Cable ID for USB Type-C Cables

General Description

RT1710 is a Type-C cable ID for active and passive cables. All USB Full-Featured Type-C cables shall be electronically marked. Electronically marked cables shall support USB Power Delivery Structured VDM Discover Identity command directed to SOP'. This provides a method to determine the characteristics of the cable, e.g. its current carrying capability, its performance, vendor identification, etc. This may be referred to as the USB Type-C Cable ID function. RT1710 is available in a WDFN-8L 2x3 package.

Ordering Information

RT1710 □□

Package Type
QW : WDFN-8L 2x3 (W-Type)

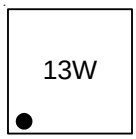
Lead Plating System
G : Green (Halogen Free and Pb Free)

Note :

Richtek products are :

- RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.
- Suitable for use in SnPb or Pb-free soldering processes.

Marking Information



13 : Product Code

W : Date Code

Features

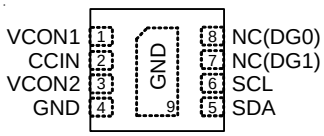
- **Support SOP' Communication**
- **Integrated Transceiver (BMC PHY)**
- **Embedded Both Side RA Resistor**
- **Embedded Both Side ISO Diode**
- **Embedded MTP**
- **Support Multi-Tme Writable Memory to Store VDM Data**
- **Support 4V to 5.5V Operation on VCON1 / VCON2 Pin**
- **Built-In Slew Rate Control for BMC Signal to Reduce the Effect of EMI**
- **Support Custom Structured VDM Writing Through CCIN Pin**
- **Support I²C Bus for Programming VDM Data**

Applications

- USB Full-Featured Type-C cables

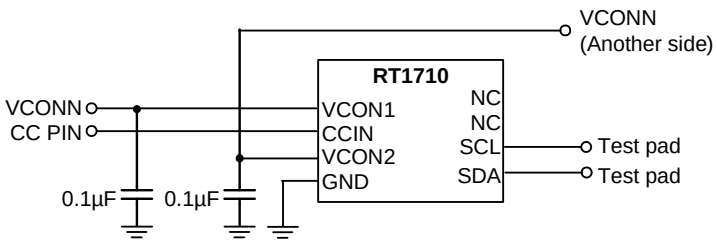
Pin Configurations

(TOP VIEW)



WDFN-8L 2x3

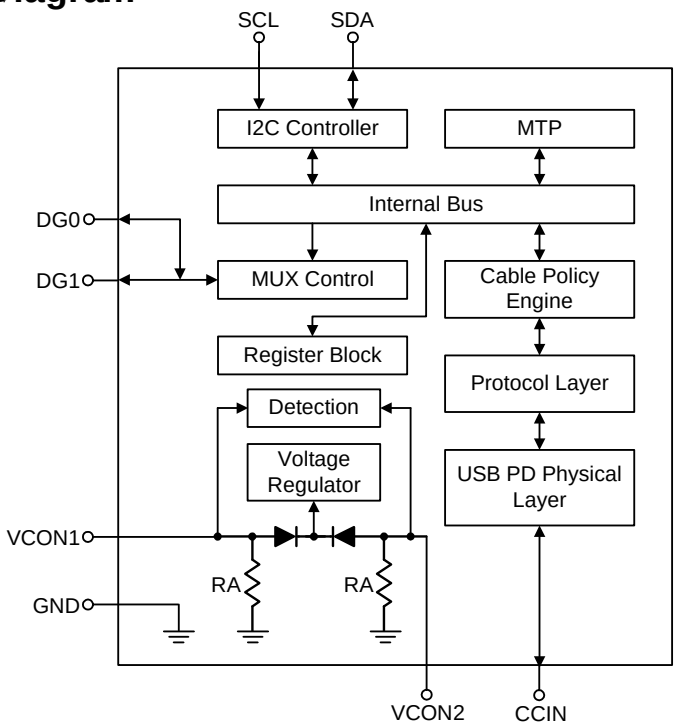
Simplified Application Circuit



Functional Pin Description

Pin No.	Pin Name	Pin Function
1	VCON1	The Input Pin Supplied from VCONN.
2	CCIN	Configuration Channel Pin Used in the Discovery, Configuration and Management of Connections.
3	VCON2	The Input Pin Supplied from Another Side VCONN.
4	GND	Ground.
5	SDA	This Pin is Only Used for Debug. Please connect it to ground.
6	SCL	This Pin is Only Used for Debug. Please connect it to ground.
7	NC(DG1)	No Internal Connection.
8	NC(DG0)	No Internal Connection.
9 (Exposed Pad)	GND	Power Ground. The exposed pad must be soldered to a large PCB and connected to GND for maximum power dissipation.

