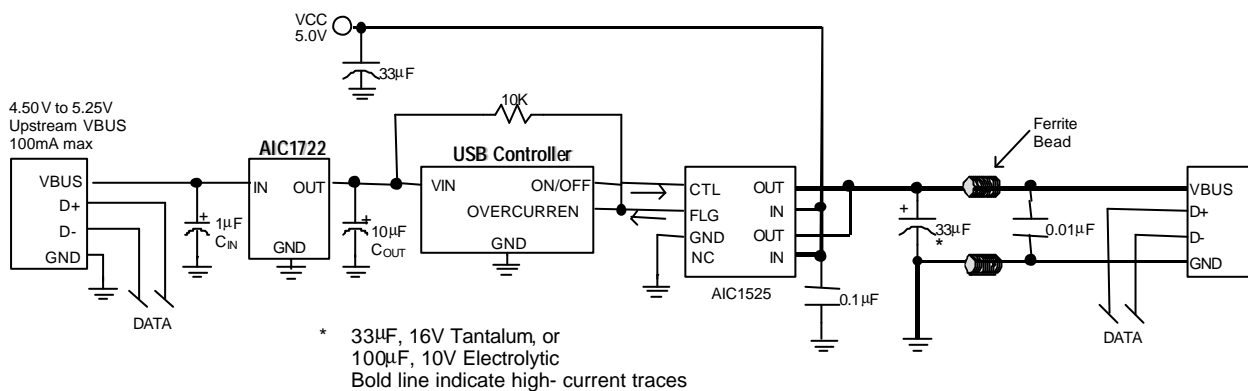# USB High-Side Power Switch

■ FEATURES

- 70mΩ (5V Input) High-Side MOSFET Switch.
- 500mA Continuous Load Current per Channel.
- 75μA Typical On-State Supply Current.
- 1μA Typical Off-State Supply Current.
- Current-Limit / Short Circuit Protection.
- Thermal Shutdown Protection under Overcurrent Condition.
- Undervoltage Lockout Ensures that Switch is off at Start Up.
- Output can be Forced Higher than Input (Off-State).
- Open-Drain Fault Flag.
- Slow Turn ON and Fast Turn OFF.
- Enable Active-High or Active-Low.

■ APPLICATIONS

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

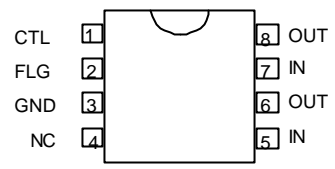## ■ TYPICAL APPLICATION CIRCUIT

■ DESCRIPTION

The AIC1525 is an integrated high-side power switch for self-powered and bus-powered Universal Serial Bus (USB) applications. The high-side switch is a MOSFET with 70mΩ $R_{DS(ON)}$, which meets USB voltage drop requirements for maximum transmission wire length.

Multi-purpose open-drain fault flag output indicates over-current limiting, thermal shutdown, or undervoltage lockout. Output current is typically limited to 0.85A below the 5A safety requirement, and thermal shutdown function shuts the switch off to prevent damage under overcurrent condition.

Guaranteed minimum output rise time limits inrush current during hot plug-in, minimizing EMI and preventing the voltage at upstream port from dropping excessively.


One-Port Self-Powered Hub

■ ORDERING INFORMATION

AIC1525-XXX

PACKAGE TYPE
N: PLASTIC DIP
S: SMALL OUTLINE

TEMPERATURE RANGE
C: 0°C~70°C

CONTROL POLARITY
0: ACTIVE LOW
1: ACTIVE HIGH

ORDER NUMBER	PIN CONFIGURATION
AIC1525-0CN AIC1525-1CN (PLASTIC DIP)	TOP VIEW CTL [1] [8] OUT FLG [2] [7] IN GND [3] [6] OUT NC [4] [5] IN
AIC1525-0CS AIC1525-1CS (PLASTIC SO)	

