GAMMA MICROELECTRONICS

GM2526

DUAL USB POWER SWITCH

Description

GM2526 is a dual high-side integrated power switch with independent enable and flag functions, designed for self-powered and bus-powered Universal Serial Bus (USB) applications. GM2526 requires few external components.

Each of the two switch channels supply up to 500mA as required by USB downstream devices. Each switch's low on-resistance meets USB voltage drop requirements. Fault current is 750mA (typical). A flag output indicates fault conditions to the local USB controller. The soft-start feature prevents the transient voltage drop on the upstream port that can occur when the switch is enabled in bus-powered applications. Thermal shutdown protection prevents switch failure from high-current loads. Undervoltage lockout (UVLO) hold GM2526 off unless there is a correct input voltage. GM2526 has 3.3V and 5V logic-compatible Enable inputs.

GM2526 is available in Active-High and Active-Low versions, and comes in 8-pin DIP and SOIC packages.

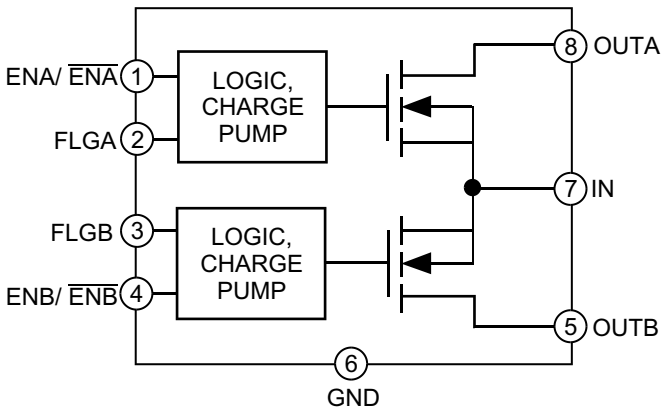
Features

- **Compliant to USB Specifications**
- **Two Independent Switches**
- **Input from 3V to 5.5V**
- **Min. Continuous Load Current 500mA per port**
- **Max. ON-Resistance 140m**
- **Max. Short Circuit Current Limit 1.25A**
- **Individual Open-Drain Fault Flag Pins**
- **ON-State Supply Current 110μA (typ.)**
- **OFF-State Supply Current 0.75μA (typ.)**
- **Thermal Shutdown**
- **Undervoltage Lockout (UVLO) Typically 2.4V**
- **1ms Turn-ON (soft-start) and Fast Turn-OFF**
- **Active-High or Active-Low Enable Versions**

Application

USB Power Management
USB Host- and Self-Powered Hubs
USB Bus-Powered Hubs
Hot Plug-In Power Supplies
Battery-Charger Circuits

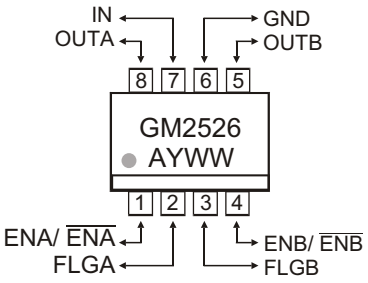
CONNECTION DIAGRAM



GM2526 H/ $\overline{L}$

◆ MARKING INFORMATION & PIN CONFIGURATIONS (TOP VIEW)