Function Block Diagram



Operation

RT1710 is a Type-C cable ID for active and passive cables. All USB Full-Featured Type-C cables shall be electronically marked. Electronically marked cables shall support USB Power Delivery Structured VDM Discover Identity command directed to SOP'. This provides a method to determine the characteristics of the cable, e.g. its current carrying capability, its performance, vendor identification, etc. This may be referred to as the USB Type-C Cable ID function.

An electronically marked cable incorporates electronics that require V_{CONN}, although V_{BUS} or another source may be used. Electronically marked cables that do not incorporate data bus signal conditioning circuits shall consume no more than 70mW from V_{CONN}. During USB suspend, electronically marked cables shall not draw more than 7.5mA from V_{CONN}.

Absolute Maximum Ratings (Note 1)

- VCON1/VCON2 ---------- –0.3V to 6V
- Power Dissipation, P_D @ T_A = 25°C
  WDFN-8L 2x3 ---------- 3.17W
- Package Thermal Resistance (Note 2)
  WDFN-8L 2x3, θ_{JA} ---------- 31.5°C/W
  WDFN-8L 2x3, θ_{JC} ---------- 7.5°C/W
- Lead Temperature (Soldering, 10 sec.) ---------- 260°C
- Junction Temperature ---------- 150°C
- Storage Temperature Range ---------- –65°C to 150°C
- ESD Susceptibility (Note 3)
  HBM (Human Body Model) ---------- 8kV
  MM (Machine Model) ---------- 600V

Recommended Operating Conditions (Note 4)

- Suply Input Voltage ---------- 4V to 5.5V
- Junction Temperature Range ---------- –40°C to 125°C
- Ambient Temperature Range ---------- –40°C to 85°C

Electrical Characteristics

(V_{DD} = 5V, T_A = 25°C, unless otherwise specified.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Common Normative Signaling Requirements						
Bit Rate	fBitRate		270	300	330	Kbps
Common Normative Signaling Requirements for Transmitter						
Maximum difference between the bit-rate during the part of the packet following the Preamble and the reference bit-rate.	pBitRate		--	--	0.25	%
Time from the end of last bit of a Frame until the start of the first bit of the next Preamble.	$t_{InterFrameGap}$		25	--	--	µs
Time before the start of the first bit of the Preamble when the transmitter shall start driving the line.	$t_{StartDrive}$		–1	--	1	µs
BMC Common Normative Requirements						
Time to cease driving the line after the end of the last bit of the Frame.	$t_{EndDriveBMC}$		--	--	23	µs
Fall Time	t_{Fall}		300	--	--	ns
Time to cease driving the line after the final high-to-low transition	$t_{HoldLowBMC}$		1	--	--	µs
Rise Time	t_{Rise}		300	--	--	ns
Voltage Swing	V_{Swing}		1.05	1.125	1.2	V
Transmitter Output Impedance	zDriver		33	--	75	Ω

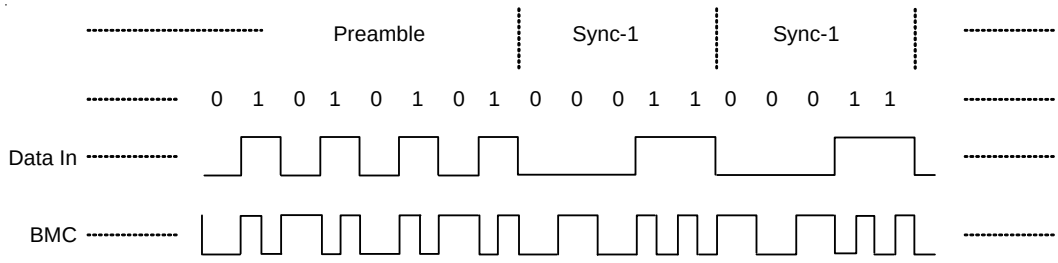
Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
BMC Receiver Normative Requirements						
Cable Termination	RA		800	--	1200	Ω
Time Window for Detecting Non-Idle	$t_{TransitionWindow}$		12	--	20	μs
Receiver Input Impedance	zBmcRx		10	--	--	MΩ

Note 1. Stresses beyond those listed "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions may affect device reliability.

