PortNum,u16Voltage,u16Current)
```

Description

This hook is to enable or disable sink hardware circuitry and configure it for Sink requested current and voltage. Implementation of this function depends on the type of Sink circuitry used. Define relevant function that has UINT8,UINT16,UINT16 arguments without return type.

Preconditions

It is applicable only for Sink operation.

Parameters

| Parameters | Description |
|------------|---|
| u8PortNum | Port number of the device. It takes value between 0 to (CONFIG_PD_PORT_COUNT-1) . |
| u16voltage | Enable Sink HW Circuitry if the u16voltage is not Vsafe0V to drain power. Disable sink HW circuitry if the u16voltage is VSafe0V. Configure the HW to requested u16voltage in mV. |
| u16Current | Configure the HW for the requested current passed in terms of mA. |

Returns

None.

Remarks

User definition of this Hook function is mandatory if PSF is configured for Sink functionality.

Example

```
#define MCHP_PSF_HOOK_PORTPWR_CONFIG_SINK_HW(u8PortNum, u16Voltage, u16Current)
    hw_Configure_SinkCircuitary(u8PortNum, u16Voltage, u16Current)
void hw_Configure_SinkCircuitary(UINT8 u8PortNum,UINT16 u16Votlage,UINT16 u16Current);
void hw_Configure_SinkCircuitary(UINT8 u8PortNum,UINT16 u16Votlage,UINT16 u16Current)
{
    if(u16Voltage == Vsafe0V)
    {
        //Disable the Sink circuitary for "u8PortNum" Port
    }
    else
    {
        //Enable the Sink circuitary for "u8PortNum" Port and
        configure it to drain u16Voltage
    }
    //Conifgure Sink circuitary for u16Current current rating
}
```

10.2.6.4 MCHP_PSF_HOOK_DRIVE_DAC_I

C

```
#define MCHP_PSF_HOOK_DRIVE_DAC_I(u16DACData)
```

Description

This hook is called to indicate the sink hardware of the implicit/explicit current capability of attached source partner. The current capability is indicated thorough a voltage level on Digital to Analog Converter(DAC)'s output pin. The voltage level on DAC's output pin is calculated based on per port Configuration parameters, which were configured using [MCHP_PSF_HOOK_BOOT_TIME_CONFIG](#)(pasCfgStatusData) hook.

In [gasCfgStatusData](#) structure, if u16DAC_I_CurrentIhd_MaxInA is 5000mA, u16DAC_I_MaxOutVollnmV is 2500mV, u16DAC_I_MinOutVollnmV is 0V and direction mentioned in u8DAC_I_Direction is High Amperage - Max Voltage, then

1. 0.5A > DAC_I = 0.25V
2. 1.5A > DAC_I = 0.75V
3. 2.0A > DAC_I = 1V
4. 3.0A > DAC_I = 1.5V
5. 4.0A > DAC_I = 2.0V
6. 5.0A > DAC_I = 2.5V

In [gasCfgStatusData](#) structure, if u16DAC_I_CurrentIhd_MaxInA is 3000mA, u16DAC_I_MaxOutVollnmV is 2500mV, u16DAC_I_MinOutVollnmV is 0V and direction mentioned in u8DAC_I_Direction is High Amperage - Max Voltage, then * If it is 3A and maximum

1. 0.5A > DAC_I = 0.42V
2. 1.5A > DAC_I = 1.25V
3. 2.0A > DAC_I = 1.67V
4. 3.0A > DAC_I = 2.5V
5. 4.0A > DAC_I = 2.5V
6. 5.0A > DAC_I = 2.5V

This is applicable only for Sink operation.

A suitable function that initializes DAC from SoC may be implemented in this hook.

Preconditions

SoC should support a DAC. And the DAC should be initialized under [MCHP_PSF_HOOK_HW_PORTPWR_INIT](#)() hook.

Returns

None.

Remarks

This hook is applicable only if [INCLUDE_PD_SINK](#) macro is 1. Definition of this hook is not mandatory.

Example

```
#define MCHP_PSF_HOOK_DRIVE_DAC_I(u16DACData)    SAMD20_Drive_DAC_I(u16DACData)
void SAMD20_Drive_DAC_I(UINT16 u16DACData);
void SAMD20_Drive_DAC_I(UINT16 u16DACData)
{
    //Implement user specific application to output volatge provided under
    //u16DACData argument in DAC's output pin
}
```

10.2.7 Boot time Configuration

Macros

| | Name | Description |
|---|--|---|
|  | MCHP_PSF_HOOK_BOOT_TIME_CONFIG | Updates the global and per port Configuration parameters. |

10.2.7.1 MCHP_PSF_HOOK_BOOT_TIME_CONFIG

C

```
#define MCHP_PSF_HOOK_BOOT_TIME_CONFIG(pasCfgStatusData)
```

Description

This function is called to update the configuration parameters of Type-C, PD, Power Balancing, Power throttling and PPS contained in [gasCfgStatusData](#) structure. This API must have an input parameter of [gasCfgStatusData](#).

Preconditions

None.

Parameters

| Parameters | Description |
|------------------|---|
| pasCfgStatusData | Holds the structure pointer of the structure _GlobalCfgStatusData |

Returns

None.

Remarks

User definition of this Hook function is mandatory

Example


```
#define MCHP_PSF_HOOK_BOOT_TIME_CONFIG(pasCfgStatusData)
PSF_LoadConfig(pasCfgStatusData)
void PSF_LoadConfig(pasCfgStatusData)
{
    // Configure the global parameters
    // Enable Power Throttling and Select Bank B
    pasCfgStatusData->u8PwrThrottleCfg = 0x03;
    // Set 120W as Total system Power of Bank A
    pasCfgStatusData->u16SystemPowerBankAIn250mW = 0x01E0U;
    // Configure per port parameters
    // Set Port 1's VBUS Maximum Fault Count as 3
    pasCfgStatusData->sPerPortData[0].u8VBUSMaxFaultCnt = 0x03; // 0 is the port number
    // Configure per port PB parameters
    // Set Port 2's maximum port power for Bank C as 60W
    pasCfgStatusData.sPBPerPortData[1]->u16MaxPrtPwrBankCIn250mW = 0x00F0U; // 1 is the
port number
}
```

10.2.8 GPIO Configuration

This section gives the details of PIO configuration and its enum.

10.2.8.1 GPIO Init Function

Macros

| | Name | Description |
|---|--|--|
|  | MCHP_PSF_HOOK_GPIO_FUNC_INIT | Hook to initialize all the GPIO functionality pins in application layer. |

10.2.8.1.1 MCHP_PSF_HOOK_GPIO_FUNC_INIT

C