SOP-8



A= Assembly Location
Y= Year
WW= Weekly

◆ ORDERING INFORMATION

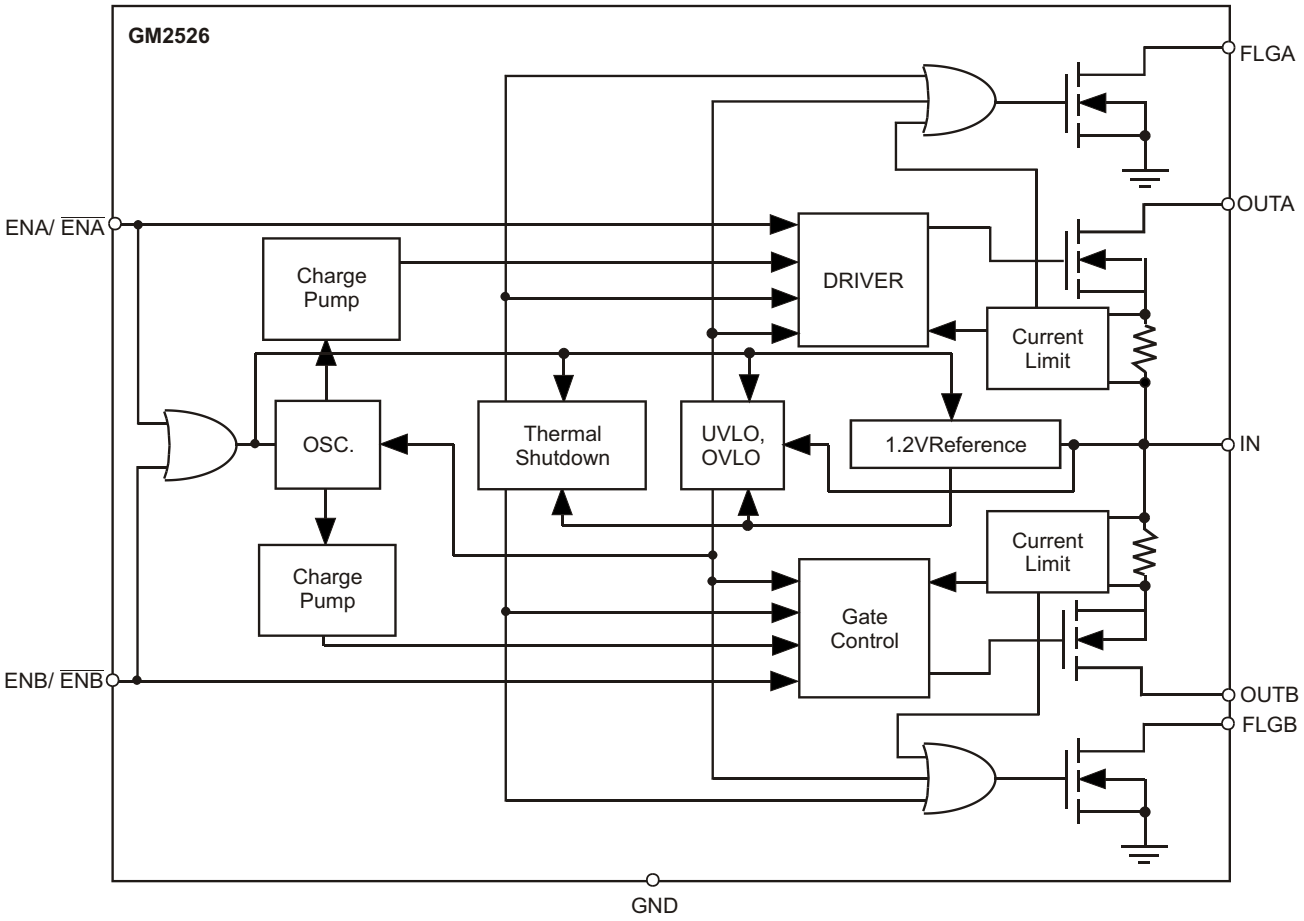
Ordering Number	Package	Shipping
GM2526HS8T	SOP - 8	100 Units / Tube
GM2526HS8R	SOP - 8	2,500 Units / Tape & Reel
GM2526LS8T	SOP - 8	100 Units / Tube
GM2526LS8R	SOP - 8	2,500 Units / Tape & Reel

* For detail Ordering Number identification, please see last page.

