MC2109

0.9A Single Channel Current-Limited Power Switch

CBC Microelectronics
http://www.cbcv.net

General Description

The MC2109 is integrated high-side power switch optimized for self-powered and bus-powered Universal Serial Bus (USB) applications. The MC2109 is fully compliant with USB standards and is suitable for single USB port applications. The low on-resistance meets USB voltage drop requirements.

When the output load exceeds current-limit threshold, MC2109 limits the output current to a safe level, which is typical 1.2A. Besides, a thermal shutdown circuit is included to prevent catastrophic switch failure caused by increasing power dissipation when continues heavy loads or short circuit occurs. An under-voltage lockout (UVLO) circuit ensures that the device remains off unless there is a valid input voltage presents.

Features

- Single USB port power switch
- 135mΩ on-resistance
- Input voltage range:2.7V-5.5V
- Over-current, short and thermal protection
- 1.2A accurate current limiting
- ESD protection:4KV HBM, 400V MM
- Reverse Current Blocking
- Ambient temperature range -40℃ to 85℃
- Package: SOT23
- Lead Free finish/ROHS Compliant

Applications

- Telecom and network systems
- USB Power Distribution
- Notebook PC

Pin Configuration

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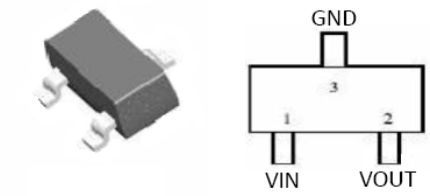
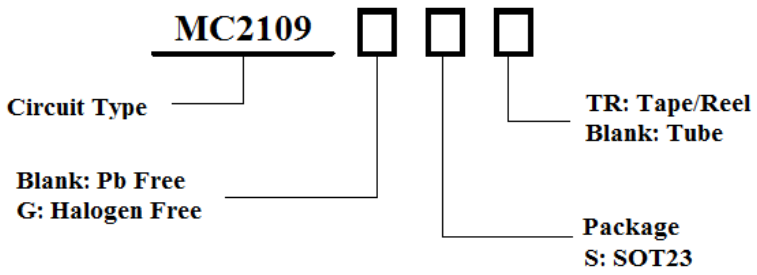


SOT23

Figure 1: Pin Configuration of MC2109

Ordering Information



Package	Part Number		Marking ID		Packing Type
	Pb-free	Halogen-Free	Pb-free	Halogen-Free	
TO-92	MC2109TTR	MC2109GTTR	1I6T	1I5T	Tape & Reel
SOT23	MC2109STR	MC2109GSTR	1I6S	1I5S	

