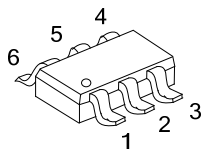
USB DEDICATED CHARGING PORT CONTROLLER



SOT-26

■ DESCRIPTION

The UTC **UCHQ613** are USB dedicated charging port (DCP) controllers. An auto-detect feature monitors USB data line voltage, and automatically provides the correct electrical signatures on the data lines to charge compliant devices among the following dedicated charging schemes:

1. Divider 1 DCP,required to apply 2V and 2.7V on the D+ and D– Lines respectively.
2. Divider 2 DCP,required to apply 2.7V and 2V on the D+ and D– Lines respectively.
3. BC 1.2 DCP,required to short the D+ Line to the D– Line.
4. Chinese Telecom Standard YD/T 1591-2009 Shorted Mode, required to short the D+ Line to the D– Line.
5. 1.2V on both D+ and D– Lines

■ FEATURES

* Supports USB DCP Shorting D+ Line to D– Line per USB Battery Charging Specification, Revision 1.2 (BC1.2)
* Supports Shorted Mode (Shorting D+ Line to D-Line) per Chinese Telecommunication Industry Standard YD/T 1591-2009
* Supports USB DCP Applying 2.7V on D+ Line And 2V on D-line (or USB DCP Applying 2V on D+ Line and 2.7V on D– Line)
* Supports USB DCP Applying 1.2V on D+ and D– Lines
* Automatically Switch D+ and D- Lines Connections for an Attached Device
* Dual USB Port Controller, **UCHQ613**
* Operating Range: 4.5V to 5.5V

■ ORDERING INFORMATION

Ordering Number	Package	Packing
UCHQ613G-AG6-R	SOT-26	Tape Reel

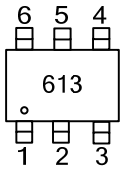
UCHQ613G-AG6-R

(1)Packing Type — (1) R: Tape Reel

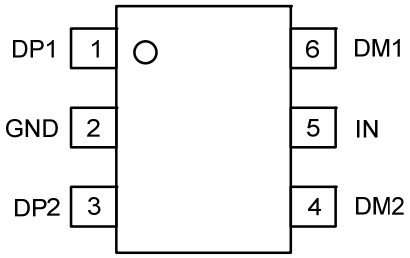
(2)Package Type — (2) AG6: SOT-26

(3)Green Package — (3) G: Halogen Free and Lead Free

■ MARKING



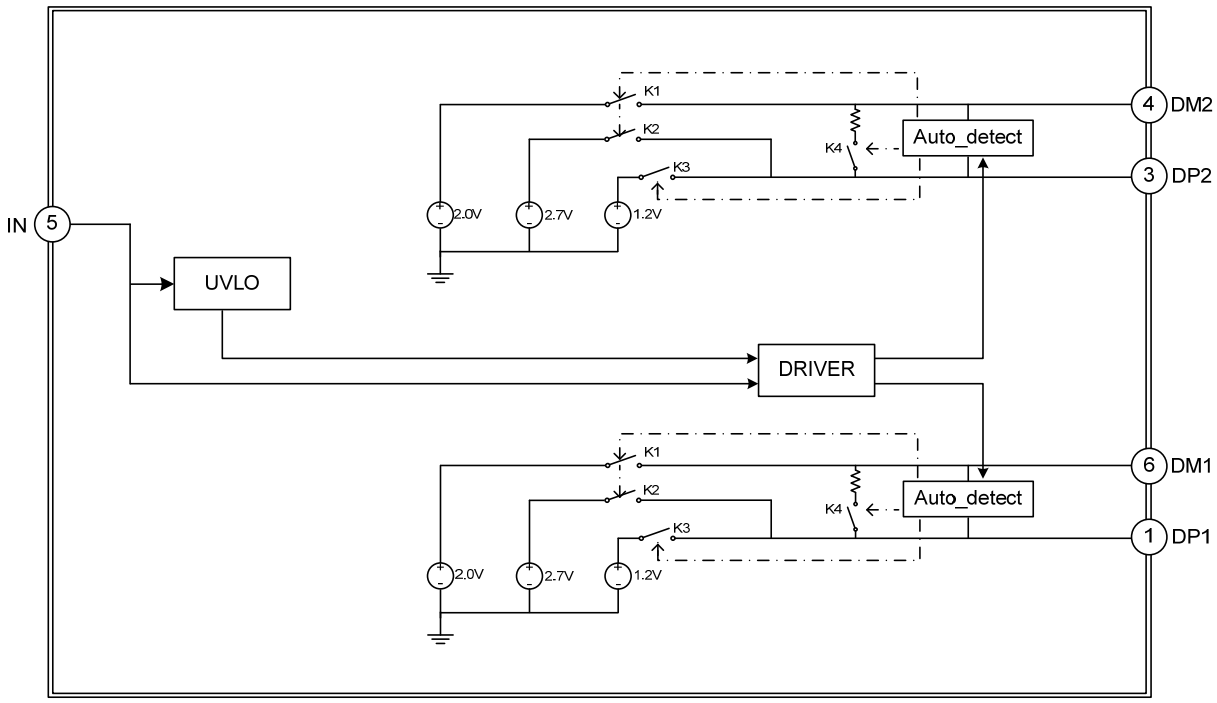
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN No.	PIN NAME	Description
1	DP1	Connected to the D+ or D– line of USB connector, provide the correct voltage with attached portable equipment for DCP detection.
2	GND	Ground connection.
3	DP2	Connected to the D+ or D– line of USB connector, provide the correct voltage with attached portable equipment for DCP detection.
4	DM2	Connected to the D+ or D– line of USB connector, provide the correct voltage with attached portable equipment for DCP detection.
5	IN	Power supply.Connect a ceramic capacitor with avalue of 0.1-μF or greater from the IN pin to GND as close to the device as possible.
6	DM1	Connected to the D+ or D– line of USB connector, provide the correct voltage with attached portable equipment for DCP detection.

