



# 生態永續共存的Type C 充電



A Leading Provider of Smart, Connected and Secure Embedded Solutions

4月22日是世界地球日，2023年邁入第53周年。  
今年以「投資我們的星球」（Invest in our planet）  
。環保、減碳、對抗暖化不是口號，如何簡單救地球？  
帶你一起探討與了解。



SMART | CONNECTED | SECURE

May ESS 2023

2023 May ESS Sustainability 發掘生態永續共存的商機

# Agenda

## 生態永續共存的Type C充電

- 未來全球標準連接器- **USB-C充電**
- **USB C PD (Power Delivery ) 充電的標準**
- **Microchip PD 電源解決方案**
  - AIPD PMPD**
  - UNG USB PD HUB**



Are your chargers piling up in a drawer?

We propose a common charger for mobile phones and other similar electronic devices.

A single charger will be more convenient for people and will reduce electronic waste.

Read more: [europa.eu/!bVgVXY](https://europa.eu/!bVgVXY) #DigitalEU



歐盟通過了這樣的立法決議，旨在減少浪費電子垃圾，並提高電子產品的可持續性。根據這一決議，自2020年起，所有新生產的智能手機、平板電腦、電子書、手持式遊戲機等可攜式電子產品，都需要使用USB-C充電介面。

可重複使用的充電線和充電器：由於USB Type C充電線可以與多種不同品牌的產品兼容，因此用戶可以使用相同的充電線和充電器來為多種不同產品充電。這種可重複使用的充電方案可以減少用戶購買不同的充電線和充電器所產生的浪費和成本。



iPhone 14 Pro Max



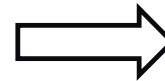
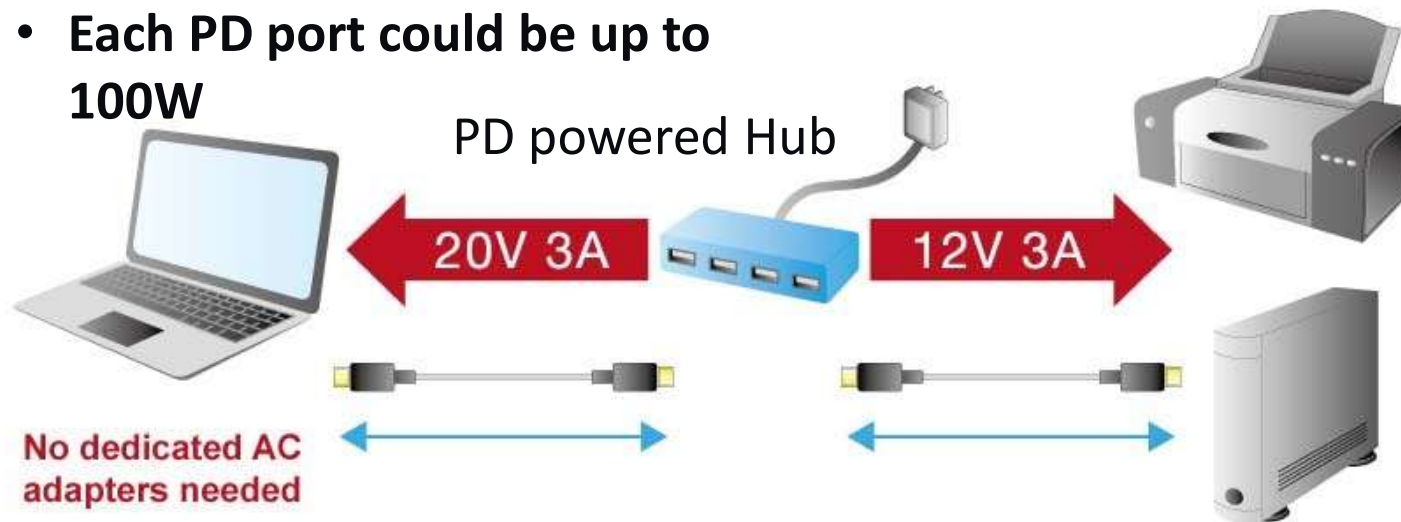
USB-C 對 Lightning 連接線

#### 我們的環境目標。

為實現我們在 2030 年前達到碳中和的目標，iPhone 14 Pro 與 iPhone 14 Pro Max 不隨附電源轉接器或 EarPods。包裝盒內隨附的是一條支援快速充電的 USB-C 對 Lightning 連接線，並可與 USB-C 電源轉接器及電腦連接埠相容。

# DC power adaptors could be replaced by USB C PD

- Each PD port could be up to 100W



# USB-Type C PD支援高充電功率

	Type-C	Micro USB	Lightning
特色	支援雙向插拔	有正反兩面	支援雙向插拔
充電效率	支援快充、充電快速	普通	普通
適用裝置	較新款的 Android 系列手機、Macbook、iPad、筆電、Switch 皆可充	早期推出的 Android 系列手機、行動電源	iPhone、iPad Air第三代、iPad





# Who Is Adopting USB C PD?

## Type C 電源提供 的裝置



## Type C 電源消耗的裝置



2025 May ESS Sustainability 發掘生態永續共存的機會



USB C PD (Power Delivery) 充電的標準





# USB-IF PD 規範 – PD 規格介紹

PD 3.0 之後, 2021 年 5 月 USB-IF 在 Power Delivery 加入了新的規格, 並發表 **PD 3.1** 規範, 以下內容皆以 PD 3.1

新的規範中加入 **EPR** ( **Extend Power Range** ) 功能, 擴展 PD 3.0 供電最大瓦數 100W 的限制, 增加到 240W ( 48V 5A )

- SPR Fixed PDO : 5V@3A~5A 、 9V@3A~5A 、 15@3A~5A 、 20V@5A

- EPR Fixed PDO : 28V@5A

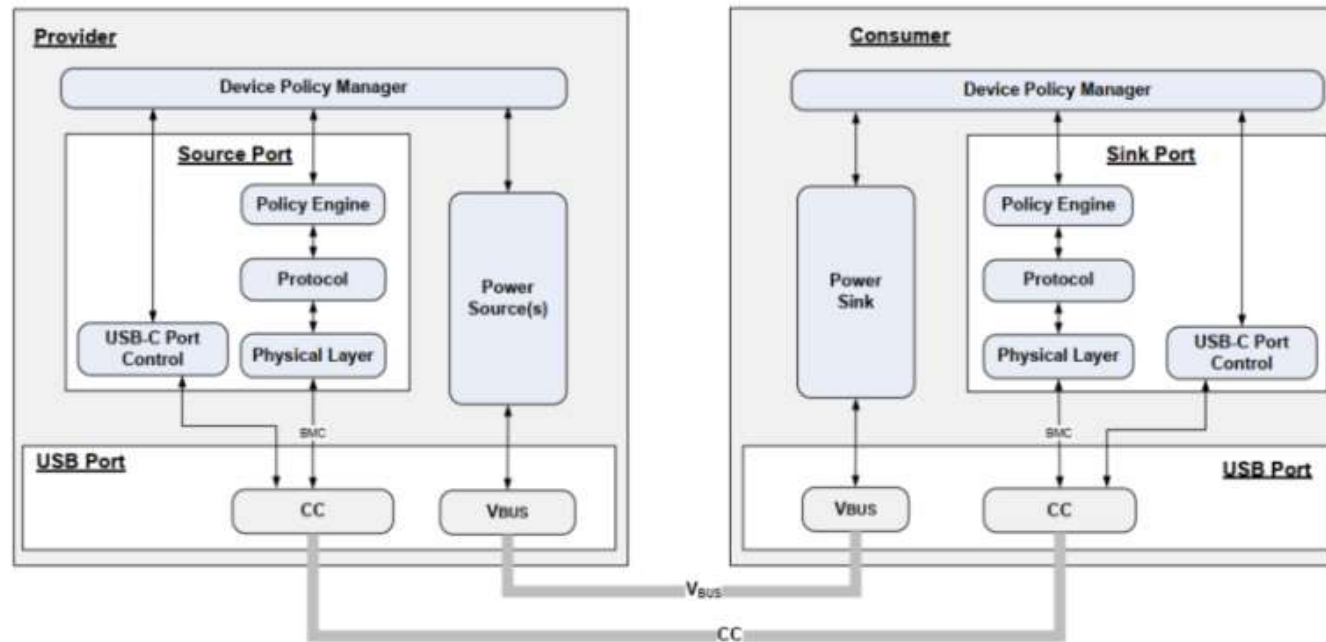
- AVS APDO 15V~28V

- AVS 類似 PPS 功能, AVS 不支援 Current Limit 操作, 且以 100 mV 為單位步階調整輸出電壓  
( PPS 則是 20mV ) 。

USB-IF在2019年初已正式推出Type-C安全驗證機制, 只有在主機、充電器跟線纜三方彼此認證通過後, 才會進入快速充電模式.

