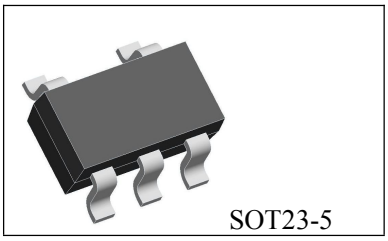
D1527

USB Dedicated Charging Port (DCP) Controller

General Description


SOT23-5

The D1527 is USB dedicated charging port (DCP) controller. It is applied in vehicle power charger, wall adapters with USB DCP and other USB chargers. The D1527 has the auto-detect feature that monitors the D+ and D– line voltages of the USB connector and provides the correct electrical signatures on the DP and DM pins for the correct detections of compliant portable devices to charge fast. These portable devices include smart phones, 5V tablets and personal media players.

The D1527 supports four of the most common protocols:

- Divider 3 (DCP Applying 2.7V on D+ Line and 2.7V on D– Line)
- USB Battery Charging Specification, Revision 1.2 (BC1.2)
- Chinese Telecommunications Industry Standard YD/T 1591-2009
- 1.2V on both D+ and D– lines

Features

- In accordance with USB Battery Charging Specification of Revision 1.2 (BC1.2), it supports USB DCP shorting D+ line to D- line
- In accordance with Chinese Telecommunications Industry Standard YD/T 1591-2009, it supports Short mode (shorting D+ line to D- line)
- It supports DCP applying 2.7V on both D+ Line and D– Line
- It supports DCP applying 1.2V on both D+ Line and D– Line
- Automatic switching D+ Line and D- Line for connected devices
- Operation voltage range from 4.5V to 5.5V

Package Information

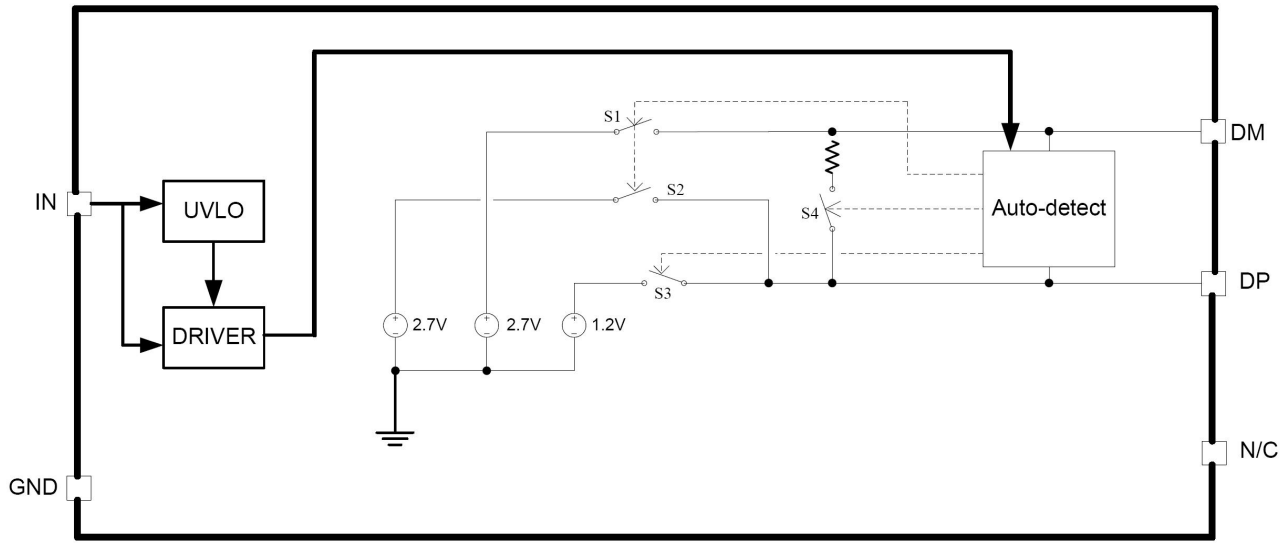
Part NO.	Package Description	Package Marking	Package Option
D1527	SOT23-5	D1527 SXXXX	3000/Reel

D1527:Part NO. SXXXX:Lot NO.