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING

PARAMETER	SYMBOL	CONDITIONS	RATINGS	UNIT
Voltage range	V_{IN}		-0.3 ~ 7.0	V
DP1, DP2 output voltage,DM1,DM2 output voltage			-0.3 ~ 5.8	V
DP1, DP2 input voltage,DM1,DM2 input voltage			-0.3 ~ 5.8	V
DP1, DP2 input current,DM1,DM2 input current		Continuous output sink current	35	mA
DP1, DP2 output current,DM1,DM2 output current		Continuous output source current	35	mA
Maximum Operating Junction Temperature	T_J		-40 ~125	°C
Storage Temperature	T_{STG}		-65 ~ 150	°C

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

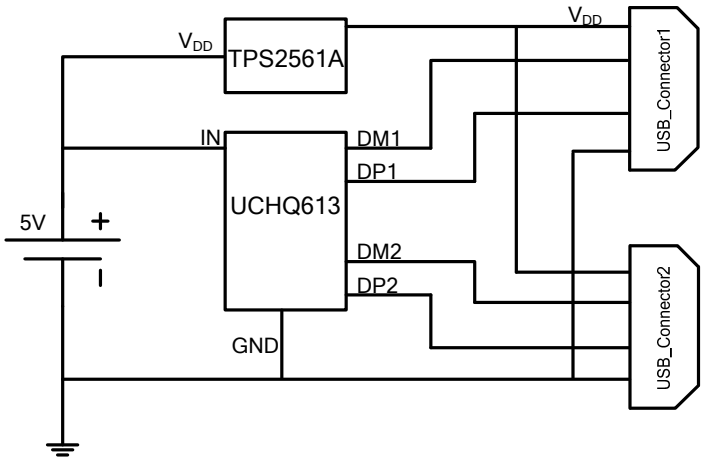
■ ELECTRICAL CHARACTERISTICS

(4.5V≤V_{DD}≤5.5V, Positive current are into pins. T_C=25°C unless otherwise specified.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
UNDERVOLTAGE LOCKOUT						
IN rising UVLO threshold voltage	V_{UVLO}		3.9	4.1	4.3	V
Hysteresis (1)				100		mV
SUPPLY CURRENT						
IN supply current	I_{IN}	4.5V≤V_{IN}≤5.5V		155	200	uA
BC 1.2 DCP MODE(SHORT MODE)						
DP1 and DM1shorting resistance	R_{DPM_SHORT1}	V_{DP1}=0.8V, I_{DM1}=1mA		157	200	Ω
DP2 and DM2 shorting resistance	R_{DPM_SHORT2}	V_{DP2}=0.8V, I_{DM2}=1mA		157	200	Ω
DIVIDER MODE						
DP1 output voltage	$V_{DP1\_2.7V}$	V_{IN} = 5 V	2.57	2.7	2.84	V
DM1 output voltage	V_{DM1_2V}	V_{IN} = 5 V	1.9	2	2.1	V
DP1 output impedance	R_{DP1_PAD1}	I_{DP1} = -5 μA	24	30	36	KΩ
DM1 output impedance	R_{DM1_PAD1}	I_{DM1} = -5 μA	24	30	36	KΩ
DP2 output voltage	$V_{DP2\_2.7V}$	V_{IN} = 5 V	2.57	2.7	2.84	V
DM2 output voltage	V_{DM2_2V}	V_{IN} = 5 V	1.9	2	2.1	V
DP2 output impedance	R_{DP2_PAD1}	I_{DP2} = -5 μA	24	30	36	KΩ
DM2 output impedance	R_{DM2_PAD1}	I_{DM2} = -5 μA	24	30	36	KΩ
1.2V / 1.2V MODE						
DP1 output voltage	$V_{DP1\_1.2V}$	V_{IN} = 5 V	1.12	1.2	1.28	V
DM1 output voltage	$V_{DM1\_1.2V}$	V_{IN} = 5 V	1.12	1.2	1.28	V
DP1 output impedance	R_{DP1_PAD2}	I_{DP1} = -5 μA	80	102	130	KΩ
DM1 output impedance	R_{DM1_PAD2}	I_{DM1} = -5 μA	80	102	130	KΩ
DP2 output voltage	$V_{DP2\_1.2V}$	V_{IN} = 5 V	1.12	1.2	1.28	V
DM2 output voltage	$V_{DM2\_1.2V}$	V_{IN} = 5 V	1.12	1.2	1.28	V
DP2 output impedance	R_{DP2_PAD2}	I_{DP2} = -5 μA	80	102	130	KΩ
DM2 output impedance	R_{DM2_PAD2}	I_{DM2} = -5 μA	80	102	130	KΩ

Note: Specified by design. Not production tested.

■ TYPICAL APPLICATION CIRCUIT



■ FUNCTIONAL DESCRIPTION

OVERVIEW

The following overview references various industry standards. It is always recommended to consult the latest standard to ensure the most recent and accurate information.