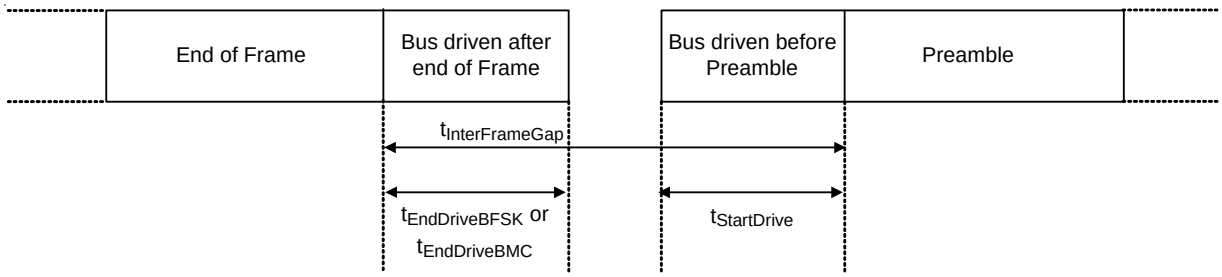
Note 2. θ_{JA} is measured at T_A = 25°C on a high effective thermal conductivity four-layer test board per JEDEC 51-7. θ_{JC} is measured at the exposed pad of the package.

Note 3. Devices are ESD sensitive. Handling precaution is recommended.

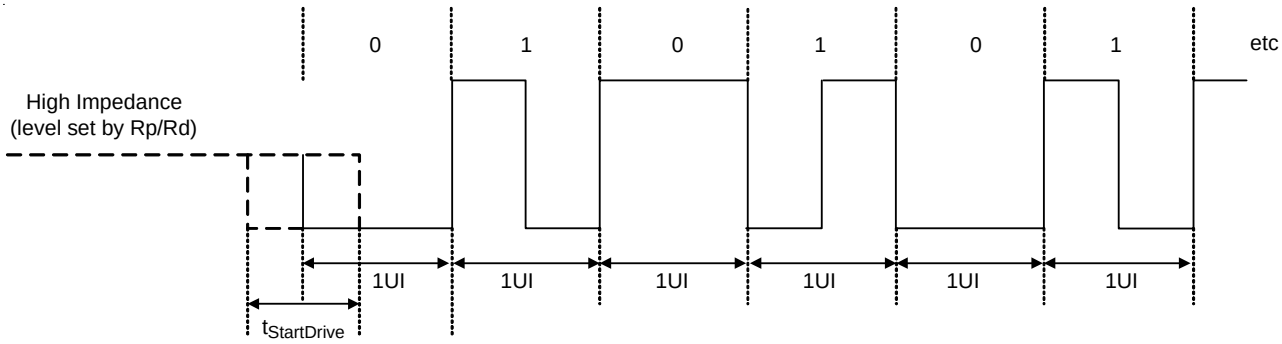
Note 4. The device is not guaranteed to function outside its operating conditions.



