

190mΩ Power Distribution Switches

Features

- 190mΩ Typ. High-Side PMOSFET (SOT 23-5)
- Guaranteed 1.1A Continuous Current
- 1.5A Current Limit
- Small SOT23-5 Package Minimizes Board Space
- Soft Start
- Thermal Protection
- Low 23 μA Supply Current
- Wide Input Voltage Range: 2.2V ~ 6V

Description

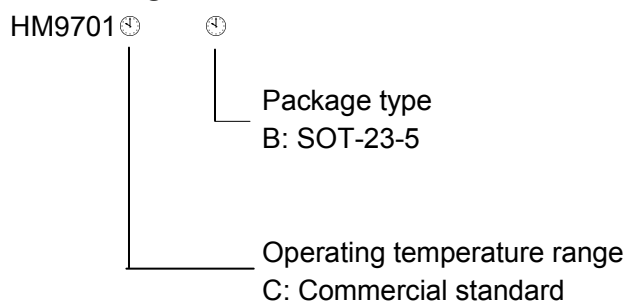
The HM9701 is an integrated 190mΩ power switch for self-powered and bus-powered Universal Series Bus (USB) applications. A built-in charge pump is used to drive the N-channel PMOSFET that is free of parasitic body diode to eliminate any reversed current flow across the switch when it is powered off. Its low quiescent supply current (23μA) and small package (SOT-23) is particularly suitable in battery-powered portable equipment.

Applications

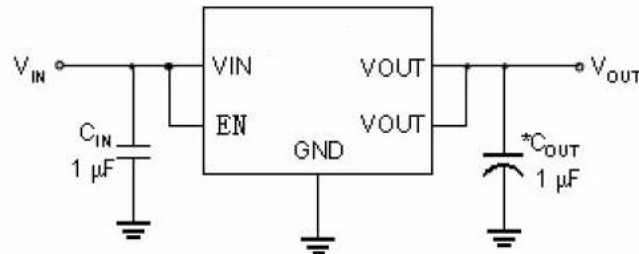
- Battery-Powered Equipment
- Motherboard USB Power Switch
- USB Device Power Switch
- Hot-Plug Power Supplies
- Battery-Charger Circuits

Several protection functions include soft start to limit inrush current during plug-in, current limiting at 1.5A to meet USB power requirement, and thermal shutdown to protect damage under over current conditions.