Typical Application

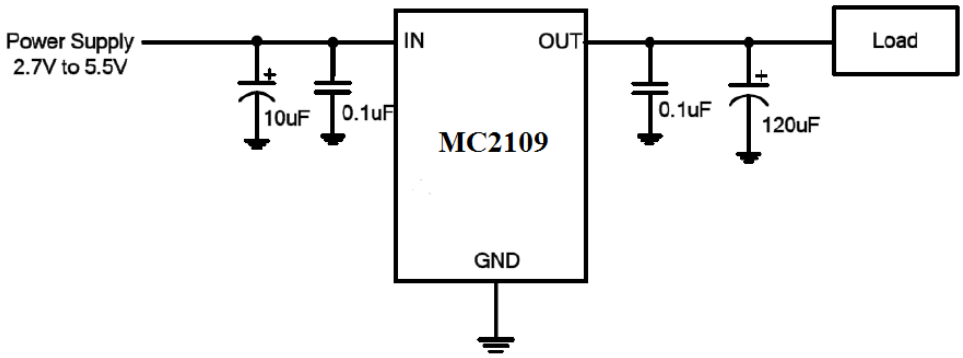


Figure 3: Typical Application of MC2109

Block Diagram

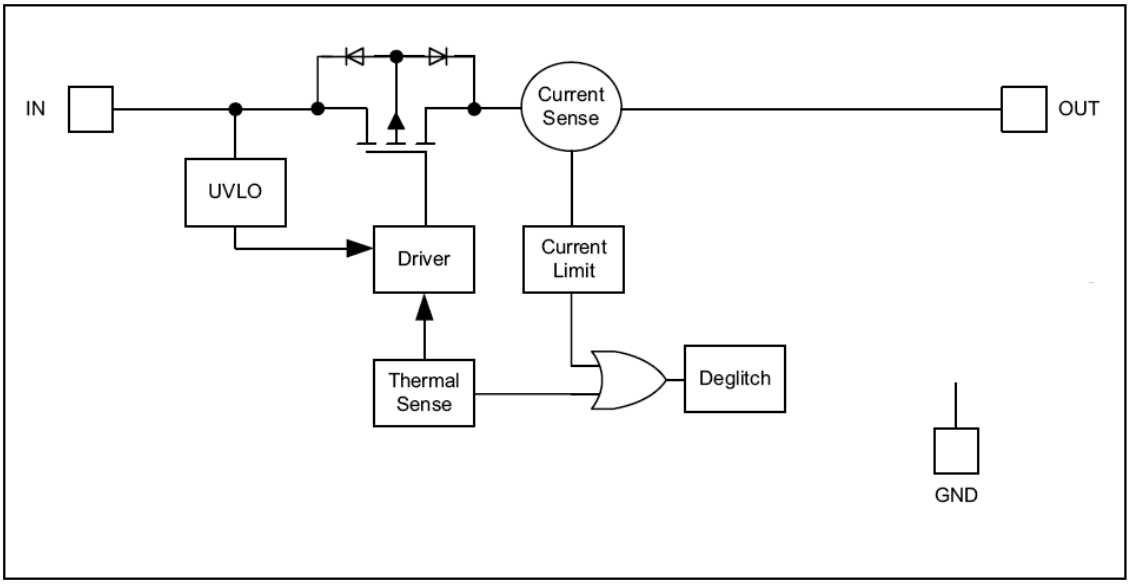


Figure 4: Functional Block Diagram of MC2109

Absolute Maximum Ratings (Note 1)

Symbol	Parameter	Rating	Units
ESD HBM	Human Body Model ESD Protection	4	KV
ESD MM	Machine Model ESD Protection	400	V
V_{IN}	Input Voltage	6.5	V
V_{OUT}	Output voltage	V_{IN}+0.3	V
I_{LOAD}	Maximum Continuous Load Current	Internal Limited	A
T_{OP}	Operating Junction Temperature Range	-40~150	℃
T_{ST}	Storage Temperature Range	-60~150	℃

Note 1: Stresses greater than those listed under: "Absolute Maximum Rating" 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 Ratings" for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Input voltage	V_{IN}	2.7	5.5	V
Operating Ambient Temperature	T_A	-40	85	℃
Output Current	I_{OUT}	0	0.9	A

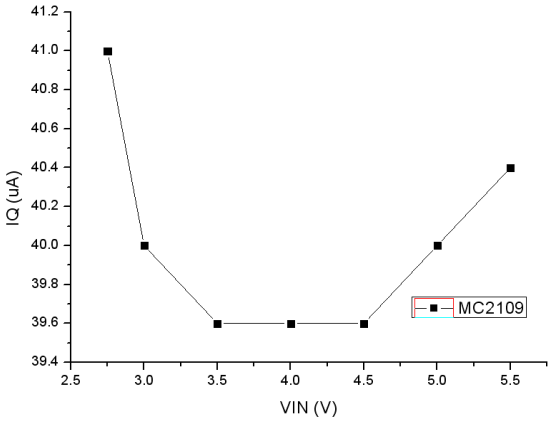
Electrical Characteristics

(T_A=25℃, V_{IN}=5V, unless otherwise stated)

