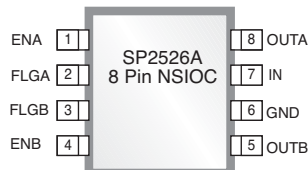


## Dual USB High-Side Power Switch

### FEATURES

- +3.0V to +5.5V Input Voltage Range
- Two Independent Power Switches
- Two Error Flag Outputs, Open Drain
- 2.6V Undervoltage Lockout
- 1.25A Short Circuit Current Limit
- 150mΩ Maximum On-Resistance
- 110μA On-State Supply Current
- 1μA Shutdown Current
- Output Can Be Forced Higher Than Input (Off-State)
- Thermal Shutdown
- 1ms Soft-Start Power Up, Fast Turn Off



Now Available in Lead Free Packaging

- Active-High Version: SP2526A-1
- Active-Low Version: SP2526A-2

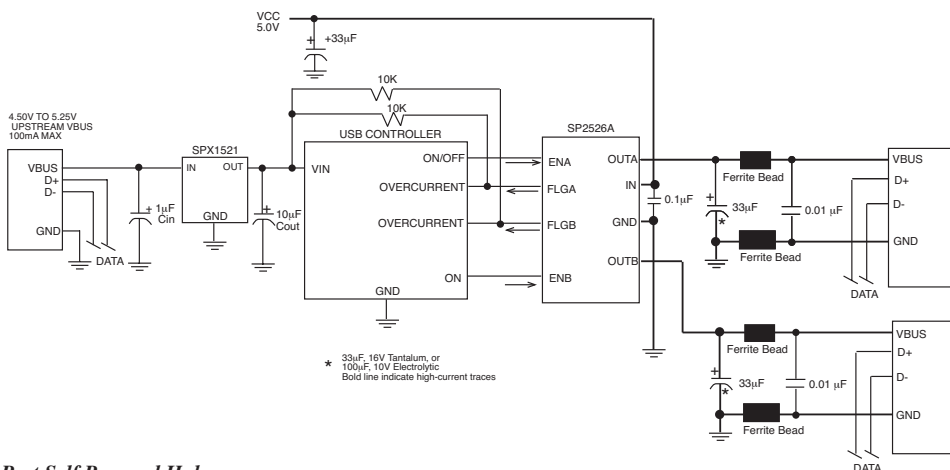
### APPLICATIONS

- USB Power Management
- Hot Plug-In Power Supplies
- Battery Charger Circuit

### DESCRIPTION

The SP2526A device is a dual +3.0V to +5.5V USB Supervisory Power Control Switch ideal for self-powered and bus-powered Universal Serial Bus (USB) applications. Each switch has low on-resistance (110mΩ typical) and can supply 500mA minimum. The fault currents are limited to 1.0A typical and the flag output pin for each switch is available to indicate fault conditions to the USB controller. The thermal shutdown feature will prevent damage to the device when subjected to excessive current loads. The undervoltage lockout feature will ensure that the device will remain off unless there is a valid input voltage present.

### TYPICAL APPLICATION CIRCUIT



*Two Port Self Powered Hub*

## ABSOLUTE MAXIMUM RATINGS

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

Supply Voltage ( $V_{IN}$ ).....7.0V  
 Fault Flag Voltage ( $V_{FLG}$ ).....7.0V  
 Fault Flag Current ( $I_{FLG}$ ).....50mA  
 Enable Control Input ( $V_{EN}$ ).....-0.3V -15V

