Description

The 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. The GM2526 requires few external components.

Each of the two switch channels supplies 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), well below the UL 25VA safety requirements. 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 buspowered applications. Thermal shutdown protection prevents switch failure from high-current loads. Undervoltage lockout (UVLO) hold the GM2526 off unless there is a correct input voltage. The GM2526 has 3.3V and 5V logic-compatible Enable inputs.

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

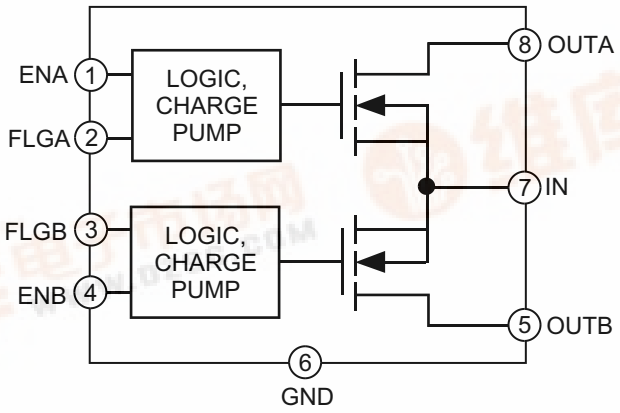
Features

- 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 1μA (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

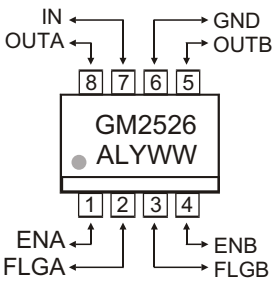
USB Power Management
USB Host- and Self-Powered Hubs
USB Bus-Powered Hubs
Hot Plug-In Power Supplies
Battery-Charger Circuits

CONNECTION DIAGRAM



◆ MARKING INFORMATION & PIN CONFIGURATIONS

SOP-8(SO-8)



(TOP VIEW)