```
#define MCHP_PSF_HOOK_GPIO_FUNC_INIT(u8PortNum, eGPIOFunc)
```

Description

PSF calls this API to initialize the ePSF_GPIO_Functionality pins in application layer. User has to define an appropriate function with UINT8 and eMCHP_PSF_GPIO_FUNCTIONALITY as argument. User can assign any PIO either from UDP350 or MCU for any GPIO functionality defined. Drive of this API will be controlled by API [MCHP_PSF_HOOK_GPIO_FUNC_DRIVE](#).

Preconditions

None.

Parameters

| Parameters | Description |
|------------|--|
| u8PortNum | Port number of the device. It takes value between 0 to (CONFIG_PD_PORT_COUNT -1). |
| eGPIOFunc | Passes the GPIO functionality type that has to be initialized by the application. |

Returns

None.

Remarks


User definition of this Hook function is mandatory as well as it is mandatory to define functionality for ePSF_GPIO_Functionality.

Example

```
#define MCHP_PSF_HOOK_GPIO_FUNC_INIT(u8PortNum, eGPIO_Func)
App_GPIOControl_Initialisation(u8PortNum, eGPIO_Func)
void App_GPIOControl_Initialisation(UINT8 u8PortNum, eMCHP_PSF_GPIO_FUNCTIONALITY
eGPIOFunc)
{
    switch(eGPIOFunc)
    {
        case eDC_DC_EN_FUNC:
        {
            //Initialise the GPIO assigned for DC_DC
            // Drive the GPIO in default state
            break;
        }
        case eVBUS_DIS_FUNC:
        {
            //Initialise the GPIO assigned for VBUS_Discharge functionality
            //Drive the GPIO in default state
        }
    }
}
```

10.2.8.2 GPIO Drive Function

Macros

| | Name | Description |
|---|--|---|
|  | <code>MCHP_PSF_HOOK_GPIO_FUNC_DRIVE</code> | Hook to drive GPIOs assigned to GPIO functionality pins in application layer. |

10.2.8.2.1 MCHP_PSF_HOOK_GPIO_FUNC_DRIVE

C

```
#define MCHP_PSF_HOOK_GPIO_FUNC_DRIVE(u8PortNum, eGPIOFunc, eDriveVal)
```

Description

PSF calls this API to drive the ePSF_GPIO_Functionality pins in application layer as per drive value ePSF_GPIO_DriveVal. User has to define an appropriate function with `UINT8`, `eMCHP_PSF_GPIO_FUNCTIONALITY`, `eMCHP_PSF_GPIO_DRIVE_VAL` as argument. User can assign any PIO either from UDP350 or MCU for any GPIO functionality defined.

Preconditions

None.

Parameters

| Parameters | Description |
|------------------------|--|
| <code>u8PortNum</code> | Port number of the device. It takes value between 0 to <code>(CONFIG_PD_PORT_COUNT-1)</code> . |
| <code>eGPIOFunc</code> | Passes the GPIO functionality type that has to be initialized by the application. |
| <code>eDriveVal</code> | Drive value for the pin |

Returns

None.

Remarks

User definition of this Hook function is mandatory as well as it is mandatory to define functionality for ePSF_GPIO_Functionality.

Example

```
#define MCHP_PSF_HOOK_GPIO_FUNC_DRIVE (u8PortNum, eGPIO_Func, eDriveVal)
App_GPIOControl_Drive(u8PortNum, eGPIO_Func, eDriveVal)
void App_GPIOControl_Drive(UINT8 u8PortNum,
                           eMCHP_PSF_GPIO_FUNCTIONALITY eGPIOFunc, eMCHP_PSF_GPIO_DRIVE_VAL
eDriveVal )
{
    switch(eGPIOFunc)
    {
        case eDC_DC_EN_FUNC:
        {
            if (eGPIO_Assert == eDriveVal)
            {
                // Assert the DC_DC pin
            }
            else
            {
                // De-assert the DC_DC pin
            }
            break;
        }
        case eVBUS_DIS_FUNC:
        {
            if (eGPIO_Assert == eDriveVal)
```



```

        {
            // Assert the VBUS Discharge pin
        }
        else
        {
            // De-assert the VBUS Discharge pin
        }
        break;
    }
}
}

```

10.2.8.3 GPIO Control enum Constants

Enumerations

| | Name | Description |
|---|--|--------------------------|
|  | eMCHP_PSF_GPIO_DriveValue | GPIO Drive enum. |
|  | eMCHP_PSF_GPIO_Functionality | GPIO Functionality enum. |

10.2.8.3.1 eMCHP_PSF_GPIO_DriveValue Enumeration

C

```

enum eMCHP_PSF_GPIO_DriveValue {
    eGPIO_DEASSERT,
    eGPIO_ASSERT
};

```

Description

eMCHP_PSF_GPIO_DRIVE_VAL enum defines Assert and Deassert drives of the various GPIO functionality Pins that are used in PSF.

Members

| Members | Description |
|----------------|-----------------------------|
| eGPIO_DEASSERT | Drive to De-Assert the GPIO |
| eGPIO_ASSERT | Drive to Assert the GPIO |

Remarks

None

10.2.8.3.2 eMCHP_PSF_GPIO_Functionality Enumeration

C