■ ABSOLUTE MAXIMUM RATINGS

Supply Voltage (V_{IN}) 7.0V

Fault Flag Voltage (V_{FLG}) 7.0V

Fault Flag Current (I_{FLG}) 50mA

Control Input (V_{CTL}) .... -0.3V ~15V

Operating Temperature Range .... -20°C~80°C

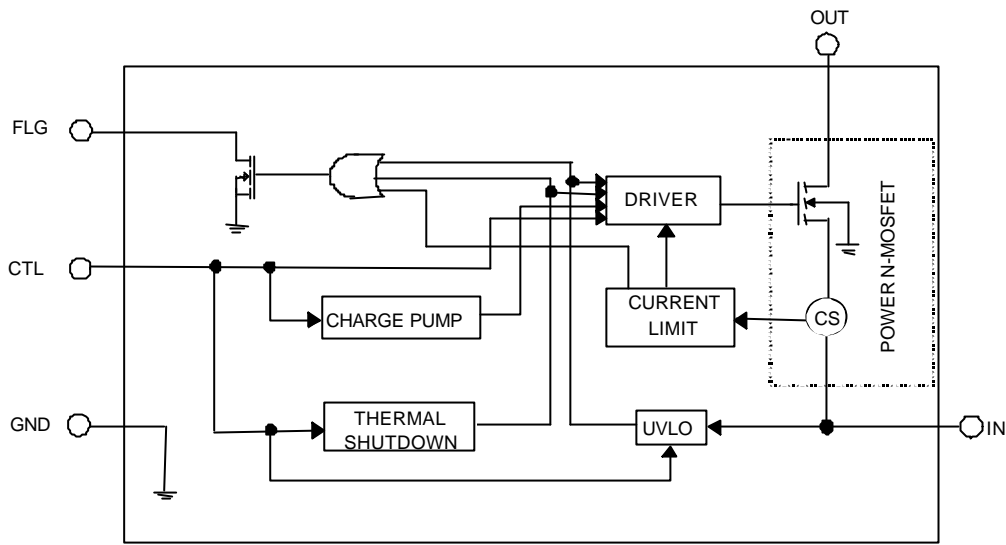Storage Temperature Range .... -65°C ~ 150°C

■ TEST CIRCUIT
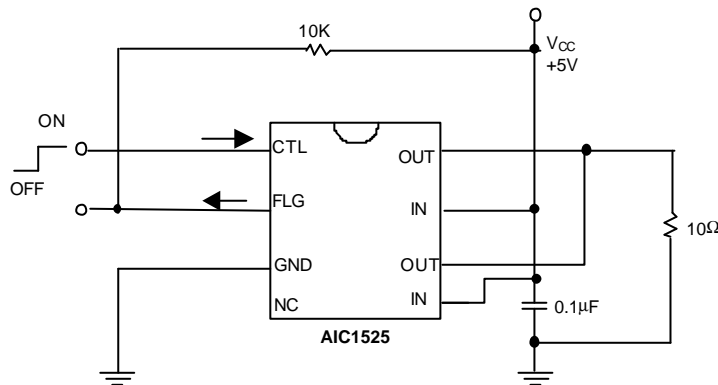
# ■ ELECTRICAL CHARACTERISTICS (V_{IN}= 5V, Ta=25°C, unless otherwise specified.)