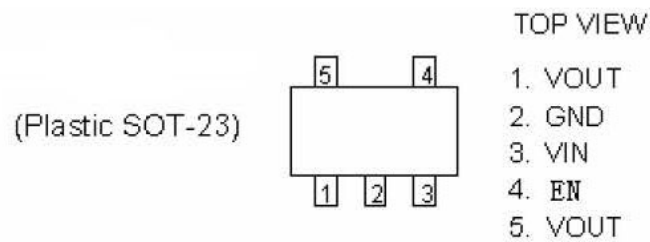
Ordering Information



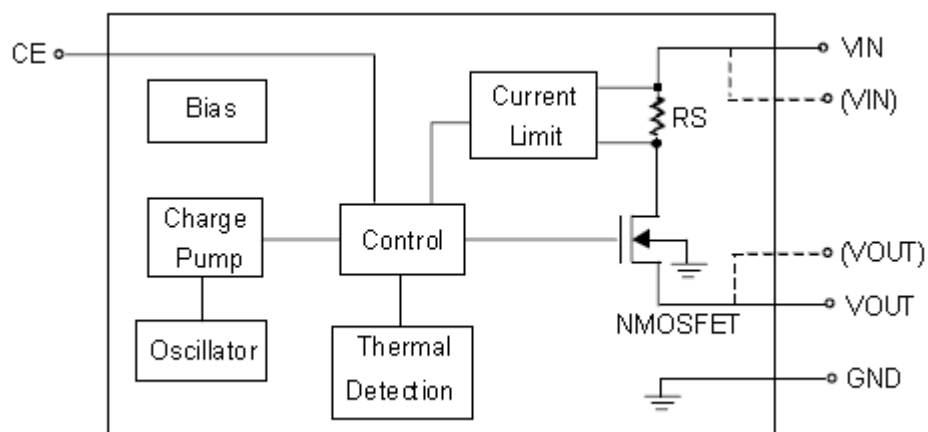
Typical Application Circuit



Pin Description



Function Block Diagram



Absolute Maximum Ratings

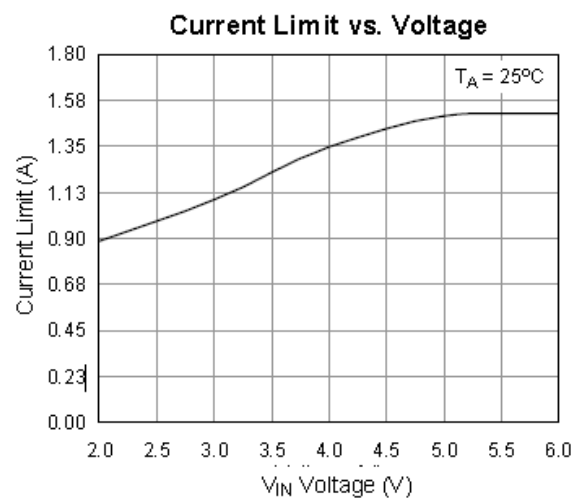
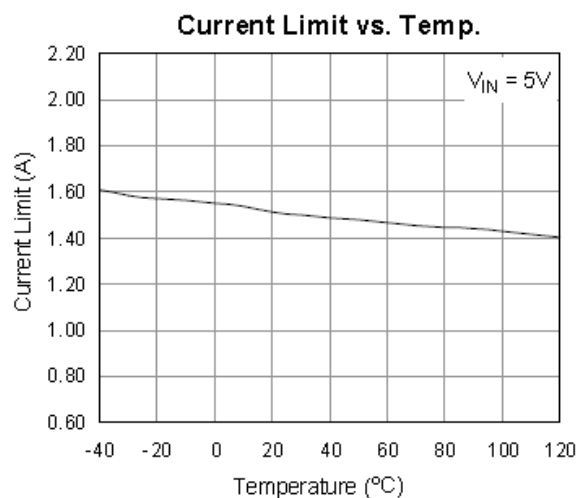
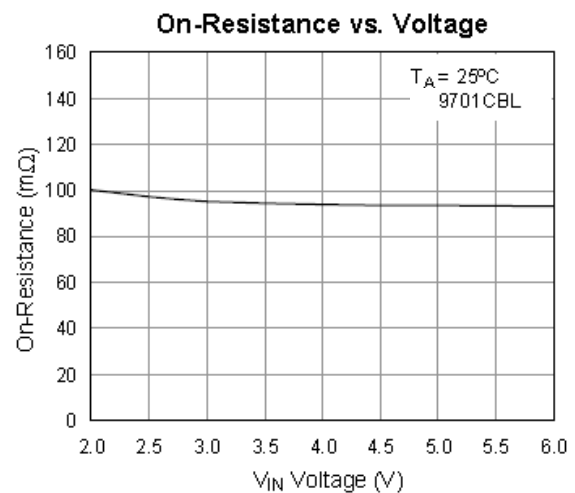
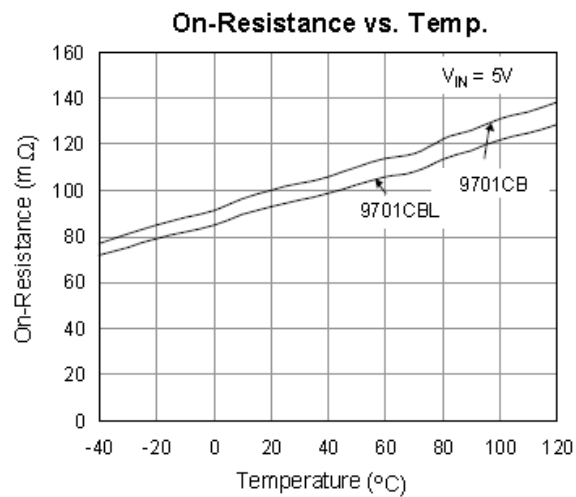
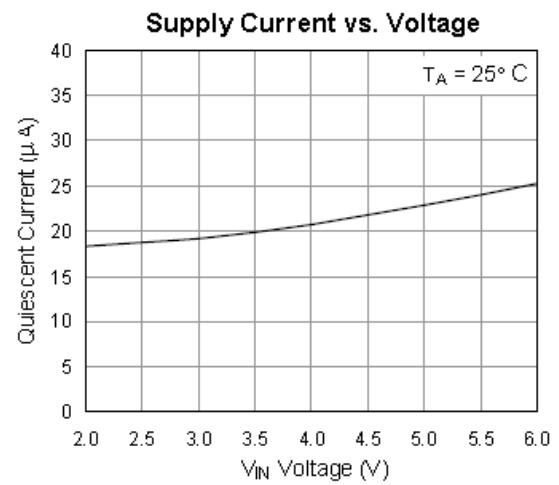