```

enum eMCHP_PSF_GPIO_Functionality {
    eUPD350_ALERT_FUNC,
    eI2C_DC_DC_ALERT_FUNC,
    eUPD350_RESET_FUNC,
    eSPI_CHIP_SELECT_FUNC,
    eVBUS_DIS_FUNC,
    eDC_DC_EN_FUNC,
    eORIENTATION_FUNC,
    eSNK_CAPS_MISMATCH_FUNC,
    eSNK_1_5A_IND_FUNC,
    eSNK_3A_IND_FUNC
};

```

Description

eMCHP_PSF_GPIO_FUNCTIONALITY enum defines the various GPIO functionality Pins that are used in PSF.

| Funtionality | Input/Output | Description |
|-----------------------|--------------|--|
| eUPD350_ALERT_FUNC | Input | <ul style="list-style-type: none"> PSF requires a GPIO specific to each port of UPD350 for interrupt detection via UPD350's IRQ_N lines. IRQ_N is an active low signal. This GPIO functionality shall initialize the SOC GPIOs connected to the IRQ_N lines of UPD350s in the system for interrupt notification. It is recommended to configure SOC GPIOs interrupt in edge level detection with internal pull up since the UPD350 keeps the IRQ_N line in low state until the interrupt is cleared. To notify PSF the occurrence of UPD350 interrupt, the API MchpPSF_UPDIrqHandler shall be called by SOC on interrupt detection of the specific port. GPIO connected to IRQ_N should be wakeup capable if INCLUDE_POWER_MANAGEMENT_CTRL defined as 1. This is a mandatory functionality and configured only during initialization. |
| eI2C_DC_DC_ALERT_FUNC | Input | <ul style="list-style-type: none"> Configures the GPIO of SOC for DC DC Alert functionality. This is not a mandatory functionality and can be configured based on the DC DC controller used. |
| eUPD350_RESET_FUNC | Input | <ul style="list-style-type: none"> This GPIO functionality is to control SOC GPIOs connected to the RESET_N lines of Port's UPD350. It is must to connect a single GPIO to the reset line of all UPD350s. The UPD350 RESET_N is active low signal. The GPIO control for reset shall be handled as below <ul style="list-style-type: none"> Initialization - Drive the GPIO high eGPIO_ASSERT - Drive the GPIO low and provide a sufficient delay for the UPD350 to reset eGPIO_DEASSERT - Drive the GPIO high As single line is connected to all the UPD350 reset pin, the port number passed as argument to the hooks MCHP_PSF_HOOK_GPIO_FUNC_INIT and MCHP_PSF_HOOK_GPIO_FUNC_DRIVE shall be 0. This is a mandatory functionality to reset UPD350 and done only during initialization. |
| eSPI_CHIP_SELECT_FUNC | Output | <ul style="list-style-type: none"> This functionality is used by PSF to enable or disable the communication to port's UPD350. It is applicable only when CONFIG_DEFINE_UPD350_HW_INTF_SEL is defined as CONFIG_UPD350_SPI. The eSPI_CHIP_SELECT_FUNC is active low signal. The GPIO control for CS shall be handled as below <ul style="list-style-type: none"> Initialization - Drive the GPIO high eGPIO_ASSERT - Drive the GPIO low for the specific port to enable communication eGPIO_DEASSERT - Drive the GPIO high for the specific port to disable communication It is mandatory to assign a MCU pin to this functionality port specifically active low signal. |


| | | |
|-------------------------|--------|---|
| eVBUS_DIS_FUNC | Output | <ul style="list-style-type: none"> VBUS Discharge mechanism is required to enable quick discharge of VBUS when VBUS transitions from higher to lower voltage.PSF requests the application layer to assert this pin whenever it requires a quick discharge of VBUS. PSF request for deassertion once the quick discharge is complete. The state of GPIO during init,Assert and Deassert of this functionality is specific discharge circuitry used. It mandatory to assign a pin to this functionality to do a quick discharge whenever it is asserted. |
| eDC_DC_EN_FUNC | Output | <ul style="list-style-type: none"> DC_DC_EN functionality is required to enable DC DC Controller. PSF request the application layer to assert when PSF is initialized, ready to operate and CC pins are functional. It will be toggled during error condition say, on occurrence of fault to reset the DC DC controller.The state of GPIO during init,Assert and Deassert of this functionality is specific DC DC Controller used. This is applicable only for Source functionality |
| eORIENTATION_FUNC | Output | <ul style="list-style-type: none"> Orientation functionality is used to indicate the detected orientation. It can be used to control an external USB data multiplexer. The PSF will request to init this functionality during device detach, assert during CC1 attach and deassert during CC2 attach. The state of GPIO during init,Assert and Deassert of this functionality is user specific This is not mandatory, depends on user application. |
| eSNK_CAPS_MISMATCH_FUNC | Output | <ul style="list-style-type: none"> Sink Caps mismatch functionality is to indicate any mismatch of capability during a PD negotiation.It is applicable only for Sink functionality. PSF request application to assert when PD Sink negotiation is complete and there was a capability mismatch with the selection. PSF request application to deassert during port partner detach or during a new negotiation.The state of GPIO during init, Assert and Deassert of this functionality is user specific This is not mandatory, depends on user application. |
| eSNK_1_5A_IND_FUNC | Output | <ul style="list-style-type: none"> This functionality is indicate the current capability is more than 1.5A. PSF request the application to assert when the Current capability or negotiated current is 1.5A or more and less than 3A. PSF request the application to deassert on detach event or during renegotiation. The state of GPIO during init, Assert and Deassert of this functionality is user specific This is applicable only for sink functionality and it is not mandatory,depends on user application. |
| eSNK_3A_IND_FUNC | Output | <ul style="list-style-type: none"> 3A indicator functionality is to indicate the current capability is more than 3A. PSF request the application to assert when current capability or negotiated current is 3A or more. PSF request the application to deassert on detach event or during renegotiation.The state of GPIO during init, Assert and Deassert of this functionality is user specific. This is applicable only for sink functionality and it is not mandatory,depends on user application. |

Remarks

None

10.2.9 Hooks for Policy Manager

Macros

| | Name | Description |
|---|--|---|
|  | <u>MCHP_PSF_HOOK_DPM_PRE_PROCESS</u> | This hook is called before entering into the DPM state machine. |

10.2.9.1 MCHP_PSF_HOOK_DPM_PRE_PROCESS

C

```
#define MCHP_PSF_HOOK_DPM_PRE_PROCESS(u8PortNum)
```

Description

This hook is called at the entry of DPM_RunStateMachine() API before executing the Type C state machine and policy engine state machine. USER_APPLICATION can define this function if a change is required in default device policy manager functionality or add a user defined state machine. Define relevant function that has one UINT8 argument without return type.

Preconditions

None.

Parameters

| Parameters | Description |
|------------|---|
| u8PortNum | Port number of the device. It takes value between 0 to (<u>CONFIG_PD_PORT_COUNT</u> -1). |

Returns

None.

Remarks





User definition of this Hook function is optional

Example