# USB PD 架構圖( PD 3.0 Spec )

以 Source 端舉例說明, Device Policy Manager 主要監控裝置整體使用狀況, 包含: 控制 Power Source 和 USB-C Port Control 模組, 並與 Policy Engine 合作以調節電源分配, 。USB C Source 端透過USB CC pin 和充電裝置達到充電協議後 由 Physical Layer (PHY Layer)、Protocol、Policy Engine 三部分共同合作, 由source 端提供出可充電電源 透過 VBUS pin 供電給對方。



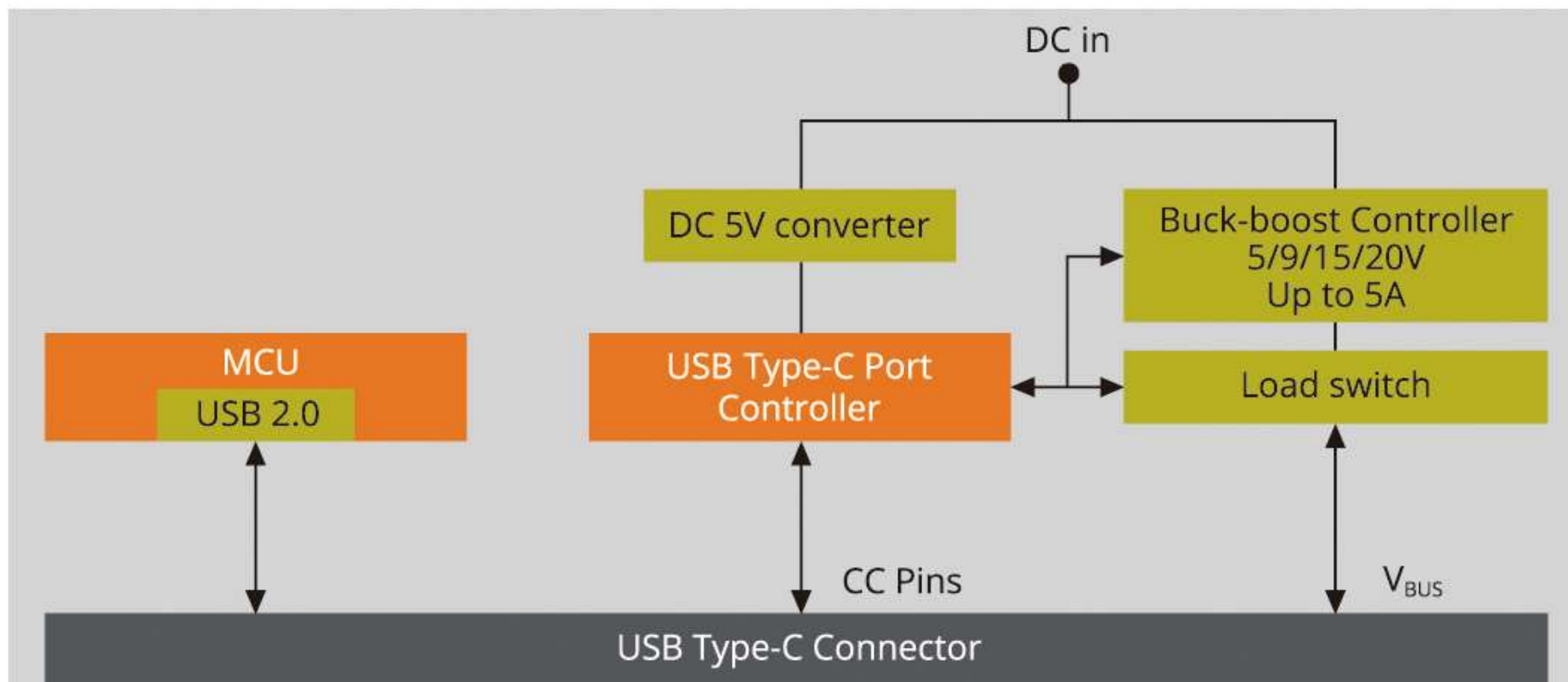
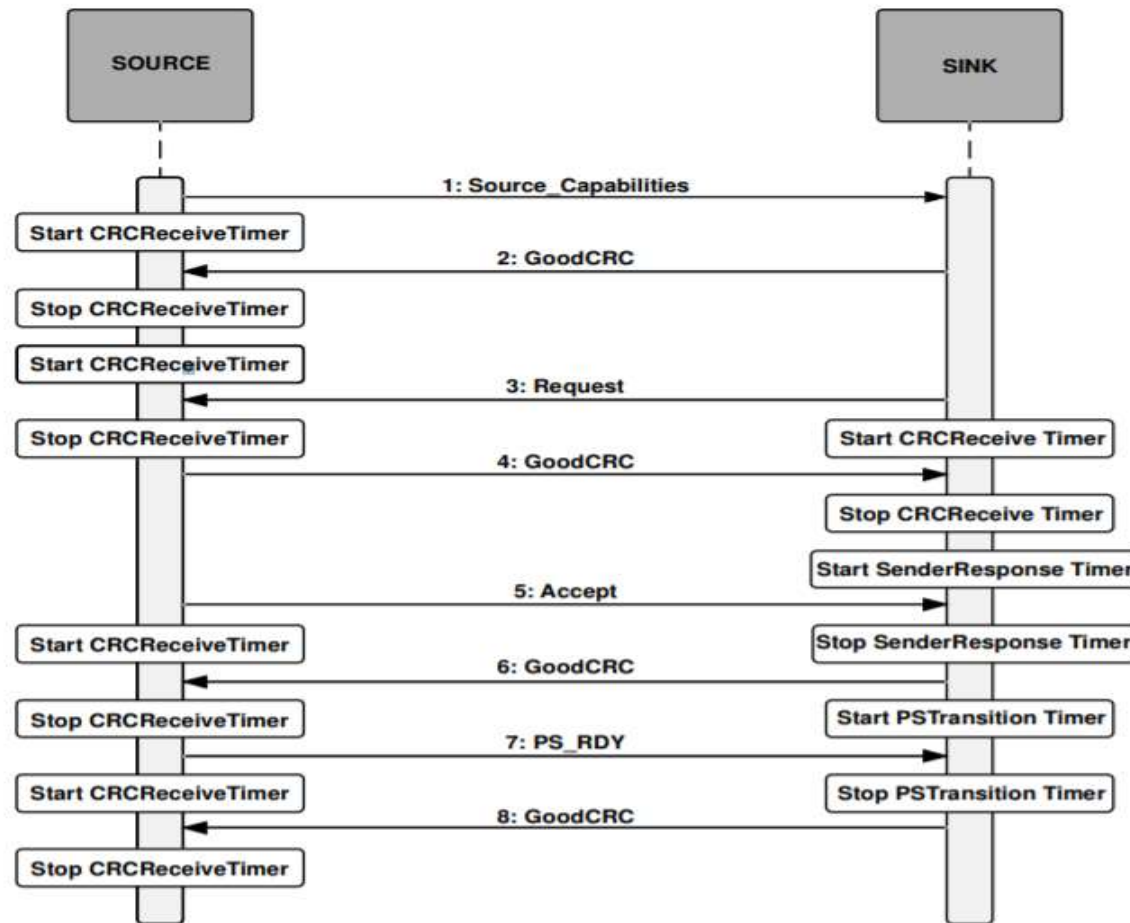


