

## FEATURES

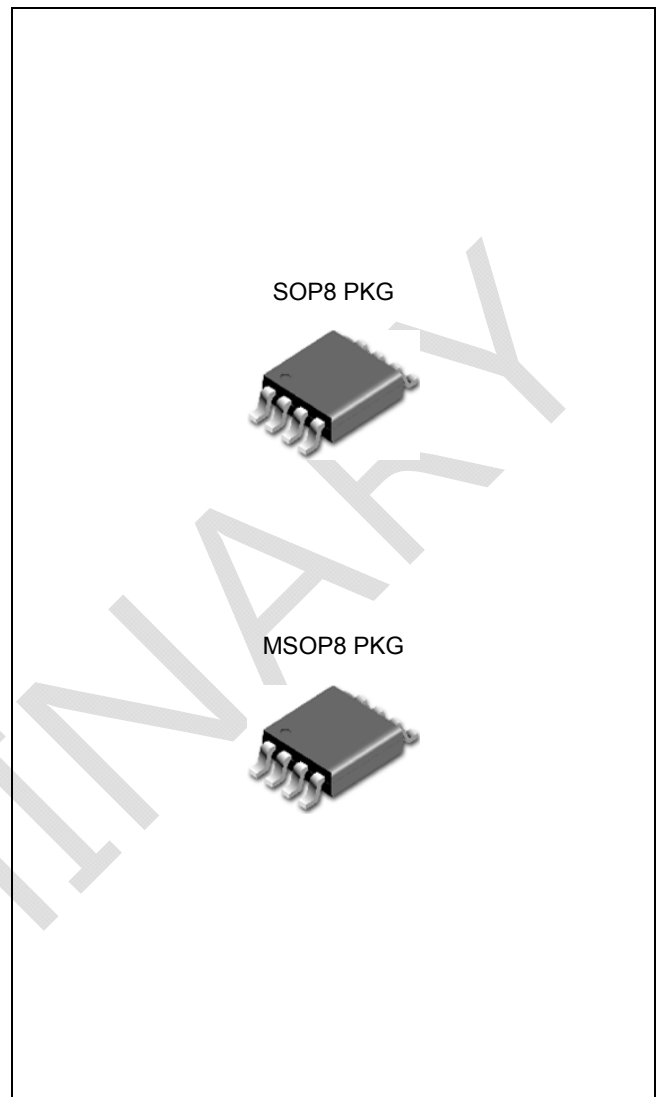
- 2.7V to 5.5V Operating Range
- 1.0A Continuous Current
- 2.2A Accurate Maximum Current limiting
- 1.6A Short Circuit Current
- 90uA Typical On-State Supply Current
- 1uA Maximum Standby Supply Current
- Independent open-drain fault flag pins
- Thermal Shutdown Protection
- Under Voltage Lockout(UVLO)
- TJ2210H : Active High version
- TJ2210L : Active Low version

## APPLICATION

- USB Peripherals
- General Purpose Power Switching
- ACPI Power Distribution
- Notebook PCs
- PDAs
- Hot Plug-in Power Supplies

## DESCRIPTION

The TJ2210X is dual-channel High-Side MOSFET switch optimized for general-purpose power distribution requiring circuit protection. The TJ2210 series support the following USB requirements. The TJ2210 series supply up to 1.0A as required by USB downstream devices. Switch's low on-resistance meets USB voltage drop requirement. Fault current is limited to typically 2.2A. Flag output indicate fault condition to the local USB controller. Soft-start prevents the transient voltage drop on the upstream port that can occur when the switch is enabled in bus-powered applications. Under voltage lockout (UVLO) feature disables the output switches until a valid input voltage. Also the TJ2210 include thermal shutdown to prevent switch failure from high-current loads.