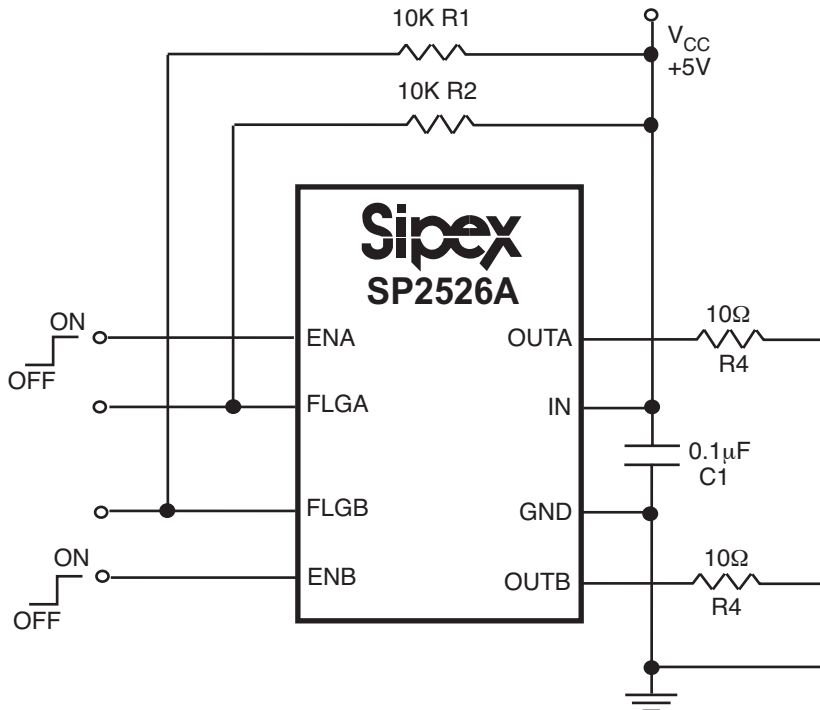
Operating Temperature Range.....-40°C to +85°C  
 Maximum Junction Temperature .....125°C  
 Storage Temperature Range.....-65°C to +150°C  
 Soldering Temperature (10 sec.).....260°C  
 Power Dissipation Per Package  
 8-pin NSOIC (derate 6.14mW/°C above +70°C).....500mW

## ELECTRICAL CHARACTERISTICS

Unless otherwise noted, the following specifications apply for  $V_{IN} = +5.0V$ ,  $T_A = 25^\circ C$ .

| PARAMETER                           | MIN. | TYP.         | MAX.       | UNITS      | CONDITIONS                                                                                                     |
|-------------------------------------|------|--------------|------------|------------|----------------------------------------------------------------------------------------------------------------|
| Supply Current                      |      | 0.75<br>110  | 5.0<br>160 | $\mu A$    | $V_{EN} = \text{Logic "0"} \text{ OUT} = \text{Open}$<br>$V_{EN} = \text{Logic "1"} \text{ OUT} = \text{Open}$ |
| Enable Input Voltage                | 0.8  | 1.7<br>2.0   | 2.4        | V          | $V_{EN} = \text{Logic "0"}$<br>$V_{EN} = \text{Logic "1"}$                                                     |
| Enable Input Current                |      | 0.01<br>0.01 | 1<br>1     | $\mu A$    | $V_{EN} = \text{Logic "0"}$<br>$V_{EN} = \text{Logic "1"}$                                                     |
| Enable Input Capacitance            |      | 1            |            | pF         |                                                                                                                |
| Output Mosfet Resistance            |      | 110          | 150        | m $\Omega$ |                                                                                                                |
| Output Turn-On Delay                |      | 100          |            | $\mu s$    | $R_L = 10\Omega$ each output                                                                                   |
| Output Turn-On Rise Time            |      | 1000         | 4000       | $\mu s$    | $R_L = 10\Omega$ each output                                                                                   |
| Output Turn-Off Delay               |      | 0.8          | 20         | $\mu s$    | $R_L = 10\Omega$ each output                                                                                   |
| Output Turn-Off Fall Time           |      | 0.7          | 20         | $\mu s$    | $R_L = 10\Omega$ each output                                                                                   |
| Output Leakage Current              |      |              | 10         | $\mu A$    |                                                                                                                |
| Current Limit Threshold             | 0.6  | 1.0          | 1.25       | A          |                                                                                                                |
| Over-Temperature Shutdown Threshold |      | 135<br>125   |            | $^\circ C$ | $T_J$ increasing<br>$T_J$ decreasing                                                                           |
| Error Flag Output Resistance        |      | 10<br>15     | 25<br>40   | $\Omega$   | $V_{IN} = 5V, I_L = 10mA$<br>$V_{IN} = 3.3V, I_L = 10mA$                                                       |
| Error Flag Off Current              |      | 0.01         | 1          | $\mu A$    | $V_{FLAG} = 5V$                                                                                                |
| UVLO Threshold                      |      | 2.6<br>2.4   |            | V          | $V_{IN}$ increasing<br>$V_{IN}$ decreasing                                                                     |