圖 (一) Type-C 電源的連接方塊圖

# Type C Simplified explicit contract negotiation

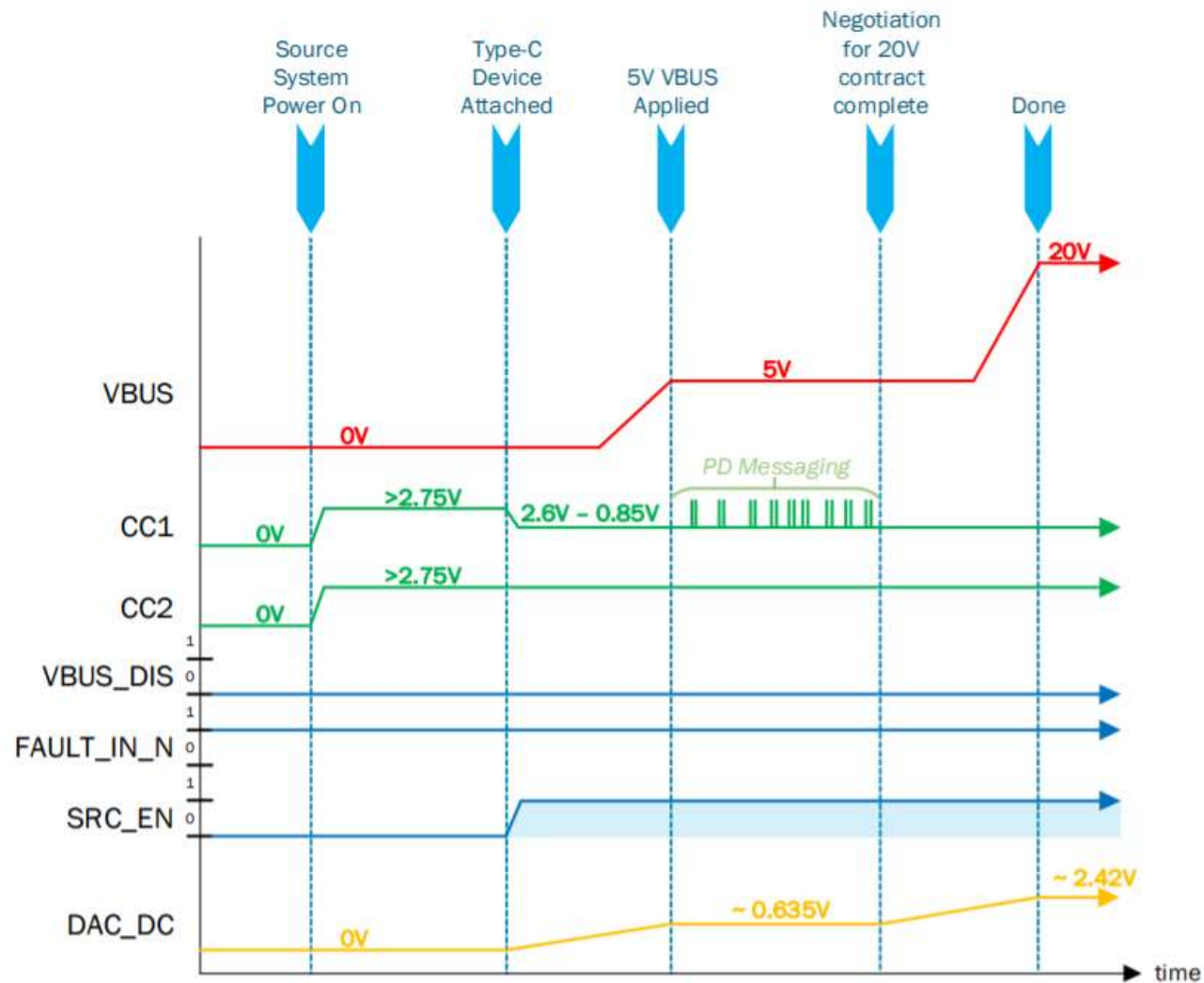


# PD protocol Analysis USB C Source and Sink

87	4.721506	5.118	-0.002	0.001	Spec	Index	m:s.ms.us	Dur	Len	Err	CC	Role	Message	Data
88	4.729506	5.118	-0.002	0.001		0	0:00.000.000						● Capture started	[11/29/21 16:55:15]
89	4.737506	5.118	-0.002	0.001	v3.0	1	0:04.709.733	1.16...	26 B		1	Source:DFP ↓	⚡ [0]Source_Cap	SOP H=0x51A1 0x0801912C 0x0002D12...
90	4.745506	5.118	-0.002	0.001	v3.0	2	0:04.709.733	1.16...	350 b		1	Source:DFP ↓	⚡ BMC	010101010101010101010101010101...
91	4.753506	5.118	-0.002	0.001	v3.0	3	0:04.709.946	66.0...	2 B		1	Source:DFP ↓	⚡ PD Header	MsgId=0 Msg=Source_Cap ObjCounts=5
92	4.761506	5.118	-0.002	0.001	v3.0	4	0:04.710.012	133 us	4 B		1	Source:DFP ↓	⚡ PD Data 0	Pos=1 Type=Fixed FixedVol=5.00V MaxC...
93	4.769506	5.118	-0.002	0.001	v3.0	5	0:04.710.145	133 us	4 B		1	Source:DFP ↓	⚡ PD Data 1	Pos=2 Type=Fixed FixedVol=9.00V MaxC...
94	4.777506	10.611	-0.002	0.001	v3.0	6	0:04.710.278	133 us	4 B		1	Source:DFP ↓	⚡ PD Data 2	Pos=3 Type=Fixed FixedVol=12.00V Max...
95	4.785506	10.611	-0.003	0.001	v3.0	7	0:04.710.412	133 us	4 B		1	Source:DFP ↓	⚡ PD Data 3	Pos=4 Type=Fixed FixedVol=15.00V Max...
96	4.793506	10.611	-0.003	0.001	v3.0	8	0:04.710.545	133 us	4 B		1	Source:DFP ↓	⚡ PD Data 4	Pos=5 Type=Fixed FixedVol=20.00V Max...
97	4.801506	10.611	-0.003	0.001		9	0:04.710.847	502 us	6 B		1	Sink:UFP ↑	⚡ [0]GoodCRC	SOP H=0x0041 CRC=0xA8BB6CBB EOP
98	4.809506	10.611	-0.003	0.001		10	0:04.710.847	502 us	150 b		1	Sink:UFP ↑	⚡ BMC	010101010101010101010101010101...
99	4.817506	10.611	-0.003	0.001		11	0:04.711.060	66.0...	2 B		1	Sink:UFP ↑	⚡ PD Header	MsgId=0 Msg=GoodCRC ObjCounts=0
00	4.825506	10.611	-0.003	0.001		12	0:04.711.886	636 us	10 B		1	Sink:UFP ↑	⚡ [0]Request	SOP H=0x1082 0x4004B12C CRC=0xB...
01	4.833506	13.318	-0.003	0.001	v3.0	13	0:04.711.886	636 us	190 b		1	Sink:UFP ↑	⚡ BMC	010101010101010101010101010101...
02	4.841506	13.318	-0.002	0.001	v3.0	14	0:04.712.099	66.0...	2 B		1	Sink:UFP ↑	⚡ PD Header	MsgId=0 Msg=Request ObjCounts=1
03	4.849506	13.318	-0.002	0.002	v3.0	15	0:04.712.165	133 us	4 B		1	Sink:UFP ↑	⚡ PD Data 0	ReqPos=4 Type=Fixed OpCur=3.00A Ma...
04	4.857506	13.318	-0.002	0.002		16	0:04.712.442	497 us	6 B		1	Source:DFP ↓	⚡ [0]GoodCRC	SOP H=0x01A1 CRC=0x81C2AFC1 EOP
05	4.865506	13.318	-0.002	0.002		19	0:04.716.114	497 us	6 B		1	Source:DFP ↓	⚡ [1]Accept	SOP H=0x03A3 CRC=0x5DFAAC6F EOP
06	4.873506	13.318	-0.002	0.002	v3.0	22	0:04.716.560				1		⚡ PD	
07	4.881506	14.407	-0.002	0.002		23	0:04.716.670	499 us	6 B		1	Sink:UFP ↑	⚡ [1]GoodCRC	SOP H=0x0241 CRC=0x46B50D97 EOP
08	4.889506	14.407	-0.002	0.002		26	0:04.962.442	501 us	6 B		1	Source:DFP ↓	⚡ [2]PS_RDY	SOP H=0x05A6 CRC=0xC9EEFD1F EOP
09	4.897506	14.407	-0.002	0.001	v3.0	29	0:04.963.098	499 us	6 B		1	Sink:UFP ↑	⚡ [2]GoodCRC	SOP H=0x0441 CRC=0xAFD6A8A2 EOP
10	4.905506	14.407	-0.002	0.001		32	36:01.808.104						● Capture stopped	[11/29/21 17:31:27]
11	4.913506	14.407	-0.002	0.001										
12	4.921506	14.407	-0.002	0.001										

