

200mΩ Power Distribution Switches

Description

The SC94A08 is an integrated 200mΩ power switch for self-powered and bus-powered Universal Serial Bus (USB) applications. A built-in charge pump is used to drive the MOSFET 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 (46.5μA) and small package (SOT-23-5) is particularly suitable in battery-powered portable equipment.

Several protection functions include soft start to limit inrush current during plug-in, current limiting at 0.55A to meet USB power requirement, and thermal shutdown to protect damage under over current conditions.

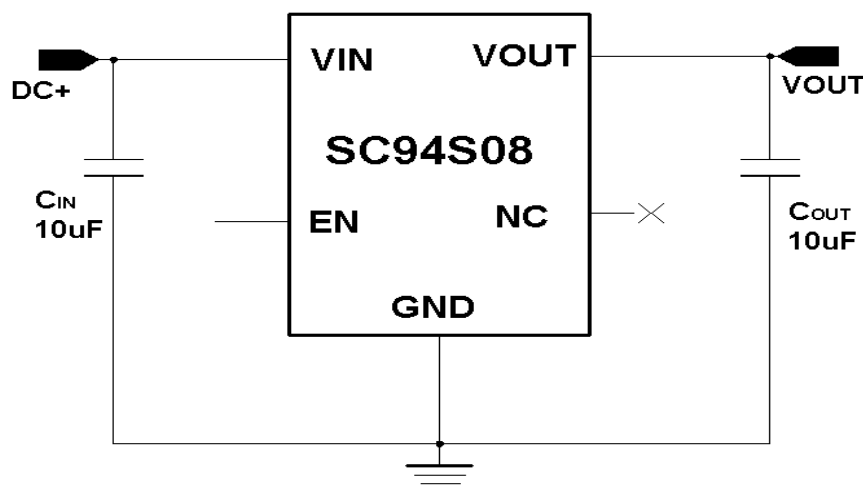
Features

- Wide Input Voltage Range: 1.9V ~ 5.5V
- 200mTyp. High-Side MOSFET
- Guaranteed 0.55A Continuous Current
- 800mA Current Limit
- Soft Start
- Thermal Protection
- Low 46.5μA Supply Current
- Small SOT-23-5 Package Minimizes Board Space

Applications

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

Typical Application Circuit



**Pin Configurations**

Package Type	Pin Configurations
SC94S08 SOT-23-5L	

Pin Description

PIN SOT-23-5L	NAME	DESCRIPTION
1	VIN	Power Input.
2	GND	Power and Signal Ground for the IC.
3	N/C	No used.
4	EN	Status Condition Indicator. This pin indicates the conducting status of the SC94S08. If the part is forward biased ($V_{IN} > V_{OUT} + V_{FWD}$) this pin will be Hi-Z. If the part is reverse biased ($V_{OUT} > V_{IN} + V_{RTO}$), then this pin will pull down 10mA through an open-drain. When terminated to a high voltage through a 470k resistor, a high voltage indicates diode conducting. May be left floating or grounded when not in use.
5	VOUT	Ideal Diode Cathode and Output. Bypass V_{OUT} with ESR capacitor. However stability improves with higher ESRs.

Absolute Maximum Ratings

- Input Supply Voltage ----- -0.3V to 7V
- Chip Enable ----- -0.3V to 7V
- Power Dissipation, PD @ TA = 25°C ----- 0.25W
- Maximum Junction Temperature ----- 125°C
- Operating Ambient Temperature Range ----- -20°C to 85°C
- Storage Temperature Range ----- -65°C to 125°C
- Package Thermal Resistance SOT-23-5 ----- 289°C/W
- V_{OUT} ESD Level HBM (Human Body Mode) ----- 4KV
- MM (Machine Mode) ----- 400V

