USB Dedicated Charging Port Controller

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 2.7 V on D+ Line and 2.7 V on D- Line**
- **Supports USB DCP Applying 1.2 V on D+ and D– Lines**
- **Automatically Switch D+ and D- Lines Connections for an Attached Device**
- **Dual USB Port Controller (JTM8120A)**
- **Single USB Port Controller (JTM8120)**
- **Operating Range: 4.5 V to 5.5 V**
- **Available in SOT23-6 Package**
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APPLICATIONS

- **Vehicle USB Power Charger**
- **AC-DC Adapter with USB Port**
- **Other USB Charger**

DESCRIPTION

The devices 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 2.7 V and 2.7 V on the D+ and D- Lines respectively

2. BC1.2 DCP, required to short the D+ Line to the D– Line

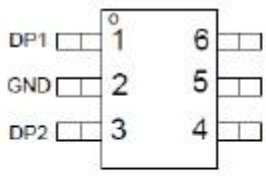
3. Chinese Telecom Standard YD/T 1591-2009 Shorted Mode, required to short the D+ Line to the D– Line

4. 1.2 V on both D+ and D– Lines

DBV PACKAGE and SIMPLIFIED APPLICATION DIAGRAM

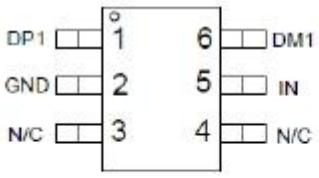
JTM8120A

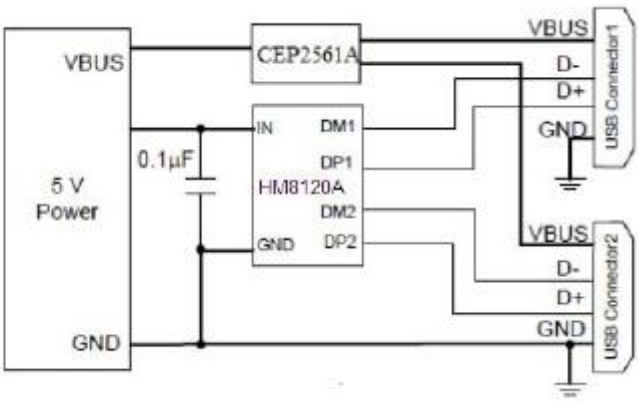
DBV (Top View)



JTM8120

DBV (Top View)





ABSOLUTE MAXIMUM RATINGS(1)

Over recommended junction temperature range, voltages are referenced to GND (unless otherwise noted)

			MIN	MAX	UNIT
Voltage range	IN		–0.3	7	V
	DP1, DP2 output voltage, DM1, DM2 output voltage		–0.3	5.8	
	DP1, DP2 input voltage, DM1, DM2 input voltage		–0.3	5.8	
Continuous output sink current	DP1, DP2 input current, DM1, DM2 input current			35	mA
Continuous output source current	DP1, DP2 output current, DM1, DM2 output current			35	mA
ESD rating	Human Body Model (HBM)	IN		2	kV
		DP1, DP2, DM1, DM2		6	
	Charging Device Model (CDM)			500	V
Operating Junction Temperature	TJ		–40	125	°C
Storage Temperature Range	Tstg		–65	150	°C

(1) Stresses beyond those listed under 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 under Recommended Operating Conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

THERMAL INFORMATION

THERMAL METRIC(1)	DBV (6 PINS)	UNITS
θ_{JA} Junction-to-ambient thermal resistance	179.9	°C/W
θ_{JCtop} Junction-to-case (top) thermal resistance	117.5	
θ_{JB} Junction-to-board thermal resistance	41.9	
ψ_{JT} Junction-to-top characterization parameter	17.2	
ψ_{JB} Junction-to-board characterization parameter	41.5	
θ_{JCbot} Junction-to-case (bottom) thermal resistance	N/A	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report