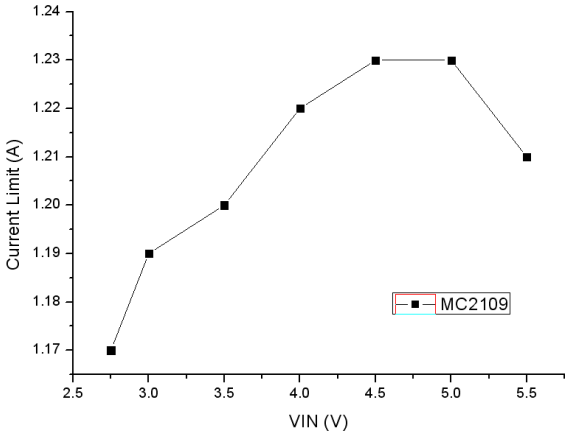
Symbol	Parameter	Test Conditions		Min	TYP	Max	Unit
V_{UVLO}	Input UVLO			1.65	2.2	2.65	V
I_{Q_ON}	Input Quiescent Current	I_{OUT}=0			40	70	μA
$R_{DS(ON)}$	Switch on-resistance	V_{IN}=5V, I_{OUT}=0.5A	SOT23		135	160	mΩ
I_{SHORT}	Short-circuit current limit	OUT short to Ground			0.9		A
I_{LIMINT}	Over-Load current limit	V_{IN}=5V, V_{OUT}=4.5V, C_L=68μF			1.2		A
I_{TRIG}	Current limiting trigger threshold	Ramp load (<100A/S)			1.2	1.8	A
T_{SHDN}	Thermal shutdown threshold	V_{IN}=5V			135		℃
T_{HYS}	Thermal shutdown hysteresis	V_{IN}=5V			15		℃
I_{REV}	Reverse Leakage Current	V_{IN}=0V,V_{OUT}=5.5V, I_{REV} at V_{IN}			0.01	1	μA

Typical Characteristics

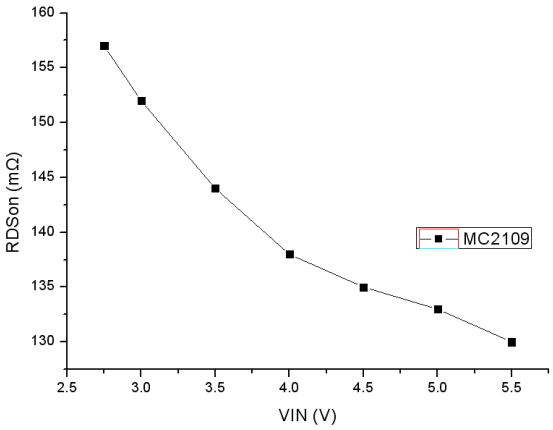
V_{IN}=5V, T_A=25℃, one switch section, unless noted.



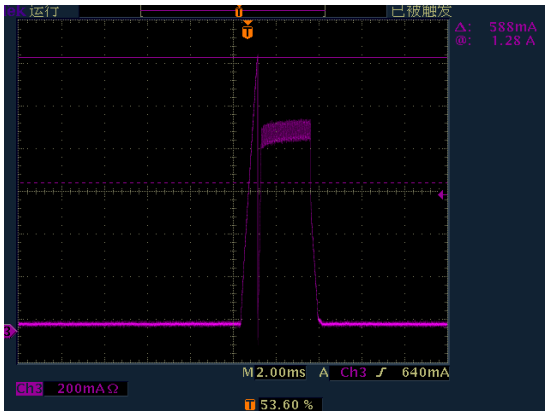
Supply Current VS Supply Voltage



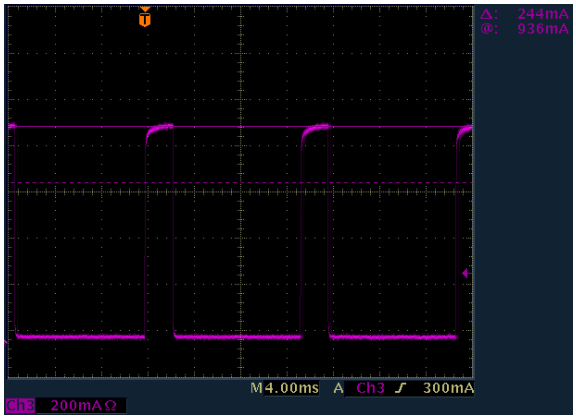
Current-Limit VS Supply Voltage (CL=47uF)



$R_{DS(ON)}$ VS Supply Voltage



Trig Current (VCC=5V, C_{in}=10uF, C_{out}=1uF,Load Current Ramp up=100A/S)



Short-circuit Current(VCC=5V, Cin=10uF)

