USB Dedicated Charging Port Controller

General Description

The uP7102 is a USB dedicated charging port (DCP) controller, used for the charging of mobile phones and tablets. The uP7102 provides integrates auto-detect feature that supports both DCP schemes for Battery Charging Specification (BC 1.2) and the Divider Mode without the need for outside user interaction. The uP7102 is available in a space-saving SOT23 - 6L package.

Ordering Information

Order Number	Package	Top Marking
uP7102PMA6	SOT23 - 6L	S97P

Note: uPI products are compatible with the current IPC/ JEDEC J-STD-020 requirement. They are halogen-free, RoHS compliant and 100% matte tin (Sn) plating that are suitable for use in SnPb or Pb-free soldering processes.

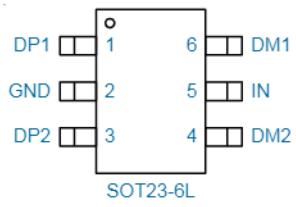
Features

- Operating Voltage from 4.5V to 5.5V
- Automatic Selection of D+/D- Mode for an Attached Device
  - D+/D- Divider Mode 2.7V and 2.7V
  - D+/D- 1.2V Mode
  - D+/D- Shorted Mode (BC 1.2)
- Dual USB Port Controller
- SOT23 - 6L Package
- RoHS Compliant and Halogen Free