```
#define MCHP_PSF_HOOK_DPM_PRE_PROCESS(u8PortNum)
HookDevicePolicyManagerPreProcess(u8PortNum)
void HookDevicePolicyManagerPreProcess(UINT8 u8PortNum);
void HookDevicePolicyManagerPreProcess(UINT8 u8PortNum)
{
    //any application related change or enhancement or user defined state machine
}
```

10.2.10 Debug Hook Functions

Macros

| | Name | Description |
|---|--|--|
|  | <u>MCHP_PSF_HOOK_DEBUG_INIT</u> | Initialization of debug module interface |
|  | <u>MCHP_PSF_HOOK_PRINT_CHAR</u> | Outputs a character via UART interface |
|  | <u>MCHP_PSF_HOOK_PRINT_INTEGER</u> | Outputs an integer via UART interface |
|  | <u>MCHP_PSF_HOOK_PRINT_TRACE</u> | Outputs a string via UART interface |

10.2.10.1 MCHP_PSF_HOOK_DEBUG_INIT

C

```
#define MCHP_PSF_HOOK_DEBUG_INIT
```

Description

This hook is called during initialization of PSF if `CONFIG_HOOK_DEBUG_MSG` is set to 1. Define relevant function to initialize the Debug interface used with no arguments without return type.

Preconditions

None.

Returns

None.

Remarks

User definition of this Hook function is mandatory when `CONFIG_HOOK_DEBUG_MSG` is declared as '1'.

Example

```
#define MCHP_PSF_HOOK_DEBUG_INIT()          uart_init()
void uart_init();
void uart_init()
{
    //Initializes the uart module to send and receive a character
}
```

10.2.10.2 MCHP_PSF_HOOK_PRINT_CHAR

C

```
#define MCHP_PSF_HOOK_PRINT_CHAR(byData)
```

Description

This hook is can be called to output a character via UART interface to help the user in debugging. byData is of type char. Define relevant function to print a character via UART terminal with argument of type char and no return type.

Preconditions

`MCHP_PSF_HOOK_DEBUG_INIT()` should have been called before using this API.

Returns

None.

Remarks

This hook API can be used only if `CONFIG_HOOK_DEBUG_MSG` is 1.

Example

```
#define MCHP_PSF_HOOK_PRINT_CHAR(byData)          uart_print_char(byData)
void uart_print_char(char);
void uart_print_char(char byData)
{
    //Print a character through UART terminal
}
```

10.2.10.3 MCHP_PSF_HOOK_PRINT_INTEGER

C

```
#define MCHP_PSF_HOOK_PRINT_INTEGER(dwData, byWidth)
```

Description

This hook is can be called to output an integer via UART interface to help the user in debugging. The size of integer is specified in byWidth. dwWriteInt is of type unsigned long. byWidth is of type unsigned char. Define relevant function to print an integer via UART terminal with arguments of type unsigned long and unsigned char and no return type.

Preconditions

MCHP_PSF_HOOK_DEBUG_INIT() should have been called before using this API.

Returns

None.

Remarks

This hook API can be used only if **CONFIG_HOOK_DEBUG_MSG** is 1.

Example

```
#define MCHP_PSF_HOOK_PRINT_INTEGER(dwWriteInt, byWidth)
uart_print_char(dwWriteInt, byWidth)
void uart_print_int(UINT32 dwWriteInt, UINT8 byWidth);
void uart_print_int(UINT32 dwWriteInt, UINT8 byWidth)
{
    //Print byWidth no of bytes from dwWriteInt through UART terminal.
}
```

10.2.10.4 MCHP_PSF_HOOK_PRINT_TRACE

C

```
#define MCHP_PSF_HOOK_PRINT_TRACE(pbyMessage)
```

Description

This hook is can be called to output a string via UART interface to help the user in debugging. pbyMessage is of type char *. Define relevant function to print a string via UART terminal with argument of type char* and no return type.

Preconditions

MCHP_PSF_HOOK_DEBUG_INIT() should have been called before using this API.

Returns

None.

Remarks


This hook API can be used only if **CONFIG_HOOK_DEBUG_MSG** is 1.






Example

```
#define MCHP_PSF_HOOK_PRINT_TRACE(pbyMessage)          uart_print_string(pbyMessage)
void uart_print_string(char *);
void uart_print_string(char * pbyMessage)
{
    //Print a string in pbyMessage through UART terminal
}
```

10.2.11 PD Firmware Upgrade

Macros

| | Name | Description |
|---|-------------------------------------|---|
|  | MCHP_PSF_HOOK_BOOT_FIXED_APP | MCHP_PSF_HOOK_BOOT_FIXED_APP shall perform necessary operation to switch from Updatable application to Fixed application. |

| | | |
|---|---|---|
|  | <u>MCHP_PSF_HOOK_BOOT_UPDATABLE_APP</u> | MCHP_PSF_HOOK_BOOT_UPDATABLE_APP shall perform necessary operation to boot from the updatable application after a PDFU is successfully completed. |
|  | <u>MCHP_PSF_HOOK_GETCURRENT_IMAGEBANK</u> | To Return the Index of the Image Bank which is currently executing. |
|  | <u>MCHP_PSF_HOOK_IS_PDFU_ALLOWED_NOW</u> | |
|  | <u>MCHP_PSF_HOOK_PROGRAM_FWBLOCK</u> | Validate the Data block and program the data to the Memory, and return the status of the Programming Operation. |
|  | <u>MCHP_PSF_HOOK_VALIDATE_FIRMWARE</u> | To validate the Flashed Binary using a user defined validation method and return the status of the Firmware Validation Operation. |

10.2.11.1 MCHP_PSF_HOOK_BOOT_FIXED_APP

C

```
#define MCHP_PSF_HOOK_BOOT_FIXED_APP
```

Description

Re-flash of the Updatable_Application image bank while currently executing in the Updatable Application image bank, requires switch to Fixed application for performing the upgrade. The application switching may include invalidating the Updatable_Application signatures (and/or) jump/reset for fresh boot from Fixed application.

Preconditions

This hook is invoked by the PD Firmware Update State-machine during the Reconfiguration phase(On reception PDFU_INITIATE Command), when the Updatable application is currently running.

Returns

No Return Value. During execution of this function the control shall be switched to the Fixed application.

Remarks

User definition of this Hook function is mandatory in the Updatable application when [INCLUDE_PDFU](#) is TRUE

Example