RECOMMENDED OPERATING CONDITIONS

Voltages are referenced to GND (unless otherwise noted), positive current are into pins

	MIN	MAX	UNIT
V_{IN} Input voltage of IN	4.5	5.5	V
V_{DP1} DP1 data line input voltage	0	5.5	V
V_{DM1} DM1 data line input voltage	0	5.5	V
I_{DP1} Continuous sink or source current		±10	mA
I_{DM1} Continuous sink or source current		±10	mA
V_{DP2} DP2 data line input voltage	0	5.5	V
V_{DM2} DM2 data line input voltage	0	5.5	V
I_{DP2} Continuous sink or source current		±10	mA
I_{DM2} Continuous sink or source current		±10	mA
T_J Operating junction temperature	–40	125	°C

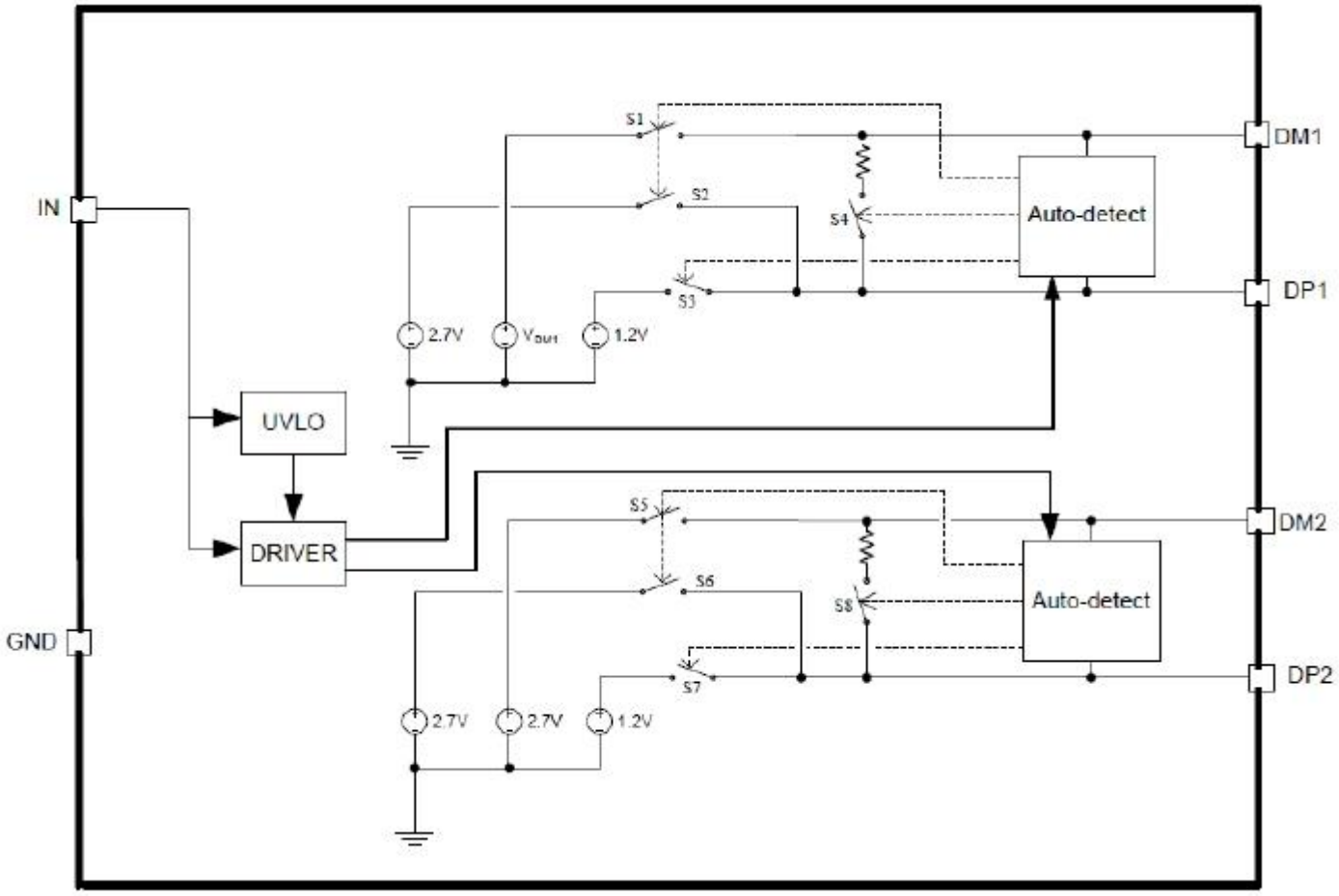
ELECTRICAL CHARACTERISTICS

Conditions are –40°C ≤ (T_J = T_A) ≤ 125°C, 4.5 V ≤ V_{IN} ≤ 5.5 V. Positive current are into pins. Typical values are at 25°C. All voltages are with respect to GND (unless otherwise noted).