Applications

- Automotive USB Power Charger
- AC-DC Adapter with USB Port
- Other USB Charger

Pin Configuration

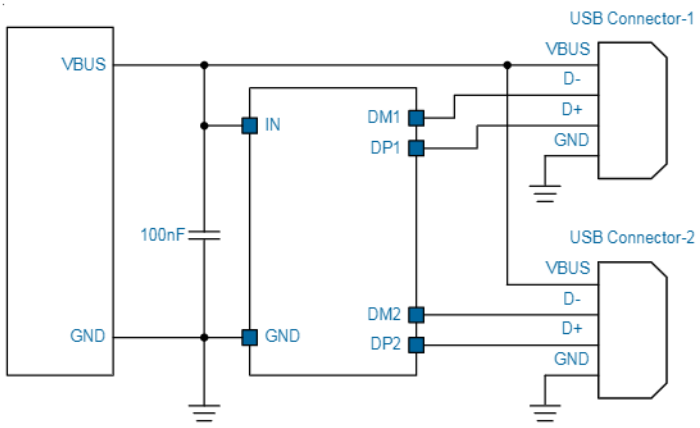


SOT23-6L

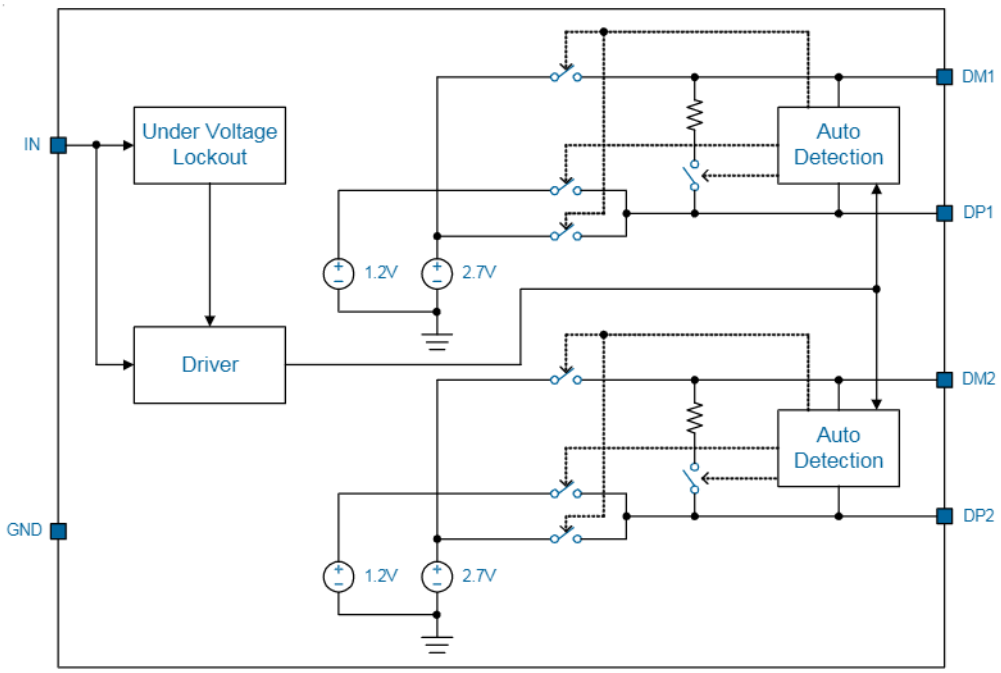
Functional Pin Description

No.	Pin Name	Pin Function
1	DP1	**D+ Data Line to Connector.** Connected to USB connector-1 D+.
2	GND	**Ground.**
3	DP2	**D+ Data Line to Connector.** Connected to USB connector -2 D+.
4	DM2	**D- Data Line to Connector.** Connected to USB connector -2 D-.
5	IN	**Power Supply Input.** Connected 0.1uF or greater ceramic capacitor from IN to GND as close to the IC as possible.
6	DM1	**D- Data Line to Connector.** Connected to USB connector -1 D-.

Typical Application Circuit



Functional Block Diagram



Functional Description

As USB charging has gained popularity, the 500mA minimum defined by USB 2.0/3.0 has become insufficient for many handset and personal media players which need a higher charging rate. On the other hand, wall adapters can provide much more current than 500mA. Several new standards have been introduced defining protocol handshaking methods that allow host and client devices to acknowledge and draw additional current beyond the 500mA minimum defined by USB 2.0/3.0 while still using a single micro-USB input connector.

The uP7102 supports four of the most common protocols:

- DCP (BC 1.2)
- Chinese Telecommunications Industry Standard YD/T 1591-2009
- Divider Mode
- 1.2V Mode

All three protocols defined three types of charging ports that provide charging current to client-side devices:

- Standard Downstream Port (SDP)
- Charging Downstream Port (CDP)
- Dedicated Charging Port (DCP)

The table below shows the differences between these ports according to BC 1.2

Port Type	Support USB 2.0 Communication	Max. Allowed Current (A)
SDP (USB 2.0)	Yes	0.5
SDP (USB 3.0)	Yes	0.9
CDP	Yes	1.5
DCP	No	1.5

To determine what type of port it is connected, the hand-shaking process has two steps.

- Step1: The portable equipment outputs a nominal 0.6V output on its D+ line and reads the voltage input on its D- line.
  - Standard Downstream Port (SDP): If the detected D- < 0.3V, the portable device concludes it is connected to a SDP. An SDP is a traditional USB port that follows USB 2.0/3.0 and supplies a minimum of 500mA/900mA per port. USB 2.0 communications is supported, and the host controller must be active to allow charging.
  - Charging Port: If 0.3V < D- < 0.8V. Then to execute the step 2 to determine it is connected to CDP or DCP.
- Step 2: The portable device outputs a nominal 0.6V output on its D- line and reads the voltage input on its D+ line.
  - Charging Downstream Port (CDP): If the detected D+ < 0.3V, the portable device concludes it is connected to a CDP. A CDP is a USB port that follows USB BC 1.2 and supplies a minimum 1.5A per port. It provides power and meets USB 2.0 requirements for device enumeration. USB 2.0 communications is supported, and the host controller must be active to allow charging.
  - Dedicated Charging Port (DCP): If 0.3V < D+ < 0.8V, the portable device concludes it is connected to a DCP. A DCP only provides power and cannot enumerate upstream facing portable equipment. It does not support USB 2.0 communications, but it does provide specific impedance on the data lines reserved for USB 2.0 so that it is identifiable as a dedicated charger.

Shorted Mode (DCP BC 1.2 and YD/T 1591-2009):

The USB BC 1.2 Specification and Chinese Telecommunications Industry Standard YD/T 1591-2009 define that the D+ and D- data lines should be shorted together with a maximum series impedance of 200Ω. This is shown in Figure1.

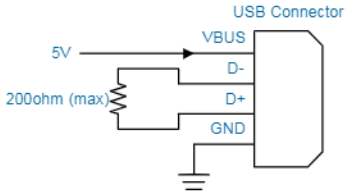


Figure 1. Shorted Mode

Divider Mode (2.7V/2.7V):

The divider mode charging scheme is used for 12-W adapters, and applies 2.7V on D+ and D- lines. This is shown in Figure2.

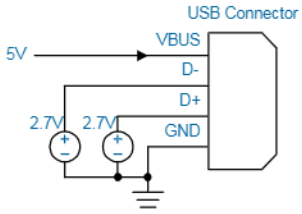


Figure 2. Divider Mode

1.2V Mode

Some tablet USB chargers require 1.2V on the shorted data lines of the USB connector. The maximum resistance between the D+ and the D- line is 200Ω. This is shown in Figure3.