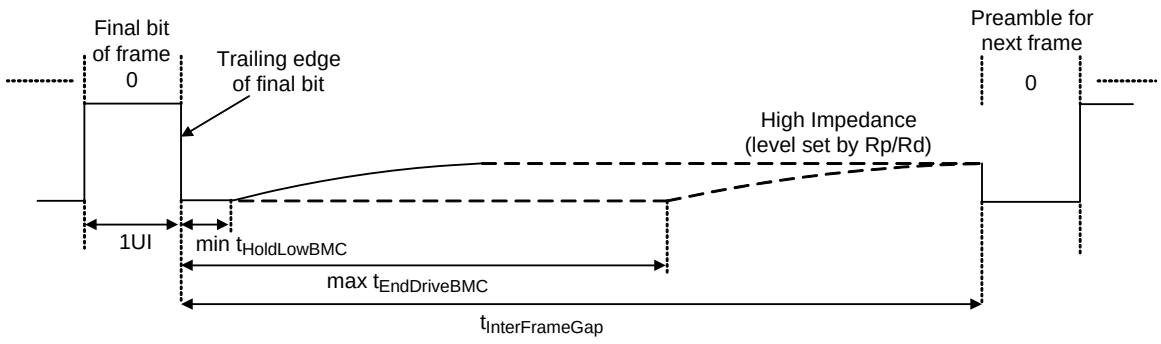
BMC Example



Inter-Frame Gap Timings



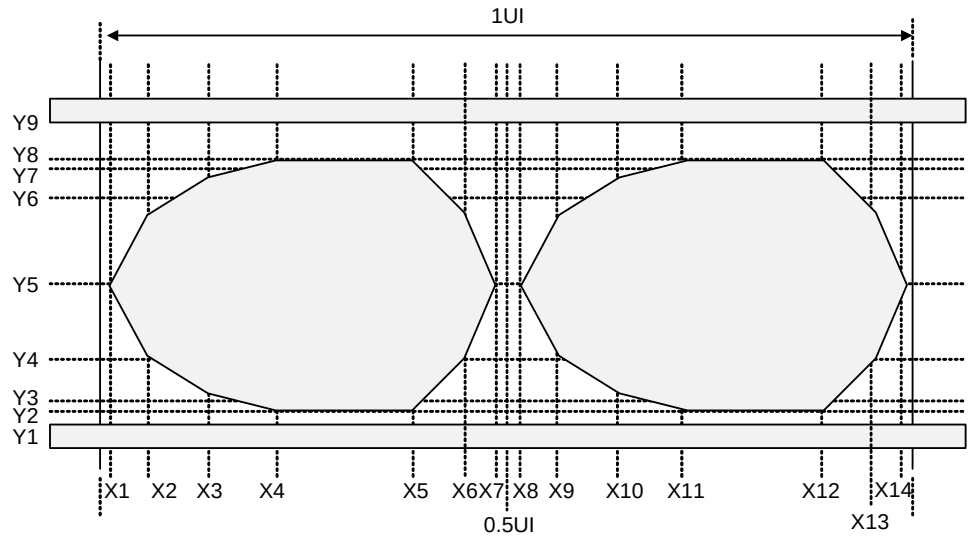
BMC Encoded Start of Preamble



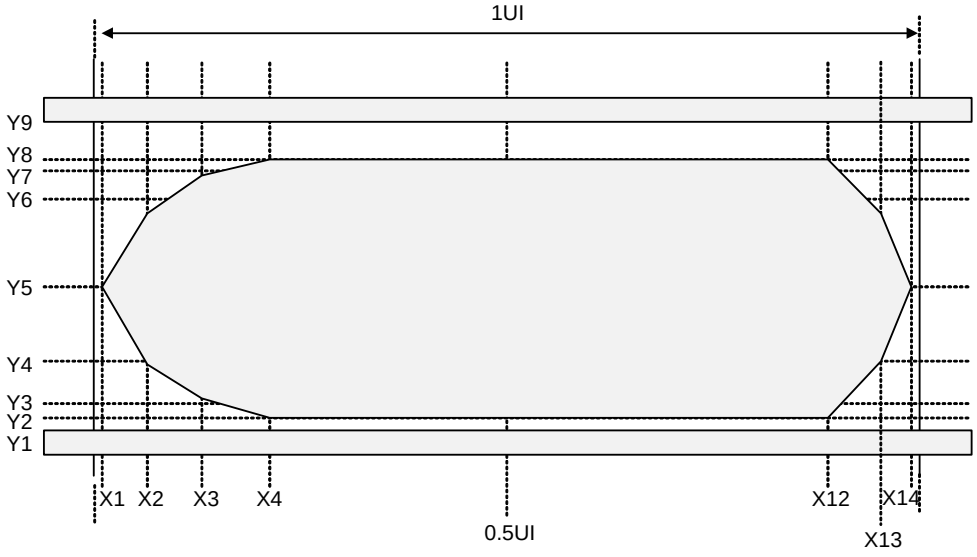
Transmitting or Receiving BMC Encoded Frame Terminated

BMC TC Mask Definition, X Values						
Parameter	**Symbol**	**Test Conditions**	**Min**	**Typ**	**Max**	**Units**
Left Edge of Mask	X1Tx			0.015		UI
X2Tx point	X2Tx			0.07		UI
X3Tx point	X3Tx			0.15		UI
X4Tx point	X4Tx			0.25		UI
X5Tx point	X5Tx			0.35		UI
X6Tx point	X6Tx			0.43		UI
X7Tx point	X7Tx			0.485		UI
X8Tx point	X8Tx			0.515		UI
X9Tx point	X9Tx			0.57		UI
X10Tx point	X10Tx			0.65		UI
X11Tx point	X11Tx			0.75		UI
X12Tx point	X12Tx			0.85		UI
X13Tx point	X13Tx			0.93		UI
Right Edge of Mask	X14Tx			0.985		UI