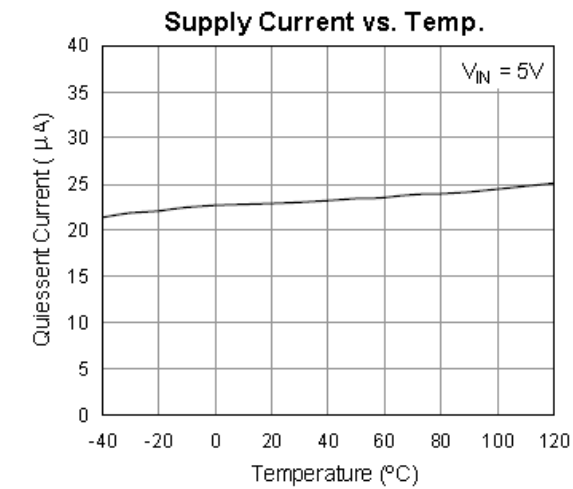
- Supply Voltage7V
- Chip Enable.....-0.3V ~ 7V
- Power Dissipation, P_D @ $T_A = 25^\circ\text{C}$SOT23-5 0.25W
- Operating Junction Temperature Range..... $-20^\circ\text{C} \sim 100^\circ\text{C}$
- Storage Temperature Range..... $-65^\circ\text{C} \sim 150^\circ\text{C}$
- Package Thermal ResistanceSOT-25, θ_{JA} 250°C/W
- V_{OUT} ESD Level HBM (Human Body Mode)8KV
- MM (Machine Mode)..... 800V

