USB TYPE C 技術說明:

USB – Universal Serial Bus

世代	最大傳輸	USB世代名稱	供電能力	推出時間
USB 1.0	1.5 Mbps	Low Speed	500 mA	1996年1月
USB 1.1	12 Mbps	Full Speed	500 mA	1998年9月
USB 2.0	480 Mbps	High Speed	500 mA	2000年4月
USB 3.0	5 Gbps	Super Speed Gen1	900 mA	2008年11月
USB 3.1	10 Gbps	Super Speed Gen2	900 mA	2013年8月

1.首先說明 Rp、Rd、Ra 這三個主要電阻在 type c 架構下的位置,請看下圖說明:

Figure 4-5 Pull-Up/Pull-Down CC Model
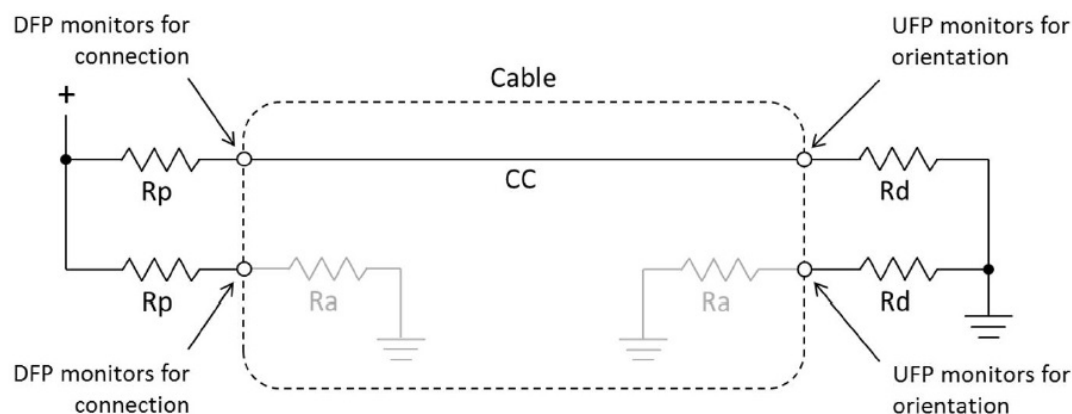
●DFP (Downstream Facing Port)為 Host 端,另一邊的 UFP (Upstream Facing Port)則為 device 端。在 DFP 的 CC pin 會有上拉電阻 Rp,在 UFP 則會有下拉電阻 Rd。

●在 DFP 與 UFP 未連接之前,DFP 的 VBUS 是沒有輸出的。當 DFP 與 UFP 連接後,CC pin 相接,DFP 的 CC pin 偵測到 UFP pulldown Rd,表示接到 Device,DFP 便打開 VBUS 的 FET 開關,輸出 VBUS 電源給 UFP,也就是說在尚未偵測到 CC PIN 的設定之前,VBUS 是不會供應任何電源給 UFP 端的。

●從上圖可以明顯得知,除了 Ra 之外,其餘電阻都不該出現在 cable 之中,Ra 數值如下圖表格所述是一

個區間值,一般使用 1k ohm,如作為電源供應器的線材則可能會略低於 800 ohm。:

Table 4-15 Powered Cable Termination Requirements

	Minimum Impedance	Maximum Impedance
Ra	800 Ω[1]	1.2 kΩ

●Rp 的數值是有被規範的,目前常見的 56k ohm 被規範為 default USB power,一般用於相容於傳統 USB 架構,故常出現 USB2.0/USB3.0 的 type A/B to type C 的線材在 type C 端加入該電阻。其餘電阻值請看下圖表格:

Table 4-13 DFP CC Termination (Rp) Requirements

DFP Advertisement	Current Source to 1.7 – 5.5 V	Resistor pull-up to 4.75 – 5.5 V	Resistor pull-up to 3.3 V ± 5%
Default USB Power	80 μA ± 20%	56 kΩ ± 20% (Note 1)	36 kΩ ± 20%
1.5 A @ 5 V	180 μA ± 8%	22 kΩ ± 5%	12 kΩ ± 5%
3.0 A @ 5 V	330 μA ± 8%	10 kΩ ± 5%	4.7 kΩ ± 5%

●Rd 在規範中僅有 5.1k ohm 的數值,不會在 cable 中使用。

●有 Ra 的 cable,內部一定都有 e-mark IC,所以都會支援 PD 協議。沒有 Ra 的 cable 一定就是 passive cable,內部是沒有 ic 的,當然一定不支援 PD 協議。

●CC pin 的偵測可分為以下數種結果:

Table 4-6 Source Perspective

CC1	CC2	State	Position
Open	Open	Nothing attached	N/A
Rd	Open	Sink attached	①
Open	Rd	Sink attached	②
Open	Ra	Powered cable without Sink attached	①
Ra	Open	Powered cable without Sink attached	②
Rd	Ra	Powered cable with Sink or Vconn-powered Accessory attached	①
Ra	Rd	Powered cable with Sink or Vconn-powered Accessory attached	②
Rd	Rd	Debug Accessory Mode attached (Appendix B)	N/A
Ra	Ra	Audio Adapter Accessory Mode attached (Appendix A)	N/A