Power adapter source PDO to PSF



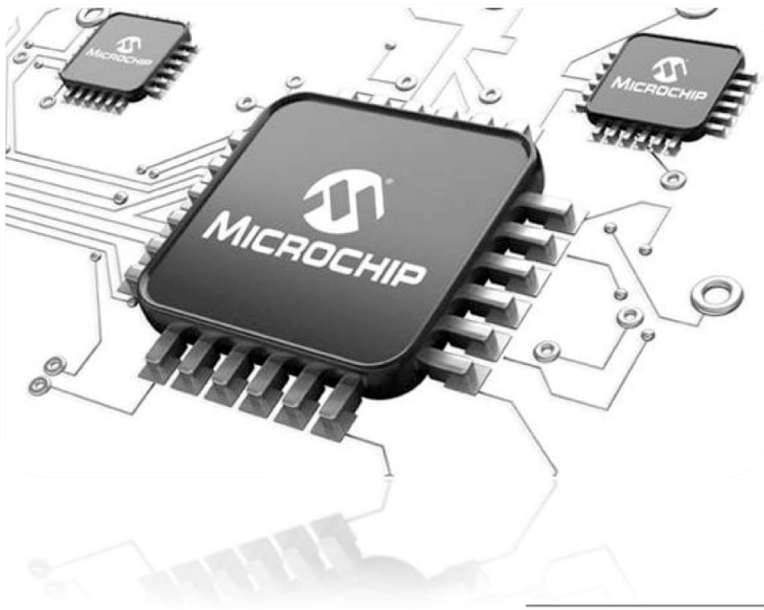


**Connection:**  
Fixed Source-Only DFP >  
PD Device

**Orientation:**  
CC wire connected to CC1  
pin

**Type-C Implicit Current (Rp):**  
3A

**Cable Type:**  
Passive Cable



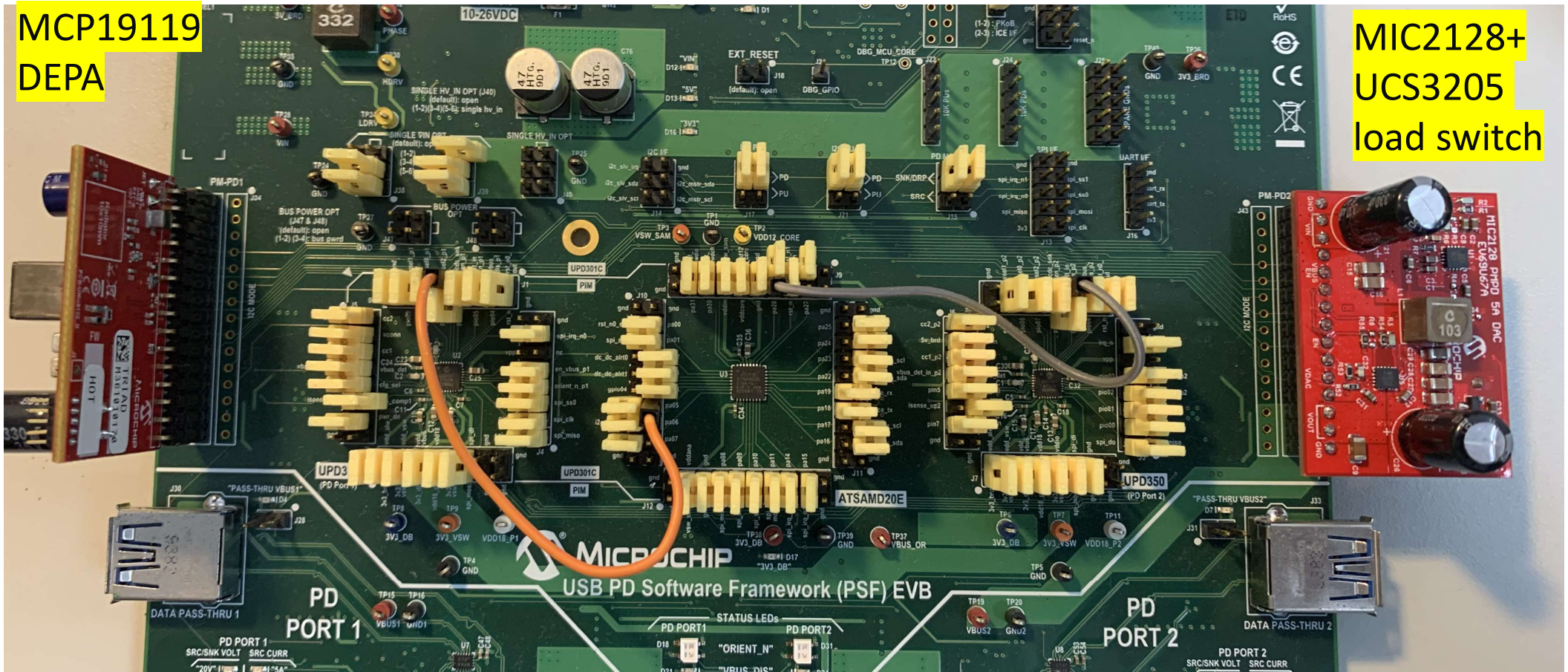
## • Microchip PD 電源解決方案



# Microchip Type C EVB –PSF EVB

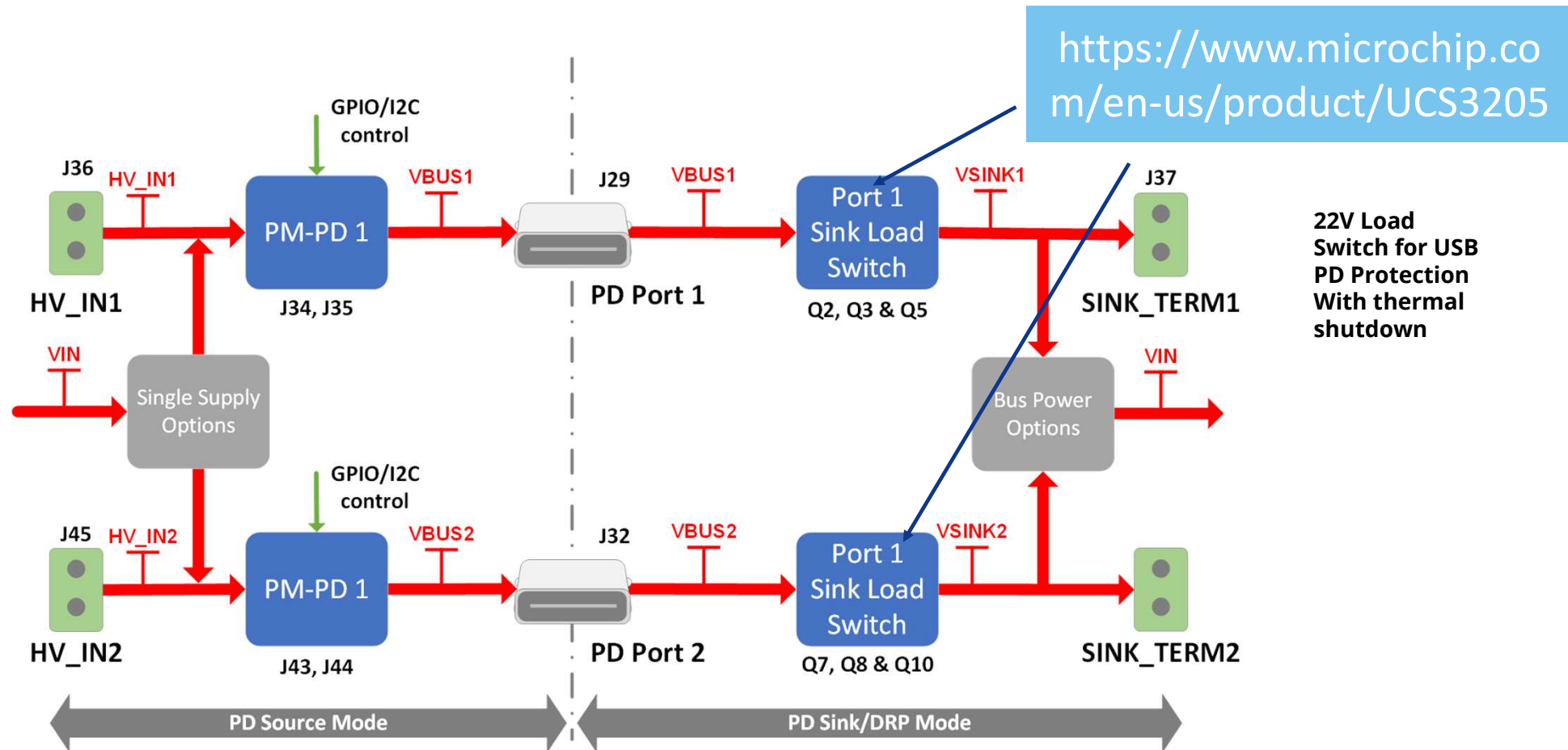
MCP19119  
DEPA

MIC2128+  
UCS3205  
load switch



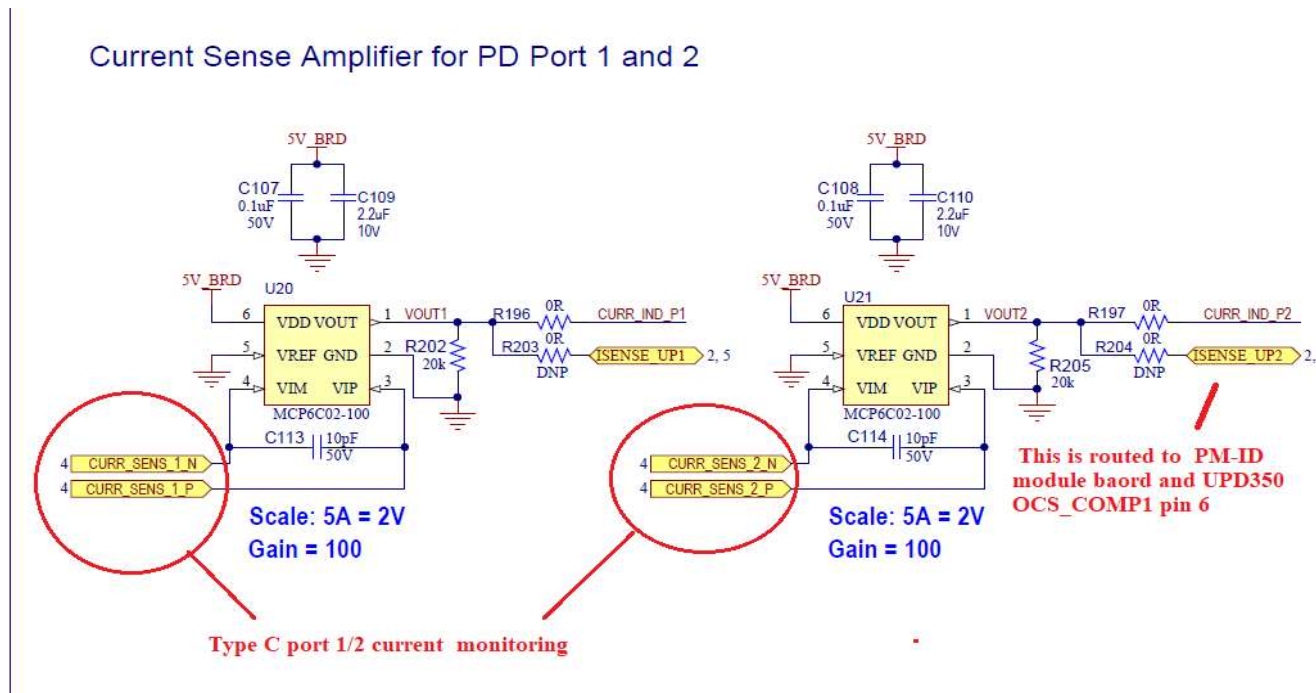


# Type C Power Delivery Power Source /Sink



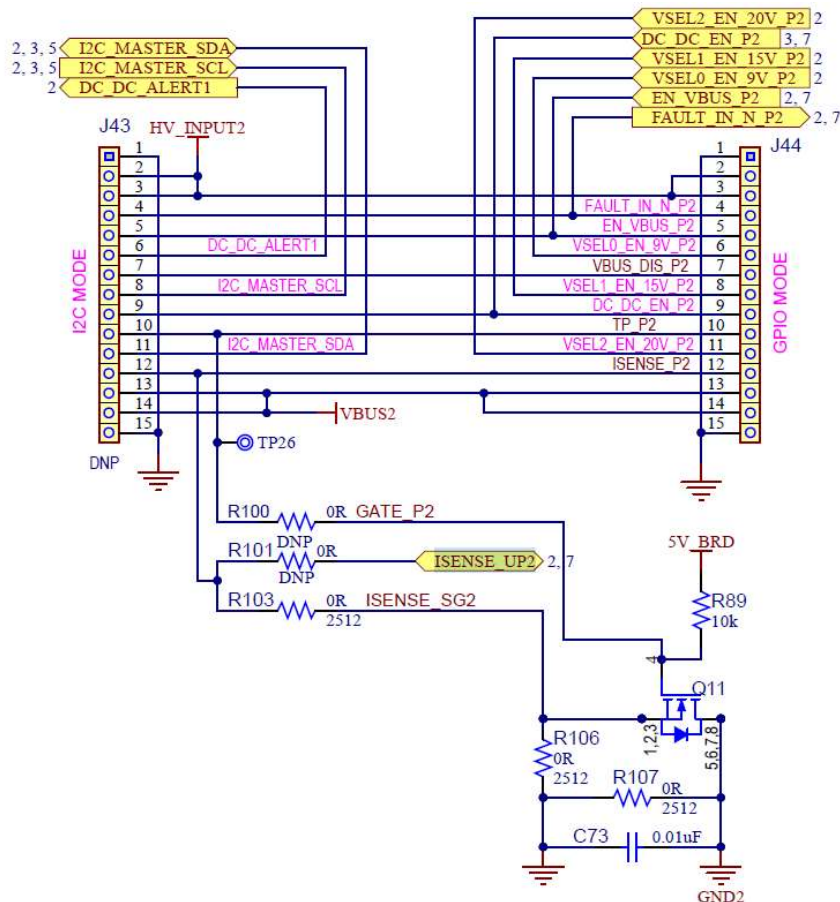
# Microchip Type C on PSF EVB

- **PM-PD module board**
  - **UPD350 + PIM MCP19119 DEPA** + Diode load switch  
(PMPD\_MCP19119\_GPIO.X FW code modification is needed if PD profile is added or changed )  
Or **MIC 2128+UCS3205 load switch** (PD profile is added or changed by HW )
- The onboard **MCP6C02** (U20 and U21) current sense amplifiers is used to measure Type C vbus current