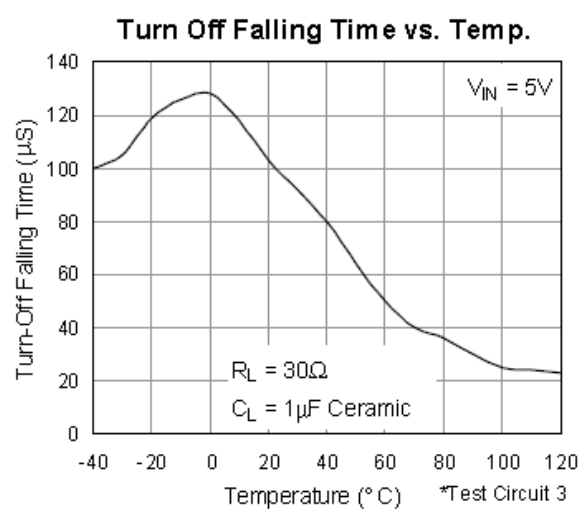
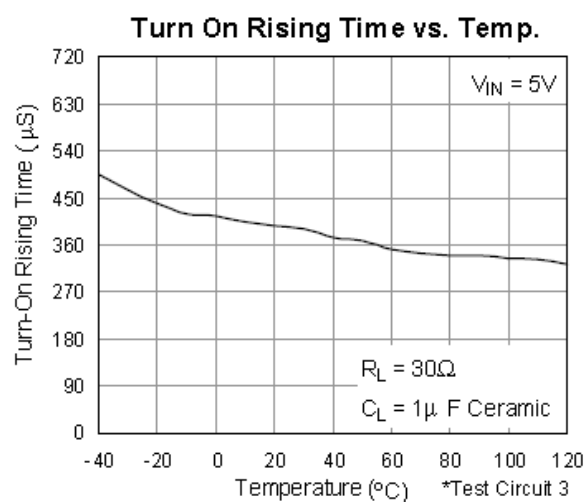
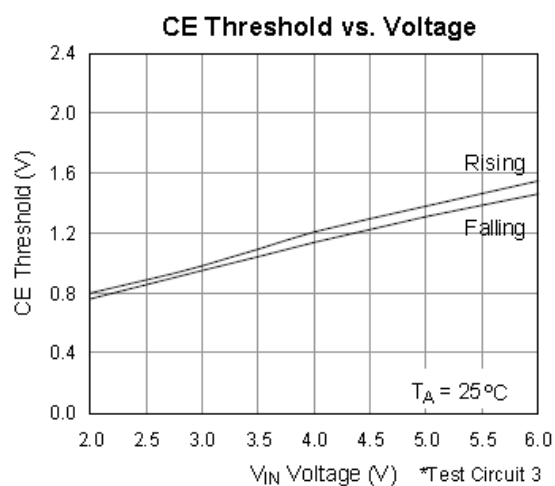
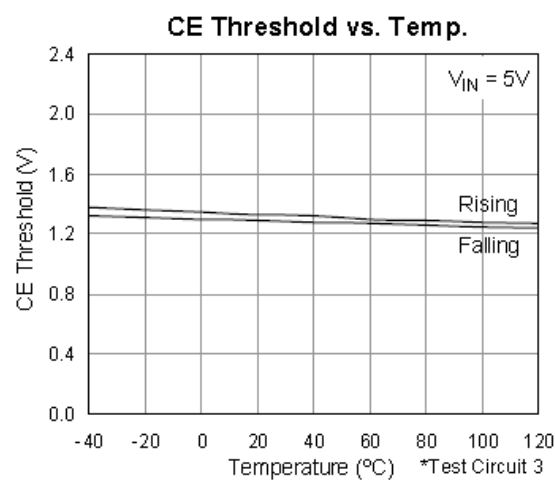
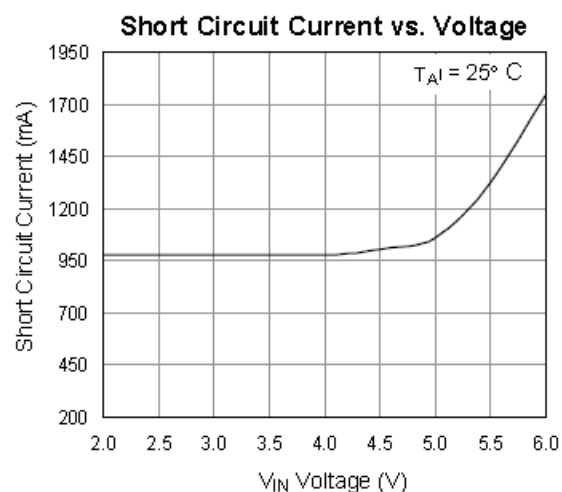
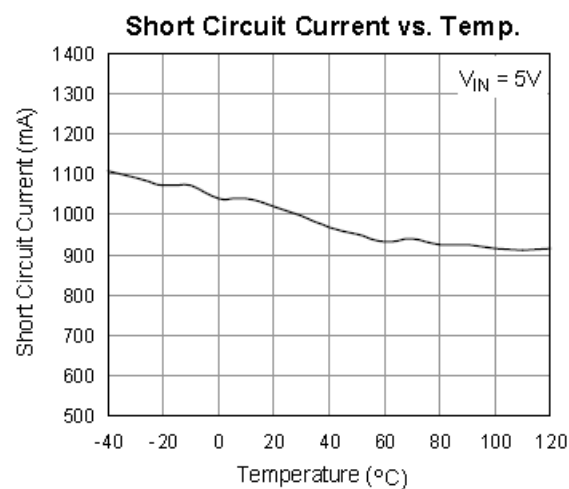
Electrical Characteristics