```
#define MCHP_PSF_HOOK_BOOT_FIXED_APP()    Boot_Fixed_Application()
void Boot_Fixed_Application(void)
{
    EraseUpdatableAppSignature(); //Invalidate the Updatable app sign
    Reset(); //Reset to boot from Fixed app
}
```

10.2.11.2 MCHP_PSF_HOOK_BOOT_UPDATABLE_APP

C

```
#define MCHP_PSF_HOOK_BOOT_UPDATABLE_APP
```

Description

As the flashing operation is executed from the Fixed application, once the PDFU process is complete it is necessary to switch to the newly upgraded updatable application. This hook definition shall implement necessary operations to safely exit the fixed application and boot from the updatable application. The application switching may include setting the valid Updatable_Application signatures (and) jump/reset for fresh boot from Updatable application.

Preconditions

This function is invoked by the PD Firmware Update State-machine during the Manifestation phase (On reception PDFU_INITIATE Command), when the Fixed application is currently running.

Returns

No Return Value. During execution of this function the control shall be switched to the Updatable application.

Remarks

User definition of this Hook function is mandatory in the Fixed application when `INCLUDE_PDFU` is TRUE.

Example

```
#define MCHP_PSF_HOOK_BOOT_UPDATABLE_APP()    Boot_Updatable_Application()
void Boot_Updatable_Application(void)
{
    Reset(); //Reset to boot from Updatable app
}
```

10.2.11.3 MCHP_PSF_HOOK_GETCURRENT_IMAGEBANK

C

```
#define MCHP_PSF_HOOK_GETCURRENT_IMAGEBANK 0x0
```

Description

This hook is called by PSF to get the Index of the image bank which is currently executing in the application. PSF follows "Architecture 2 - Fixed base application with updatable application image". In which the Fixed Application is Image Bank 1 and updatable Application is Image Bank 2.

Preconditions

This function is invoked by the PD Firmware Update State-machine during the Enumeration Phase (On reception PDFU_GET_FW_ID Command).

Returns

Returns UINT8 - the index of the Image Bank. It can take following values: 0x01 - IMAGE_BANK_BOOTLOADER 0x02 - IMAGE_BANK_FIXED_APP 0x03 - IMAGE_BANK_UPDATABLE_APP

Remarks

The User definition of the function is mandatory in both Fixed and Updatable application when `INCLUDE_PDFU` is TRUE.

Example 1

1. 0x01 - Corresponds to Bootloader Application
2. 0x02 - Corresponds to Fixed Application
3. 0x03 - Corresponds to Updatable Application

Example 2

```
#define MCHP_PSF_HOOK_GETCURRENT_IMAGEBANK()    getCurrentImageBank()
UINT8 getCurrentImageBank(void)
{
    return u8ImageBankIndex;
}
```

10.2.11.4 MCHP_PSF_HOOK_IS_PDFU_ALLOWED_NOW

C

```
#define MCHP_PSF_HOOK_IS_PDFU_ALLOWED_NOW 0
```

Description

MCHP_PSF_HOOK_IS_PDFU_ALLOWED_NOW specifies if PD Firmware Update can be currently allowed, based on the priority of the application tasks currently executing.

1. When the PD Firmware Update is allowed, the PDFU Initiator can perform firmware upgrade by the PDFU Sequence
2. When the PD Firmware Update is not allowed, the PDFU Initiator is responded with the error code during the

Reconfiguration phase.

Example scenario of When PDFU cannot be allowed: Assuming a product with firmware update capability through CC and I2C as well. In an example, if the firmware upgrade through I2C is already in progress, then PDFU through CC interface shall not be allowed. To handle such situations, this macro shall return the current status of allow-ability of firmware upgrade.

Preconditions

This function is invoked by the PD Firmware Update State-machine during the Reconfiguration Phase (On reception PDFU_INITIATE Command).

Returns

UINT8 value - Shall return the run time status whether PDFU via CC is allowed now or not. 0x00 - PDFU Not Allowed. 0x01 - PDFU Allowed.

Remarks

User definition of this Hook function is mandatory in fixed as well as updatable when **INCLUDE_PDFU** is TRUE.

Example

```
#define MCHP_PSF_HOOK_IS_PDFU_ALLOWED_NOW    isPdfuAllowedNow()
UINT8 isPdfuAllowedNow(void)
{
    return u8PdfuAllow;
}
```

10.2.11.5 MCHP_PSF_HOOK_PROGRAM_FWBLOCK

C

```
#define MCHP_PSF_HOOK_PROGRAM_FWBLOCK(u8pObj,u16Len) 0
```

Description

This hook is invoked during the Transfer Phase on the successful reception event of every PDFU_DATA packet. It is responsible for updating the Firmware data to the memory and identifying any errors during the Firmware flash.

Preconditions

Only during the Policy Engine State-Reconfigure Phase or Transfer phase this function hook will be invoked.

Parameters

| Parameters | Description |
|----------------------|---|
| u8pObj | UINT8 Pointer to PDFU_DATA packet payload Buffer. |
| u8pObj[0] | Reserved field Contains PD FW Version. |
| u8pObj[1] | Reserved field Contains Msg Type which is PDFU_DATA 0x83. |
| u8pObj[2] | LSB of Data Block Index. |
| u8pObj[3] | MSB of Data Block |
| Index u8pObj[4..260] | Firmware Image data upto 256 bytes where the Data block index is used to calculate the Physical memory address to which the current data block corresponds to 16 bit parameter. |
| u16Len | Indicates the length of the Firmware data contained in the packet. |

Returns

Returns ePE_PDFU_RESPONSE_CODE Type Return Value - The Status of the Program Operation.

1. ePE_FWUP_OK - Upon successful flash operation.
2. ePE_FWUP_errVERIFY - When verification of the flash operation failed.
3. ePE_FWUP_errADDRESS - When data block index is out of range.

Remarks

User definition of this Hook function is mandatory when **INCLUDE_PDFU** is TRUE.

Example