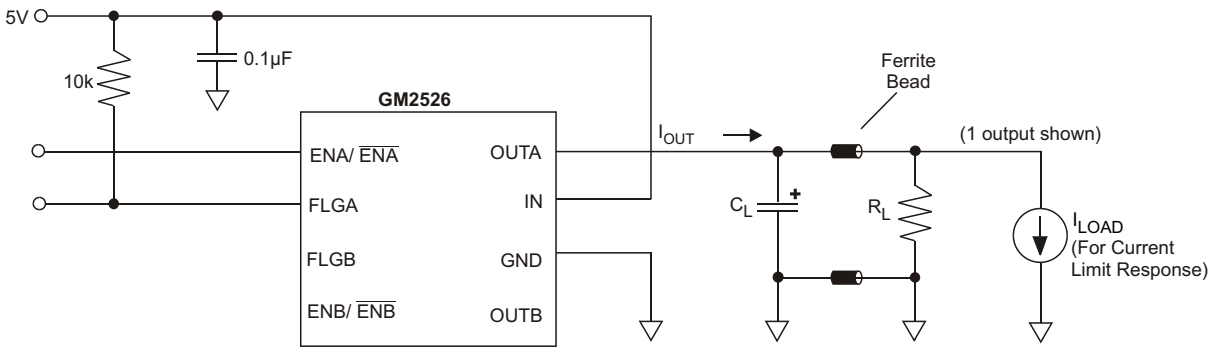
◆ PIN DESCRIPTION

PIN NUMBER	PIN SYMBOL	FUNCTION
1/4	EN(A/B) $\overline{\text{EN(A/B)}}$	Enable (Input): Logic-compatible enable input. High input > 2.1V typical Low input < 1.9V typical (H active high, L active low). Do not float.
2/3	FLG(A/B)	Fault Flag (Output): Active-low, open-drain output. Indicates overcurrent, and thermal shutdown, UVLO, OVLO
6	GND	Ground: Supply return.
7	IN	Supply Input: Output MOSFET drain. Also supplies IC's internal circuitry. Connect to positive supply.
8/5	OUT(A/B)	Switch Output: Output MOSFET source. Typically connect to switched side of load.

BLOCK DIAGRAM



FUNCTIONAL CHARACTERISTICS TEST CIRCUIT



◆ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage	V_{IN}	6	V
Fault Flag Voltage	V_{FLG}	6	V
Output Voltage	V_{OUT}	6	V
Fault Flag Current	I_{FLG}	50	mA
Output Current	I_{OUT}	Internally limited	mA
Control Input	V_{EN}	-0.3 to 12	V
Storage Temperature Range	T_S	-65 to +150	°C

◆ Operation Rating

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage	V_{IN}	3 to 5.5	V
Ambient Operating Temperature	T_A	-40 to 85	°C

◆ ELECTRICAL CHARACTERISTICS V_{IN} = 5V, T_A = 25°C (unless otherwise noted)

CHARACTERISTICS	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Current	Switch off, OUT= open (Note 3)	-	0.75	5	μA
	All switch on, OUT= open (Note 3)	-	110	160	
Enable Input Threshold	Low-to-high transition	-	2.1	2.4	V
	High-to-low transition (Note 3)	0.8	1.9	-	
Enable Input Current	V_{EN}= 0V to 5.5V	-1.0	±0.01	1.0	μA
Enable Input Capacitance	-	-	1	-	pF
Switch Resistance	V_{IN}= 5V , I_{OUT}= 500mA, each switch	-	100	140	m
	V_{IN}= 2.7V, I_{OUT}= 500mA, each switch	-	140	180	
Output Turn- ON Delay	R_L= 10 each output	-	0.5	-	ms
Output Turn- ON Rise Time	R_L= 10 each output	-	1	-	ms
Output Turn- OFF Delay	R_L= 10 each output	-	1	20	μs
Output Turn- OFF Fall Time	R_L= 10 each output	-	1	20	μs
Output Leakage Current	each output (output disabled)	-	-	10	μA
Continuous Load Current	each output	0.5	-	-	A
Short-Circuit Current Limit	each output (enable into load)= 4.0V	0.5	0.75	1.25	A
Current-Limit Threshold	ramped load applied to enabled output, $V_{OUT} \leq 4.0V$	-	1.6	2.2	A
Overtemperature Shutdown Threshold	T_J increasing	-	135	-	°C
	T_J decreasing	-	125	-	
Error Flag Output Resistance	V_{IN} =5V, I_L =10mA	-	10	25	
	V_{IN} =3.3V, I_L =10mA	-	15	40	
Error Flag Off Current	V_{FLG} =5V	-	0.01	1	μA
UVLO Threshold	V_{IN} = increasing	-	2.5	-	V
	V_{IN} =decreasing	-	2.3	-	