## ORDERING INFORMATION

Device	Package
TJ2210HGD	SOP8
TJ2210LGD	
TJ2210HGMD	MSOP8
TJ2210LGMD	

**Absolute Maximum Ratings** (Note 1)

Characteristic	Symbol	Min	Max	Unit
Supply Voltage	$V_{IN}$	-0.3	6.0	V
Enable Input Voltage (Note 2)	$V_{EN}$	-0.3	6.0	V
Fault Flag Voltage	$V_{FLG}$	-	6.0	V
Fault Flag Current	$I_{FLAG}$	-	25	mA
Output Voltage	$V_{OUT}$		6.0	V
Output Current	$I_{OUT}$		Internally Limited	
Storage Temperature Range	$T_{STG}$	-65	150	°C

**Operating Ratings** (Note 3)

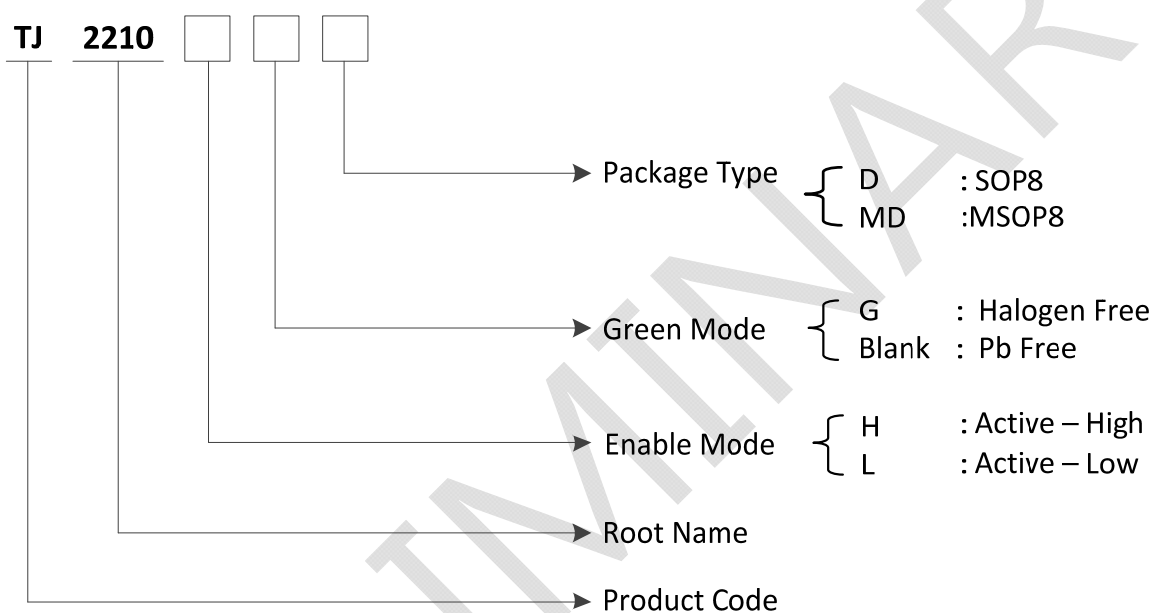
Characteristic	Symbol	Min	Max	Unit
Supply Voltage	$V_{IN}$	2.7	5.5	V
Ambient Temperature Range	$T_A$	-40	+85	°C
Operating Junction Temperature Range	$T_J$	-40	125	°C

## Note:

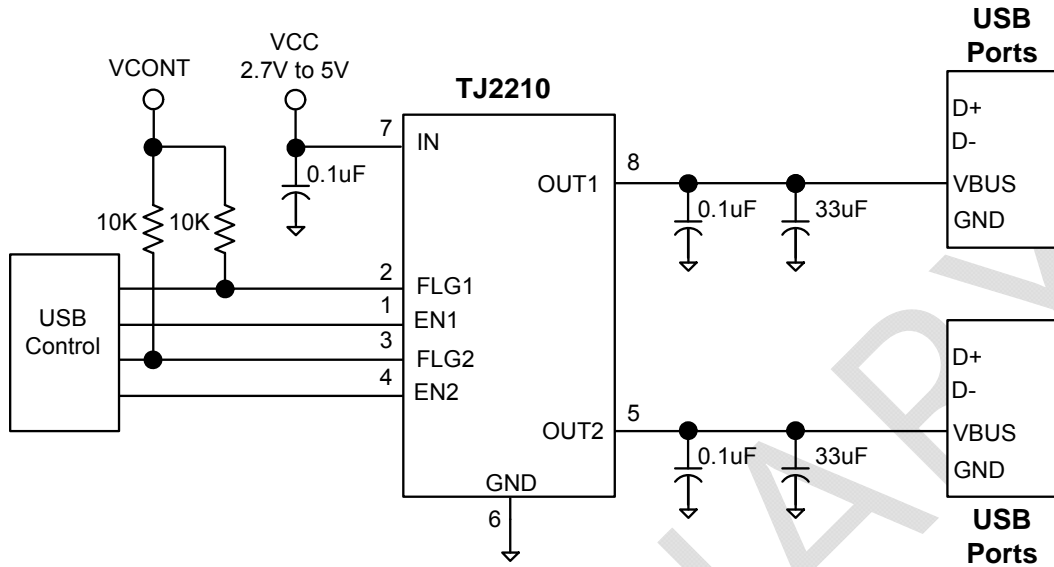
1. Exceeding the absolute maximum ratings may damage the device.
2. It is recommended for  $V_{EN}$  voltage not to exceed  $V_{IN}$  voltage.
3. The device is not guaranteed to function outside its operating rating.
4. Devices are ESD sensitive. Handling precautions are recommended.