```

#define MCHP_PSF_HOOK_PROGRAM_FWBLOCK(u8pObj, u16Len)
    PDFW_ProcessPDFUDDataRequest(u8pObj, u16Len)
ePE_PDFU_RESPONSE_CODE PDFW_ProcessPDFUDDataRequest( UINT8 u8RequestBuffer,
    UINT16 u16RequestLength)
{
    UINT16 u16DataBlockIndex = *((UINT16*)&u8RequestBuffer[2]);
    u32ProgAddr = CalculateAddress(u16DataBlockIndex);
    if( u32ProgAddr < 0xFFFFFu )
    {
        ProgramMemoryCB(u32ProgAddr, &u8RequestBuffer[4u],u16RequestLength);
        ReadMemoryCB(u32ProgAddr, &u8ResponseBuffer[0u],u16RequestLength);
        //Compare data written and read
        if (0 == MCHP_PSF_HOOK_MEMCMP(&u8ResponseBuffer[0],
            &u8RequestBuffer[4], u16RequestLength))
        {
            //Set the status as OK
            u8Status = ePE_FWUP_OK;
        }
        else
        {
            //Verification Stage failure
            u8Status = ePE_FWUP_errVERIFY;
        }
    }
    else
    {
        u8Status = ePE_FWUP_errADDRESS;
    }

    return u8Status;
}

```

10.2.11.6 MCHP_PSF_HOOK_VALIDATE_FIRMWARE**C**

```
#define MCHP_PSF_HOOK_VALIDATE_FIRMWARE 0
```

Description

This hook is invoked during the validation phase on reception of every PDFU Validation Request. It is responsible for validating the Firmware data in the memory. It shall return the progress status of the Validation on every invocation. If the Status indicates "On going" then the Validation command will be responded with the configured Wait time [CONFIG_VALIDATION_PHASE_WAITTIME](#). Validation Method can be any custom method as required by the User.

Preconditions

Multiple invocations of the function hook is possible from PDFU Validation phase. Until the Validation process is complete, for every request of PDFU_VALIDATION command this function will be invoked. The definition of this function shall include 1) Starting the Validation process on the First call, 2) Returning the Status of the Validation process during subsequent invocation of the function.

Returns

Returns the UINT8 Status of the Validation Operation. It take following values

0x00u - PE_FWUP_VALIDATION_SUCCESSFUL

0x01u - PE_FWUP_VALIDATION_INPROGRESS

0x02u - PE_FWUP_VALIDATION_FAILURE

Remarks



User definition of this Hook function is mandatory when [INCLUDE_PDFU](#) is TRUE

Example

```
#define MCHP_PSF_HOOK_VALIDATE_FIRMWARE() PDFW_ProcessPDFUDataRequest()
UINT8 PDFW_ProcessPDFUValidateRequest(void)
{
    The definition of this function shall include
    1) Starting the Validation process on the First call,
    2) Returning the Status of the Validation process during subsequent invocation of
    the function.
}
```

10.2.12 Hooks to Read Output Voltage and Current

Macros

| | Name | Description |
|---|--|---|
|  | MCHP_PSF_HOOK_GET_OUTPUT_CURRENT_IN_mA | Gets the output current. |
|  | MCHP_PSF_HOOK_GET_OUTPUT_VOLTAGE_IN_mV | Gets the current output voltage driven in the VBUS. |

Description

This section contains the hooks that are needed to read the Voltage and Current parameters from DC DC Controller.

10.2.12.1 MCHP_PSF_HOOK_GET_OUTPUT_CURRENT_IN_mA

C

```
#define MCHP_PSF_HOOK_GET_OUTPUT_CURRENT_IN_mA 0xFFFFFFFF
```

Description

This hook is called when PSF needs to know about the current drawn from external DC_DC controller. The function should be defined with return type UINT32 and UINT8 type as input parameter. If the DC_DC controller doesnot have feature to get output current, return 0xFFFFFFFF to denote the feature is not supported.

Preconditions

Output Current shall be returned in terms of mA.

Returns

None.

Remarks

User definition of this Hook function is mandatory when [INCLUDE_PD_SOURCE_PPS](#) is defined as '1'.

Example

```
#define MCHP_PSF_HOOK_GET_OUTPUT_CURRENT_IN_mV(u8PortNum)
DCDC_GetOutCurrent(u8PortNum)
UINT32 DCDC_GetOutCurrent(UINT8 u8PortNum)
{
    // return Output current driven by the external DC_DC controller
    // in terms of mA.
}
```

10.2.12.2 MCHP_PSF_HOOK_GET_OUTPUT_VOLTAGE_IN_mV

C

```
#define MCHP_PSF_HOOK_GET_OUTPUT_VOLTAGE_IN_mV 0xFFFFFFFF
```

Description

This hook is called when PSF needs to know about the present voltage driven by external DC_DC controller. The function

should be defined with return type UINT32 and UINT8 type as input parameter. If the DC_DC controller does not have feature to get output voltage, return 0xFFFFFFFF to denote the feature is not supported.

Preconditions

Output voltage shall be returned in terms of milliVolts.

Returns

None.

Remarks

User definition of this Hook function is mandatory when `INCLUDE_PD_SOURCE_PPS` is defined as '1'.

Example

```
#define MCHP_PSF_HOOK_GET_OUTPUT_VOLTAGE_IN_mV(u8PortNum)
DCDC_GetOutVoltage(u8PortNum)
UINT32 DCDC_GetOutVoltage(UINT8 u8PortNum)
{
    // return Output voltage driven by the external DC_DC controller
    // in terms of milliVolts
}
```

10.3 APIs to be called by the User application

Functions

| | Name | Description |
|---|--|--|
| ≡ | MchpPSF_Init | PSF initialization API |
| ≡ | MchpPSF_PDTimerHandler | PD Timer Interrupt Handler |
| ≡ | MchpPSF_UPDIrqHandler | UPD350 IRQ Interrupt Handler |
| ≡ | MchpPSF_RUN | PSF state machine run API |

Description

PSF APIs have to be called by the SoC User_Application for PSF to run as well as to get to know about the Timer and IRQ_N interrupt from the [UPD350](#). This section explains them in detail

10.3.1 MchpPSF_Init

C