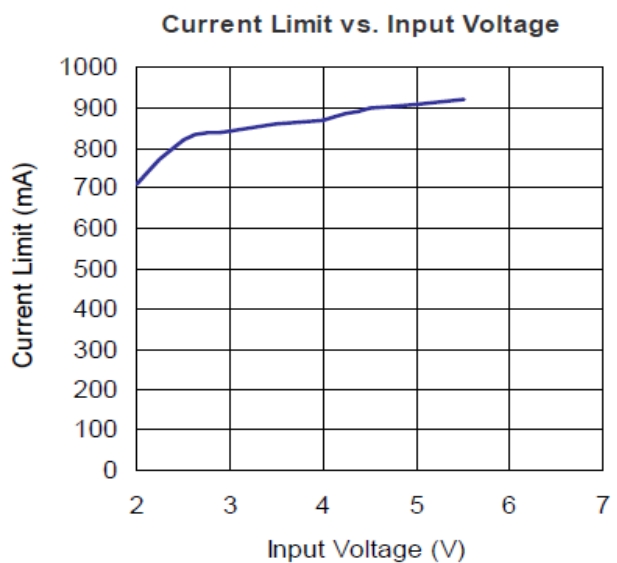
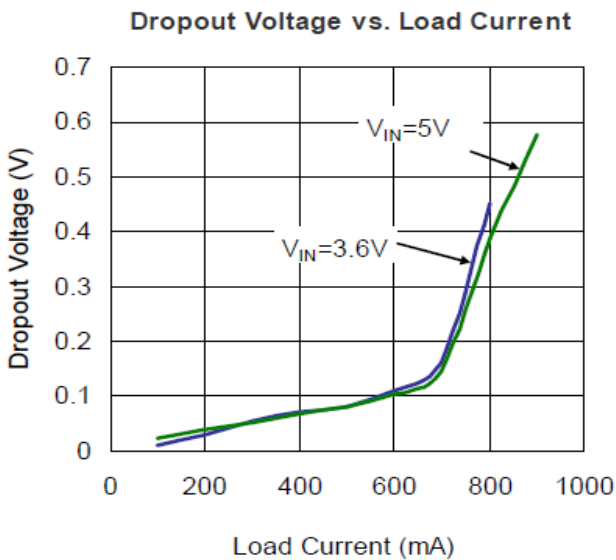


Electrical Characteristics

V_{IN} = 5V, C_{IN} =10μF, C_{OUT} = 10μF, T_A = 25°C, unless otherwise specified.

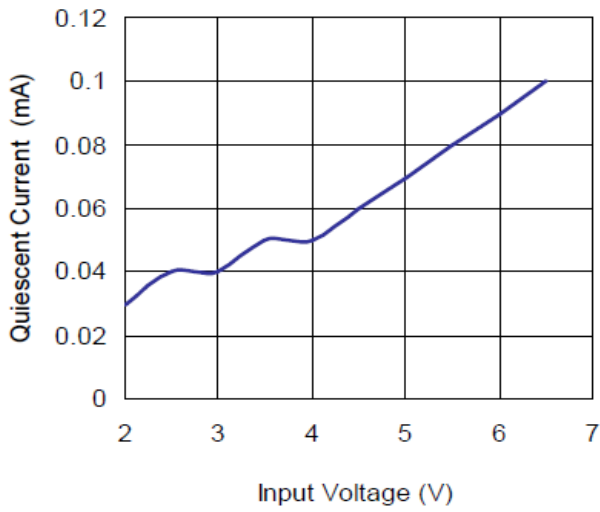
SYMBOL	PARAMETER	CONDITIONS	SC94S08			UNITS
			MIN	TYP	MAX	
V _{IN}	Input Voltage Range		1.9		5.5	V
R _{DS(ON)}	Output NMOFET R _{DS(ON)}	V _{IN} =5V, I _{LOAD} =500mA		200		mΩ
I _{IN}	Supply Current	V _{IN} =3V		46.5		μA
		V _{IN} =5V		60		
T _R	Output Turn-On Rising Time	R _L =10Ω,90%Settling		100		μs
I _{LIMIT}	Current Limit Threshold	R _L =3Ω		500		mA
I _{OS}	Short-circuit Fold Back Current	V _{OUT} = 0V		25		mA
	EN Input High Threshold		1.2	0.86		V
	EN Input Low Threshold		0.6	0.86		
I _{OFF}	Shutdown Supply Current	EN=0		0.1	1	μA
I _{LEAKAGE}	Output Leakage Current	EN=0, V _{OUT} =0V		0.1	1	μA
U _{VLO}	V _{IN} Under Voltage Lockout			1.8		V
	V _{IN} Under Voltage Hysteresis			100		mV
T _{SD}	Thermal Limit			130		°C
T _{SD}	Thermal Limit Hysteresis			20		°C