($V_{IN} = 5\text{V}$, $C_{IN} = C_{OUT} = 1\mu\text{F}$, $T_A = 25^\circ\text{C}$, unless otherwise specified)

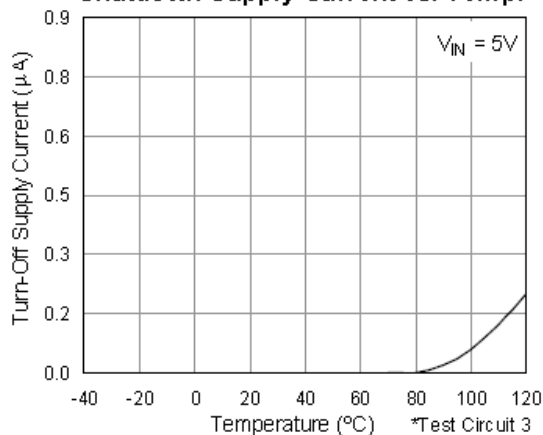
Parameter		Symbol	Test Conditions	Min	Typ	Max	Units
Input Voltage Range		V_{IN}		1.9	--	5.5	V
Output NMOFET $R_{DS(ON)}$	HM9701CBL	$R_{DS(ON)}$	$I_L = 1\text{A}$	--	100	130	m Ω
	HM9701CB		$I_L = 1\text{A}$	--	105	135	
Supply Current			$V_{IN} = 3\text{V}$	--	19	40	μA
			$V_{IN} = 5\text{V}$	--	23	70	
Output Turn-On Rising Time		T_R	$R_L = 10\Omega$, 90% Settling	--	20	--	μs
Current Limit Threshold		I_{LIMIT}	$R_L = 2\Omega$	1.1	1.5	2	A
Short-circuit Fold Back Current		I_{OS}	$V_{OUT} = 0\text{V}$, measured prior to thermal shutdown	--	1.0	--	A
CE Input High Threshold	HM9701CB			2.0	--	--	V
CE Input Low Threshold	HM9701CB			--	--	0.86	V
Shutdown Supply Current	HM9701CB	I_{OFF}	CE = "0"	--	0.1	1	μA
Output Leakage Current	HM9701CB	$I_{LEAKAGE}$	CE = "0", $V_{OUT} = 0\text{V}$	--	0.5	10	μA
V_{IN} Under Voltage Lockout		UVLO		1.3	1.8	--	V
V_{IN} Under Voltage Hysteresis				--	100	--	mV
Thermal Limit		T_{SD}		--	130	--	$^\circ\text{C}$
Thermal Limit Hysteresis		ΔT_{SD}		--	20	--	$^\circ\text{C}$

Typical Operating Characteristics

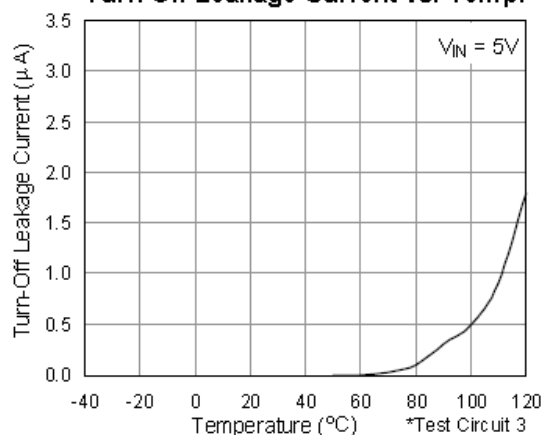




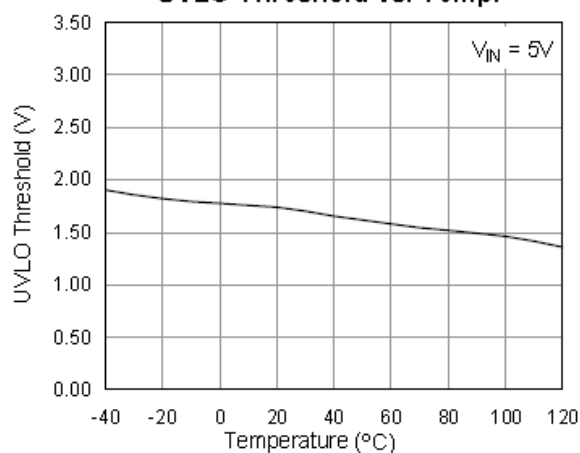
Shutdown Supply Current vs. Temp.