```
UINT8 MchpPSF_Init();
```

Description

This API should be called by the SOC layer to initialize the PSF stack and [UPD350](#) Hardware.

Preconditions

API should be called before [MchpPSF_RUN\(\)](#).

Returns

TRUE - Stack and [UPD350](#) HW successfully initialized. FALSE - Stack and [UPD350](#) HW initialization failed.

Remarks

For the current PSF implementation, return value is not used. API called with void. With SAMD20 environment configured for CPU frequency 48MHZ, this API took maximum of 3.488ms and 6.182ms execution time for 1 and 2 port solution respectively.

10.3.2 MchpPSF_PDTimerHandler

C

```
void MchpPSF_PDTimerHandler();
```

Description

This API is used to handle the PD Timer (Software timer) Interrupt, User should call this API whenever the hardware timer interrupt triggered.

Preconditions

This API should be called inside the Hardware timer ISR.

Returns

None

Remarks

With SAMD20 environment configured for CPU frequency 48MHZ, this API took maximum of 262us execution time for both 1 and 2 port solution.

10.3.3 MchpPSF_UPDIrqHandler

C

```
void MchpPSF_UPDIrqHandler(
    UINT8 u8PortNum
);
```

Description

This API handles the [UPD350](#) IRQ_N Interrupt, User should call this API when the IRQ line interrupt triggered to the SOC. This API will services and then clear the Alert interrupt for corresponding port.

Preconditions

This API should be called inside the GPIO ISR for IRQ interrupt

Parameters

| Parameters | Description |
|------------|--|
| u8PortNum | Port number of the device. It takes value between 0 to (CONFIG_PD_PORT_COUNT -1). |

Returns

None

Remarks

With SAMD20 environment configured for CPU frequency 48MHZ, this API took maximum of 3.98us and 5.8us execution time for 1 and 2 port solution respectively.

10.3.4 MchpPSF_RUN

C

```
void MchpPSF_RUN();
```

Description

This API is to run the PSF state machine. For single threaded environment, it should be called repeatedly within a while(1).

Preconditions

API should be called only after `MchpPSF_Init()`.

Returns


None

Remarks

In SAMD20 environment where CPU frequency is configured for 48MHZ and single threaded environment where MchpPSF_RUN is called in a while(1) loop, it took maximum of 74.57us and 0.1439 ms execution time for 1 port and 2 source port solution respectively. In Multi threaded SAMD20 configured for 48MHz environment, MchpPSF_RUN can be called for every 1ms to 5ms for Successful 2-Port Source only operation.

11 Notification callback from PSF

Enumerations

| | Name | Description |
|---|-------------------------------------|-----------------------|
|  | <u>MCHP_PSF_NOTIFICATION</u> | PSF notification enum |

Macros

| | Name | Description |
|---|---|---|
|  | <u>MCHP_PSF_NOTIFY_CALL_BACK</u> | Notifies the USER_APPLICATION about various PD events from PSF. |

Description

This sections gives details on the all the notifications given by PSF through its callback.

11.1 MCHP_PSF_NOTIFICATION Enumeration

C