A = Assembly Location
L = Wafer Lote
Y = Year
W W = Work Week

◆ ORDERING INFORMATION

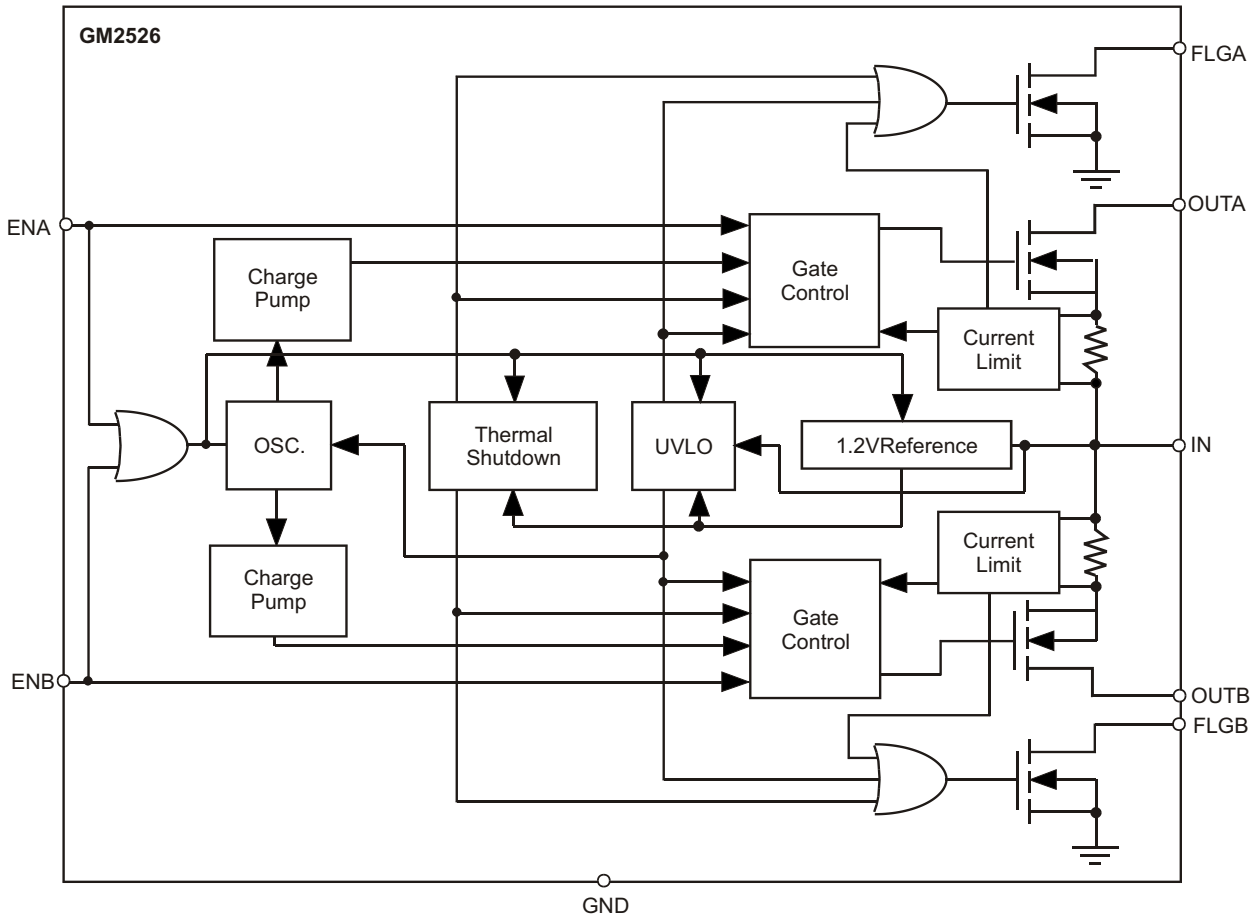
Ordering Number	Package	Shipping
GM2526HS8T	SO - 8	100 Units / Tube
GM2526HS8R	SO - 8	2,500 Units / Tape & Reel
GM2526LS8T	SO - 8	100 Units / Tube
GM2526LS8R	SO - 8	2,500 Units / Tape & Reel

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

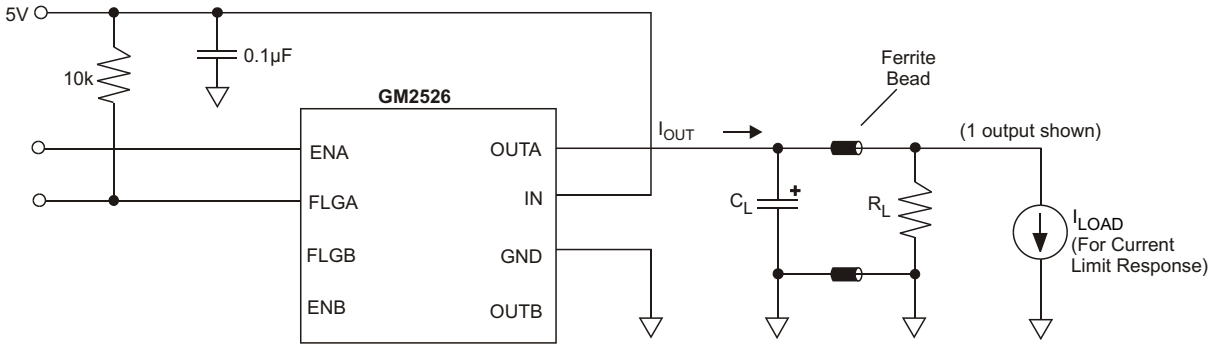
◆ PIN DESCRIPTION

PIN NUMBER	PIN SYMBOL	FUNCTION
1/4	EN(A/B)	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, UVLO, and thermal shutdown.
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	UNITS
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
Lead Temperature (Soldering 5 secretary.)	T_L	260	°C
ESD Rating**	EDS	2	KV

* Exceeding the absolute maximum rating may damage the device and will adversely affect reliability. Always operate the GM2526 within "Recommended Operating Conditions" (below).
** Devices are ESD sensitive. Handling precautions recommended. Human body model, 1.5k in series with 100pF.