Rechargeable portable equipment requires an external power source to charge its batteries. USB ports are convenient locations for charging because of an available 5-V power source. Universally accepted standards are required to ensure host and client-side devices meet the power management requirements. Traditionally, USB host ports following the USB 2.0 Specification must provide at least 500 mA to downstream client-side devices. Because multiple USB devices can be attached to a single USB port through a bus-powered hub, it is the responsibility of the client-side device to negotiate the power allotment from the host to guarantee the total current draw does not exceed 500 mA. In general, each USB device can subsequently request more current, which is granted in steps of 100 mA up 500 mA total. The host may grant or deny the request based on the available current.

Additionally, the success of the USB technology makes the micro-USB connector a popular choice for wall adapter cables. This allows a portable device to charge from both a wall adapter and USB port with only one connector.

One common difficulty has resulted from this. As USB charging has gained popularity, the 500-mA minimum defined by the USB 2.0 Specification or 900 mA defined in the USB 3.0 Specification, has become insufficient for many handsets, tablets and personal media players (PMP) which have a higher rated charging current. Wall adapters and car chargers can provide much more current than 500 mA or 900 mA to fast charge portable devices. Several new standards have been introduced defining protocol handshaking methods that allow host and client devices to acknowledge and draw additional current beyond the 500 mA (defined in the USB 2.0 Specification) or 900 mA (defined in the USB 3.0 Specification) minimum while using a single micro-USB input connector.

The UTC **UCHQ613** support four of the most common protocols:

• USB Battery Charging Specification, Revision 1.2 (BC1.2)
• Chinese Telecommunications Industry Standard YD/T 1591-2009
• Divider mode
• 1.2 V on both D+ and D– lines

YD/T 1591-2009 is a subset of the BC1.2 specification supported by the vast majority of devices that implement USB charging. Divider and 1.2-V charging schemes are supported in devices from specific yet popular device makers. BC1.2 has three different port types, listed as follows.