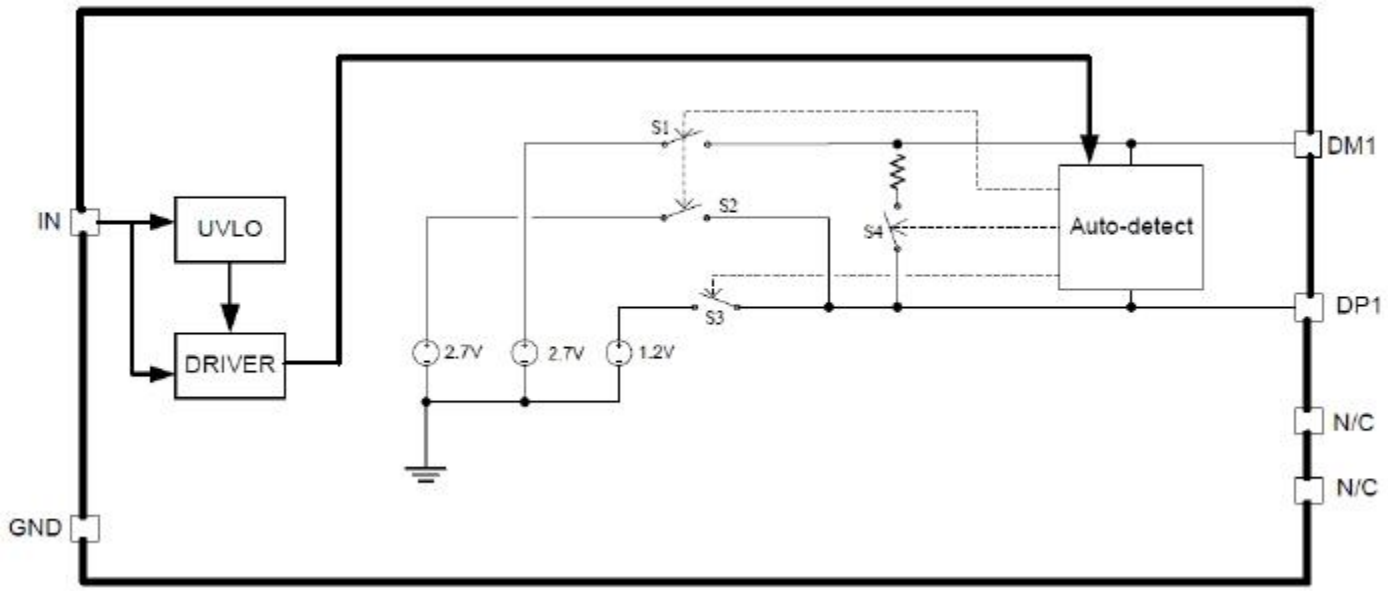
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
UNDERVOLTAGE LOCKOUT					
V_{UVLO} IN rising UVLO threshold voltage		3.9	4.1	4.3	V
Hysteresis(1)				100	mV
SUPPLY CURRENT					
I_{IN} IN supply current	4.5 V ≤ V_{IN} ≤ 5.5 V	155		200	μA
BC 1.2 DCP MODE (SHORT MODE)					
R_{DPM_SHORT1} DP1 and DM1 shorting resistance	V_{DP1} = 0.8 V, I_{DM1} = 1 mA	157		200	Ω
R_{DCHG_SHORT1} Resistance between DP1/DM1 and GND	V_{DP1} = 0.8 V	350	656	1150	kΩ
$V_{DPL\_TH\_DETACH1}$ Voltage threshold on DP1 under which the device goes back to divider mode		310	330	350	mV
$V_{DPL\_TH\_DETACH\_HYS1}$ Hysteresis(1)				50	mV
R_{DPM_SHORT2} DP2 and DM2 shorting resistance	V_{DP2} = 0.8V, I_{DM2} = 1 mA	157		200	Ω
R_{DCHG_SHORT2} Resistance between DP2/DM2 and GND	V_{DP2} = 0.8 V	350	656	1150	kΩ
$V_{DPL\_TH\_DETACH2}$ Voltage threshold on DP2 under which the device goes back to divider mode		310	330	350	mV
$V_{DPL\_TH\_DETACH\_HYS2}$ Hysteresis(1)				50	mV
DIVIDER MODE					
$V_{DP1\_2.7V}$ DP1 output voltage	V_{IN} = 5 V	2.57	2.7	2.84	V
$V_{DM1\_2.7V}$ DM1 output voltage	V_{IN} = 5 V	2.57	2.7	2.84	V
R_{DP1_PAD1} DP1 output impedance	I_{DP1} = –5 μA	24	30	36	kΩ