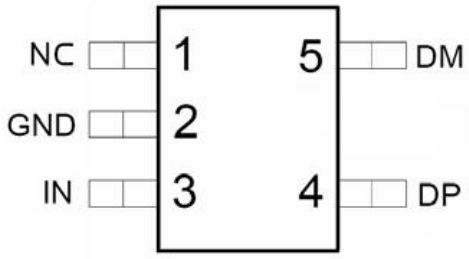
Applications

- USB car charger
- AC-DC adapter with USB port
- Other USB charger

Functional Block Diagram



Pin Configuration



Pin Description

Pin Number	Pin Name	Type	Function Description
1	NC		No Connect
2	GND	G	Ground connection
3	IN	P	Power supply. Connect a ceramic capacitor with a value of 0.1μF or greater from the IN pin to GND as close to the device as possible.
4	DP	I/O	Connected to the D+ or D– line of USB connector, provide the correct voltage with attached portable equipment for DCP detection.
5	DM	I/O	Connected to the D+ or D– line of USB connector, provide the correct voltage with attached portable equipment for DCP detection.

Absolute Maximum Ratings

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

Parameter Name	Conditions	Min	Max	Unit
Voltage Range	In	-0.3	7	V
	DP1 Output Voltage and DM1 Output Voltage	-0.3	5.8	
	DP1 Input Voltage and DM1 Input Voltage	-0.3	5.8	
Continuous Output Sink Current	DP1 Input Voltage and DM1 Input Voltage		35	mA
Continuous Output Source Current	DP1 Output Voltage and DM1 Output Voltage		35	mA
Operating Junction Temperature	Tj	-40	125	℃
Storage Temperature Range	Tstg	-65	150	℃
ESD (Human Body Mode)		8000		V

*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	Symbol	DBV	Unit
Junction-to-Ambient Thermal Resistance	θ_{JA}	179.9	℃/W
Junction-to-Case (Top) Thermal Resistance	θ_{JCtop}	117.5	
Junction-to-Board Thermal Resistance	θ_{JB}	41.9	
Junction-to-Top Characterization Parameter	ψ_{JT}	17.2	
Junction-to-Board Characterization Parameter	ψ_{JB}	41.5	
Junction-to-Case (Bottom) Thermal Resistance	θ_{JCbot}	N/A	

Recommended Operating Conditions

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

Parameter Name	Symbol	Min.	Max.	Unit
Input Voltage of IN	V_{IN}	4.5	5.5	V
DP1 Data Line Input Voltage	V_{DP1}	0	5.5	V
DM1 Data Line Input Voltage	V_{DM1}	0	5.5	V
DP1 Continuous Sink or Source Current	I_{DP1}		±10	mA
DM1 Continuous Sink or Source Current	I_{DM1}		±10	mA
Operating Junction Temperature	T_J	-40	125	℃