• Standard downstream port (SDP)
• Charging downstream port (CDP)
• Dedicated charging port (DCP)

The BC1.2 Specification defines a charging port as a downstream facing USB port that provides power for charging portable equipment.

Table 3 shows different port operating modes according to the BC1.2 Specification.

Table 3. Operating Modes Table

PORT TYPE	SUPPORTS USB2.0 COMMUNICATION	MAXIMUM ALLOWABLE CURRENT DRAWN BY PORTABLE EQUIPMENT (A)
SDP (USB 2.0)	YES	0.5
SDP (USB 3.0)	YES	0.9
CDP	YES	1.5
DCP	NO	1.5

■ FUNCTIONAL DESCRIPTION (Cont.)

The BC1.2 Specification defines the protocol necessary to allow portable equipment to determine what type of port it is connected to so that it can allot its maximum allowable current drawn. The hand-shaking process is two steps. During step one, the primary detection, the portable equipment outputs a nominal 0.6 V output on its D+ line and reads the voltage input on its D– line. The portable device concludes it is connected to a SDP if the voltage is less than the nominal data detect voltage of 0.3 V. The portable device concludes that it is connected to a Charging Port if the D– voltage is greater than the nominal data detect voltage of 0.3V and less than 0.8 V. The second step, the secondary detection, is necessary for portable equipment to determine between a CDP and a DCP. The portable device outputs a nominal 0.6 V output on its D– line and reads the voltage input on its D+ line. The portable device concludes it is connected to a CDP if the data line being remains is less than the nominal data detect voltage of 0.3 V. The portable device concludes it is connected to a DCP if the data line being read is greater than the nominal data detect voltage of 0.3 V and less than 0.8 V.

Dedicated Charging Port (DCP)

A dedicated charging port (DCP) is a downstream port on a device that outputs power through a USB connector,but is not capable of enumerating a downstream device, which generally allows portable devices to fast charge at their maximum rated current. A USB charger is a device with a DCP, such as a wall adapter or car power adapter. A DCP is identified by the electrical characteristics of its data lines. The following DCP identification circuits are usually used to meet the handshaking detections of different portable devices.

Short the D+ Line to the D– Line

The USB BC1.2 Specification and the 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 200 Ω. This is shown in Figure 1.

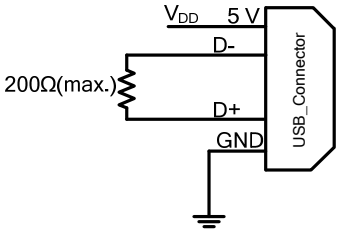


Figure 1. DCP Short Mode

Divider 1 (DCP Applying 2 V on D+ Line and 2.7 V on D– Line) or Divider 2 (DCP Applying 2.7 V on D+ Line and 2 V on D– Line)

There are two charging schemes for divider DCP. They are named after Divider 1 and Divider 2 DCPs that are shown in Figure 2 and Figure 3. The Divider 1 charging scheme is used for 5-W adapters, and applies 2 V to the D+ line and 2.7 V to the D– data line. The Divider 2 charging scheme is used for 10-W adapters, and applies 2.7 V on the D+ line and 2 V is applied on the D– line.

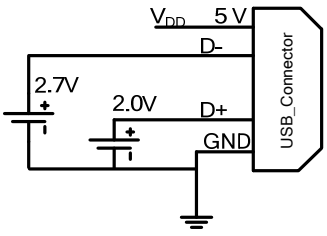


Figure 2. Divider 1 DCP

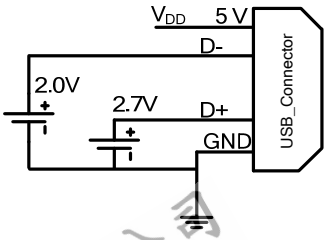


Figure 3. Divider 2 DCP

■ FUNCTIONAL DESCRIPTION (Cont.)

Applying 1.2 V to the D+ Line and 1.2 V to the D– Line

As shown in Figure 4, some tablet USB chargers require 1.2 V on the shorted data lines of the USB connector.The maximum resistance between the D+ line and the D- line is 200 Ω.