Note 1: Exceeding the absolute maximum rating may damage the device.
Note 2: The device is not guaranteed to function outside its operating rating.
Note 3: Off is 0.8V and on is ≤ 2.4V for the GM2526-H. Off is ≥ 2.4V and on is ≥ 0.8V for the GM2526-L.
The enable input has approximately 200mV of hysteresis.

◆ FUNCTIONAL DESCRIPTION

The GM2526-H (active-high) and GM2526-L (active-low) are dual high-side switches. Fault conditions turn off (or inhibit turn-on) of one or more of the output transistors, depending upon the type of fault, activate the open-drain error flag transistors, and sinking current to ground.

Input and Output

IN (input) is the power supply connection to the logic circuitry and the drain of the output MOSFET. OUTx (output) is the source of its respective MOSFET. In a typical application, current flows through the switch from IN to OUT toward the load. If V_{OUT} is greater than V_{IN} when a switch is enabled, current will flow from OUT to IN since the MOSFET is bidirectional when active. 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 ($V_{OUT} > V_{IN}$) when the output is off. In this situation, the GM2526 avoids undesirable current flow from OUT to IN. If V_{IN} falls below 2.5V, and UVLO disables both switches.

Thermal Shutdown

Thermal shutdown shuts off the affected output MOSFETs and signals all fault flags if the die temperature exceeds 135°C. Hysteresis of 10°C pre-vents the switch from turning on until the die temperature drops to 125°C. Note: over-temperature detection functions only when at least one switch is enabled.

Current Limit Induced Thermal Shutdown

GM2526 raises the output MOSFET on-resistance until series combination of the MOSFET on-resistance and load impedance limit current to 850mA (typ.). Normally the increased power dissipation will activate thermal shutdown, and disabling affected channels of GM2526. If you prefer to avoid this, you can respond to the fault and disable the current limited channel externally before GM2526 reaches shutdown temperature. The time between the flag indicates a current limit fault and thermal shutdown depends on ambient temperature, board layout, and load impedance. But, you will have typically a few hundred milliseconds. If you do not want GM2526 to go into thermal shutdown, the USB controller recognize a fault and disable the appropriate channel within this time. If the fault is not removed or the switch is not disabled within this time, then GM2526 will experience thermal oscillation of about 2Hz. This does not damage GM2526.

Undervoltage Lockout

UVLO prevents the output MOSFET from turning on until V_{IN} exceeds approximately 2.5V. Until turn-on, the FLAG will be low. After the switch turns on, UVLO signals the fault flag and shuts off the output MOSFET if the voltage drops below approximately 2.3V. Undervoltage detect functions only when at least one switch is enabled.

Current Sensing and Limiting

The current-limit threshold is preset internally. The preset level prevents damage to the output MOSFET and external load, but allows a minimum current of 0.5A through each channel's output MOSFET. The current-limit circuit senses a portion of the output MOSFET switch current. The current sense resistor shown in the block diagram is virtual and has no voltage drop. The reaction to an overcurrent condition varies according to the circumstances: (a) If a switch is powered on or enabled into a heavy load or short-circuit, the switch immediately goes into a constant-current mode, and reducing the output voltage. The fault flag goes low until the load is reduced. (b) When a heavy load is applied, a large transient current may flow until the current limit circuitry responds. At which point the device limits current to less than the short-circuit current limit specification. (C) GM2526 current-limit profile exhibits a small (~500mA) foldback effect. Once past the current-limit threshold, GM2526 operates in constant-current mode (see "short circuit current limit" in the Electrical Characteristics).
Note, GM2526 will deliver load current up to the current-limit threshold, typically 1.6A.