Electrical Characteristics

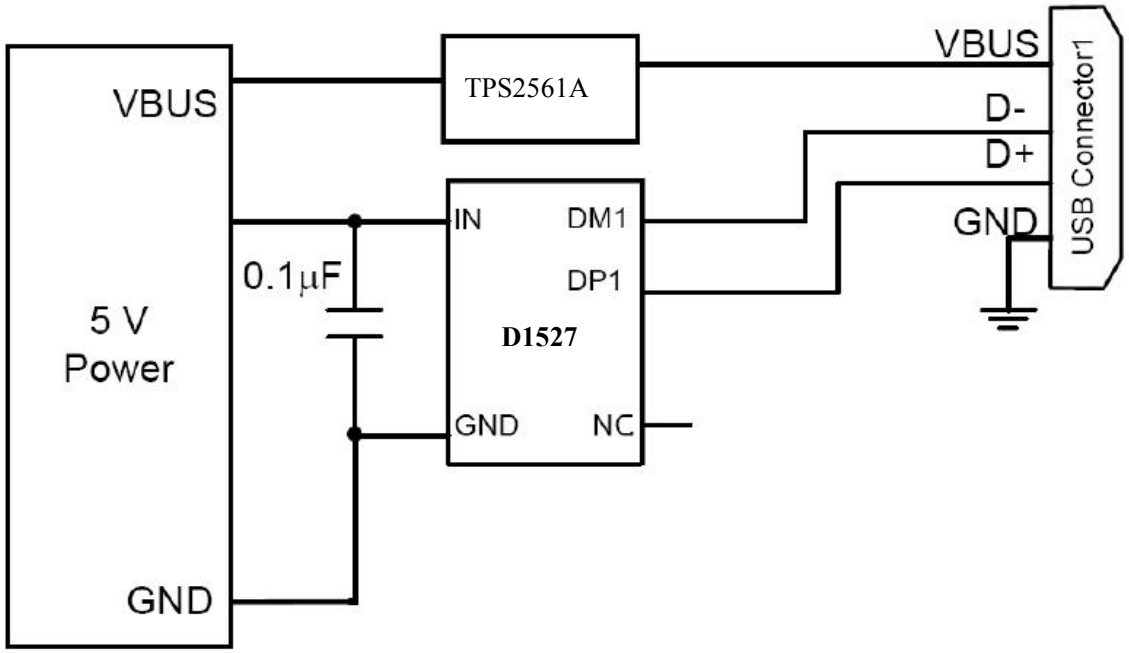
Conditions are –40°C ≤ (TJ= TA) ≤ 125°C, 4.5V ≤ VIN ≤ 5.5V. Positive current are into pins. Typical values are at 25°C. All voltages are with respect to GND (unless otherwise noted).

Parameter Name	Symbol	Conditions	Min	Typ	Max	Unit
Undervoltage Lockout						
IN Rising UVLO Threshold Voltage	V_{UVLO}		3.89	4.15	4.38	V
Hysteresis				100		mV
Supply Current						
IN Supply Current	I_{IN}	4.5 V ≤ V_{IN} ≤ 5.5 V		155	231	μA
BC 1.2 DCP Mode(Short Mode)						
DP1 and DM1 Shorting Resistance	R_{DPM_SHORT1}	V_{DP1}=0.8V, I_{DM1}= 1mA		157	200	Ω
Resistance Between DP1/DM1 And GND	R_{DCHG_SHORT1}	V_{DP1}=0.8V	350	656	1150	kΩ
Voltage Threshold On DP1 Under Which The Device Goes Back To Divider Mode	$V_{DPL\_TH\_DETACH1}$		310	330	350	mV
Hysteresis *	$V_{DPL\_TH\_DETACH\_HYS1}$			50		mV
Divider Mode						
DP1 Output Voltage	$V_{DP1\_2.7V}$	VIN=5V	2.56	2.7	2.87	V
DM1 Output Voltage	V_{DM1_2V}	VIN=5V	2.56	2.7	2.87	V
DP1 Output Impedance	R_{DP1_PAD1}	IDP1=-5μA	23.9	30	36.1	kΩ
DM1 Output Impedance	R_{DM1_PAD1}	IDM1=-5μA	23.9	30	36.1	kΩ

Parameter Name	Symbol	Conditions	Min	Typ	Max	Unit
1.2V/1.2V Mode						
DP1 Output Voltage	$V_{DP1\_2.7V}$	VIN=5V	1.11	1.2	1.29	V
DM1 Output Voltage	V_{DM1_2V}	VIN=5V	1.11	1.2	1.29	V
DP1 Output Impedance	R_{DP1_PAD1}	IDP1=-5μA	79.9	102	130.1	kΩ
DM1 Output Impedance	R_{DM1_PAD1}	IDM1=-5μA	79.9	102	130.1	kΩ

* Specified by design. Not production tested.