# PM-PD module board IO pin definition



- GPIO mode PM-PDs should be exemplified to connect to headers J44 on the EVB-PSF.** The PMPD-VM-HOT modules provided in the evaluation kit are controlled by GPIOs and work in “One-Hot” mode where the voltage output is determined by the following truth table:

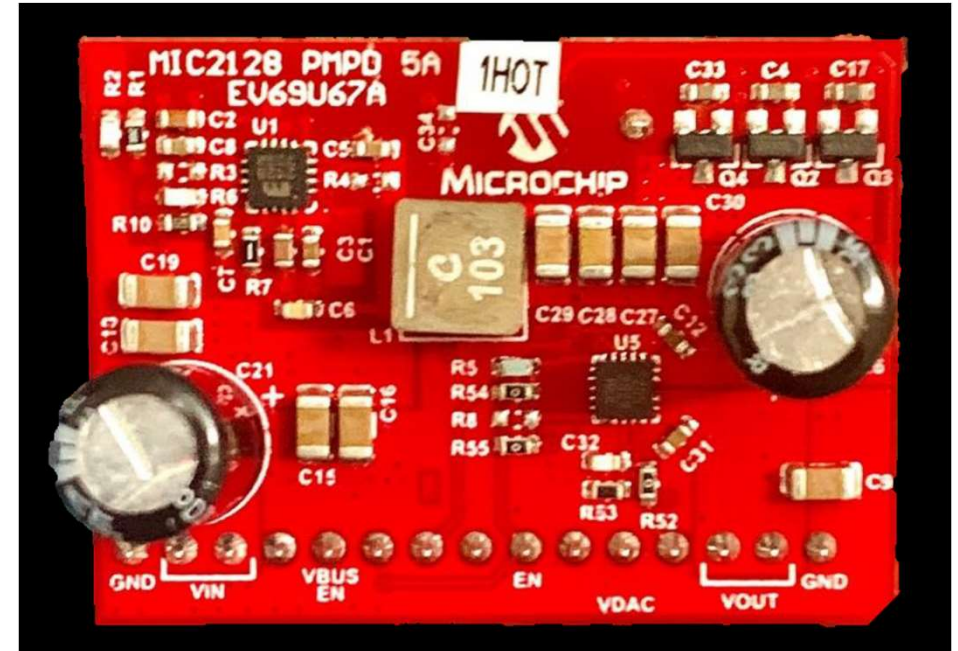
Output Voltage	VSEL0	VSEL1	VSEL2
5 V	0	0	0
9 V	1	0	0
15 V	0	1	0
20 V	0	0	1

PM-PD modules are configured by default to output 5 V because of weak pull-downs on the VSEL[0:2] and DC\_DC\_EN pins  
 5 V will be available on the PD port only when the load switch (UCS3205) is turned on by PSF EVB SAMD21 MCU IO

# PM-PD

02-00066: PM-PD-VM HOT

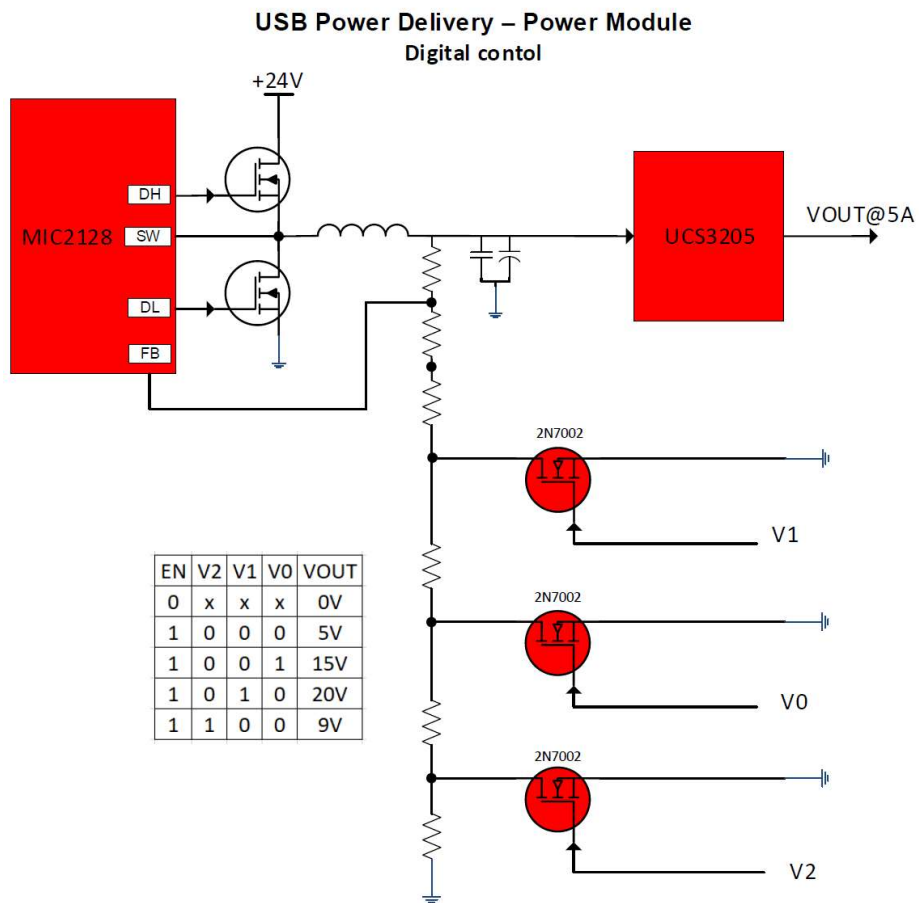
- MIC2128 Buck DC-DC + UCS3205 Load Switch (5A)
- Can support 100W operation with PSF
- Controlled via GPIOs VSEL[0:2]
- Sold separately for existing designs
- Bundled with future designs