BMC TC Mask Definition, Y Values						
Parameter	**Symbol**	**Test Conditions**	**Min**	**Typ**	**Max**	**Units**
Lower bound of Outer mask	Y1Tx			-0.075		V
Lower bound of inner mask	Y2Tx			0.075		V
Y3Tx point	Y3Tx			0.15		V
Y4Tx point	Y4Tx			0.325		V
Inner mask vertical midpoint	Y5Tx			0.5625		V
Y6Tx point	Y6Tx			0.8		V
Y7Tx point	Y7Tx			0.975		V
Y8Tx point	Y8Tx			1.04		V
Upper Bound of Outer mask	Y9Tx			1.2		V

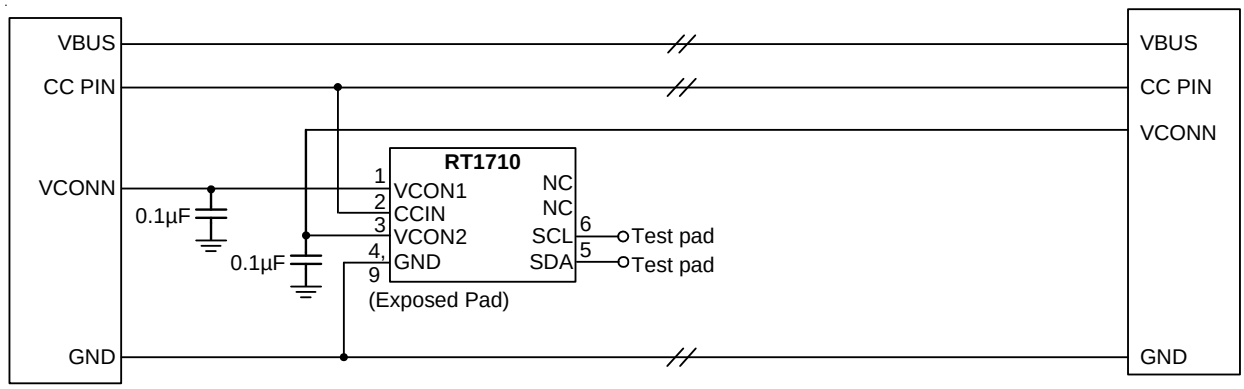


BMC T_X "ONE" Mask

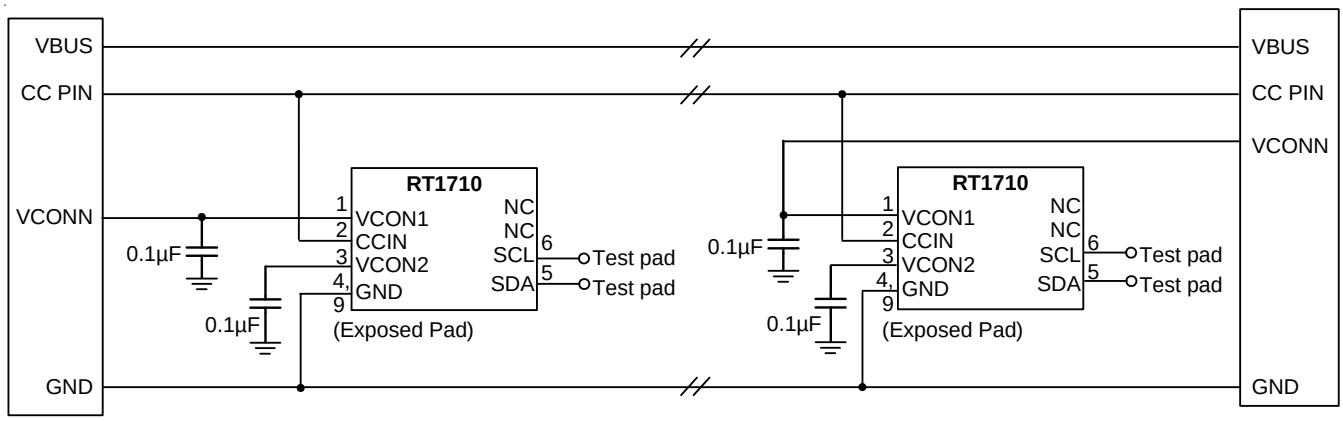


BMC T_X "ZERO" Mask

Typical Application Circuit



Electronically Marked Cable with VCONN Connected Through The Cable



Electronically Marked Cable with SOP' at Both Ends

Application Information

Start of Packet Sequence Prime (SOP')

The SOP' ordered set is defined as : two Sync-1 K-codes followed by two Sync-3 K-codes

K-Code Number	K-Code in Code Table
1	Sync-1
2	Sync-1
3	Sync-3
4	Sync-3

A Cable Plug capable of SOP' Communications shall only detect and communicate with packets starting with SOP'.