Typical Operating Characteristics

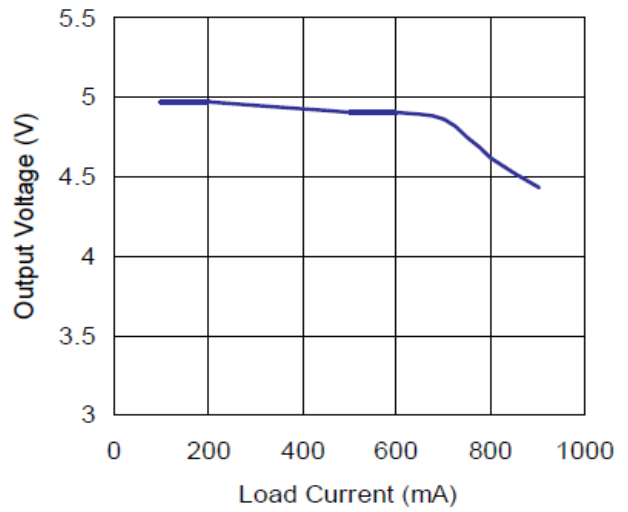




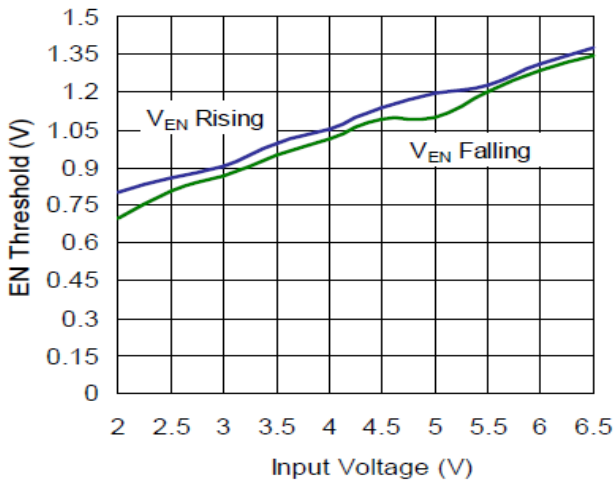
Quiescent Current vs. Input Voltage



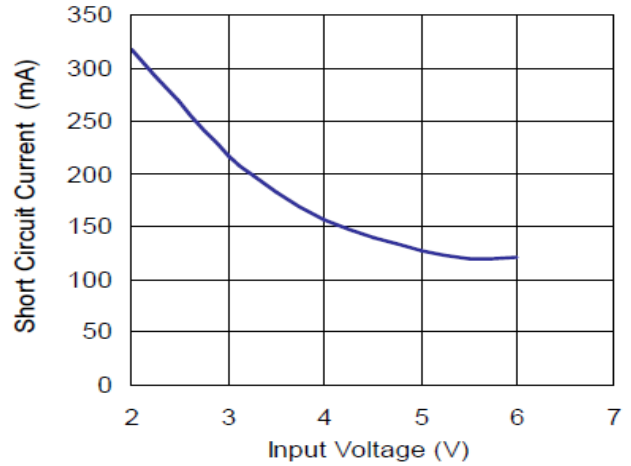
Output Voltage vs. Load Current



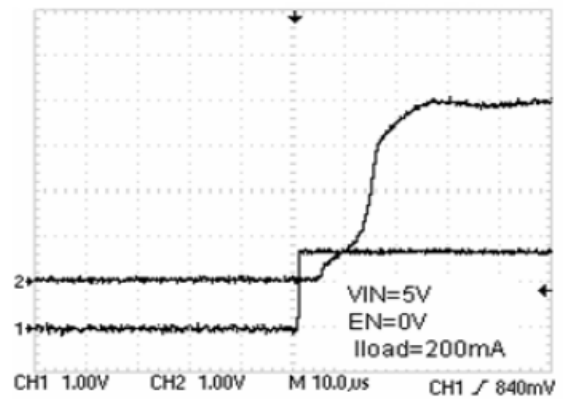
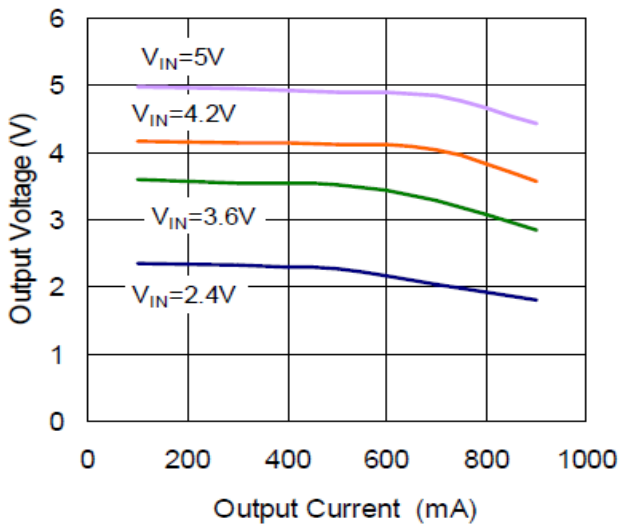