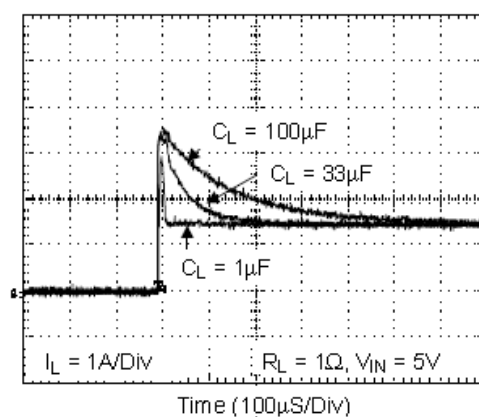
Turn-Off Leakage Current vs. Temp.



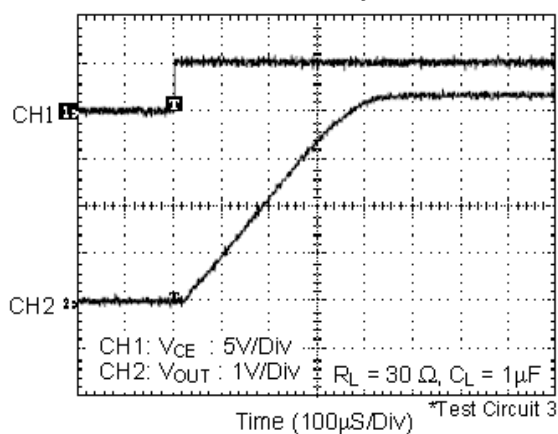
UVLO Threshold vs. Temp.



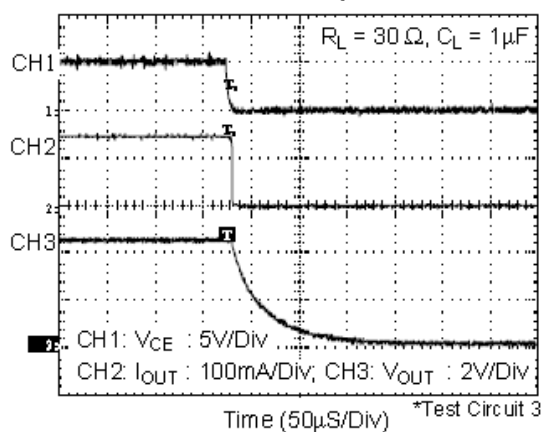
Inrush Current Response



Turn-On Response



Turn-Off Response



Functional Description

The HM9701 is a high-side single N-channel switch with active-high enable input.

Input and Output

VIN (input) is the power supply connection to the circuitry and the drain of the output MOSFET. VOUT(output) is the source of the output MOSFET. In a typical circuit, current flows through the switch from VIN to VOUT toward the load. Both VOUT pins must be short on the board and connected to the load and so do both VIN pins but connected to the power source.

Thermal Shutdown

Thermal shutdown shuts off the output MOSFET if the die temperature exceeds 130°C and 20°C of hysteresis forces the switch turning off until the die temperature drops to 110°C.

Soft Start

In order to eliminate the upstream voltage droop caused by the large inrush current during

hot-plug events, the “soft-start” feature effectively isolates power supplies from such highly capacitive loads.

Under-voltage Lockout

UVLO prevents the MOSFET switch from turning on until input voltage exceeds 1.8V (typical). If input voltage drops below 1.8V (typical), UVLO shuts off the MOSFET switch.

Current Limiting and Short Protection

The current limit circuit is designed to protect the system supply, the MOSFET switch and the load from damage caused by excessive currents. The current limit threshold is set internally to allow a minimum of 1.1A through the MOSFET but limits the output current to approximately 1.5A typical. When the output is short to ground, it will limit to a constant current 1A until thermal shutdown or short condition Removed.

Filtering

To limit the input voltage drop during hot-plug events, connect a 1μF ceramic capacitor from VIN to GND. However, higher capacitor values will further reduce the voltage drop at the input.

Connect a sufficient capacitor from VOUT to GND.

This capacitor helps to prevent inductive parasitics from pulling VOUT negative during turn-off or EMI damage to other components during the hotdetachment. It is also necessary for meeting the USB specification during hot plug-in operation. If HM9701 is implanted in device end application, minimum 1μF capacitor from VOUT to GND is recommended and higher capacitor values are also preferred.

In choosing these capacitors, special attention

must be paid to the Effective Series Resistance, ESR, of the capacitors to minimize the IR drop across the capacitor's ESR. A lower ESR on this capacitor can get a lower IR drop during the operation.