A DFP or Source needing to communicate with a Cable Plug capable of SOP' Communications, attached between a Port Pair will be able to communicate using both packets starting with SOP' to communicate with the Cable Plug and starting with SOP to communicate with its Port Partner. The DFP or Source shall co-ordinate SOP and SOP' Communication so as to avoid collisions.

Structured VDM

Setting the VDM Type field to 1 (Structured VDM) defines the use of bits B14..0 in the Structured VDM Header. The fields in the Structured VDM Header are defined in Table.

The following rules apply to the use of Structured VDM messages :

- Structured VDMs shall only be used when an Explicit Contract is in place with the following exception :

Prior to establishing an Explicit Contract a Source may issue Discover Identity messages, to a Cable Plug using SOP' Packets, as an Initiator.

- Only the DFP shall be an Initiator of Structured VDMs except for the Attention Command that shall only be initiated by the UFP.
- Only the UFP or a Cable Plug shall be a Responder to Structured VDMs.
- Structured VDMs shall not be initiated or responded to under any other circumstances.
- A DFP or UFP which does not support Structured VDMs shall ignore any Structured VDMs received.
- A Command sequence shall be interruptible e.g. due to the need for a message sequence using SOP Packets.

Bit (s)	Field	Description
Bit[31:16]	Standard or Vendor ID (SVID)	Unique 16 bit unsigned integer, assigned by the USB-IF
Bit[15]	VDM Type	1 = Structured VDM
Bit[14:13]	Structured VDM Version	Version Number of the Structured VDM (not this specification Version) : Version 1.0 = 0 Values 1-3 are reserved
Bit[12:11]	Reserved	Shall be set to 0 and shall be ignored
Bit[10:8]	Object Position	For the Enter Mode and Exit Mode Commands : 000b = Reserved 001b..110b = Index into the list of VDOs to identify the desired Mode VDO 111b = Exit all Modes (equivalent of a power on reset). Shall not be used with the Enter Mode Command.
Bit[7:6]	Command Type	00b = Initiator 01b = Responder ACK 10b = Responder NAK 11b = Responder BUSY
Bit[5]	Reserved	Shall be set to 0 and shall be ignored
Bit[4:0]	Command (note 1)	0 = Reserved, shall not be used 1 = Discover Identity 2 = Discover SVIDs 3 = Discover Modes 4 = Enter Mode 5 = Exit Mode 6 = Attention 7-15 = Reserved, shall not be used 16..31 = SVID Specific Commands
Note 1 : In the case where a SID is used the modes are defined by a standard. When a VID is used the modes are defined by the Vendor.		

Discover Identity

The Discover Identity Command is provided to enable an Initiator (DFP) to identify its Port Partner and for an Initiator (Source or DFP) to identify the attached Cable Plug (Responder).

The SVID in the Discover SVIDs Command shall be set to the PD SID by both the Initiator and the Responder for this Command.

The Discover Identity Command sent back by the Responder contains an ID Header, a Cert Stat VDO and some Type specific VDOs which depend on the Product Type. This specification defines the following Type specific VDOs :

Header No. of Data Objects = 4..7	VDM Header	ID Header	Cert Stat VDO	Product VDO	0..3 Product Type VDO(s)

ID Header

The ID Header contains the Vendor ID corresponding to the Power Delivery Product.

Bit (s)	Description
Bit[31]	Data Capable as USB Host : • Shall be set to one if the product is capable of enumerating USB Devices. • Shall be set to zero otherwise
Bit[30]	Data Capable as a USB Device : • Shall be set to one if the product is capable of enumerating as a USB Device. • Shall be set to zero otherwise
Bit[29:27]	Product Type: • 000b – Undefined • 001b – Hub • 010b – Peripheral • 011b – Passive Cable • 100b – Active Cable • 101b – Alternate Mode Adapter (AMA) • 111b..110b – Reserved, shall not be used.
Bit[26]	Modal Operation Supported : • Shall be set to one if the product supports Modal Operation. • Shall be set to zero otherwise
Bit[25:16]	Reserved. Shall be set to zero.
Bit[15:0]	16-bit unsigned integer. USB Vendor ID

Cert Stat VDO

The Cert Stat VDO contains the Test ID (TID) allocated by USB-IF during certification.