| Pin Number | Pin Name | Description                                                                                                                                                                                                                   |
|------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1          | ENA      | Enable Input for MOSFET Switch A. This input pin is active high for the SP2526A-1 and active low for the SP2526A-2                                                                                                            |
| 2          | FLGA     | An active-low and open-drained fault flag output for channel A. It can indicate current limit when ENA is active. In normal mode operation (ENA or/and ENB is active), it also can indicate thermal shutdown or undervoltage. |
| 3          | FLGB     | An active-low and open-drained fault flag output for channel B. It can indicate current limit when ENB is active. In normal mode operation (ENA or/and ENB is active), it also can indicate thermal shutdown or undervoltage. |
| 4          | ENB      | Enable Input for MOSFET Switch B. This input pin is active high for the SP2526A-1 and active low for the SP2526A-2                                                                                                            |
| 5          | OUTB     | Output for MOSFET Switch Channel B. This is the output pin of the MOSFET source of channel B, typically connected to the switched side of the load.                                                                           |
| 6          | GND      | Ground.                                                                                                                                                                                                                       |
| 7          | IN       | Power supply input                                                                                                                                                                                                            |
| 8          | OUTA     | Output for MOSFET Switch Channel A. This is the output pin of the MOSFET source of channel A, typically connected to the switched side of the load.                                                                           |

**TEST CIRCUIT**


### Error Flag

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

### Current Limit

The current limit threshold is preset internally. It protects the output MOSFET switches from damage resulting from undesirable short circuit conditions or excess inrush current, which is often encountered during hot plug-in. The low limit of the current limit threshold of the SP2526A allows a minimum current of 0.6A through the MOSFET switches. A current limit condition will signal the error flag.

### Thermal Shutdown

When the chip temperature exceeds 135°C for any reason other than overcurrent fault of either one of the two MOSFETs, the thermal shutdown function turns off both MOSFET switches and signals the error flag. A hysteresis of 10°C prevents the MOSFETs from turning back on until the chip temperature drops below 125°C. However, if thermal shutdown is triggered by chip temperature rise resulting from overcurrent fault condition of either one of the MOSFET switches, the thermal shutdown function will only turn off the switch that is in overcurrent condition and the other switch can still remain its normal operation. In other words, the thermal shutdown function of the two switches is independent of each other in the case of overcurrent fault.

### Supply Filtering

A 0.1μF to 1μF bypass capacitor from IN to GND, located near the device, is strongly recommended to control supply transients. Without a bypass capacitor, an output short may cause sufficient ringing on the input (from supply lead inductance) to damage internal control circuitry.

