200mΩ Power Distribution Switches

Features

- 200mΩ Typ. High-Side MOSFET
- Guaranteed 1A Continuous Current
- 1.5A Current Limit
- Small SOT-23-5 Package Minimizes Board Space
- Soft Start
- Thermal Protection
- Low 50μA Supply Current
- Wide Input Voltage Range:1.9V~5.5V

Applications

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

Description

The XA9011 is an integrated 200m Ω power switch for self-powered and bus-powered Universal Series 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 (50μA) and small package (SOT-23-5) is particularly suitable in battery-powered portable equipment.

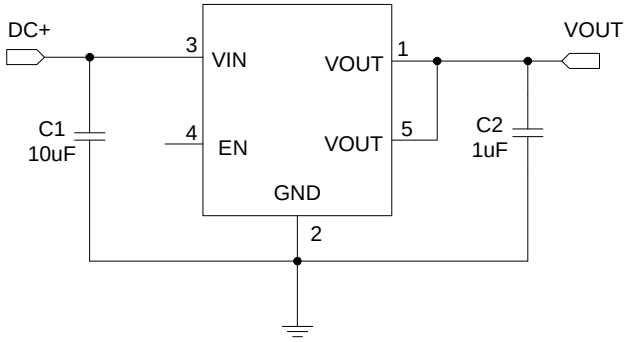
Several protection functions include soft start to limit inrush current during plug-in, current limiting at 1.5A to meet USB power requirement, and thermal shutdown to protect damage under over current condition.

Ordering Information

XA9011– ① ②:

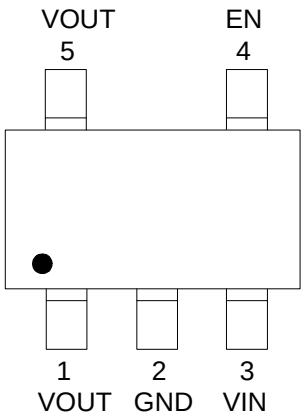
Symbol	Description
①	Operating temperature range: Commercial standard
②	Denotes Package Types: E: SOT-23-5

Typical Application Circuit



Pin Assignment

(TOP VIEW)



SOT-23-5

PIN Number SOT23- 5L	PIN Name	Function
1	VOUT	Output Pin
2	GND	Ground
3	VIN	Power Input
4	EN	ON/OFF Control (High Enable)
5	VOUT	Output Pin

Absolute Maximum Ratings (Note 1)

- Maximum Supply Voltage 7V
- Chip Enable..... -0.3V ~ 7V
- Power Dissipation, P_D @ T_A = 25°C.....SOT-23-5 0.25W
- Operating Junction Temperature Range..... -20°C ~ 100°C
- Storage Temperature Range.....-65°C ~ 150°C
- Package Thermal ResistanceSOT-23-5, ...289°C /W
- V_{OUT} ESD Level HBM (Human Body Mode) 4KV
- MM (Machine Mode)..... 400V
- Junction Temperature .....Internally Limited

Note 1. Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

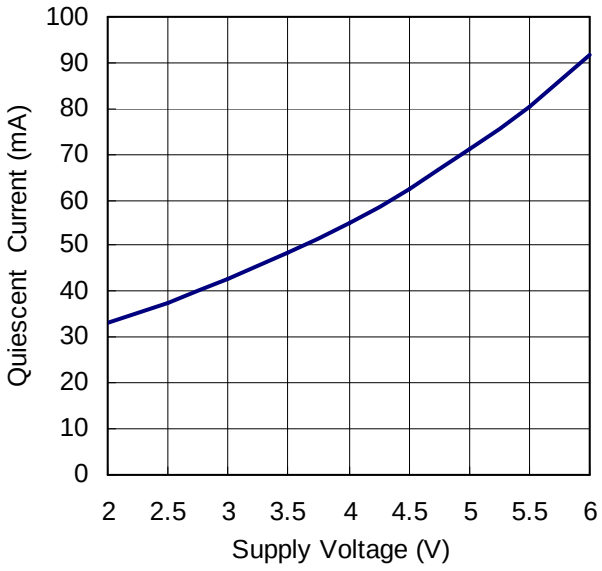
Electrical Characteristics

VIN = 5V, CIN =10μF, COUT = 1μF, TA = 25℃, unless otherwise specified.