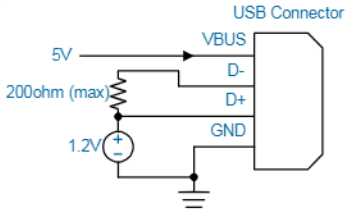


Figure 3. 1.2V Mode

Absolute Maximum Rating

(Note 1)

Supply Input Voltage, IN ---------- -0.3V to +7V

Other Pins to GND ---------- -0.3V to +7V

Storage Temperature Range ---------- -65°C to +150°C

Junction Temperature ---------- 150°C

Lead Temperature (Soldering, 10 sec) ---------- 260°C

ESD Rating (Note 2)

HBM (Human Body Mode) ---------- ±8kV

MM (Machine Mode) ---------- 200V

Thermal Information

Package Thermal Resistance (Note 3)

SOT23 - 6L θ_{JA} ---------- 250°C/W

SOT23 - 6L θ_{JC} ---------- 140°C/W

Power Dissipation, P_D @ T_A = 25°C

SOT23 - 6L ---------- 0.40W

Recommended Operation Conditions

(Note 4)

Operating Junction Temperature Range ---------- -40°C to +125°C

Operating Ambient Temperature Range ---------- -40°C to +85°C

Supply Input Voltage, V_{IN} ---------- +4.5V to +5.5V

Note 1. Stresses beyond those listed as the above *Absolute Maximum Ratings* may cause permanent damage to the device. These are for stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the *Recommended Operation Condition* section of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

Note 2. Devices are ESD sensitive. Handling precaution recommended.

Note 3. θ_{JA} is measured in the natural convection at T_A = 25°C on a low effective thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

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

Electrical Characteristics

(V_{IN} = 4.5V ~ 5.5V, T_A = -40°C ~ 125°C, Typical value are at T_A = 25°C, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Supply Input						
Operating Input Voltage	V_{IN}		--	4.5	5.5	V
Under Voltage Lockout	V_{ULVO}	V_{IN} rising	3.8	4	4.2	V
	V_{ULVO_HYS}	V_{IN} falling	--	0.1	--	V
Supply Current	I_{VIN}	4.5V < V_{IN} < 5.5V	--	155	220	uA
DIVIDER MODE (2.7V/2.7V)						
DP1 output voltage	$V_{DP1\_2.7V}$	V_{IN} = 5V	2.57	2.7	2.84	V
DM1 output voltage	$V_{DM1\_2.7V}$	V_{IN} = 5V	2.57	2.7	2.84	V
DP1 output impedance	$R_{DP1\_2.7V}$	I_{DP1} = -5uA	28.8	36	43.2	kΩ
DM1 output impedance	$R_{DM1\_2.7V}$	I_{DM1} = -5uA	28.8	36	43.2	kΩ
DP2 output voltage	$V_{DP2\_2.7V}$	V_{IN} = 5V	2.57	2.7	2.84	V
DM2 output voltage	$V_{DM2\_2.7V}$	V_{IN} = 5V	2.57	2.7	2.84	V
DP2 output impedance	$R_{DP2\_2.7V}$	I_{DP1} = -5uA	28.8	36	43.2	kΩ
DM2 output impedance	$R_{DM2\_2.7V}$	I_{DM1} = -5uA	28.8	36	43.2	kΩ
1.2V/1.2V MODE						
DP1 output voltage	$V_{DP1\_1.2V}$	V_{IN} = 5V	1.12	1.2	1.28	V
DM1 output voltage	$V_{DM1\_1.2V}$	V_{IN} = 5V	1.12	1.2	1.28	V
DP1 and DM1 shorting resistance	R_{DPM_SHORT1}	V_{DP1} = 0.8V, I_{DM1} = 1mA	--	100	200	Ω
DP1 output impedance	$R_{DP1\_1.2V}$	I_{DP1} = -5uA	80	102	130	kΩ
DM1 output impedance	$R_{DM1\_1.2V}$	I_{DM1} = -5uA	80	102	130	kΩ
DP2 output voltage	$V_{DP2\_1.2V}$	V_{IN} = 5V	1.12	1.2	1.28	V
DM2 output voltage	$V_{DM2\_1.2V}$	V_{IN} = 5V	1.12	1.2	1.28	V
DP2 and DM2 shorting resistance	R_{DPM_SHORT2}	V_{DP2} = 0.8V, I_{DM2} = 1mA	--	100	200	Ω
DP2 output impedance	$R_{DP2\_1.2V}$	I_{DP1} = -5uA	80	102	130	kΩ
DM2 output impedance	$R_{DM2\_1.2V}$	I_{DM1} = -5uA	80	102	130	kΩ