Typical Application



Application Information

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 500mA 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 500mA. In general, each USB device can subsequently request more current, which is granted in steps of 100mA up 500mA 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 900mA 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 500mA or 900mA 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 500mA (defined in the USB 2.0 Specification) or 900mA (defined in the USB 3.0 Specification) minimum while using a single micro-USB input connector.

The D1527 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 Von 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: shows different port operating modes according to the BC1.2 Specification.

Port Type	Supports USB2.0 Communication	Maximum Allowable Current Drawn by Portable Equipment(A)
SDP(USB2.0)	Yes	0.5
SDP(USB3.0)	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 Voutput 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 right.

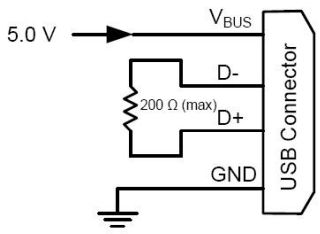


Fig. DCP Short Mode

Divider 3 (DCP Applying 2.7 V on D+ Line and 2.7 V on D– Line)

There is one charging scheme for divider DCP. The Divider 3 charging scheme is used for 12-W adapters, and applies 2.7V on D+ and D- lines.

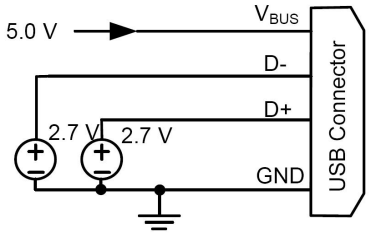


Fig. Divider 3 DCP

The D1527 is USB dedicated charging port (DCP) controllers. Applications include vehicle power charger, wall adapters with USB DCP and other USB chargers. The D1527 controllers has 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.

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

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

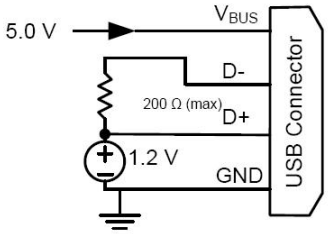


Fig. DCP Applying 1.2V to the D+ Line and 1.2V to the D-Line

The D1527 is USB dedicated charging port (DCP) controllers. Applications include vehicle power charger, wall adapters with USB DCP and other USB chargers. The D1527 controllers has 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 D1527 integrate an auto-detect feature to support divider mode, short mode and 1.2V / 1.2V modes. If a divider device is attached, 2.7V is applied to the DP pin and 2.7V is applied to the DM pin. If a BC1.2-compliant

device is attached, the D1527 automatically switches into short mode. If a device compliant with the 1.2V / 1.2V charging scheme is attached, 1.2V 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 below. DCP autodetect feature has the same functional configuration.

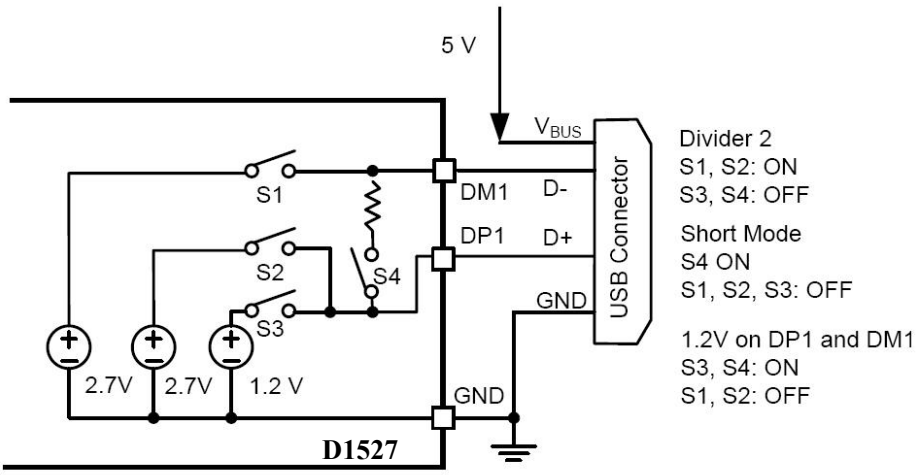


Fig. DCP Auto-Detect Functional Diagram

Undervoltage Lockout (UVLO)

The undervoltage lockout (UVLO) circuit disables DP1, DM1 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.