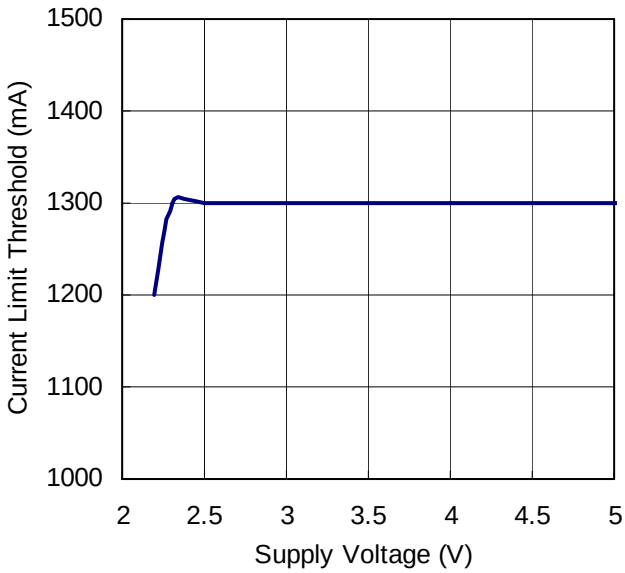
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range	V_{IN}		1.9		5.5	V
Output NMOFET $R_{DS(ON)}$)	$R_{DS(ON)}$	V_{IN}=5V, I_{LOAD} = 500 mA		200		mΩ
Supply Current		V_{IN}=3V		40	45	μA
		V_{IN}=5V		60	80	
Output Turn-On Rising Time	T_R	R_L = 10Ω, 90% Settling		30		us
Current Limit Threshold	I_{LIMIT}	R_L = 3Ω	1	1.38	1.5	A
Short-circuit Fold Back Current	I_{OS}	V_{OUT} = 0V		200		mA
EN Input High Threshold			1.2	0.86		V
EN Input Low Threshold			0.6			
Shutdown Supply Current	I_{OFF}	EN = “0”		0.1	1	μA
Output Leakage Current	$I_{LEAKAGE}$	EN = “0”, V_{OUT} = 0V		0.1	1	μA
V_{IN} Under Voltage Lockout	UVLO			1.8		V
V_{IN} Under Voltage Hysterics				100		mV
Thermal Limit	T_{SD}			130		°C
Thermal Limit Hysterics	ΔT_{SD}			20		°C

Typical Operating Characteristics

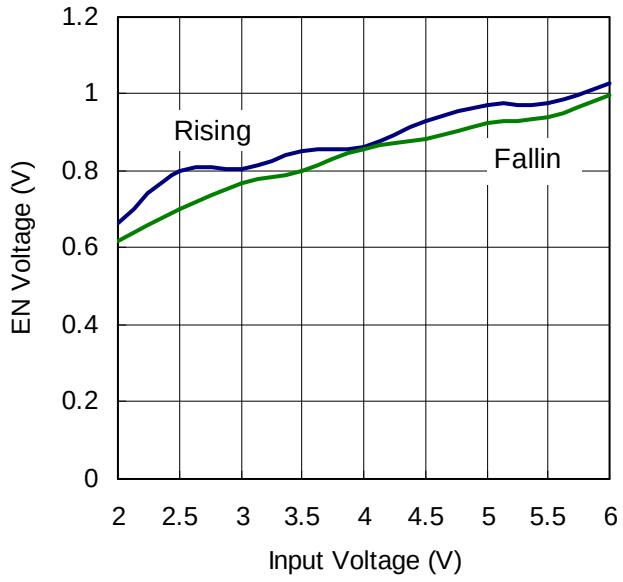
Quiescent Current vs.Supply Voltage (Io=0A)