Fault Flag

FLG is an N-channel, open-drain MOSFET output. The faultflag is active (low) for one or more of the following conditions: undervoltage current limit, or thermal shutdown. The flag output MOSFET can sink a 10mA load to 100mV (typically) above ground. You can "wire NOR" multiple FLG pins to a common pull-up resistor.

◆ APPLICATION INFORMATION

Supply Filtering

To control supply transients, place a 0.1µF to 1µF bypass capacitor from IN to GND right at GM2526. 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 ($V_{IN\ max}$ = 6V).

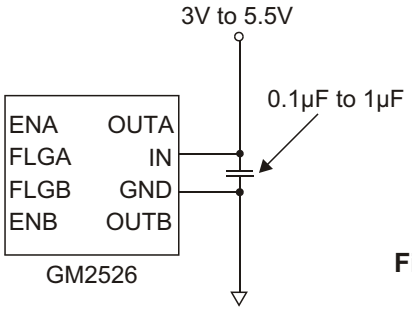


Figure1. Supply Bypassing

Enable Input

EN must been driven logic high or logic low for a clearly defined input. Floating the input will have unpredictable (but certainly undesirable) results. EN must never be allowed to go negative with respect to GND.

Soft Start

The GM2526 has high impedance when off, which gradually shifts to a low impedance as the chip turns on. This reduces the inrush current and voltage drop, which occured when charging a capacitive load, thus meeting the USB voltage drop requirements for bus-powered applications as shown in Figure 3.

You can use the soft start circuit shown in Figure 4 to meet USB transient regulation specifications with large load capacitances (C_{BULK} > 10uF). GM2526 provides inrush current limiting for these applications

Transient Overcurrent Filter

When GM2526 is turned on, large capacitance values at the output of GM2526 cause the inrush current to cross GM2526's short circuit current-limit threshold and assert the flag. The duration of this situation depends on the value of the output capacitance.

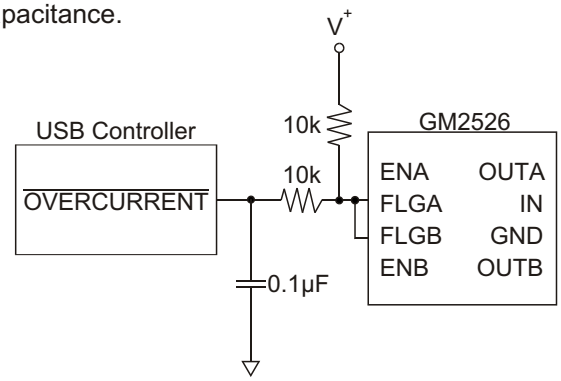


Figure 2. Transient Filter

While the capacitors are charging, GM2526 enters into
Into constant-current mode. As the capacitance is charged, the current decreases below the short circuit current-limit threshold, and the flag is deasserted. In USB applications, output bulk capacitance must be used to support hot-plug events. When the GM2526 is enabled, the flag may go active for about 1ms due to inrush current exceeding the current-limit setpoint. During hot-plug events, inrush currents may also cause the flag to go active for about 30µs. Since these situations are not relevant overcurrent faults, the USB controller must ignore the flag during these events. To prevent needless overcurrent reporting, you can use a 1ms RC filter as shown in Figure 2, or you can program a 1ms debounce routine, which may be programmed into the USB logic controller.