## Ordering Information

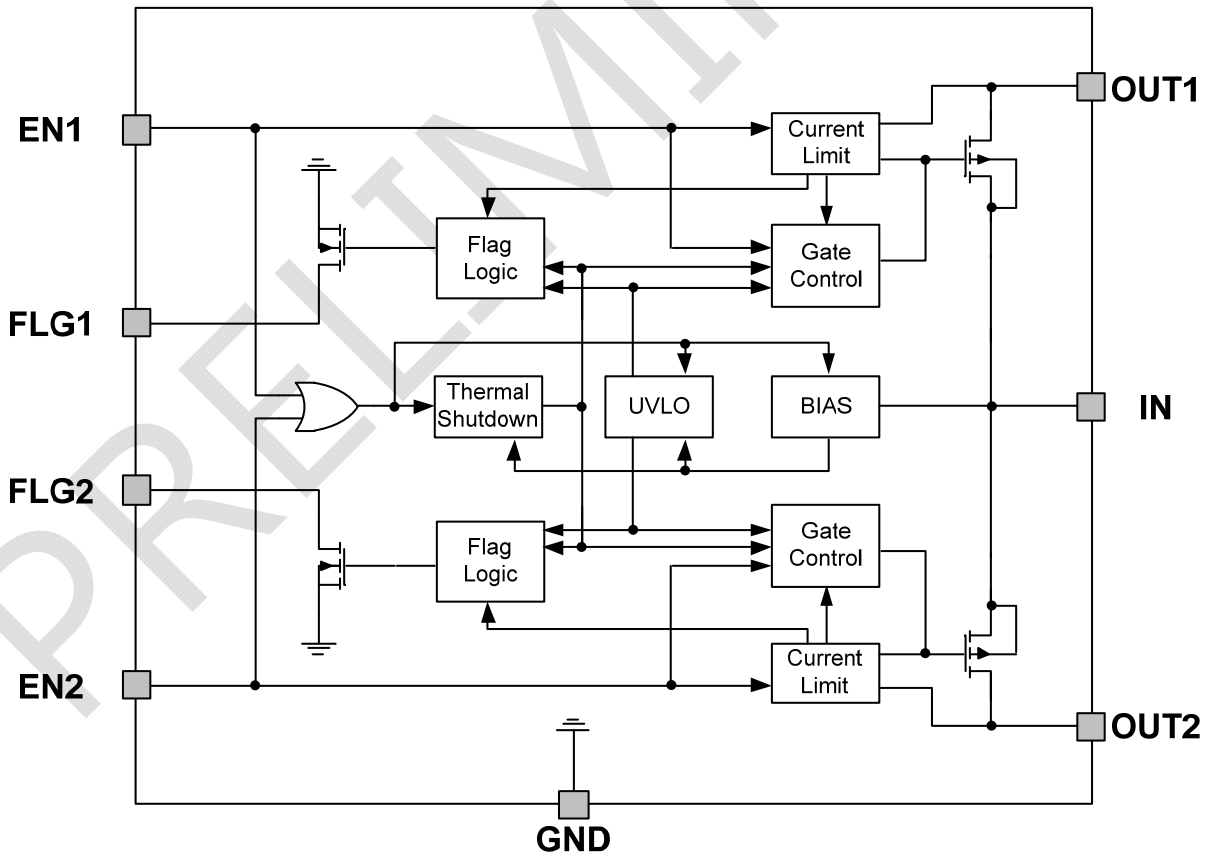
Package	Oder No.	Description	Marking	Compliance	Status
SOP8	TJ2210LGD	1A, Active Low	TJ2210LG	RoHS, Green	Contact Us
MSOP8	TJ2210LGMD	1A, Active Low	TJ2210LG	RoHS, Green	Contact Us
SOP8	TJ2210HGD	1A, Active High	TJ2210HG	RoHS, Green	Contact Us
MSOP8	TJ2210HGMD	1A, Active High	TJ2210HG	RoHS, Green	Contact Us