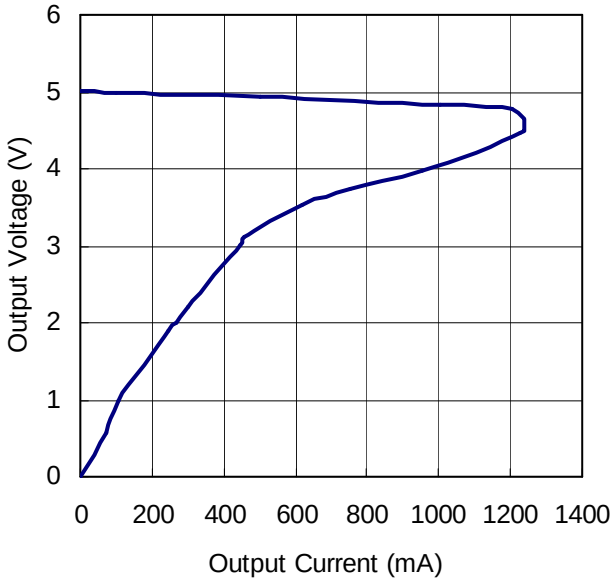
Current Limit Threshold vs.Supply Voltage (Io=0A)



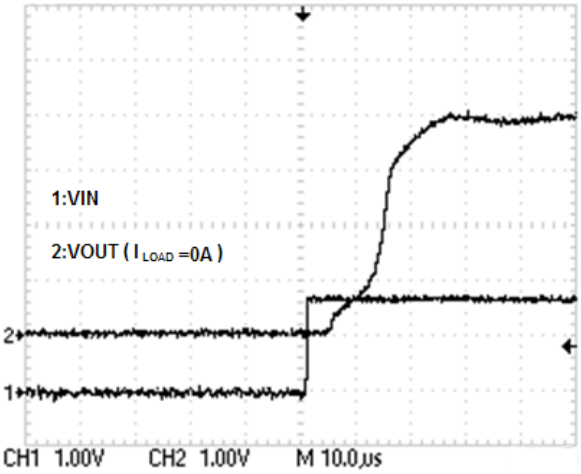
EN Threshold vs.Input Voltage



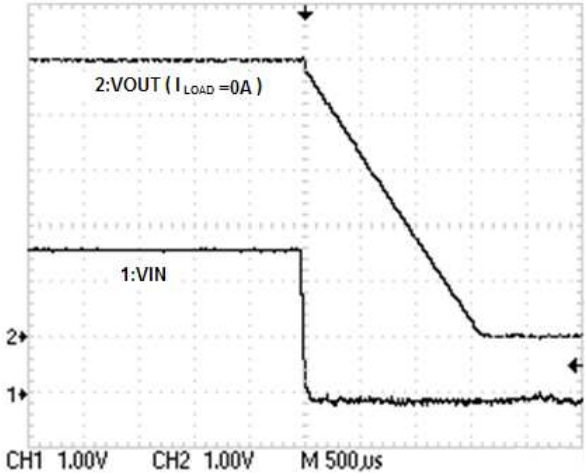
Output Voltage vs.Output Current



Turn-On Response



Turn-OFF Response



Application Information

Pin Assignment

VOUT (Pin 1, 5): MOSFET Drain. Bypass VOUT with ESR capacitor. However stability improves with higher ESRs.

GND (Pin 2): Power and Signal Ground for the IC.

VIN (Pin 3): MOSFET Source. When operating XA9011 as a switch it must be bypassed with a low ESR ceramic capacitor.