Power Bank Application

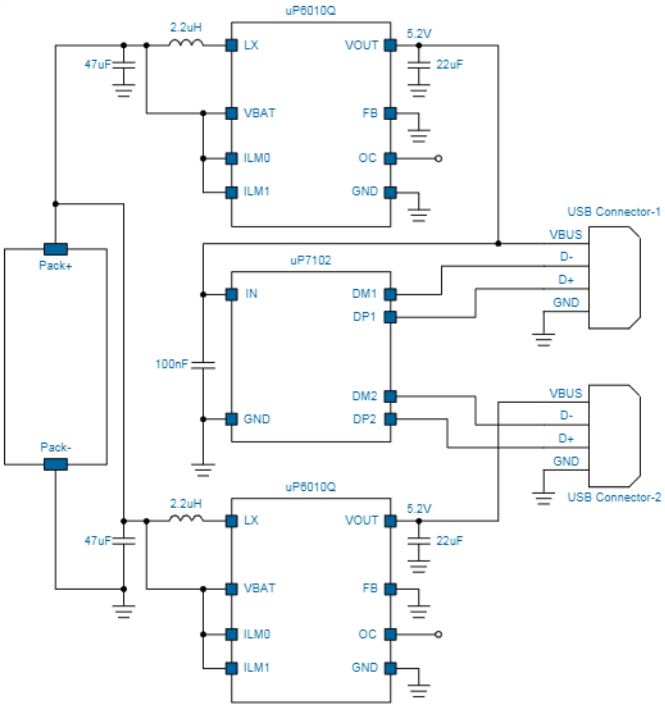


Figure 4. Power Bank Application

For Power Bank application, recommend use uP6010Q to supply USB VBUS source. The uP6010Q provides output current limit, output short circuit protection and 5V/2.4A maximum output current at 3.3V input voltage. Detail function description, please see the uP6010Q datasheet.

PCB Layout Example

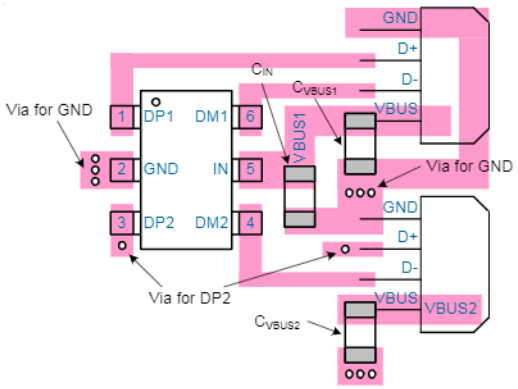
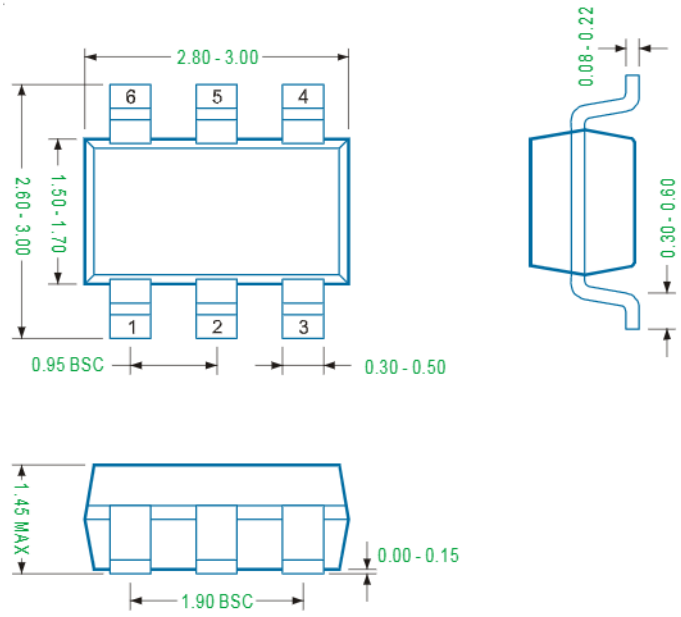


Figure 5. Layout Example

Package Information

SOT23 - 6L



Note

1. Package Outline Unit Description:
   BSC: Basic. Represents theoretical exact dimension or dimension target
   MIN: Minimum dimension specified.
   MAX: Maximum dimension specified.
   REF: Reference. Represents dimension for reference use only. This value is not a device specification.
   TYP. Typical. Provided as a general value. This value is not a device specification.
2. Dimensions in Millimeters.
3. Drawing not to scale.
4. These dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm.

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