### Transient Requirements

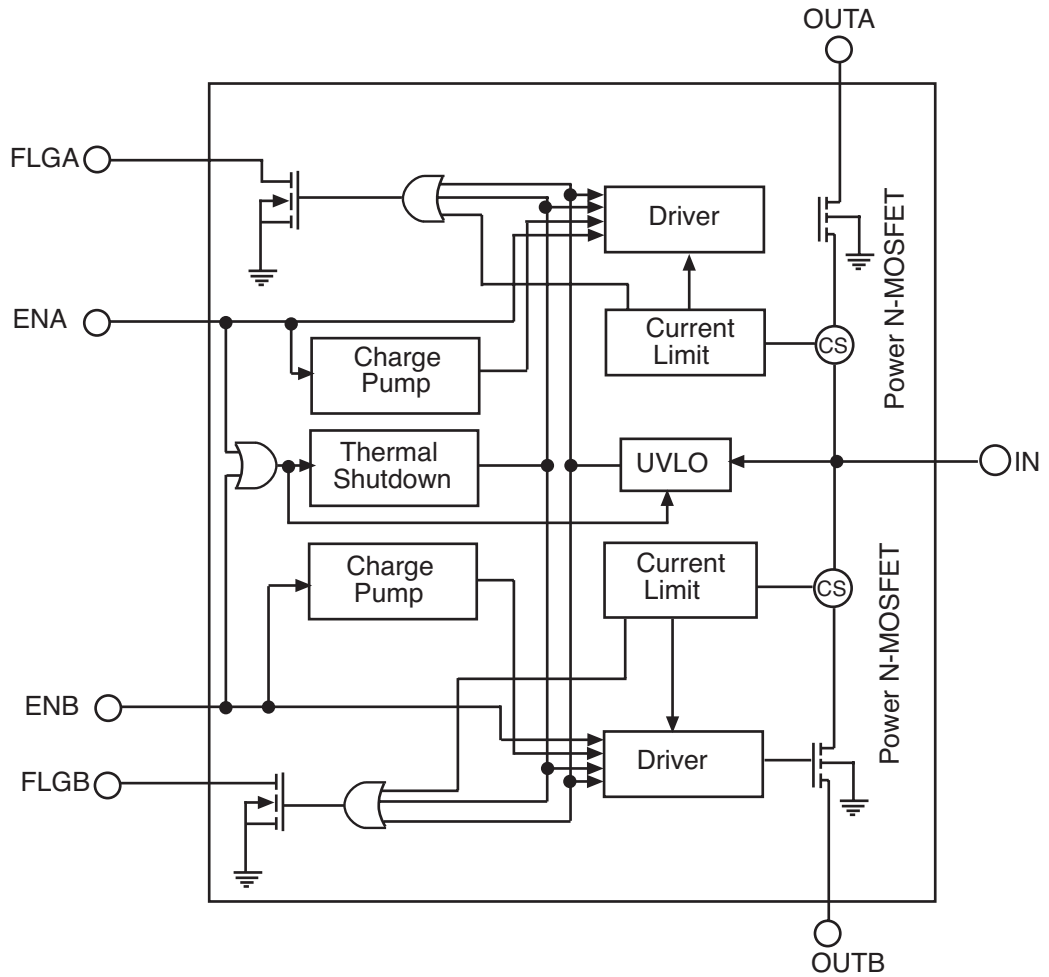
USB supports dynamic attachment (hot plug-in) of peripherals. A current surge is caused by the input capacitance of downstream device. Ferrite beads are recommended in series with all power and ground connector pins. Ferrite beads reduce EMI and limit the inrush current during hot-attachment by filtering high-frequency signals.

### Short Circuit Transient

Bulk capacitance provides the short-term transient current needed during a hot-attachment event. A 33 μF, 16V tantalum or a 100μF, 10V electrolytic capacitor mounted close to downstream connector each port should provide transient drop protection

### 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.



## TYPICAL PERFORMANCE CHARACTERISTICS

$V_{IN} = +5.0V$ , single MOSFET switch section, and  $T_{AMB} = +25^{\circ}C$  unless otherwise noted.