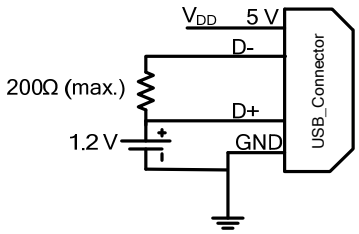


Figure 4. DCP Applying 1.2V to the D+ Line and 1.2V to the D- Line

The UTC **UCHQ613** are USB dedicated charging port (DCP) controllers. Applications include vehicle power charger, wall adapters with USB DCP and other USB chargers. The UTC **UCHQ613** DCP controllers have the auto-detect feature that monitors the D+ and D– line voltages of the USB connector, providing the correct electrical signatures on the DP and DM pins for the correct detections of compliant portable devices to fast charge. These portable devices include smart phones, 5-V tablets and personal media players.

DCP Auto-Detect

The UTC **UCHQ613** integrate an auto-detect feature to support divider mode, short mode and 1.2 V / 1.2V modes. If a divider device is attached, 2.7 V is applied to the DP pin and 2 V is applied to the DM pin. If a BC1.2-compliant device is attached, the UTC **UCHQ613** automatically switches into short mode. If a device compliant with the 1.2 V / 1.2 V charging scheme is attached, 1.2 V is applied on both the DP pin and the DM pin. The functional diagram of DCP auto-detect feature (DM1 and DP1) is shown in Figure 5. DCP autodetect feature (DM2 and DP2 of **UCHQ613**) has the same functional configuration.

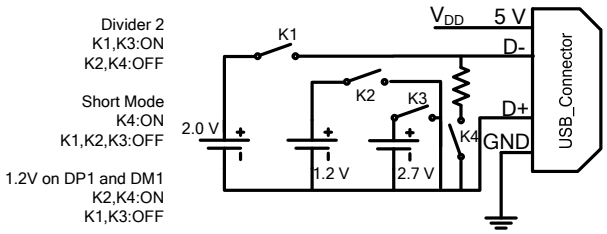


Figure 5. UCHQ613 DCP Auto_Detect Functional Diagram

Undervoltage Lockout (UVLO)

The undervoltage lockout (UVLO) circuit disables DP1, DM1, DP2 and DM2 output voltage until the input voltage reaches the UVLO turn-on threshold. Built-in hysteresis prevents unwanted oscillations due to input voltage drop from large current surges.

■ APPLICATION INFORMATION

The UTC **UCHQ613** only provide the correct electrical signatures on the data line of USB charger port and do not provide any power for the VBUS.

Divide Mode Selection of 5-W and 10-W USB Chargers

The UTC **UCHQ613** provide two types of connections between the DP pin and the DM pin and between the D+ data line and the D– data line of the USB connector for a 5-W USB charger and a 10-W USB charger with a single USB port. For 5-W USB charger, the DP1 pin is connected to the D– line and the DM1 pin is connected to the D+ line. This is shown in Figure 6. For 10-W USB charger, the DP1 pin is connected to the D+ line and the DM1 pin is connected to the D– line. This is shown in Figure 7. Table 4 shows different charging schemes for both 5-W and 10-W USB charger solutions. DP2 and DM2 of **UCHQ613** also provides this two types of connections.

Table 4. Charging Schemes for 5-W and 10-W USB Chargers

USB CHARGER TYPE	CONTAINING CHARGING SCHEMES		
5-W	Divider 1	1.2 V on both D+ and D– Lines	BC1.2 DCP
10-W	Divider 2	1.2 V on both D+ and D– Lines	BC1.2 DCP

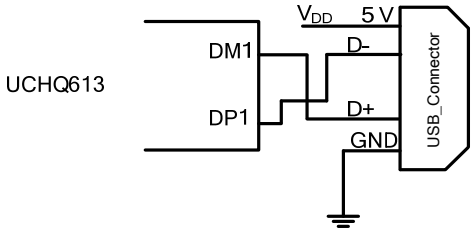


Figure 6. 5-W USB Charger Application

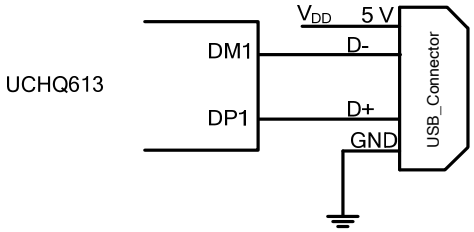


Figure 7. 10-W USB Charger Application

Layout Guidelines

Place the UTC **UCHQ613** near the USB output connector and place the 0.1-μF bypass capacitor near the IN pin.