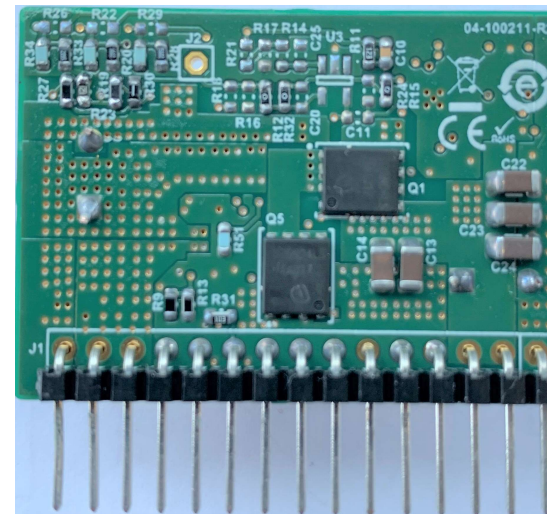
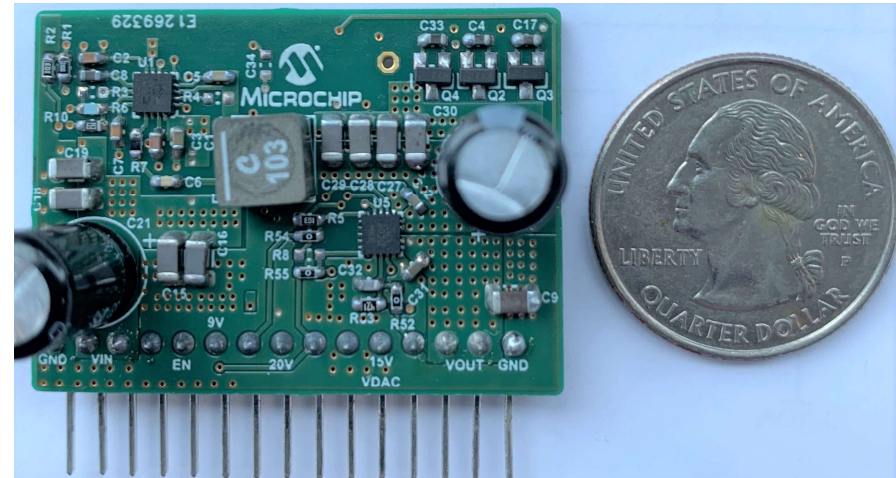
Status:  
Available

# USB Power Delivery – Power Module – Digital Control

## Block Diagram



## Functional Prototype



### Microchip Devices

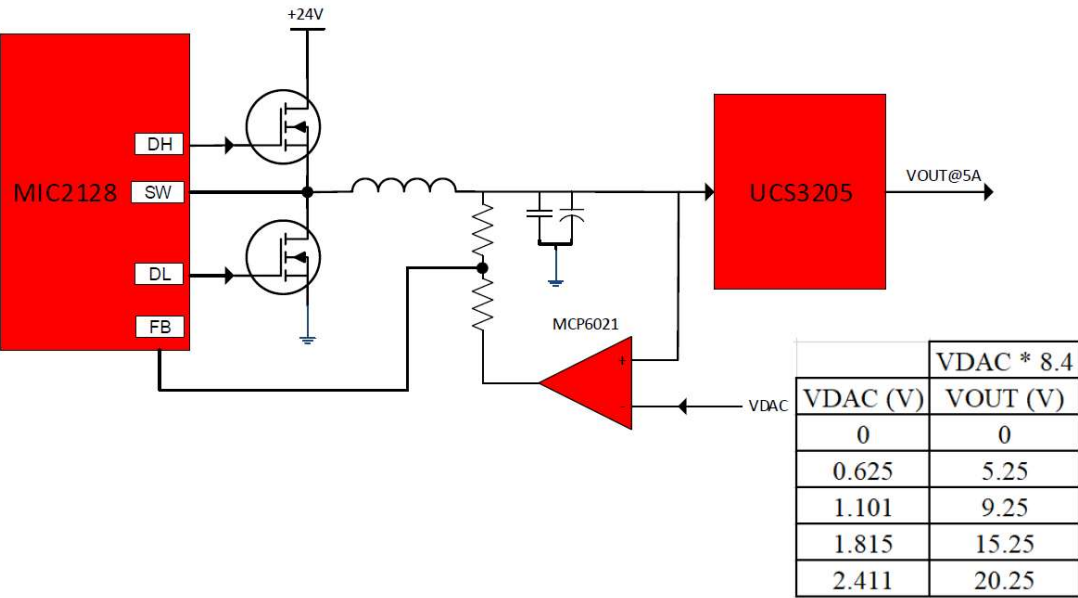
- MIC2128
- UCS3205
- 2N7002



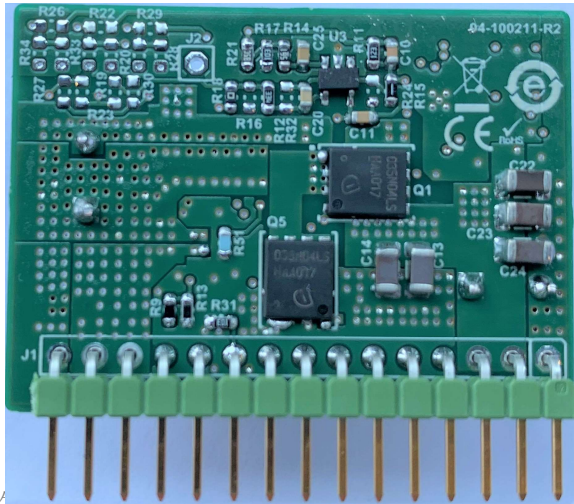
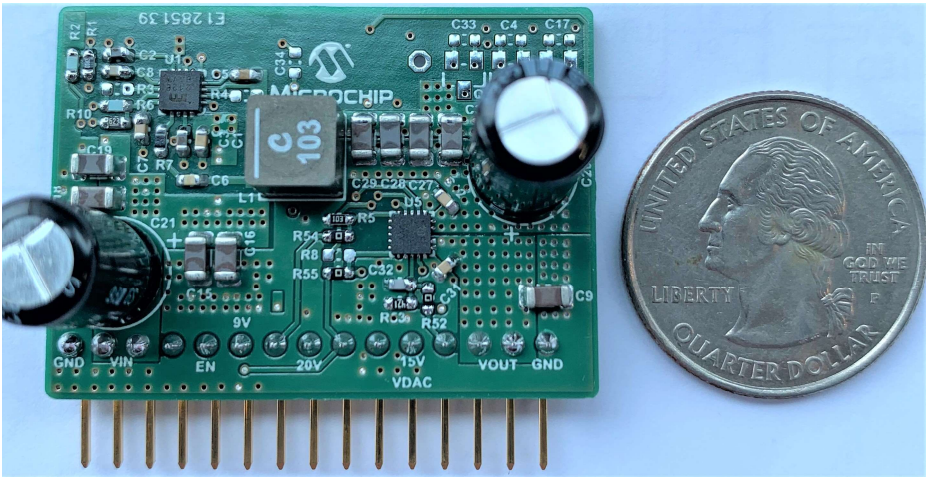
# USB Power Delivery – Power Module – Analog Control

## Block Diagram

USB Power Delivery – Power Module  
Analog control



## Functional Prototype



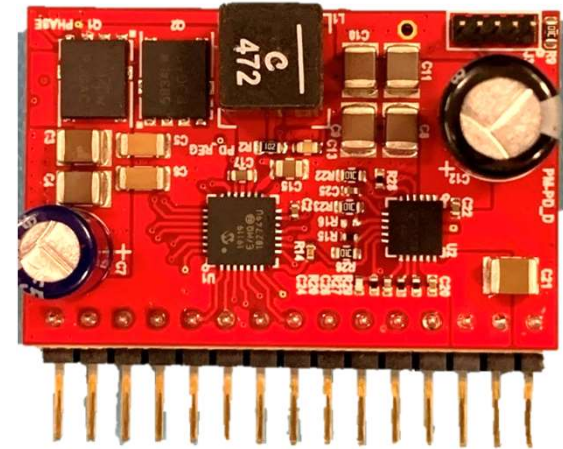
### Microchip Devices

- MIC2128
- UCS3205
- MCP6021

# PM-PD

02-00066: PM-PD-VM HOT

- PM-PD – Power Module for Power Delivery
- Ships as part of the PSF Evaluation Kit
- **MCP19119 DEPA controller**  
Buck only. Needs 24V input for sourcing 60W
- Controlled via GPIOs  
VSEL[0:2]