◆ RECOMMENDED OPERATING CONDITIONS*

PARAMETER	SYMBOL	MIN	MAX	UNITS
Supply Voltage	V_{IN}	3	5.5	V
Ambient Operating Temperature Range	T_A	-40	85	°C
Thermal Resistance for SOIC Package	R_{JA}	-	120	°C/ W
Thermal Resistance for DIP Package	R_{JA}	-	130	°C/ W

* The GM2526 is not guaranteed to function outside these operating ranges.

◆ 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	-	0.75	5	μA
	All switch on, OUT= open	-	110	160	
Enable Input Threshold	Low-to-high transition	-	2.1	2.4	V
	High-to-low transition*	0.8	1.9	-	
Enable Input Current	V_{EN}= 0V to 5.5V	-1	±0.01	1	μA
Enable Input Capacitance	-	-	1	-	pF
Switch Resistance*	V_{IN}= 5V , I_{OUT}= 500mA, each switch	-	100	140	m
	V_{IN}= 3.3V , 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), V_{OUT}= 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	-	

* OFF is ≤ 8V, and ON is ≥ 2.4V for the GM2526-H. OFF is≥ 2.4V, and ON is ≤ 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 with. Fault conditions turn off (or inhibit turn-on) of one or more of the output transistors, depending upon the type of fault, and activate the open-drain error flag transistors, 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, 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

The GM2526 raises the output MOSFET on-resistance until the series combination of the MOSFET on-resistance and the load impedance limit current to 850mA (typ.). Normally the increased power dissipation will activate thermal shutdown, disabling affected channels of the GM2526. If you prefer to avoid this, you can respond to the fault and disable the current limited channel externally before the GM2526 reaches shutdown temperature. The time between the flag indicating 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 the 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 the GM2526 will experience thermal oscillation of about 2Hz. This does not damage the 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, if the voltage drops below approximately 2.3V, UVLO signals the fault flag and shuts off the output MOSFET. Undervoltage detection 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, 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) The GM2526 current-limit profile exhibits a small (~500mA) foldback effect. Once past the current-limit threshold, the GM2526 operates in constant-current mode (see "short circuit current limit" in the Electrical Characteristics).
Note, the 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 ($2V < V_{IN} < 2.7$), 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 re-

◆ APPLICATION INFORMATION

Supply Filtering

To control supply transients, place a 0.1µF to 1µF bypass capacitor from IN to GND right at the 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).

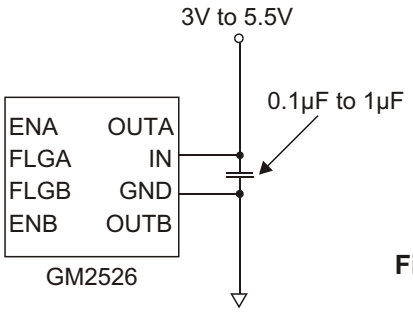


Figure1. Supply Bypassing

Enable Input

EN must be 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 occur 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). The GM2526 provides inrush current limiting for these applications

Transient Overcurrent Filter

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

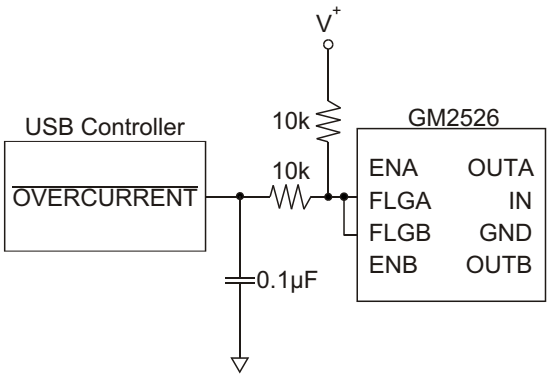


Figure 2. Transient Filter

While the capacitors are charging, the GM2526 enters
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 30us. Since these situations are not relevant overcurrent faults, the USB controller must ignore the To prevent needless overcurrent reporting, you can use a 1ms RC filter as shown