R_{DM1_PAD1} DM1 output impedance	I_{DP1} = –5 μA	24	30	36	kΩ
$V_{DP2\_2.7V}$ DP2 output voltage	V_{IN} = 5 V	2.57	2.7	2.84	V
$V_{DM2\_2.7V}$ DM2 output voltage	V_{IN} = 5 V	2.57	2.7	2.84	V
R_{DP2_PAD1} DP2 output impedance	I_{DP1} = –5 μA	24	30	36	kΩ
R_{DM2_PAD1} DM2 output impedance	I_{DP1} = –5 μA	24	30	36	kΩ
1.2 V / 1.2 V MODE					
$V_{DP1\_1.2V}$ DP1 output voltage	V_{IN} = 5 V	1.12	1.2	1.28	V
$V_{DM1\_1.2V}$ DM1 output voltage	V_{IN} = 5 V	1.12	1.2	1.28	V
R_{DM1_PAD2} DP1 output impedance	I_{DP1} = –5 μA	80	102	130	kΩ
R_{DP1_PAD2} DM1 output impedance	I_{DP1} = –5 μA	80	102	130	kΩ
$V_{DP2\_1.2V}$ DP2 output voltage	V_{IN} = 5 V	1.12	1.2	1.28	V
$V_{DM2\_1.2V}$ DM2 output voltage	V_{IN} = 5 V	1.12	1.2	1.28	V
R_{DP2_PAD2} DP2 output impedance	I_{DP1} = –5 μA	80	102	130	kΩ
R_{DM2_PAD2} DM2 output impedance	I_{DP1} = –5 μA	80	102	130	kΩ

(1) Parameters provided for reference only, and do not constitute part of TI's published device specifications for purposes of TI's product Warranty

FUNCTIONAL BLOCK DIAGRAM JTM8120A



FUNCTIONAL BLOCK DIAGRAM, JTM8120



DEVICE INFORMATION

JTM8120 , JTM8120A DBV (SOT23-6)
(TOP VIEW)