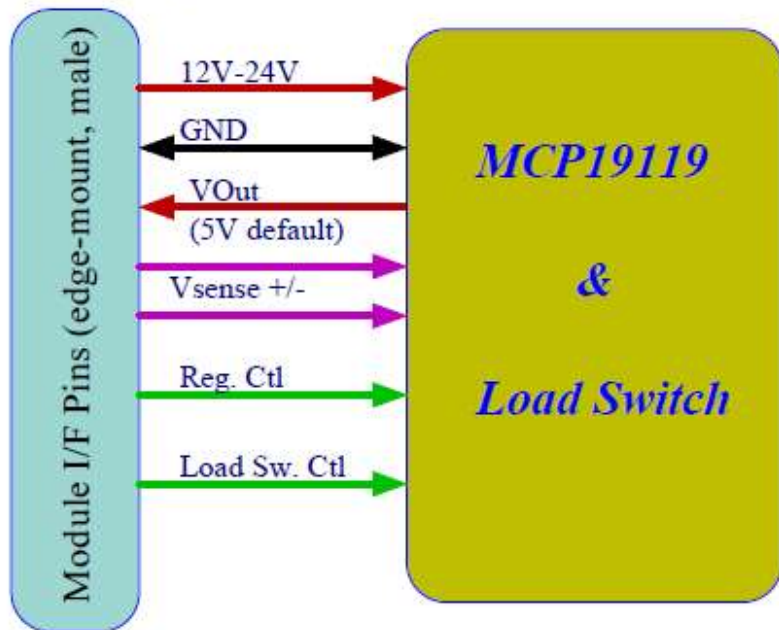


Status: **Available**

APID Contacts: ESE Wayne Tsou



# PFS EVB via MCP19119 +DPS1133 (load switch)



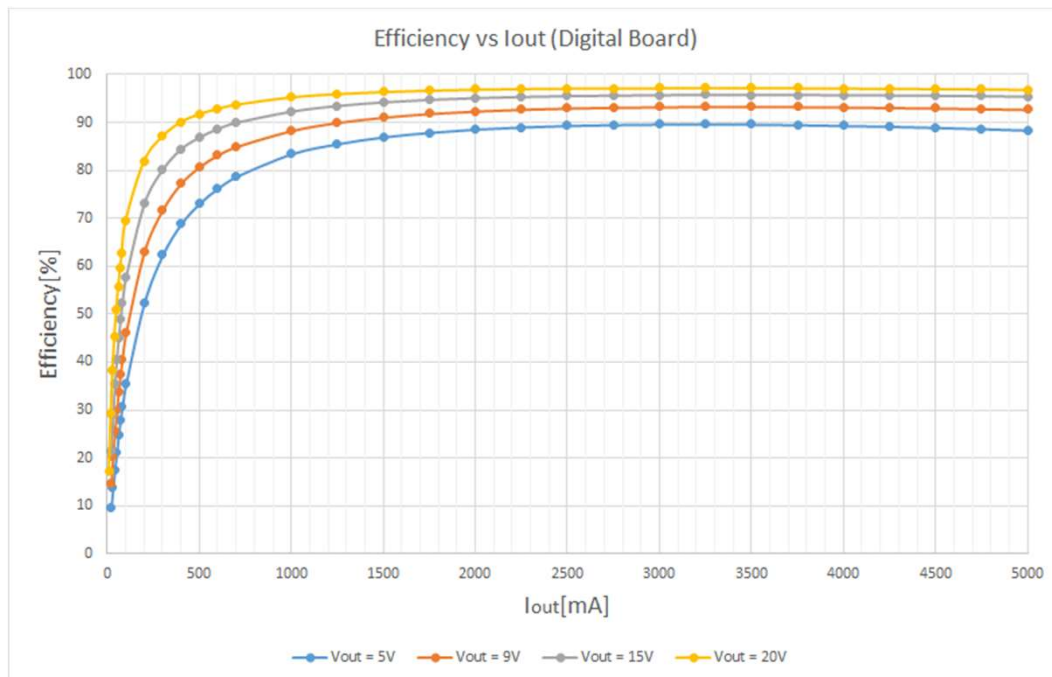
PFS –EVB

PM-PD GPIO mode

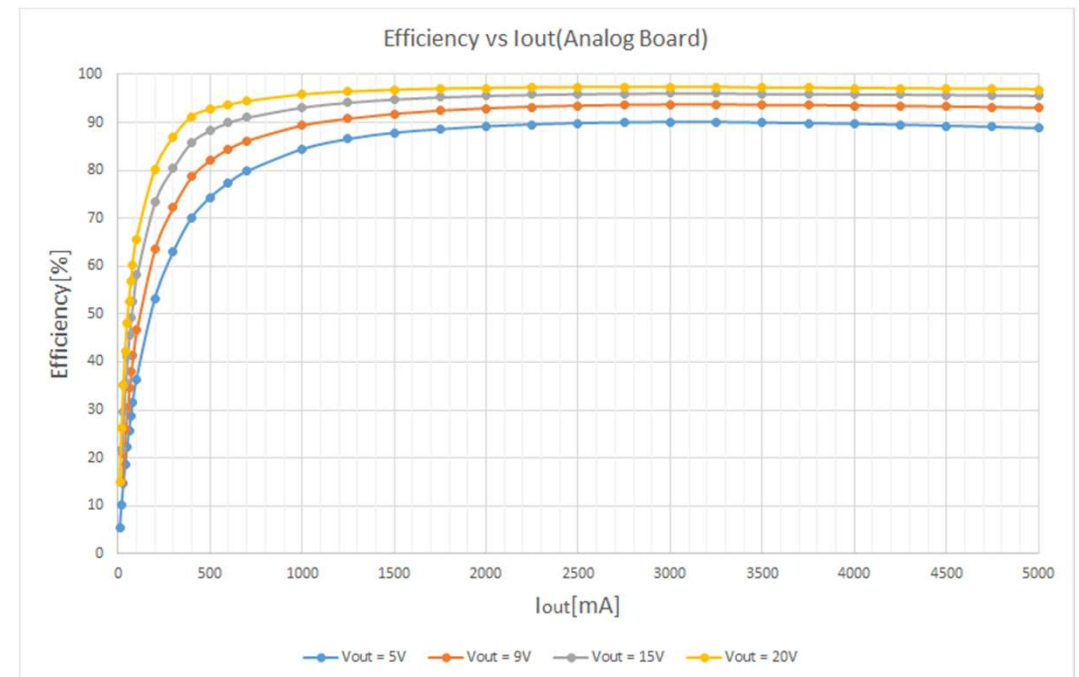
I/F Pinout				
Pin	Name	Type	Logic	
2	VIN	P		B A S I C
3	VIN	P		
13	VOUT	P		
14	VOUT	P		
1	GND	P		
15	GND	P		L o a d S w i t c h
4	FAULTn_OUT	Open Drain	Active Low	
5	VBUS_SRC_EN	Input	Active High	
9	DC/DC_EN	Output	Active High	
7	VBUS_DISCHG	Input	Active High	
10	FRS_EN	Input	Active High	A d v a n c e d
12	ISENSE	Input		
8	VSEL0/EN_15V/SCL	Input	Active High	
11	VSEL1/EN_20V/SDA/ADC	Input	Active High	
6	VSEL2/EN_9V/ALERT_n	Input	Active Low	

# USB Power Delivery – Power Module – Efficiency

## Digital



## Analog



**MIC2128**恆定頻率同步降壓控制器涵蓋由**4.5V** 至 **75V** 的輸入電壓應用範圍，而輸出電壓亦可向下調節至**0.6V**，保證**±1%**的精度，在**270 kHz**至**800 kHz**的可編程開關頻率下工作。**MIC2128**透過數位IO腳位控制可以具有高效能電源輸出的表現在高瓦特數 **20V@5A**