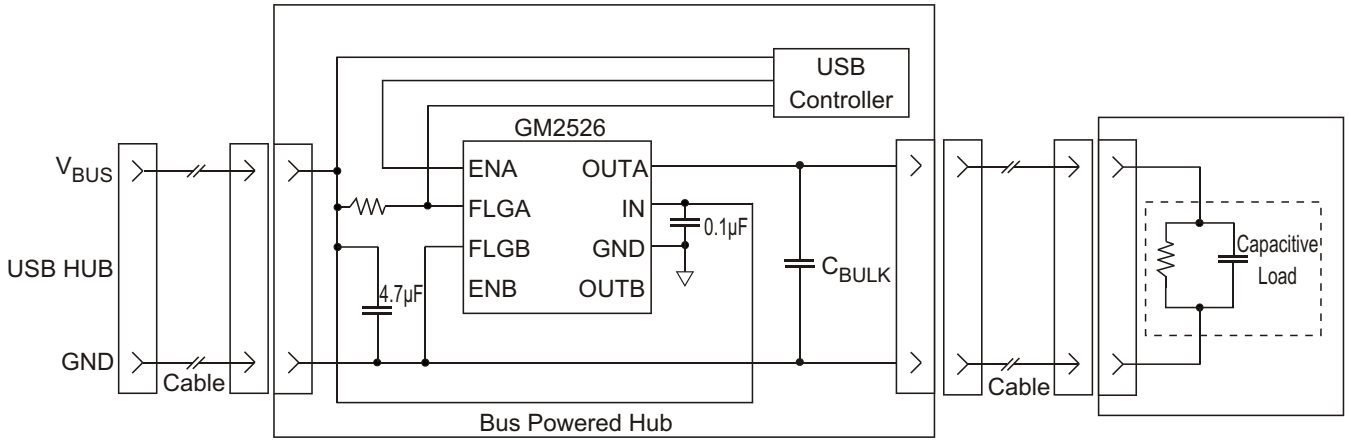


Figure 3. SOFT START (Single Channel)