EN Threshold vs. Input Voltage

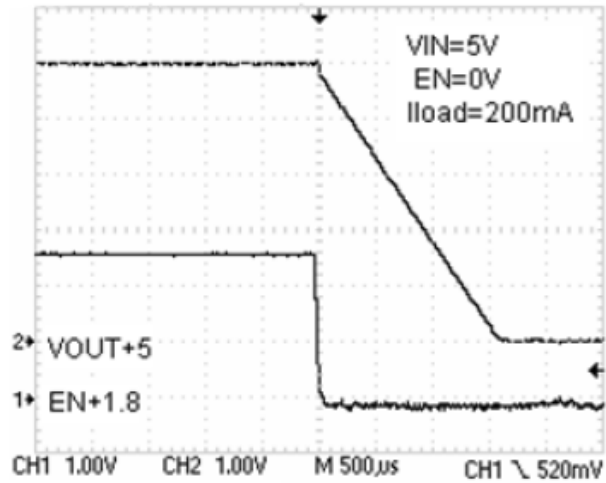
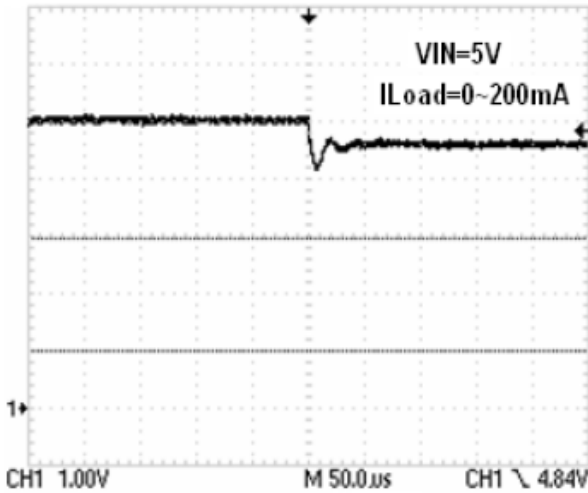


Short Circuit Current vs. Input Voltage



Output Voltage vs. Output Current





Functional Description

The SC94S08 is a high-side single switch with active-high enable input.