Ferrite beads in series with all power and ground lines are recommended to eliminate or significantly reduce EMI. In selecting a ferrite bead, the DC resistance of the wire used must be kept to a minimum to reduce the voltage drop.

Reverse current preventing

The output MOSFET and driver circuitry are also designed to allow the MOSFET source to be externally forced to a higher voltage than the drain ($V_{OUT} > V_{IN} \pm 0$). To prevent reverse current from such condition, disable the switch

(HM9701) or connect VIN to a fixed voltage under 1.3V.

Layout and Thermal Dissipation

Place the switch as close to the USB connector as possible. Keep all traces as short as possible to reduce the effect of undesirable parasitic Inductance.

Place the output capacitor and ferrite beads as close to the USB connector as possible.

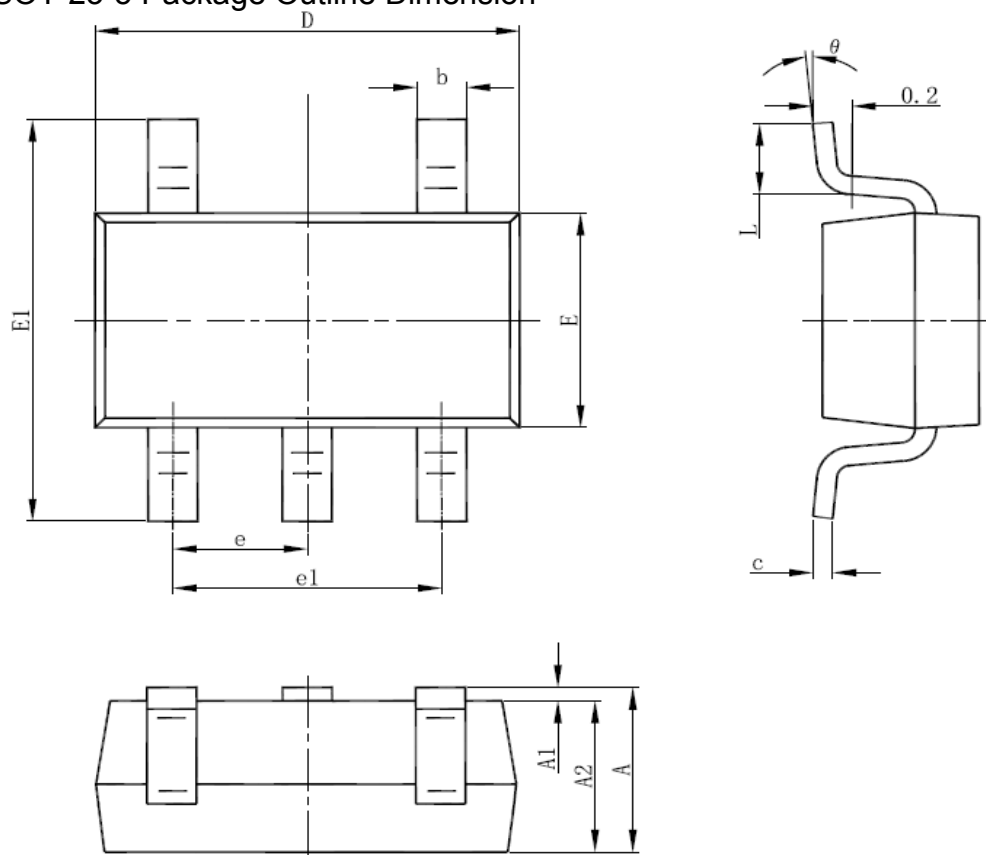
If ferrite beads are used, use wires with minimum resistance and large solder pads to minimize connection resistance.

If the package is with dual VOUT or VIN pins, short both the same function pins as Fig.1 or Fig.2 to reduce the internal turn-on resistance. If the output power will be delivered to two individual ports, it is specially necessary to short both VOUT pin at the switch output side in order to protect the switch when each port are plug-in separately.

Under normal operating conditions, the package can dissipate the channel heat away. Wide powerbus planes connected to VIN and VOUT and a ground plane in contact with the device will help dissipate additional heat.

Package Information

SOT-23-5 Package Outline Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°