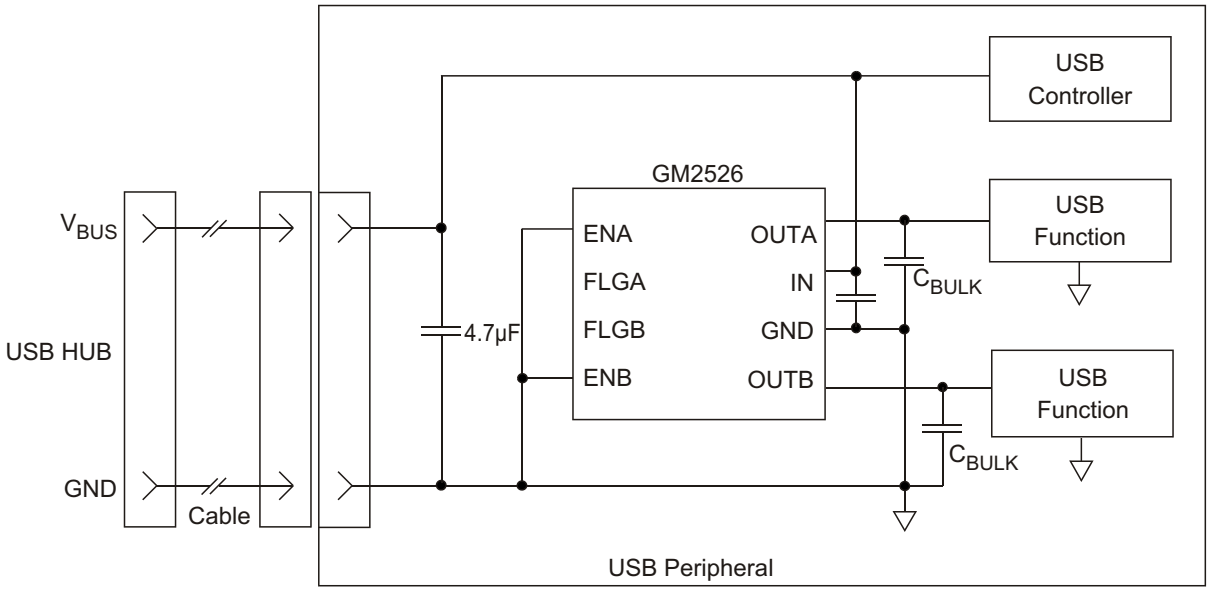
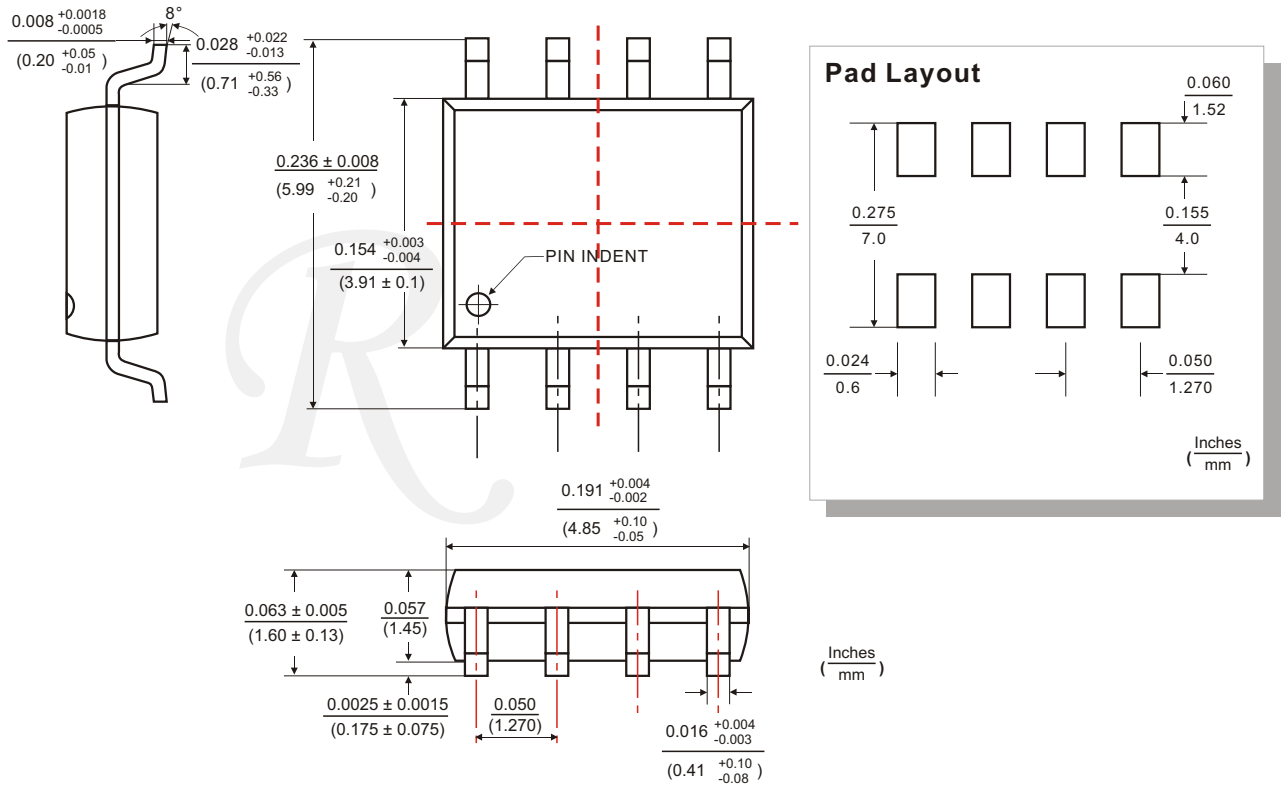


Figure 4. INRUSH CURRENT- LIMIT APPLICATION

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



◆ ORDERING NUMBER