```
enum MCHP_PSF_NOTIFICATION {
    eMCHP_PSF_TYPEC_DETACH_EVENT = 1,
    eMCHP_PSF_TYPEC_CC1_ATTACH,
    eMCHP_PSF_TYPEC_CC2_ATTACH,
    eMCHP_PSF_TYPEC_ERROR_RECOVERY,
    eMCHP_PSF_UPDS_IN_IDLE,
    eMCHP_PSF_VCONN_PWR_FAULT,
    eMCHP_PSF_VBUS_PWR_FAULT,
    eMCHP_PSF_PD_CONTRACT_NEGOTIATED,
    eMCHP_PSF_SINK_CAPS_RCVD,
    eMCHP_PSF_SINK_CAPS_NOT_RCVD,
    eMCHP_PSF_CAPS_MISMATCH,
    eMCHP_PSF_NEW_SRC_CAPS_RCVD,
    eMCHP_PSF_SINK_ALERT_RCVD,
    eMCHP_PSF_SINK_STATUS_RCVD,
    eMCHP_PSF_SINK_STATUS_NOT_RCVD,
    eMCHP_PSF_BUSY
};
```

Description

eMCHP_PSF_NOTIFICATION enum defines the all the notifications PSF can notify via **MCHP_PSF_NOTIFY_CALL_BACK**.

eMCHP_PSF_TYPEC_DETACH_EVENT: This event is posted by PSF Type C state machine when port partner Detach event is detected.

eMCHP_PSF_TYPEC_CC1_ATTACH: This event is posted by PSF Type C state machine when port partner Type C attach is detected in CC1 pin.

eMCHP_PSF_TYPEC_CC2_ATTACH: This event is posted by PSF Type C state machine when port partner Type C attach is detected in CC2 pin.

eMCHP_PSF_TYPEC_ERROR_RECOVERY: This event is posted by PSF Type C state machine when the port has entered Type C Error Recovery state.

eMCHP_PSF_UPDS_IN_IDLE: This event is posted by Power management control. PSF runs an algorithm backend for Power management control. If there is no activity in **UPD350** for **CONFIG_PORT_UPD_IDLE_TIMEOUT_MS** corresponding **UPD350** is put to low power mode. When all the **UPD350** present in the system enters low mode, eMCHP_PSF_UPDS_IN_IDLE is posted. User can put SOC in low power mode as required on this notification. This notification occurs only when **INCLUDE_POWER_MANAGEMENT_CTRL** defined as 1.

eMCHP_PSF_VCONN_PWR_FAULT: [UPD350](#) has VCONN comparators to detect VCONN OCS faults. This event is notified when VCONN OCS fault is detected by [UPD350](#). For this notification, PSF expects a return value to decide whether to handle the fault occurred. When user returns TRUE for VCONN power fault, Incase of explicit contract, if VCONN power fault count is less than CONFIG_MAX_VCONN_POWER_FAULT_COUNT, PSF DPM power fault manager handles it by sending Hard Reset. If the count exceeds max fault count,VCONN is powered off until physical detach of port partner. Incase of implicit contract, PSF handles by entering TypeC Error Recovery. This notification occurs only when [INCLUDE_POWER_FAULT_HANDLING](#) is defined as 1.

eMCHP_PSF_VBUS_PWR_FAULT : PSF notifies all VBUS power fault VBUS Over voltage, VBUS under voltage, VBUS OCS via this notification. For this notification, PSF expects a return value to decide whether to handle the fault occurred. When user returns TRUE for power fault, Incase of explicit contract, if power fault count is less than CONFIG_MAX_VBUS_POWER_FAULT_COUNT, PSF DPM power fault manager handles it by sending Hard Reset. When the power fault count exceeds the max fault count,CC termination on the port is removed until the physical detach of the port partner. Incase of implicit contract, PSF handles by entering TypeC Error Recovery. This notification occurs only when [INCLUDE_POWER_FAULT_HANDLING](#) is defined as 1.

eMCHP_PSF_PD_CONTRACT_NEGOTIATED : PSF notifies when PD contract is established with the Port partner.

eMCHP_PSF_SINK_CAPS_RCVD : This event is used by PSF to notify application when Sink capabilities has been received from Port Partner in response to the Get_Sink_Caps message initiated by PSF on request from the application through u32ClientRequest variable in sPerPortDatastructure. Application can read the sink capabilities by accessing gasCfgStatusData.sPerPortData[u8PortNum].u32aPartnerPDO[7].

eMCHP_PSF_SINK_CAPS_NOT_RCVD : This event is used by PSF to notify application when Sink capabilities has not been received from Port Partner within tSenderResponseTimer as a response to the Get_Sink_Caps message initiated by PSF on request from application through u32ClientRequest variable in sPerPortDatastructure.

eMCHP_PSF_CAPS_MISMATCH : It is notified by PSF when there is a capability mismatch with Source partner PDOs in a PD negotiation.

eMCHP_PSF_NEW_SRC_CAPS_RCVD : It is notified by PSF when new source capability message is received from the Source Partner.

eMCHP_PSF_SINK_ALERT_RCVD : This event is used by PSF to notify application when PD Alert message has been received from Sink Partner. Application can read the alert information by accessing gasCfgStatusData.sPerPortData[u8PortNum].u32PartnerAlert.

eMCHP_PSF_SINK_STATUS_RCVD : This event is used by PSF to notify application when Sink Status has been received from Port Partner in response to the Get_Status message initiated by PSF on request from the application. Application can read the Sink Status by accessing gasCfgStatusData.sPerPortData[u8PortNum].u8aPartnerStatus[6]

eMCHP_PSF_SINK_STATUS_NOT_RCVD : This event is used by PSF to notify application when Sink Status has not been received from Port Partner within tSenderResponseTimer as a response to the Get_Status message initiated by PSF on request from application. gasCfgStatusData.sPerPortData[u8PortNum].u8aPartnerStatus[6] would have 0 when this notification is posted.

eMCHP_PSF_BUSY : This event is used by PSF to indicate that it is Busy due to which it cannot process any of the client requests, say Renegotiation, Get Sink Caps, Get Status, etc., which were raised by the application through u32ClientRequest variable in sPerPortDatastructure. On receiving this notification, the application can re-initiate the request.

Members

| Members | Description |
|----------------------------------|--|
| eMCHP_PSF_TYPEC_DETACH_EVENT = 1 | Detach event has occurred |
| eMCHP_PSF_TYPEC_CC1_ATTACH | Port partner attached at CC1 orientation |
| eMCHP_PSF_TYPEC_CC2_ATTACH | Port partner attached at CC2 orientation |
| eMCHP_PSF_TYPEC_ERROR_RECOVERY | Entered Error recovery State |
| eMCHP_PSF_UPDS_IN_IDLE | All the UPD350s are in Idle |
| eMCHP_PSF_VCONN_PWR_FAULT | VCONN Power Fault has occurred |

| | |
|----------------------------------|---|
| eMCHP_PSF_VBUS_PWR_FAULT | VBUS Power Fault has occurred |
| eMCHP_PSF_PD_CONTRACT_NEGOTIATED | PD Contract established with port partner |
| eMCHP_PSF_SINK_CAPS_RCVD | Sink Caps received from Port Partner |
| eMCHP_PSF_SINK_CAPS_NOT_RCVD | Sink Caps not received from Port Partner |
| eMCHP_PSF_CAPS_MISMATCH | Capability mismatch with Source Port Partner |
| eMCHP_PSF_NEW_SRC_CAPS_RCVD | New source capability message is received from Source Partner |
| eMCHP_PSF_SINK_ALERT_RCVD | Alert message received from Sink Partner |
| eMCHP_PSF_SINK_STATUS_RCVD | Sink Status received from Sink Partner |
| eMCHP_PSF_SINK_STATUS_NOT_RCVD | Sink Status not received from Sink Partner |
| eMCHP_PSF_BUSY | PSF is busy, cannot handle client request |

Remarks

None

11.2 MCHP_PSF_NOTIFY_CALL_BACK

C

```
#define MCHP_PSF_NOTIFY_CALL_BACK(u8PortNum, ePSFNotification)
```

Description

This hook is called by the various modules of PSF to notify the USER_APPLICATION about different PD events such as Type-C Attach and Detach , Type-C Orientation. USER_APPLICATION can define this hook function if it wants external handling of the PD events. Define relevant function that has UINT8, eMCHP_PSF_NOTIFICATION argument without return type.

Preconditions

None.

Parameters

| Parameters | Description |
|------------------|--|
| u8PortNum | Port number of the device. It takes value between 0 to (CONFIG_PD_PORT_COUNT-1). |
| ePSFNotification | Type of Notification occurred inside the stack. This argument can take one of the values from enum eMCHP_PSF_NOTIFICATION. |

Returns

UINT8 - Except for eMCHP_PSF_VCONN_PWR_FAULT and eMCHP_PSF_VBUS_PWR_FAULT the return value is ignored by PSF. For eMCHP_PSF_VCONN_PWR_FAULT and eMCHP_PSF_VBUS_PWR_FAULT event, user can return TRUE - if the Power fault shall be handled by PSF FALSE - if the Power fault occurrence is ignored.

Remarks

User definition of this Hook function is mandatory

Example

```
#define MCHP_PSF_NOTIFY_CALL_BACK(u8PortNum, ePSFNotification)
    HookNotifyPDEvents(u8PortNum, ePSFNotification)
void HookNotifyPDEvents(UINT8 u8PortNum, eMCHP_PSF_NOTIFICATION ePSFNotification);
void HookNotifyPDEvents(UINT8 u8PortNum, eMCHP_PSF_NOTIFICATION ePSFNotification)
{
    // Return for Power fault notification
    // Implement user specific application as required
}
```