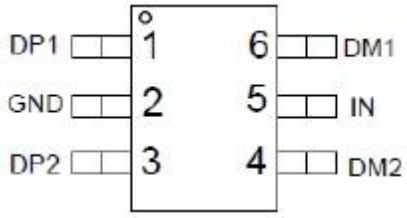


Table 1. PIN FUNCTIONS, JTM8120A

NO.	NAME	TYPE(1)	DESCRIPTION
1	DP1	I/O	Connected to the D+ or D– line of USB connector, provide the correct voltage with attached portable equipment for DCP detection.
2	GND	G	Ground connection
3	DP2	I/O	Connected to the D+ or D– line of USB connector, provide the correct voltage with attached portable equipment for DCP detection.
4	DM2	I/O	Connected to the D+ or D– line of USB connector, provide the correct voltage with attached portable equipment for DCP detection
5	IN	P	Power supply. Connect a ceramic capacitor with a value of 0.1-μF or greater from the IN pin to GND as close to the device as possible.
6	DM1	I/O	Connected to the D+ or D– line of USB connector, provide the correct voltage with attached portable equipment for DCP detection

(1) G = Ground, I = Input, O = Output, P = Power

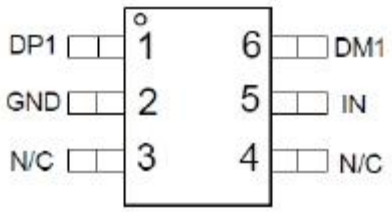


Table 2. PIN FUNCTIONS, JTM8120

NO.	NAME	TYPE(1)	DESCRIPTION
1	DP1	I/O	Connected to the D+ or D– line of USB connector, provide the correct voltage with attached portable equipment for DCP detection.
2	GND	G	Ground connection
3	N/C	–	No connect pin. Can be grounded or left floating.
4	N/C	–	No connect pin. Can be grounded or left floating.
5	IN	P	Power supply. Connect a ceramic capacitor with a value of 0.1-μF or greater from the IN pin to GND as close to the device as possible.
6	DM1	I/O	Connected to the D+ or D– line of USB connector, provide the correct voltage with attached portable equipment for DCP detection

(1) G = Ground, I = Input, O = Output, P = Power

TYPICAL CHARACTERISTICS

SUPPLY CURRENT
Vs
TEMPERATURE

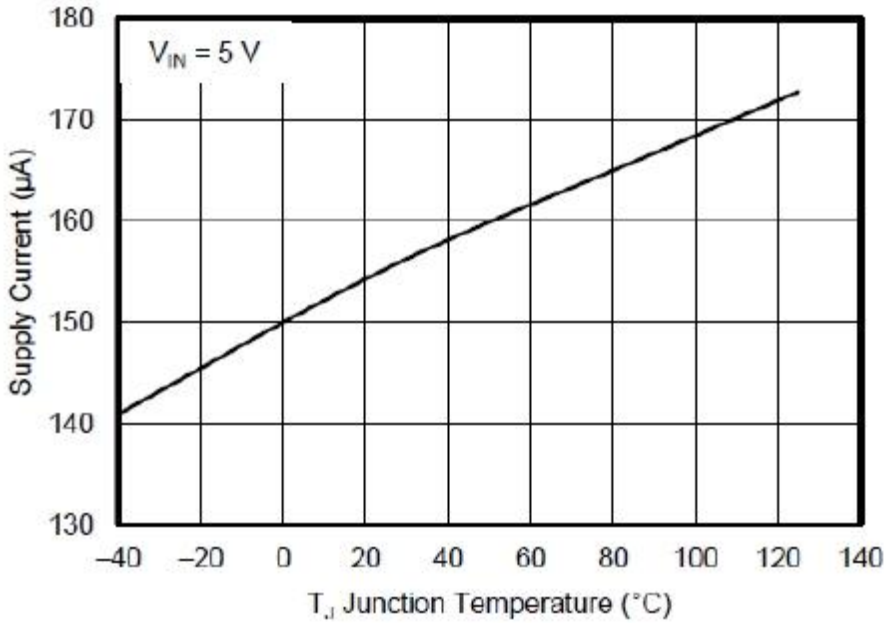


Figure 1.