Test Circuit

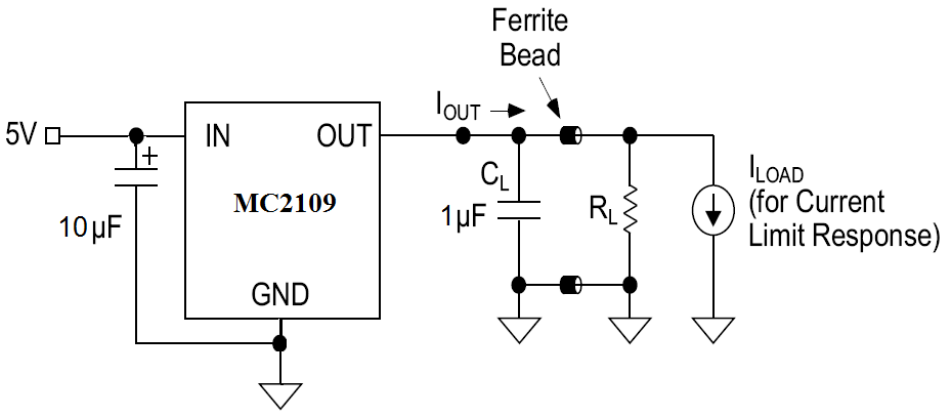


Figure 5: Functional Characteristics Test Circuit

Power Switch

The power switch is a P-channel MOSFET with a low on-state resistance. Configured as a high-side switch, the power switch prevents current flow from OUT to IN and IN to OUT.

Driver

The driver controls the gate voltage of the power switch. To limit large current surges and reduce the associated electromagnetic interference (EMI) produced, the driver incorporates circuitry that controls the rise times and fall times of the output voltage.

Current Sense

A sense FET monitors the current supplied to the load. The sense FET measures current more efficiently than conventional resistance methods. When an overload or short circuit is encountered, the current-sense circuitry sends a control signal to the driver. The driver in turn reduces the gate voltage and drives the power FET into its saturation region, which switches the output into a constant-current mode and holds the current constant while varying the voltage on the load.

Thermal Sense

The MC2109 implements a thermal sensing to monitor the operating temperature of the power distribution switch. In an over-current or short-circuit condition, the junction temperature rises. When the die temperature rises to approximately 135℃ due to over-current conditions, the internal thermal sense circuitry turns off the switch, thus preventing the device from damage. Hysteresis is built into the thermal sense, and after the device has cooled approximately 15 ℃, the switch turns back on. The switch continues to cycle off and on until the fault is removed.

Under-voltage Lockout

A voltage sense circuit monitors the input voltage. When the input voltage is below approximately 2.0V, a control signal turns off the power switch.

Power Supply Considerations

Over 10uF capacitor between IN and GND is recommended. This precaution reduces power supply transients that may cause ringing on the input and improves the immunity of the device to short-circuit transients. In order to achieve smaller output load transient, placing a high-value electrolytic capacitor on the output pin is recommended when the output load is heavy.

Over-current

A sense FET is employed to check for over-current conditions. Unlike current-sense resistors, sense FET does not increase the series resistance of the current path. When an over-current condition is detected, the device maintains a constant output current and reduces the output voltage accordingly. Complete shutdown occurs only if the fault is presented long enough to activate thermal limiting.