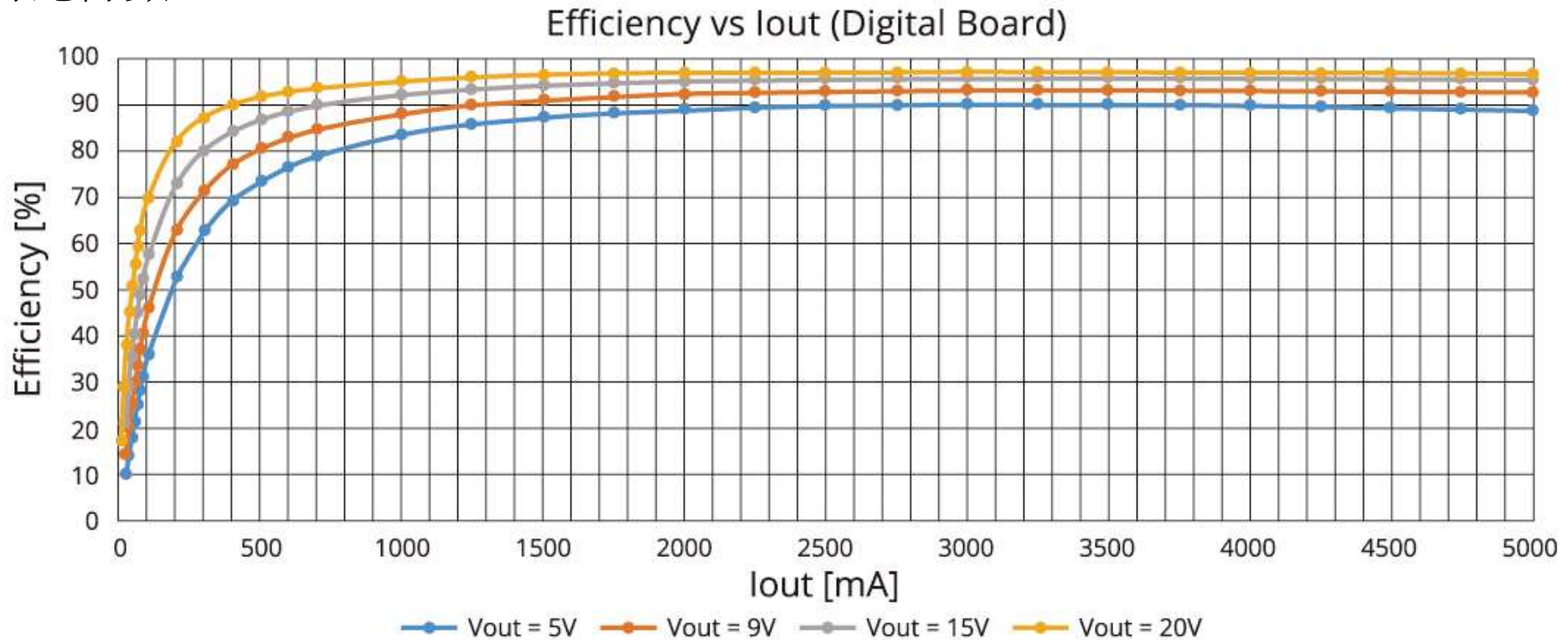
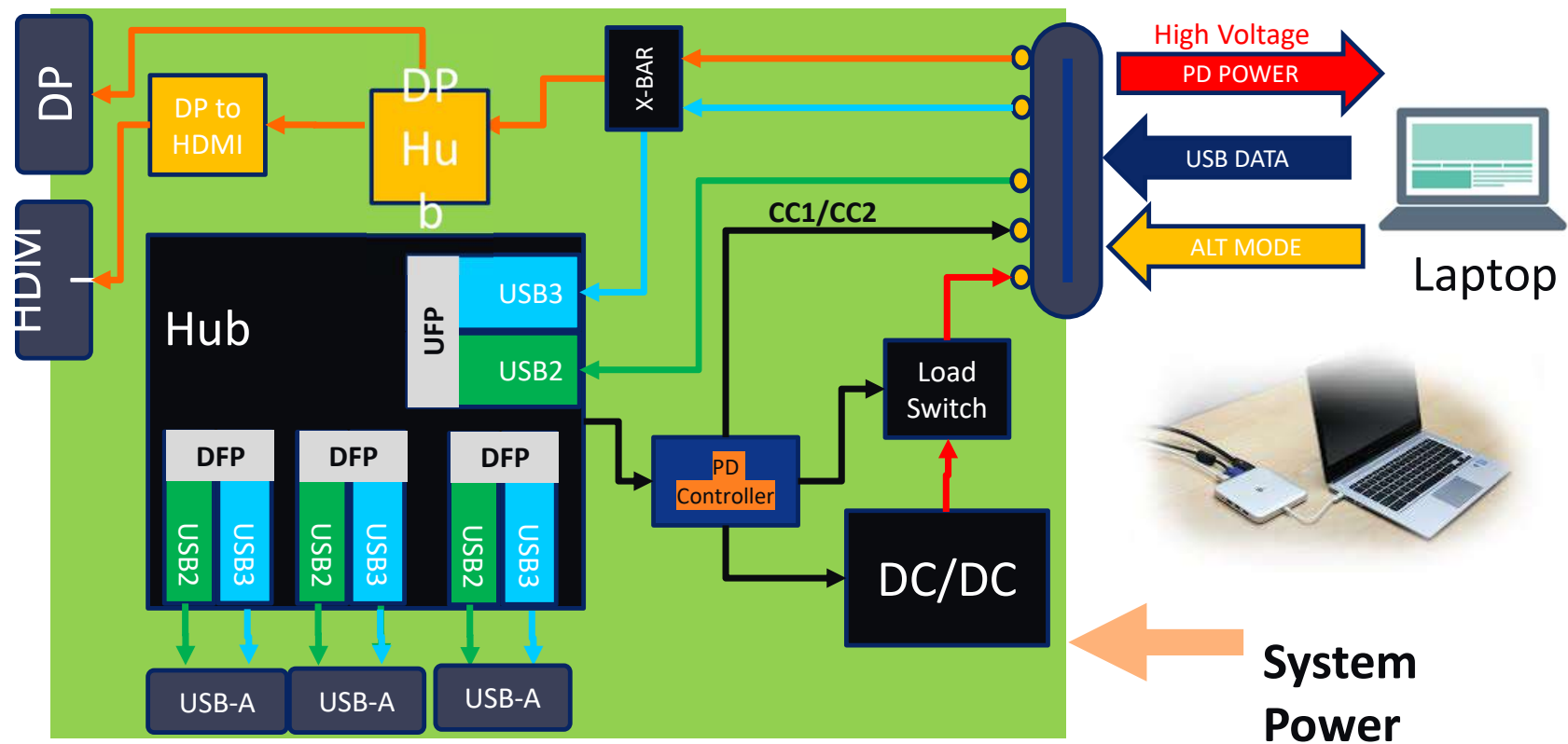


圖 (三) Microchip 數位 IO PMPD 電源輸出效率

# USB C PD Hubs with Alt mode Blocks

- **Most of dock support one USB-C for upstream port**

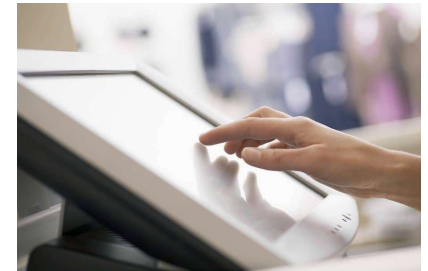


# USB7050P SmartHub™ for Comm / Industrial Applications requiring PD

- Four-port USB 3.2 Gen1 Hub

P/N	Downstream Ports	USB Type C Supporting PD Down	USB Type A Down
USB7050P	4	2 ports	1x USB3, 1x USB2

- USB Type-C downstream ports **with external PD controller** support up to 100W power
- Support for Billboard





# Introducing USB7050P SmartHub™ for Automotive Applications requiring PD

- **Four-port USB 3.2 Gen1 Hub**

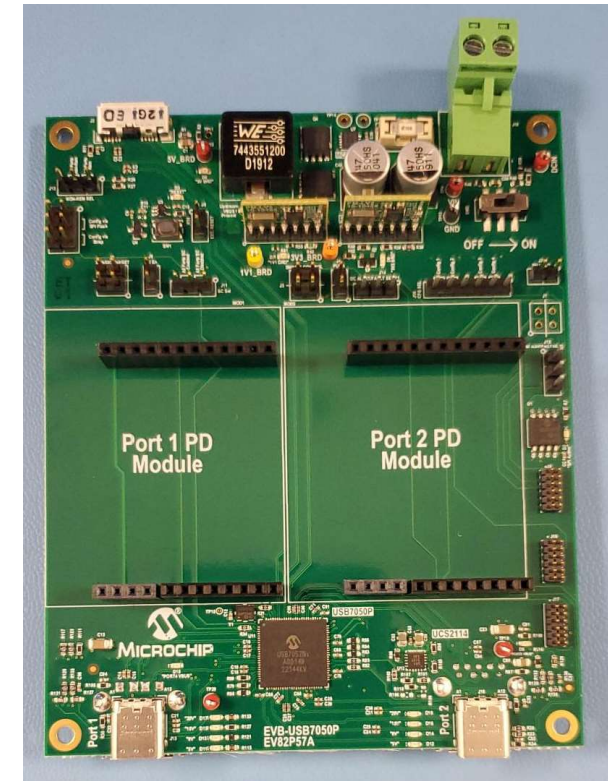
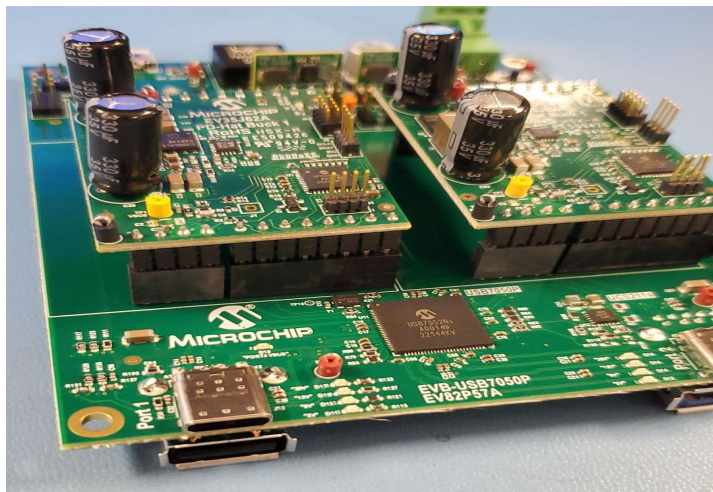
P/N	Downstream Ports	USB Type C Supporting PD Down	USB Type A Down
USB7050P	4	2 ports	1x USB3, 1x USB2

- **USB Type-C downstream ports with external PD controller support up to 100W power**
- **All ports CarPlay®, Android™ Auto + CarLife support**



# USB7050P/PD Generic Controller PD solution

- **EVB-USB7050P Base/Hat - Two part Evaluation Platform**
  - Baseboard support USB7050P with generic interface to PD Control
  - PD “Hat” board – adds PD functionality to USB Type-C™ architecture
    - MIC2128/UCS3205 – Q2CY2023



**Microchip 發佈首款符合 IEEE® 802.3bt標準的 PoE至 USB Type-C®轉接器**  
能透過PoE基礎設施支援的乙太網電纜提供高達60W Type C 輸出功率



<https://www.microchip.com/en-us/product/PD-USB-DP60>

Build-In LAN7800 (USB 3.1 Gen 1 to GigaLan )



SMART | CONNECTED | SECURE

***“Drive Design Wins to Revenue”***