DETAILED 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 devices 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 4 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

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 8.

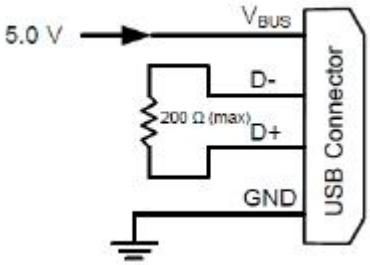


Figure 2. DCP Short Mode

Divider DCP

The Divider 1 charging scheme is used for 12-W adapters, and applies 2.7V on D+ and D- lines.

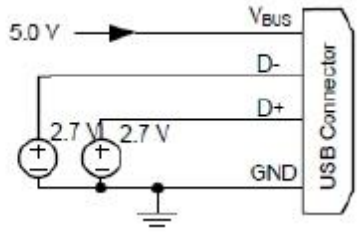


Figure 3. Divider 1 DCP

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

As shown in Figure 12, 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.

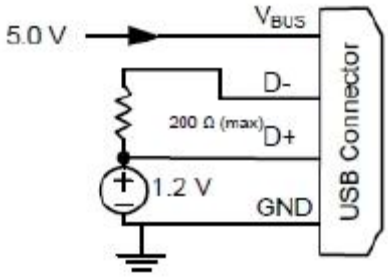


Figure 4. DCP Applying 1.2 V to the D+ Line and 1.2 V to the D– Line

The devices are USB dedicated charging port (DCP) controllers. Applications include vehicle power charger, wall adapters with USB DCP and other USB chargers. The device 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 devices integrate an auto-detect feature to support divider mode, short mode and 1.2 V / 1.2 V modes. If a divider device is attached, 2.7 V is applied to the DP pin and the DM pin. If a BC1.2-compliant device is attached, the JTM8120 and JTM8120A 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 13. DCP auto-detect feature (DM2 and DP2 of JTM8120A) has the same functional configuration.