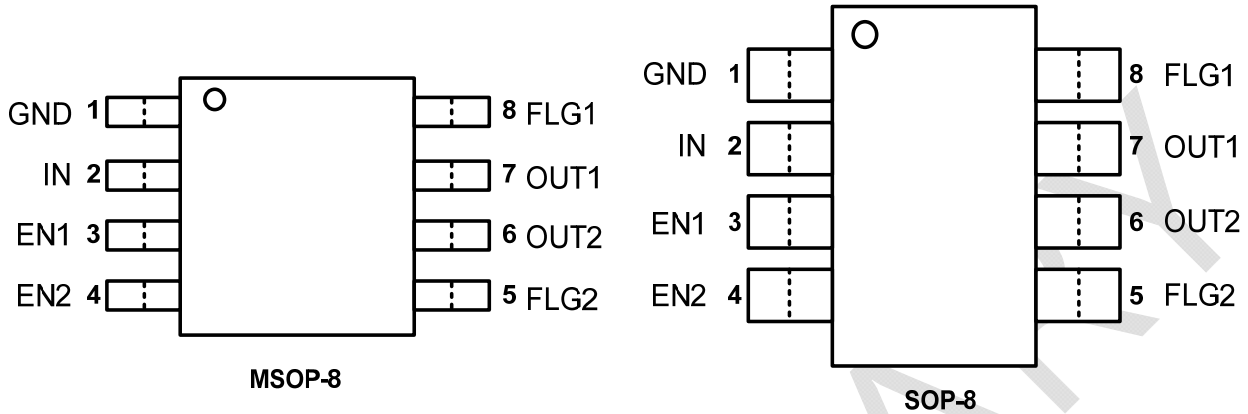
## TYPICAL APPLICATION CIRCUIT



## FUNCTION BLOCK DIAGRAM



## PIN CONFIGURATION



## PIN DESCRIPTION

Pin Name	Pin No.	Pin Description & Function
	SOP-8 / MSOP-8	
<b>GND</b>	1	Ground
<b>IN</b>	2	Supply Input: Output MOSFET drain. Also supplies IC's internal circuitry. Connect to positive supply.
<b>EN1</b>	3	Enable1: Logic-Compatible enable input. (H: active high, L: active low). Do not float.
<b>EN2</b>	4	Enable2: Logic-Compatible enable input. (H: active high, L: active low). Do not float.
<b>FLG2</b>	5	Fault Flag2: Active-low, open-drain output. Indicates over current, UVLO and Thermal shutdown.
<b>OUT2</b>	6	Switch Output2: Output MOSFET source. Typically connect to switched side of load.
<b>OUT1</b>	7	Switch Output1: Output MOSFET source. Typically connect to switched side of load.
<b>FLG1</b>	8	Fault Flag1: Active-low, open-drain output. Indicates over current, UVLO and Thermal shutdown.