●由於 Type-C 是支援正反插，CC pin 被用來偵測正反插，從 DFP 的角度來看，當 CC1 接到 Pulldown 就是正插，如果是 CC2 接到 Pulldown 就是反插。在偵測完正反插後，就會輸出相對應的 USB 信號，例如 CC1 對應的是 SSTX1 與 SSRX1。下圖的右邊整合了 MUX，由於 USB 3.1 的 data rate 高達 10 Gbps，為了避免 PCB 的走線出現分支，所以正反插進來的訊號會由 MUX 來切換，正插時，切換到 SSRX1&SSTX1，反插時，切換到 SSRX2&SSTX2。

Figure 4-3 Logical Model for Data Bus Routing across USB Type-C-based Ports
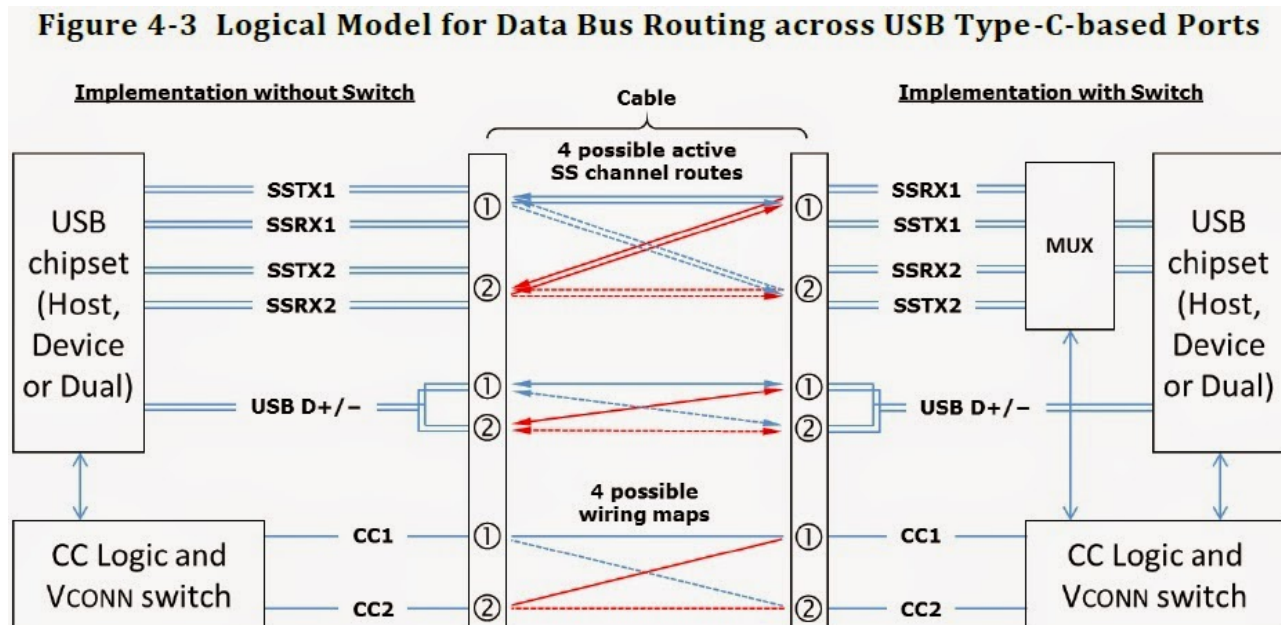
Signal Assignments

Looking into the product receptacle:

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
GND	TX1+	TX1−	Vbus	CC1	D+	D−	SBU1	Vbus	RX2−	RX2+	GND

GND	RX1+	RX1−	Vbus	SBU2	D−	D+	CC2	Vbus	TX2−	TX2+	GND
B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1

Looking into the cable or product plug:

A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
GND	RX2+	RX2−	Vbus	SBU1	D−	D+	CC	Vbus	TX1−	TX1+	GND

GND	TX2+	TX2−	Vbus	VCONN			SBU2	Vbus	RX1−	RX1+	GND
B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12

2.關於 Electronically Marked 的使用時機:

●對於 E-MARK 在規範中有詳細的紀載,簡單來說,輸出 POWER 電流達 5A 的就必須使用 E-MARK。E-

mark 欄位標示 required 就是必須使用 e-mark, optional 則可以不使用 e-mark。請看下圖規範表格:

■TYPE C TO C:

Table 3-1 USB Type-C Standard Cable Assemblies

Cable Ref	Plug 1	Plug 2	USB Version	Cable Length	Current Rating	USB Power Delivery (BMC)	USB Type-C Electronically Marked
CC2-3	C	C	USB 2.0	≤ 4 m	3 A	Supported	Optional
CC2-5					5 A		Required
CC3G1-3	C	C	USB 3.1 Gen1	≤ 2 m	3 A	Supported	Required
CC3G1-5					5 A		
CC3G2-3	C	C	USB 3.1 Gen2	≤ 1 m	3 A	Supported	Required
CC3G2-5					5 A		