Input and Output

V_{IN} (input) is the power supply connection to the circuitry and the drain of the output MOSFET. V_{OUT} (output) is the source of the output MOSFET. In a typical circuit, current flows through the switch from V_{IN} to V_{OUT} toward the load. Both V_{OUT} pins must be short on the board and connected to the load and so do both V_{IN} 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 U_{VLO} prevents the MOSFET switch from turning on until input voltage exceeds 1.7V (typical). If input voltage drops below 1.7V (typical), U_{VLO} 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 550mA through the MOSFET but limits the output current to approximately 500mA typical. When the output is short to ground, it will limit to a constant current 30mA until thermal shutdown or short condition removed.

**Filtering**

To limit the input voltage drop during hot-plug events connect a 10 μ F ceramic capacitor from V_{IN} to GND. However, higher capacitor values will further reduce the voltage drop at the input. Connect a sufficient capacitor from V_{OUT} to GND. This capacitor helps to prevent inductive parasitics from pulling V_{OUT} negative during turn-off or EMI damage to other components during the hot detachment. It is also necessary for meeting the USB specification during hot plug-in operation. If SC94A08 is implanted in device end application, minimum 1 μ F capacitor from V_{OUT} to GND is recommended and higher capacitor values are also preferred. 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 ($V_{OUT} > V_{IN} \geq 0$). To prevent reverse current from such condition, SC94S08 will automatically shut off the MOS FET.

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.

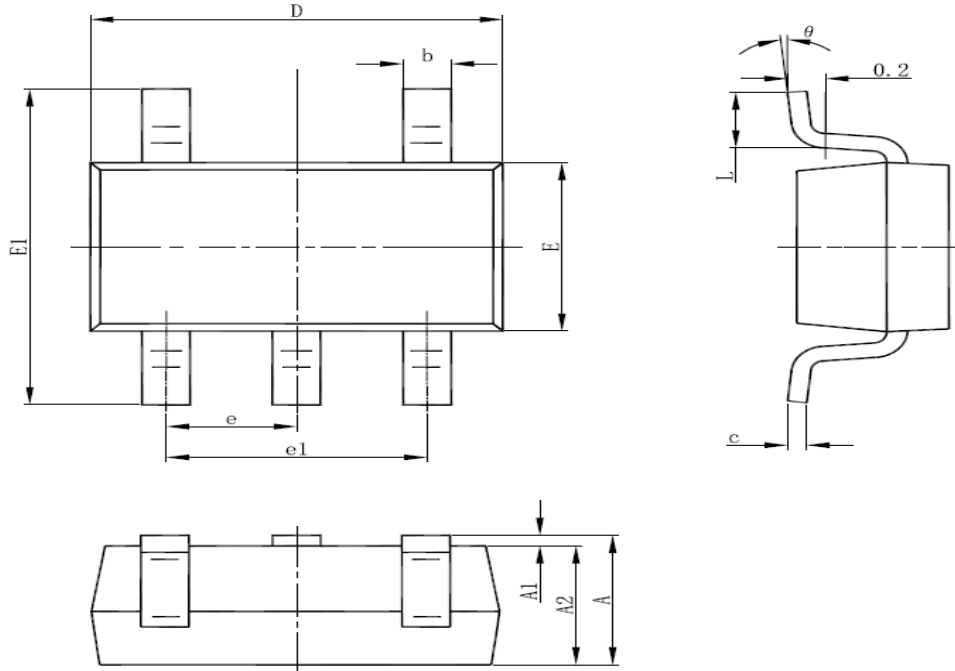
If the package is with dual V_{OUT} or V_{IN} pins, short both the same function pins to reduce the internal turn-on resistance. If the output power will be delivered to two individual ports, it is especially necessary to short both V_{OUT} pin at the switch output side in order to protect the switch when each port is plug-in separately.

Under normal operating conditions, the package can dissipate the channel heat away. Wide power bus planes connected to V_{IN} and V_{OUT} and a ground plane in contact with the device will help dissipate additional heat.



Packaging Information

SOT-23-5L 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°