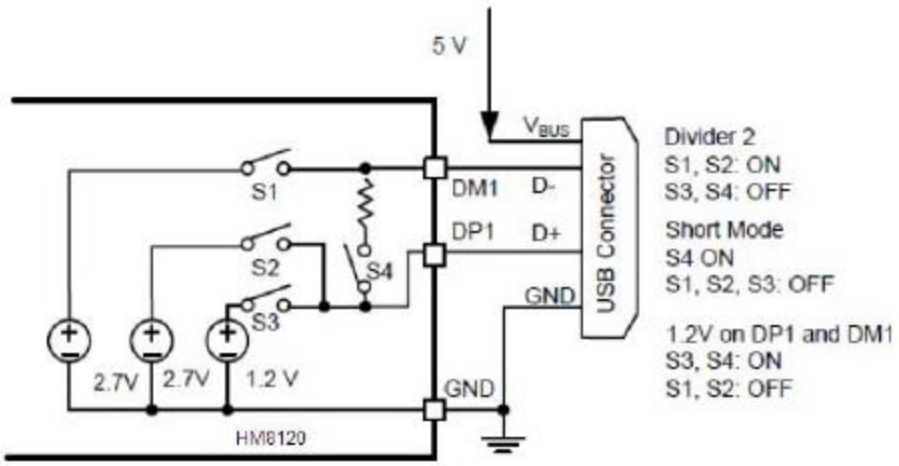


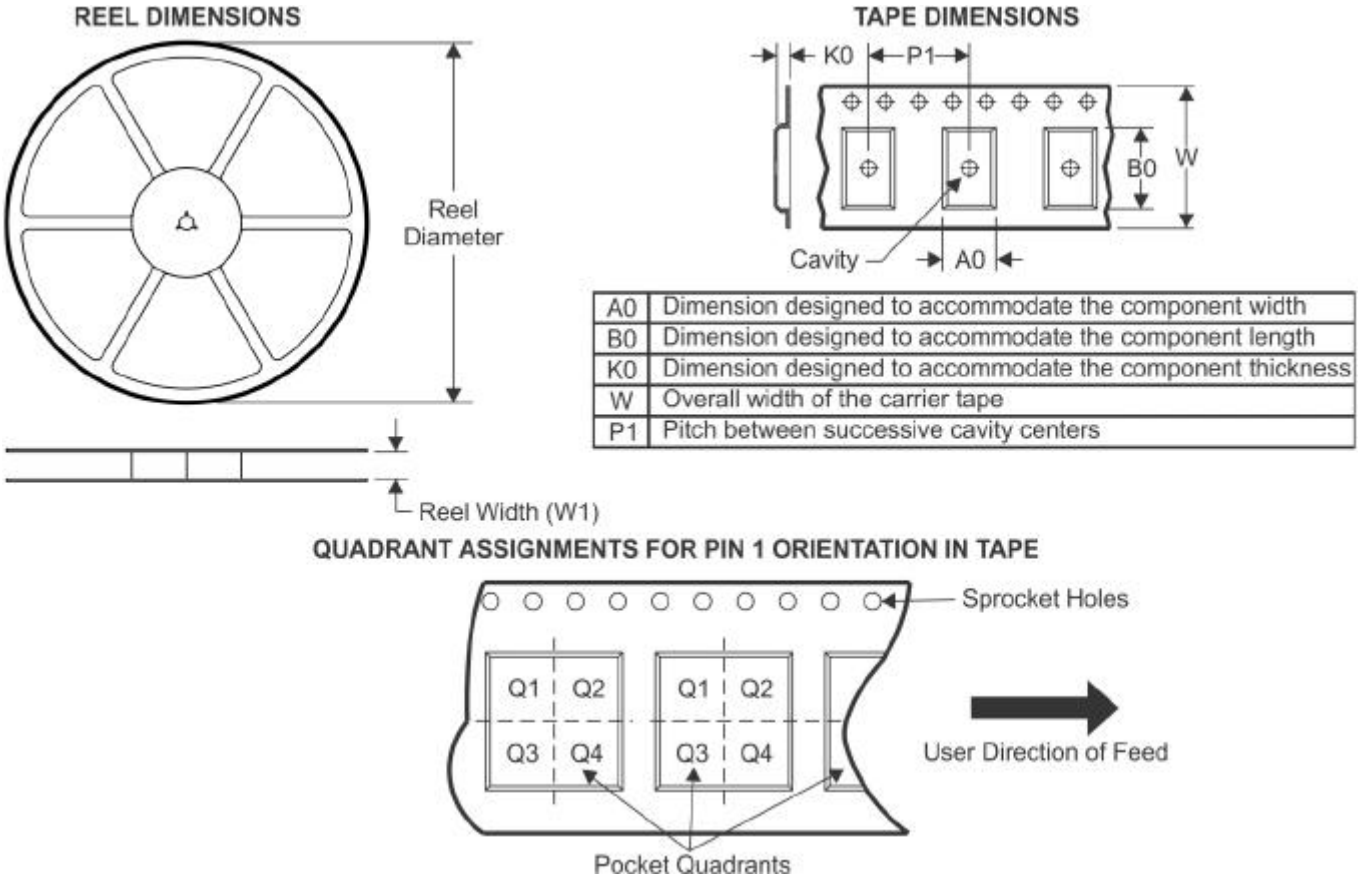
Figure 5. JTM8120 and JTM8120A DCP Auto-Detect Functional Diagram

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.

Layout Guidelines

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

TAPE AND REEL INFORMATION



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
JTM8120	SOT-23	C8120	6	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3
JTM8120A	SOT-23	C8120A	6	3000	178.0	9.0	3.23	3.17	1.37	4.0	8.0	Q3