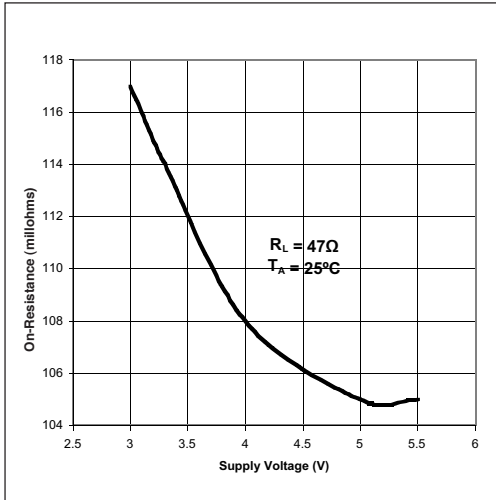


Figure 1. Output On-Resistance vs. Supply Voltage

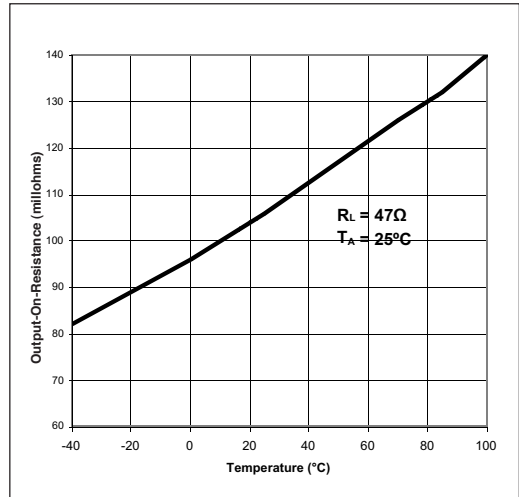


Figure 2. Output On-Resistance vs. Temperature

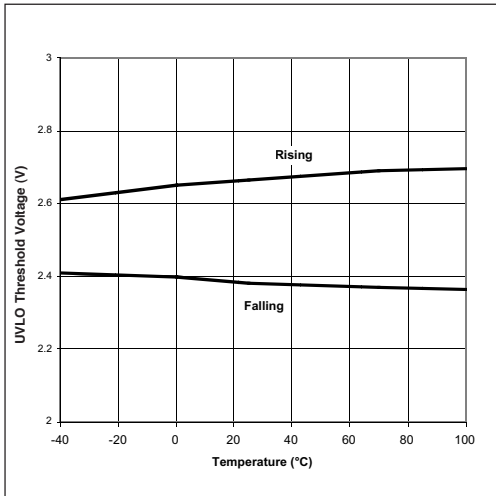


Figure 3. UVLO Threshold Voltage vs. Temperature

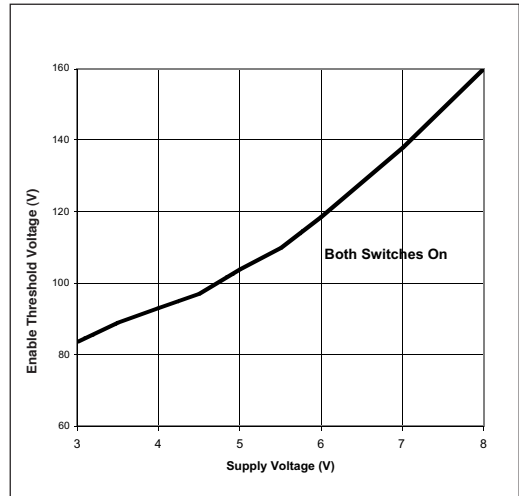


Figure 4. On-state Supply Current vs. Supply Voltage

## TYPICAL PERFORMANCE CHARACTERISTICS

$V_{IN} = +5.0V$ , single MOSFET switch section, and  $T_{AMB} = +25^{\circ}C$  unless otherwise noted.