The D1527 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 12-W USB Chargers

The D1527 provide one type 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 12-W USB charger

Table: Charging Scheme for 12-W USB Chargers

USB Charger Type	Containing Charging Schemes		
12-W	Divider 3	2.7V on both D+ and D- Lines	BC1.2DCP

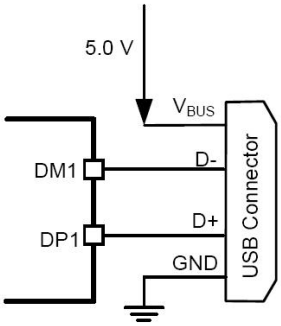
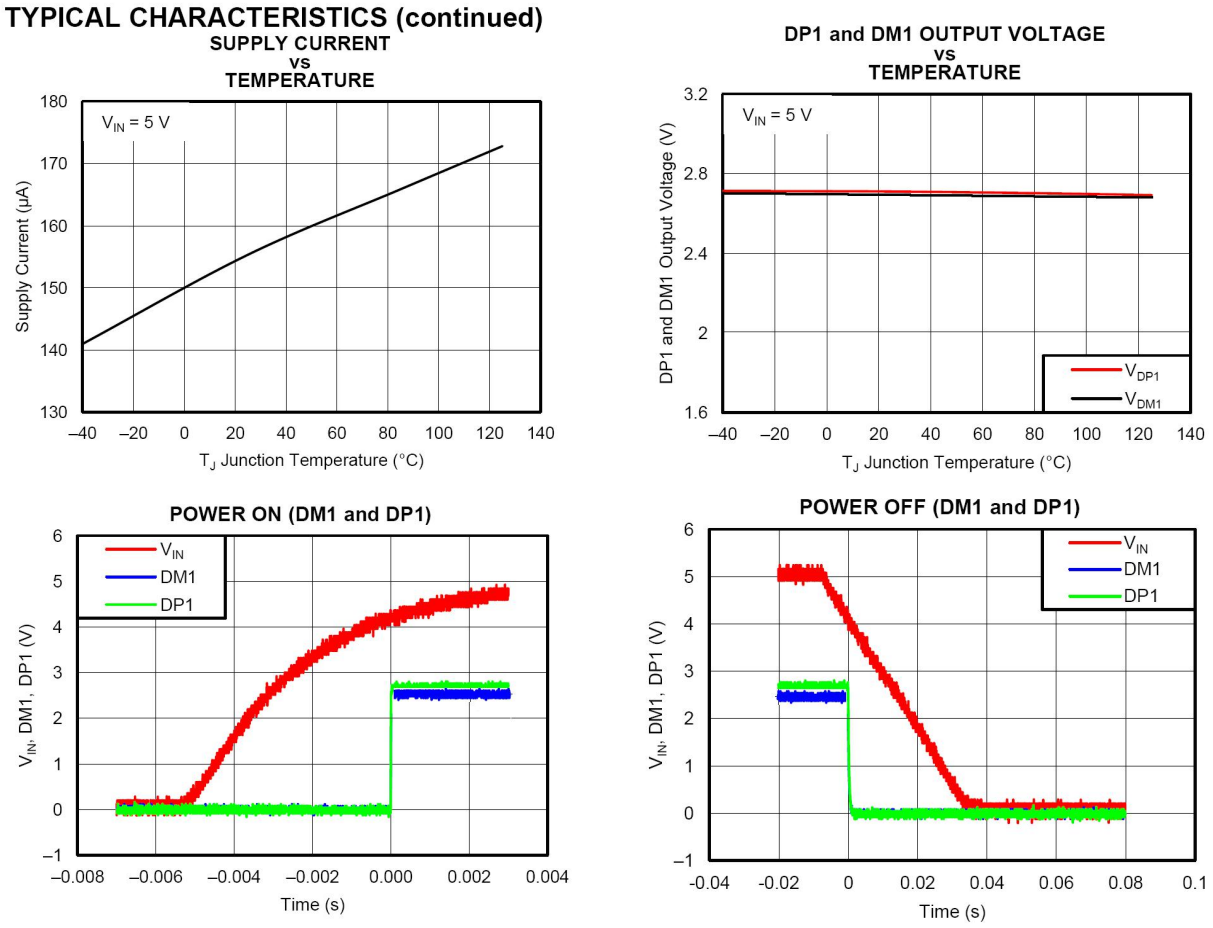