■Type-C TO Legacy Cable:

Table 3-2 USB Type-C Legacy Cable Assemblies

Cable Ref	Plug 1[4]	Plug 2[4]	USB Version	Cable Length	Current Rating	USB Type-C Electronically Marked[3]
AC2-3	USB 2.0 Standard-A	USB 2.0 Type-C[1]	USB 2.0	≤ 4 m	3 A	Optional
AC2-5	USB 2.0 PD Standard-A				5 A	Required
AC3G2-3	USB 3.1 Standard-A	USB Full-Featured Type-C[1]	USB 3.1 Gen2	≤ 1 m	3 A	Optional
AC3G2-5	USB 3.1 PD Standard-A				5 A	Required
CB2-3	USB 2.0 Type-C[2]	USB 2.0 Standard-B	USB 2.0	≤ 4 m	3 A	Optional
CB2-5		USB 2.0 PD Standard-B			5 A	Required
CB3G2-3	USB Full-Featured Type-C[2]	USB 3.1 Standard-B	USB 3.1 Gen2	≤ 1 m	3 A	Optional
CB3G2-5		USB 3.1 PD Standard-B			5 A	Required
CmB2	USB 2.0 Type-C[2]	USB 2.0 Mini-B	USB 2.0	≤ 4 m	500 mA	Optional
CµB2-3	USB 2.0 Type-C[2]	USB 2.0 PD Micro-B	USB 2.0	≤ 2 m	3 A	Optional
CµB3G2-3	USB Full-Featured Type-C[2]	USB 3.1 PD Micro-B	USB 3.1 Gen2	≤ 1 m	3 A	Optional

●e-mark IC 會放在稱為 paddle card 的 pcb 之中,晶片內有包含 SOP'IC,可以用來做 PD(Power Delivery Specification)溝通,宣告這條 Cable 的功能。Paddle card 內有含 Ra 電阻。

●目前通過認證的 e-mark 晶片(至 2015/9/14 為止):

Date Certified	Company	Product Contact Name	Product Contact Email	Product Type	Product Marketing Name	Product Model/Part Number	Product Rev	TID	EID
5/22/2015	Cypress Semiconductor	Benjamin Kropf	btk@cypress.com	Development > Power Delivery > E-marker	Cypress CCG1 EMCA	CYPD1103-35FNXI	Rev 1	1095059	0000001
5/22/2015	Cypress Semiconductor	Manu Kumar	kumr@cypress.com	Development > Power Delivery > E-marker	Cypress CCG2 EMCA	CYPD2103	1	1095054	0000002
5/22/2015	Etron Technology, Inc.	Chien-Cheng Kuo	cc.kuo@etron.com.tw	Development > Power Delivery > E-marker	EJ901	EJ901	A0	1095010	0000009
5/22/2015	Lotes Co., Ltd	Max Lo	max@lintestech.com	Development > Power Delivery > E-marker	LINTES USB Type-C Passive Cable with E-Marker	CPCLLL-E31	CYPD1103	1095025	0000003
5/22/2015	Luxshare-ICT	Alan Kinningham	alan.kinningham@luxshare-ict.com	Development > Power Delivery > E-marker	Camel	LX5059	0001	1095048	0000004
5/22/2015	Luxshare-ICT	Pat Young	pat.young@luxshare-ict.com	Development > Power Delivery > E-marker	Camel 5G2	Camel 5G2	1.0	1095056	0000005
5/22/2015	Richtek Technology Corporation	Ming-Shih Yu	andy_yu@richtek.com	Development > Power Delivery > E-marker	TC0513	TC0513	01	1095016	0000006
5/22/2015	Richtek Technology Corporation	TZUHSIEN CHUANG	th_chuang@richtek.com	Development > Power Delivery > E-marker	RT1710	RT1710	01	1095034	0000007
5/22/2015	VIA Technologies, Inc.	Jay Tseng	jaytseng@viatech.com	Development > Power Delivery > E-marker	VL150	VL150	A0	1095014	0000008
8/14/2015	Richtek Technology Corporation	TH Chuang	andy_yu@richtek.com	Development > Power Delivery > E-marker	RT1710	RT1710	02	1096003	0000382

3.Type C Spec. 1.1 版加電容資料 P.59 如下:

All VBUS pins shall be connected together within the USB Type-C plug. A bypass capacitor is required

between the VBUS and ground pins in the USB Type-C plug side of the cable. The bypass capacitor shall be 10nF ± 20% in cables which incorporate a USB Standard-A plug. The bypass capacitor shall be 100pF ± 20% (minimum voltage rating of 30V) in cables which incorporate a USB PD Standard-A plug. The bypass capacitor shall be placed as close as possible to the power supply pad.

4.SBU1 & 2：邊帶使用（Side Band Use）信號適用於傳輸非 USB 信號，它們用於類比音訊（Analog Audio）模式，也可用於備用（Alternate）模式。

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