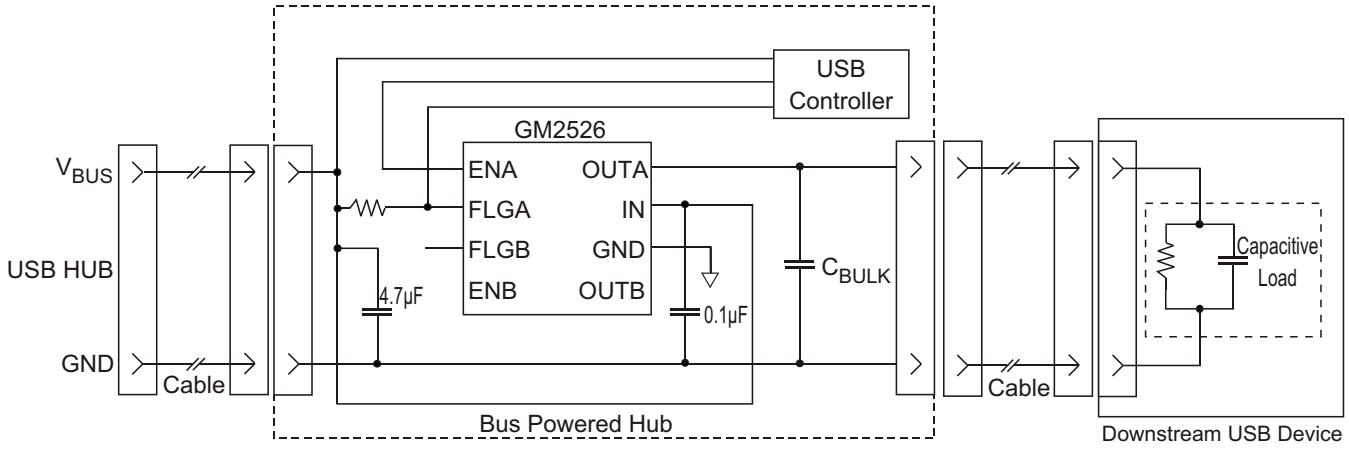


Figure 3. SOFT START (Single Channel)