Fig. 12-w USB Charge Application

Layout Guidelines

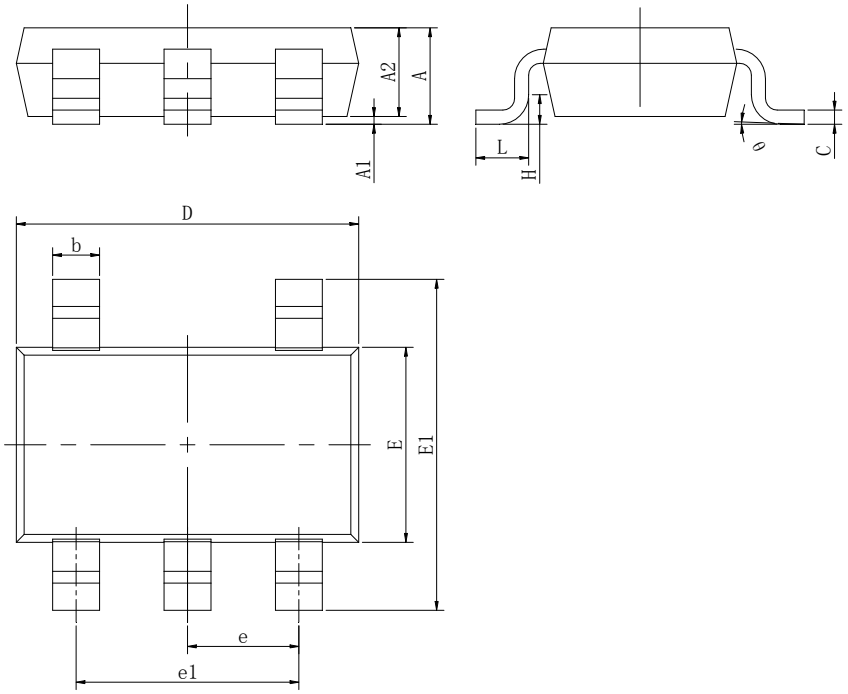
Place the D1527 near the USB output connector and place the 0.1-μF bypass capacitor near the IN pin.

Characteristics Curves



Outline Dimensions

SOT23-5 Unit: mm



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.700	0.900	0.028	0.035
A1	0.000	0.100	0.000	0.004
A2	0.700	0.800	0.028	0.031
b	0.350	0.500	0.014	0.020
c	0.080	0.200	0.003	0.008
D	2.820	3.020	0.111	0.119
E	1.600	1.700	0.063	0.067
E1	2.650	2.950	0.104	0.116
e	0.95（BSC）		0.037(BSC)	
e1	1.90（BSC）		0.075(BSC)	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

Statements

- Silicore Technology reserves the right to make changes without further notice to any products or specifications herein. Before customers place an order, customers need to confirm whether datasheet obtained is the latest version, and to verify the integrity of the relevant information.

- Failure or malfunction of any semiconductor products may occur under particular conditions, customers shall have obligation to comply with safety standards when customers use Silicore Technology products to do their system design and machine manufacturing, and take corresponding safety measures in order to avoid potential risk of failure that may cause personal injury or property damage.

- The product upgrades without end, Silicore Technology will wholeheartedly provide customers integrated circuits that have better performance and better quality.