EN (Pin 4): Status Condition Indicator. This pin indicates the conducting status of the XA9011. If the part is forward biased (VIN > VOUT + VFWD) this pin will be Hi-Z. If the part is reverse biased (VOUT > VIN + VRTO), 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.

Functional Description

The XA9011 is a high-side single 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℃ and 20℃ of hysterics forces the switch turning off until the die temperature drops to 110℃.

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 1.7V (typical). If input voltage drops below 1.7V (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 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 10μF 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 XA9011 is implanted in device end application, minimum 1μF capacitor from V_{OUT} 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 (VOUT > VIN ≥ 0). To prevent reverse current from such condition, XA9011 will automatically shut off the MOSFET.

Layout and Thermal Dissipation

1. 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.

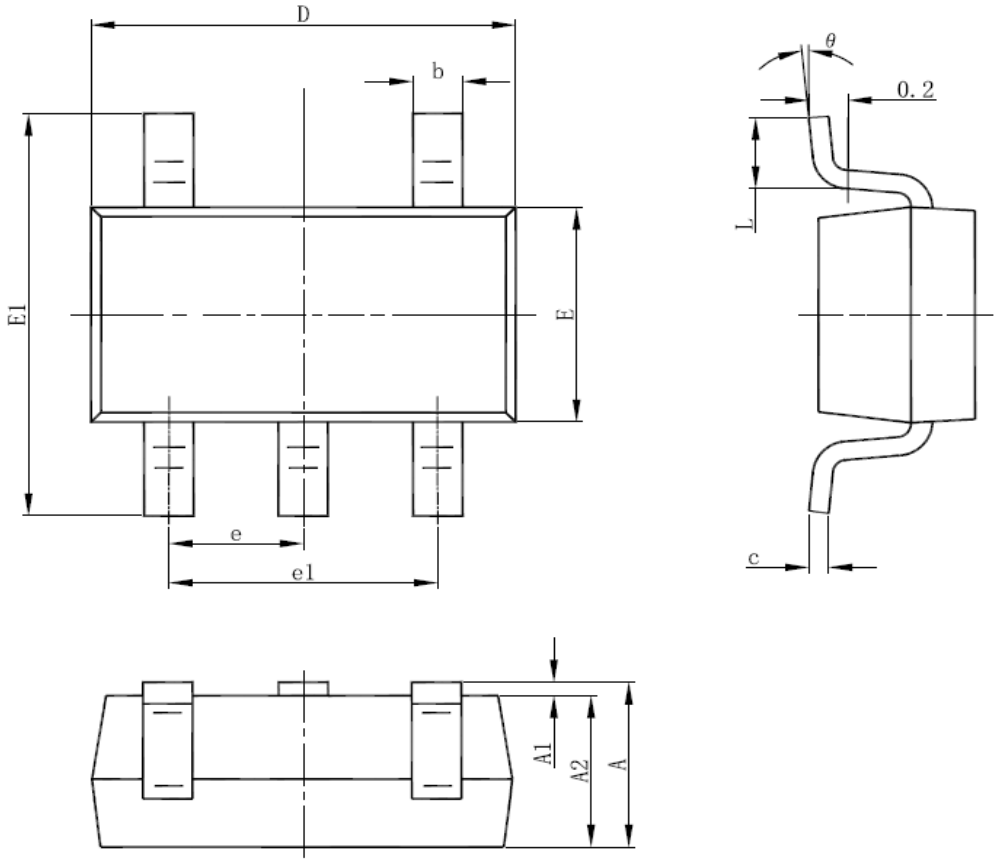
2. Place the output capacitor and ferrite beads as close to the USB connector as possible. If ferrite beads are used, use wires with minimum resistance and large solder pads to minimize connection resistance.

3. If the package is with dual VOUT or VIN 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 VOUT pin at the switch output side in order to protect the switch when each port is plug-in separately.

4. Under normal operating conditions, the package can dissipate the channel heat away. Wide power bus 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°