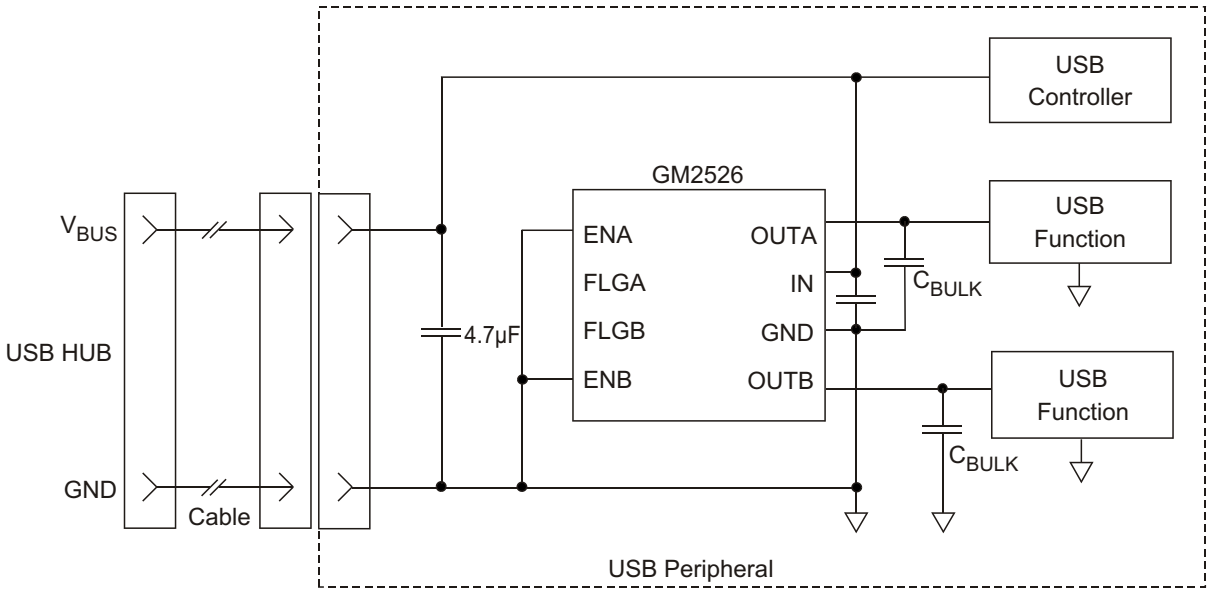
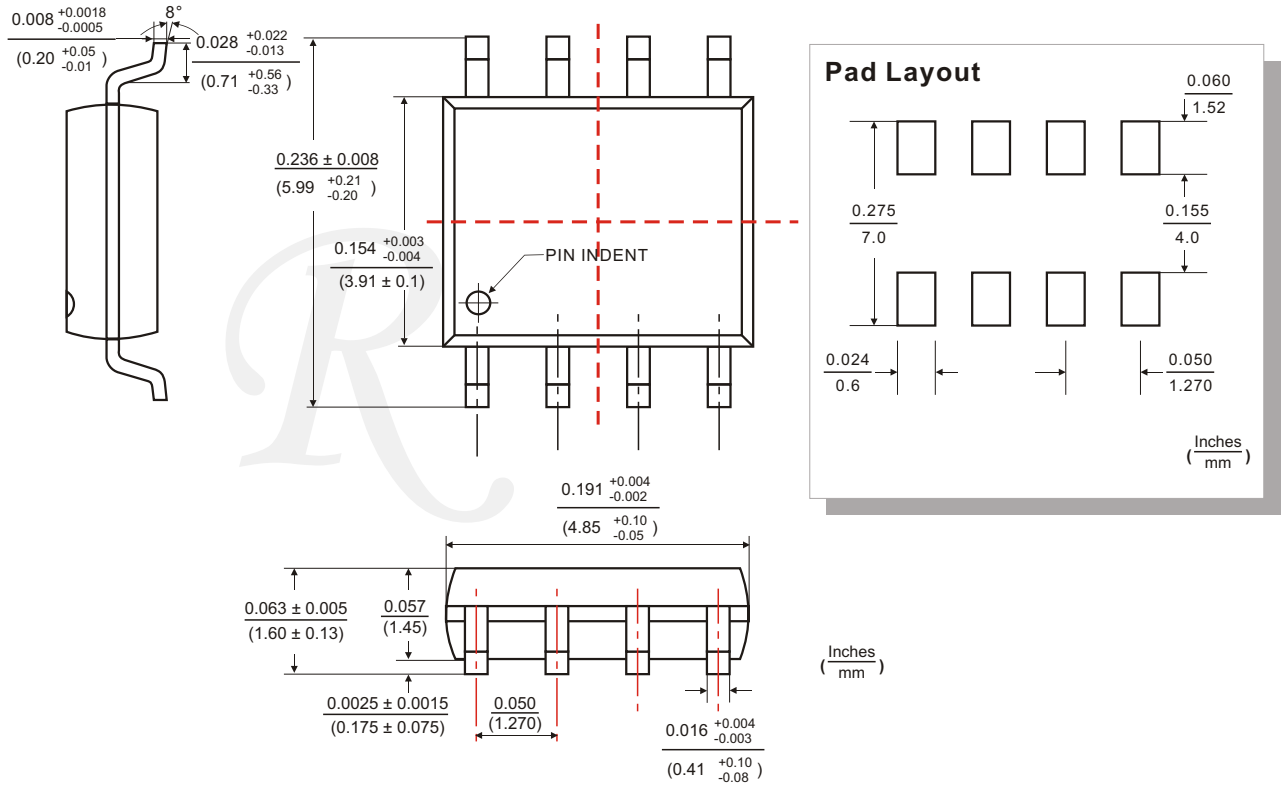


Figure 4. INRUSH CURRENT- LIMIT APPLICATION

◆ SOP-8(SO-8) PACKAGE OUTLINE DIMENSIONS



◆ ORDERING NUMBER