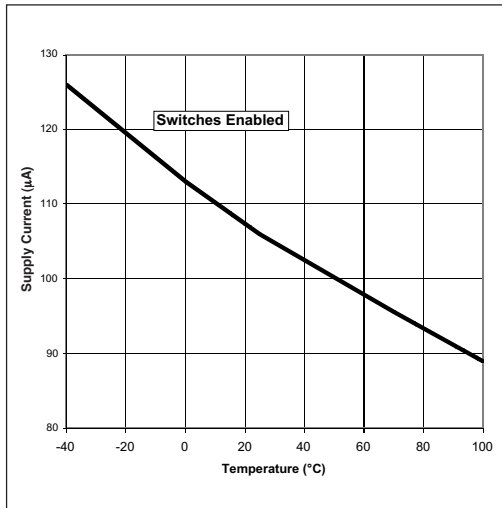


Figure 5. On-state Supply Current vs. Temperature

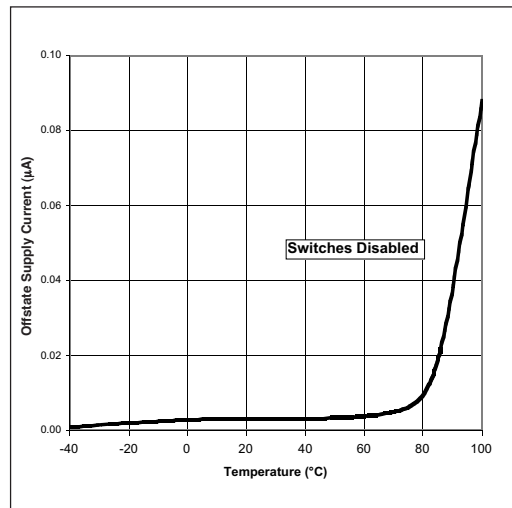


Figure 6. Off-state Supply Current vs. Temperature

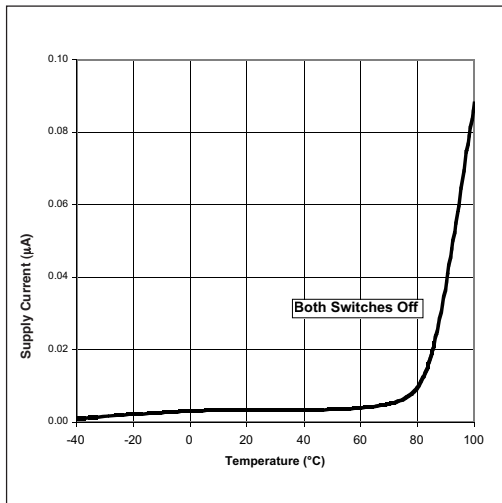


Figure 7. Off-state Supply Current vs. Supply Voltage

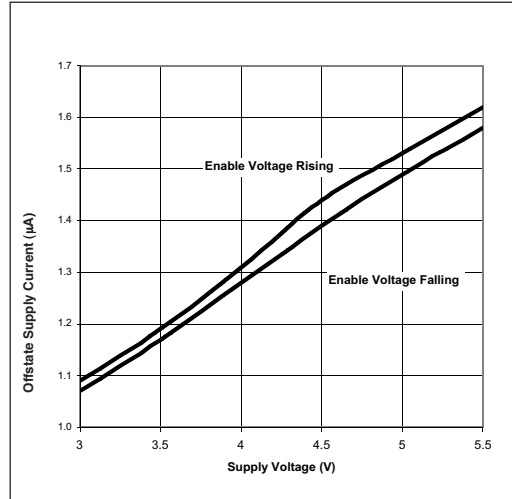


Figure 8. Control Threshold vs. Supply Voltage

## TYPICAL PERFORMANCE CHARACTERISTICS

$V_{IN} = +5.0V$ , single MOSFET switch section, and  $T_{AMB} = +25^{\circ}C$  unless otherwise noted.

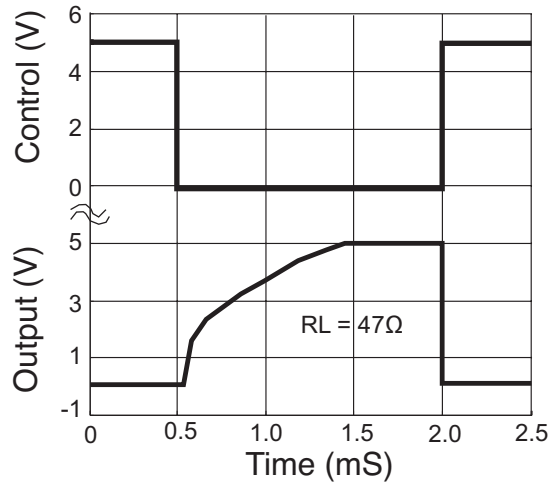
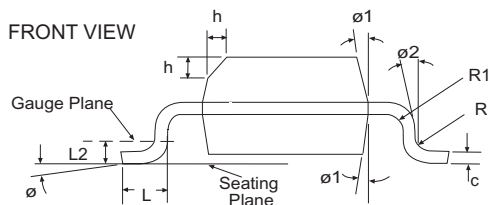
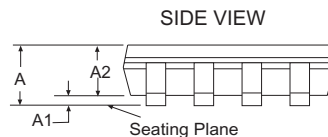
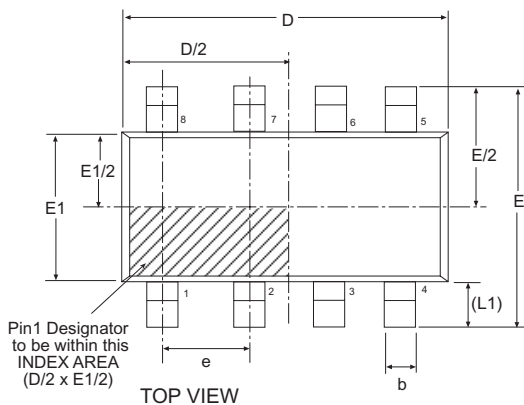