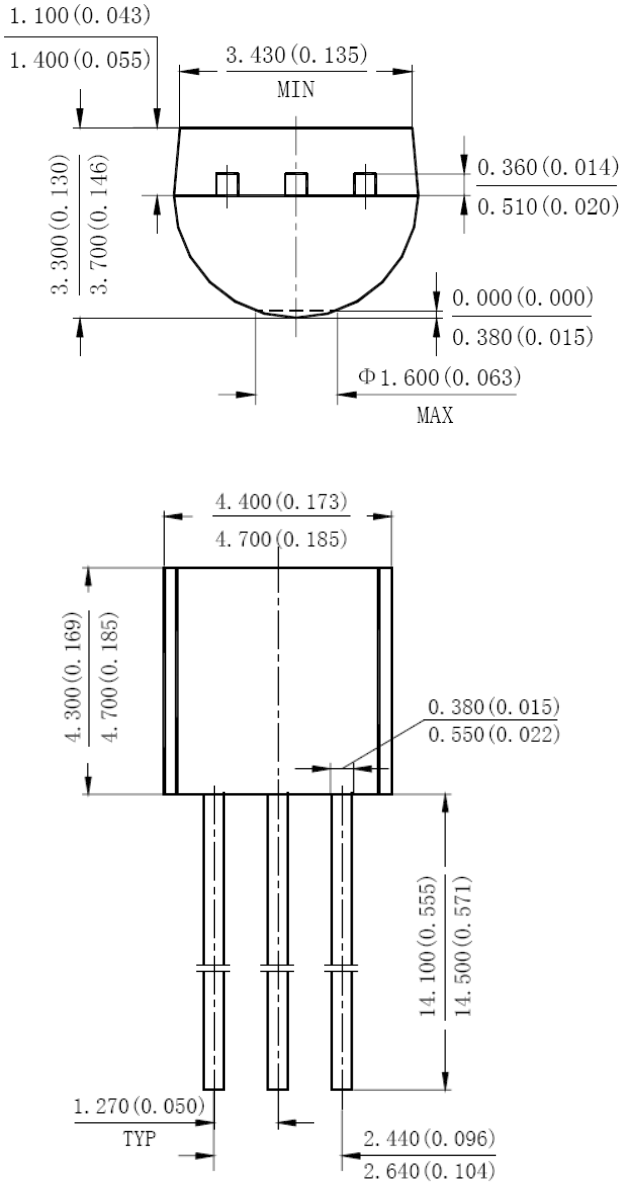
Three possible overload conditions can occur.

In the first condition, the output has been shorted before VIN has been applied. The MC2109 senses the short and immediately switches into a constant-current output.

In the second condition, a short or an overload occurs. At the instant the overload occurs, high currents may flow for a short period of time before the current-limit circuit can react. After the current-limit circuit has tripped (reached the over-current trip threshold), the device switches into constant-current mode.

In the third condition, the load has been gradually increased beyond the recommended operating current. The current is permitted to rise until the current-limit threshold is reached or until the thermal limit of the device is exceeded. The MC2109 is capable of delivering current up to the current-limit threshold without damaging the device. Once the threshold has been reached, the device switches into its constant-current mode.

Mechanical Dimensions



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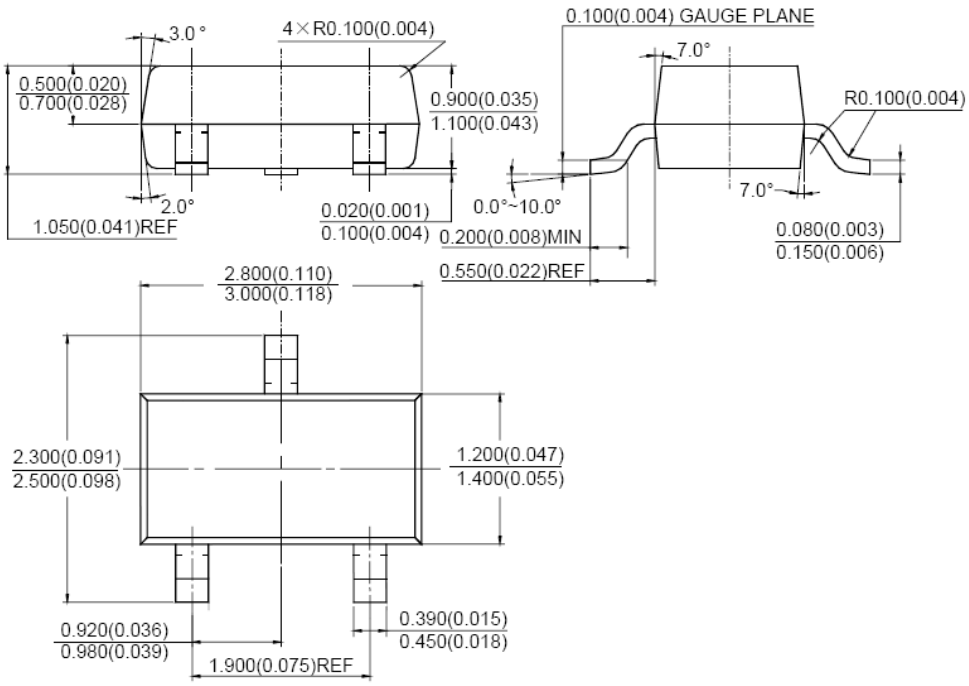

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