Bit (s)	Description
Bit[31:20]	Reserved, shall be set to zero.
Bit[19:0]	20-bit unsigned integer

Product VDO

The Product VDO contains identity information relating to the product.

Bit (s)	Description
Bit[31:16]	16-bit unsigned integer. USB Product ID
Bit[15:0]	16-bit unsigned integer. bcdDevice

Cable VDO

The Cable VDO defined in this section shall be sent when the Product Type is given as Passive or Active Cable.

Bit (s)	Field	Description
Bit[31:28]	Cable HW Version	0000b..1111b assigned by the VID owner
Bit[27:24]	Cable Firmware Version	0000b..1111b assigned by the VID owner
Bit[23:20]	Reserved	Shall be set to zero.
Bit[19:18]	Type-C to Type-A/B/C	00b = Type-A 01b = Type-B 10b = Type-C 11b = Captive
Bit[17]	Type-C to Plug/Receptacle	0 = Plug 1 = Receptacle (not valid when B19..18 set to Type-C or Captive)
Bit[16:13]	Cable Latency	0000b – reserved 0001b – <10ns (~1m) 0010b – 10ns to 20ns (~2m) 0011b – 20ns to 30ns (~3m) 0100b – 30ns to 40ns (~4m) 0101b – 40ns to 50ns (~5m) 0110b – 50ns to 60ns (~6m) 0111b – 60ns to 70ns (~7m) 1000b –1000ns (~100m) 1001b –2000ns (~200m) 1010b – 3000ns (~300m) 1011b ….1111b reserved Includes latency of electronics in Active Cable
Bit[12:11]	Cable Termination Type	00b = Both ends Passive, VCONN not required 01b = Both ends Passive, VCONN required 10b = One end Active, one end passive, VCONN required 11b = Both ends Active, VCONN required
Bit[10]	SSTX1 Directionality Support	0 = Fixed 1 = Configurable
Bit[9]	SSTX2 Directionality Support	0 = Fixed 1 = Configurable
Bit[8]	SSRX1 Directionality Support	0 = Fixed 1 = Configurable
Bit[7]	SSRX2 Directionality Support	0 = Fixed 1 = Configurable
Bit[6:5]	VBUS Current Handling Capability	00b = VBUS not through cable 01b = 3A 10b = 5A 11b = reserved.
Bit[4]	VBUS through cable	0 = No 1 = Yes
Bit[3]	SOP” controller present	1 = SOP” controller present 0 = No SOP” controller present
Bit[2:0]	USB Super speed Signaling Support	000b = USB 2.0 only 001b = [USB3.1] Gen1 010b = [USB3.1] Gen1 and Gen2 011b.. 111b = reserved.

Thermal Considerations

For continuous operation, do not exceed absolute maximum junction temperature. The maximum power dissipation depends on the thermal resistance of the IC package, PCB layout, rate of surrounding airflow, and difference between junction and ambient temperature. The maximum power dissipation can be calculated by the following formula :

$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$

where $T_{J(MAX)}$ is the maximum junction temperature, T_A is the ambient temperature, and θ_{JA} is the junction to ambient thermal resistance.

For recommended operating condition specifications, the maximum junction temperature is 125°C. The junction to ambient thermal resistance, θ_{JA}, is layout dependent. For WDFN-8L 2x3 package, the thermal resistance, θ_{JA}, is 31.5°C/W on a standard JEDEC 51-7 four-layer thermal test board. The maximum power dissipation at T_A = 25°C can be calculated by the following formula :

$P_{D(MAX)}$ = (125°C – 25°C) / (31.5°C/W) = 3.17W for WDFN-8L 2x3 package

The maximum power dissipation depends on the operating ambient temperature for fixed $T_{J(MAX)}$ and thermal resistance, θ_{JA}. The derating curve in Figure 3 allows the designer to see the effect of rising ambient temperature on the maximum power dissipation.