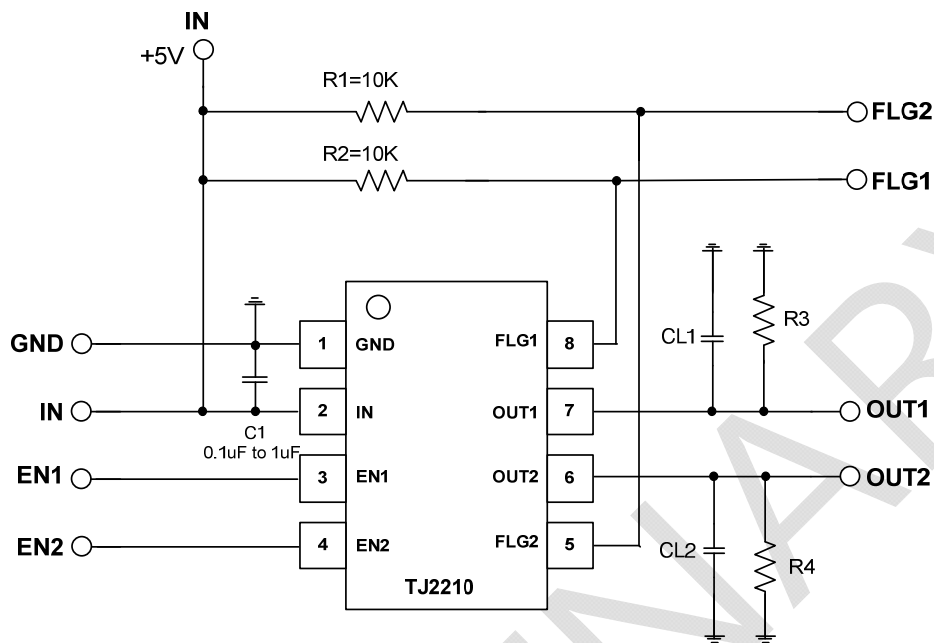
**ELECTRICAL CHARACTERISTICS** (Under the conditions of  $V_{IN}=+5V$  and  $T_A=25^{\circ}C$ )

PARAMETER	Symbol	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Voltage Range	$V_{IN}$		2.7		5.5	V
Supply Current	$I_{CC}$	Enable off ,OUT=Open		0.05	1	$\mu A$
		Enable on, OUT=Open		80	120	$\mu A$
Enable Input Threshold Voltage	$V_{EN}$	(Note 5)	0.8		2.0	V
Enable Input Current	$I_{EN}$	$V_{EN} = 0V$ to $5.5V$	-1	0.01	1	$\mu A$
Enable Input Capacitance	$C_{EN}$			1		pF
Switch Resistance	$R_{DS(ON)}$	$V_{IN}=5V, I_{OUT}=1.0A$		120	140	m $\Omega$
		$V_{IN}=3.3V, I_{OUT}=1.0A$		140	160	m $\Omega$
Output Turn-On Delay	$T_{DON}$	RL=10 $\Omega$ each output, CL=1 $\mu F$		50		$\mu s$
Output Turn-On Rise Time	$T_R$	RL=10 $\Omega$ each output, CL=1 $\mu F$		40		$\mu s$
Output Turn-Off Delay	$T_{DOFF}$	RL=10 $\Omega$ each output, CL=1 $\mu F$		0.5	10	$\mu s$
Output Turn-On Fall Time	$T_F$	RL=10 $\Omega$ each output, CL=1 $\mu F$		0.5	10	$\mu s$
Output leakage Current	$I_{LEAK}$	$V_{ENX} \leq 0.8V$		0.01	5	$\mu A$
Current Limit Threshold	$I_{LIM}$	Ramped load applied to output	1.8	2.2	2.6	A
Short Circuit Current Limit	$I_{OS}$	each output, $V_{OUT}=0V$	1.3	1.6	1.9	A
Over-Temperature Shutdown Threshold	$T_{TS}$	Temperature increasing switch		145		$^{\circ}C$
		Temperature decreasing switch		135		$^{\circ}C$
Error Flag Output Resistance	$R_{FO}$	$V_{IN}=5V, I_L=10mA$		10	25	$\Omega$
		$V_{IN}=3.3V, I_L=10mA$		15	40	$\Omega$
Error Flag Off Current	$I_{FOH}$	$V_{FLAG}=5V$		0.01	10	$\mu A$
UVLO Threshold	UVLO	$V_{IN}$ = increasing	2.1	2.3	2.6	V
		$V_{IN}$ = decreasing	1.9	2.1	2.45	V
Overcurrent Flag Response Delay	$T_{DFOV}$	$V_{IN}=5V,$ apply $V_{OUT}=0V$ until FLG low	4	7	10	ms

Note:

5. OFF is  $V_{EN} \leq 0.8V$  and ON is  $V_{EN} \geq 2.0V$  for the TJ2210H. OFF is  $V_{EN} \geq 2.0V$  and ON is  $V_{EN} \leq 0.8V$  for the TJ2210L.