Figure 9. Turn-on/Turn-off Characteristics



| 8 Pin NSOIC                 |                                                     |     | JEDEC MS-012 |                                                                 | Variation AA |       |
|-----------------------------|-----------------------------------------------------|-----|--------------|-----------------------------------------------------------------|--------------|-------|
| SYMBOL                      | Dimensions in Millimeters:<br>Controlling Dimension |     |              | Dimensions in Inches<br>Conversion Factor:<br>1 Inch = 25.40 mm |              |       |
|                             | MIN                                                 | NOM | MAX          | MIN                                                             | NOM          | MAX   |
| A                           | 1.35                                                | -   | 1.75         | 0.053                                                           | -            | 0.069 |
| A1                          | 0.10                                                | -   | 0.25         | 0.004                                                           | -            | 0.010 |
| A2                          | 1.25                                                | -   | 1.65         | 0.049                                                           | -            | 0.065 |
| b                           | 0.31                                                | -   | 0.51         | 0.012                                                           | -            | 0.020 |
| c                           | 0.17                                                | -   | 0.25         | 0.007                                                           | -            | 0.010 |
| E                           | 6.00 BSC                                            |     |              | 0.236 BSC                                                       |              |       |
| E1                          | 3.90 BSC                                            |     |              | 0.154 BSC                                                       |              |       |
| e                           | 1.27 BSC                                            |     |              | 0.050 BSC                                                       |              |       |
| h                           | 0.25                                                |     | 0.50         | 0.010                                                           | -            | 0.020 |
| L                           | 0.40                                                | -   | 1.27         | 0.016                                                           | -            | 0.050 |
| L1                          | 1.04 REF                                            |     |              | 0.041 REF                                                       |              |       |
| L2                          | 0.25 BSC                                            |     |              | 0.010 BSC                                                       |              |       |
| R                           | 0.07                                                | -   | -            | 0.003                                                           | -            | -     |
| R1                          | 0.07                                                | -   | -            | 0.003                                                           | -            | -     |
| ø                           | 0°                                                  | -   | 8°           | 0°                                                              | -            | 8°    |
| ø1                          | 5°                                                  | -   | 15°          | 5°                                                              | -            | 15°   |
| ø2                          | 0°                                                  | -   | -            | 0°                                                              | -            | -     |
| D                           | 4.90 BSC                                            |     |              | 0.193 BSC                                                       |              |       |
| SIPEX Pkg Signoff Date/Rev: |                                                     |     |              | JL Aug16-05 / Rev A                                             |              |       |

## ORDERING INFORMATION

| Part Number          | Temperature Range    | Package Types |
|----------------------|----------------------|---------------|
| SP2526A-1EN .....    | -40°C to +85°C ..... | 8-pin NSOIC   |
| SP2526A-1EN/TR ..... | -40°C to +85°C ..... | 8-pin NSOIC   |
| SP2526A-2EN .....    | -40°C to +85°C ..... | 8-pin NSOIC   |
| SP2526A-2EN/TR ..... | -40°C to +85°C ..... | 8-pin NSOIC   |

Available in lead free packaging. To order add "-L" suffix to part number.

Example: SP2526A-1EN/TR = standard; SP2526A-1EN-L/TR = lead free.

/TR = Tape and Reel

Pack quantity is 2,500 for NSOIC.



ANALOG EXCELLENCE

Sipex Corporation

**Headquarters and  
Sales Office**

233 South Hillview Drive  
Milpitas, CA 95035  
TEL: (408) 934-7500  
FAX: (408) 935-7600

Sipex Corporation reserves the right to make changes to any products described herein. Sipex does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey any license under its patent rights nor the rights of others.