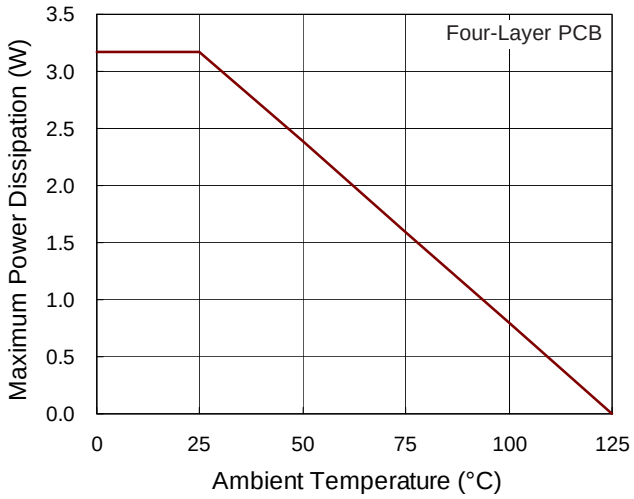


Figure 3. Derating Curve of Maximum Power Dissipation

Layout Consideration

- PCB layout is very important for designing e-marked IC (RT1710) circuits.
- The VCON1 and VCON2 traces should be wide (10mil) and short especially for the current loop.
- Connect VCON1/VCON2 pins with bypass capacitor, and as near the pins as possible.
- The exposed pad of the chip should be connected to a large ground plane for thermal consideration.
- Keep the CC1 traces away from those sensing pins (D+, D-, SSTX+, SSTX-, SSRX+, SSRX-, SBU).

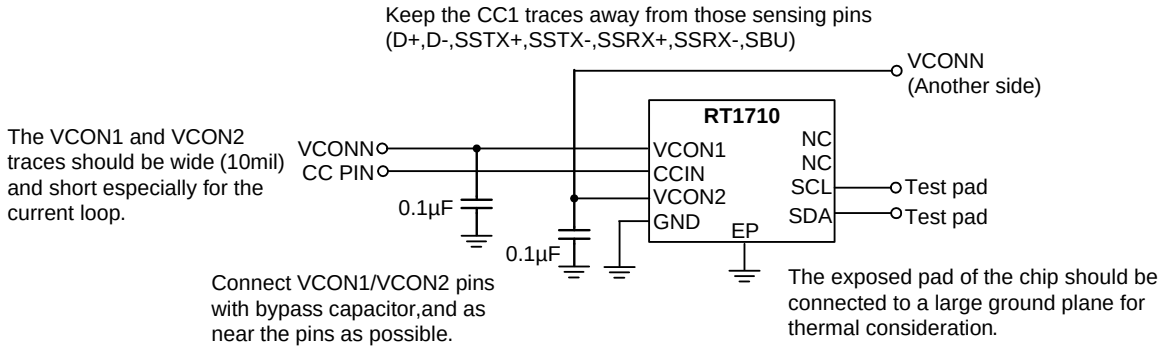
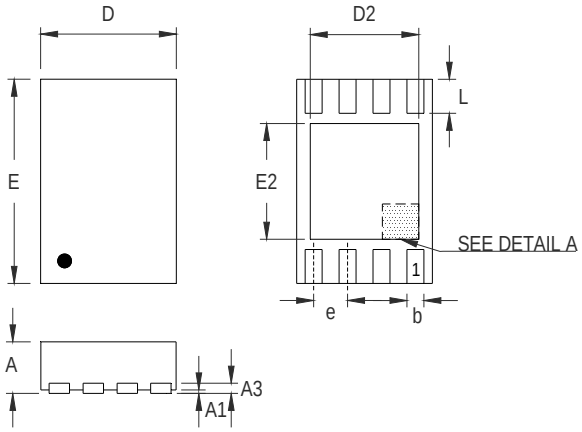
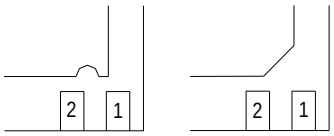


Figure 4. PCB Layout Guide

Outline Dimension





DETAIL A

Pin #1 ID and Tie Bar Mark Options

Note : The configuration of the Pin #1 identifier is optional, but must be located within the zone indicated.

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A3	0.175	0.250	0.007	0.010
b	0.200	0.300	0.008	0.012
D	1.900	2.100	0.075	0.083
D2	1.550	1.650	0.061	0.065
E	2.900	3.100	0.114	0.122
E2	1.650	1.750	0.065	0.069
e	0.500		0.020	
L	0.350	0.450	0.014	0.018

W-Type 8L DFN 2x3 Package

Richtek Technology Corporation

14F, No. 8, Tai Yuen 1st Street, Chupei City

Hsinchu, Taiwan, R.O.C.

Tel: (8863)5526789