## Test Circuit



## TYPICAL OPERATING CHARACTERISTICS

T.B.D

## Functional Characteristics

T.B.D

## Function Description

### Supply Filtering

A 0.1uF to 1uF bypass capacitor from IN pin to GND pin is recommended to control power supply transients. Without this bypass capacitor, an output short can cause ringing from supply lead inductance on the input and damage the internal control circuitry.

Input or output transients must never exceed the absolute maximum supply voltage ( $V_{INmax} = 6V$ )

### Power Dissipation

The device's junction temperature depends on several factors such as the load, PCB layout, ambient temperature, and package type. Equations that can be used to calculate power dissipation of each channel and junction temperature are found below:

$$P_D = R_{DS(ON)} \times I_{OUT}^2$$

Total power dissipation of the device will be the summation of  $P_D$  for both channels. To relate this to junction temperature, the following equation can be used:

$$T_J = P_D \times \Theta_{JA} + T_A$$

Where:

$T_J$  = Junction temperature

$T_A$  = Ambient temperature

$\Theta_{JA}$  = Thermal resistance of the package

### Enable/Shutdown

The EN1 and EN2 control pins must be driven to a logic high or logic low for a clearly defined signal input. Floating these control lines may cause unpredictable operation.

### Fault Flag

The FLG signal is open-drained output of N-channel MOSFET, the FLG output is pulled low to signal the following fault conditions: input under voltage, output current limit, and thermal shutdown.

### Soft-Start Condition

The TJ2210 has high impedance when off, which gradually shifts to low impedance as the chip turns on. This prevents an inrush current from causing voltage drops that result from charging a capacitive load and can pull the USB voltage bus below specified levels. This satisfies the USB voltage droop requirements for bus-powered applications.

The TJ2210 can provide inrush current limiting for applications with large load capacitances where  $C_L > 10\mu F$ .

### Current Sense

A sense MOSFET monitors the current supplied to the load. The sense MOSFET 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-source voltage and drives the power MOSFET 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.

### Over-Current and Short-Circuit Protection

The TJ2210 features an over-current protection circuitry to protect the device against overload conditions. The current limit threshold is preset internally. It protects the output MOSFET switches from damage due to undesirable short circuit conditions of excess inrush current often encountered during hot plug-in. The low limit of the current limit threshold of the TJ2210 allows a minimum current of 1.0A through the



MOSFET switches. A current limit condition will signal the error flag. These features can protect the load system effectively at any accidental circumstances.

## Thermal Shutdown Protection

Thermal shutdown limits the TJ2210 junction temperature and protects the device from damage as a result of overheated.

Thermal protection turns off when the TJ2210's junction temperature 145°C reached, allowing it to cool down until 135°C. The TJ2210 is reactivated when a junction temperature drops to approximately 130°C. It depends on the power dissipation, thermal resistance, and ambient temperature.

## Under Voltage Lockout

Under Voltage Lockout (UVLO) prevents the output MOSFET from turning on until  $V_{IN}$  exceeds approximately 2.3V. After the switch turns on, if the voltage drops below 2.1V typically, UVLO shuts off the output MOSFET. Under voltage detection functions only when the switch is enabled.

## Printed Circuit Layout

The power circuitry of USB printed circuit boards requires a customized layout to maximize thermal dissipation and to minimize voltage drop and EMI.

## USB Compliance

The TJ2210 is ideal for self-powered and bus powered Universal Serial Bus (USB) applications. A USB port provides a +5.0V bus and ground return line in addition to a twisted pair for data.

The TJ2210 will comply with the following USB requirements:

- 1) The fault current is well below the UL 25VA safety requirements.
- 2) The Flag Outputs are available to indicate fault conditions to USB controllers.
- 3) The MOSFET switches' low on-resistance meets USB voltage drop requirements.
- 4) The MOSFET switch channel can supply 1.0A as required by USB downstream devices.
- 5) Soft start eliminates any momentary voltage drops on the upstream port that may occur when the switches are enabled in bus-powered applications.
- 6) An Under-voltage Lockout ensures that the device remains off unless there is a valid input supply voltage present.
- 7) +2.7V and +5.0V logic compatible enable inputs.
- 8) Thermal Shutdown prevents the possibility of catastrophic switch failure from high-current loads.
- 8) The device is available in both active-high and active-low versions.

## PRELIMINARY REVISION NOTICE

The information in this datasheet can be revised without any notice.