| PARAMETERS	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply Current	V_{CTL} =Logic "0" , OUT=Open		0.75	5	μA
	V_{CTL} =Logic "1" , OUT=Open		75	100	
Control Input Voltage	V_{CTL} =Logic "0"		1.7	0.8	V
	V_{CTL} =Logic "1"	2.4	2.0		
Control Input Current	V_{CTL} =Logic "0"		0.01	1	μA
	V_{CTL} =Logic "1"		0.01	1	
Control Input Capacitance			1		pF
Output MOSFET Resistance			70	100	mΩ
Output Turn-On Rise Delay	R_L = 10Ω each Output		100		μS
Output Turn-On Rise Time	R_L = 10Ω each Output		1000	4000	μS
Output Turn-Off Delay	R_L = 10Ω each Output		0.8	20	μS
Output Turn-Off Fall Time	R_L = 10Ω each Output		0.7	20	μS
Output Leakage Current				10	μA
Current Limit Threshold		0.7	1.0	1.25	A
Overtemperature Shutdown Threshold	T_J Increasing		135		°C
	T_J Decreasing		125		
Error Flag Output Resistance	V_{IN} = 5V , I_L =10 mA		10	25	Ω
	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		2.6		V
	V_{IN} Decreasing		2.4		

■ BLOCK DIAGRAM

■ TYPICAL PERFORMANCE CHARACTERISTICS

Output ON Resistance vs. Supply Voltage

On-Resistance vs. Temperature
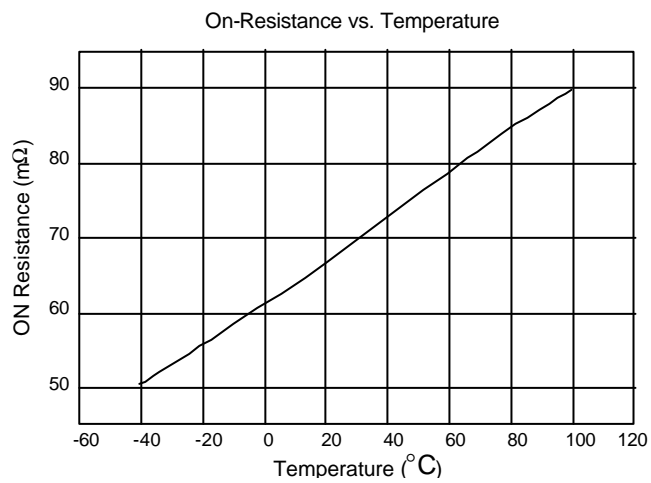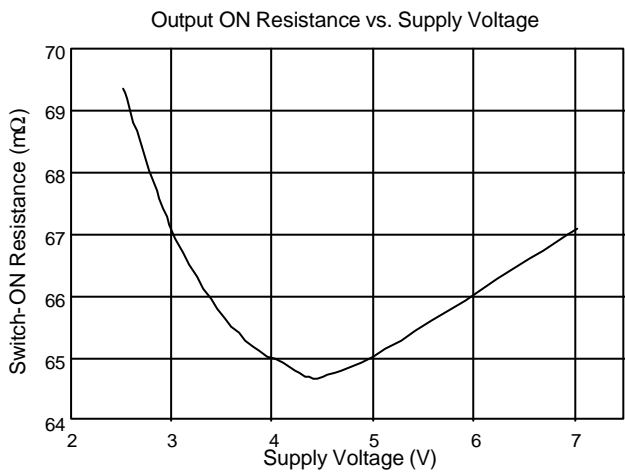
ON-State Supply Current vs. Supply Voltage
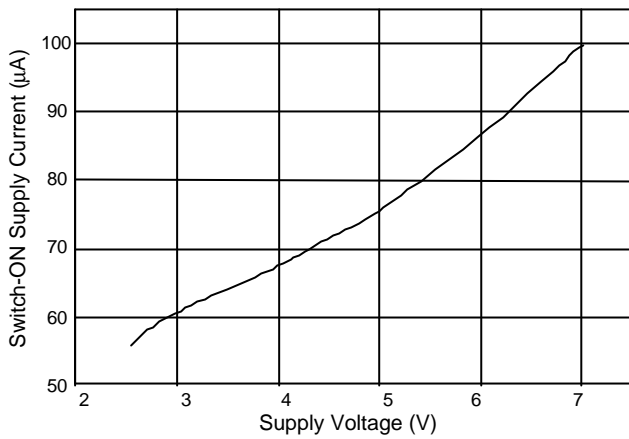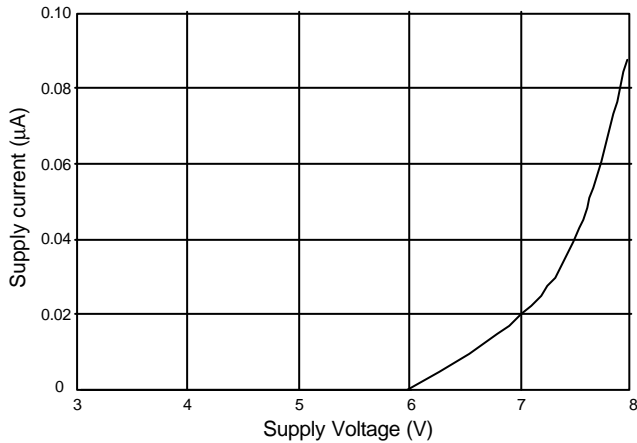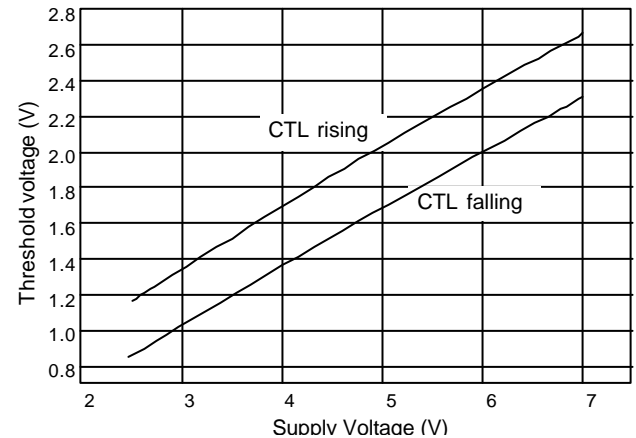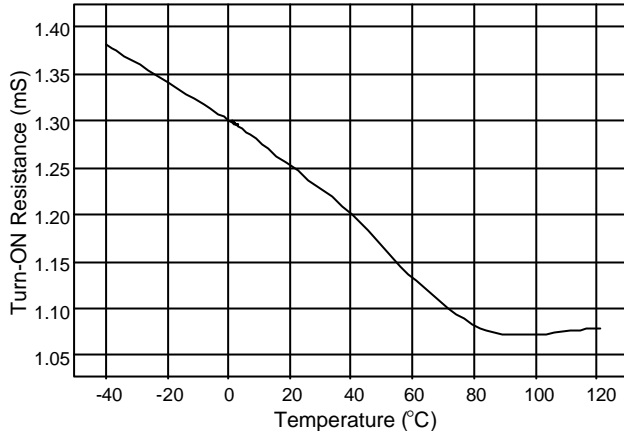

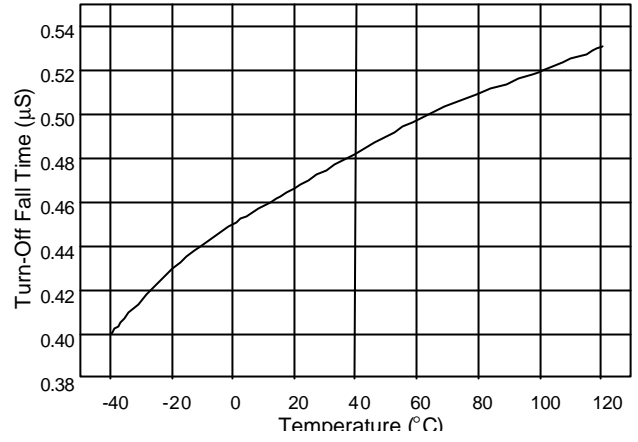UVLO Threshold Voltage vs. Temperature
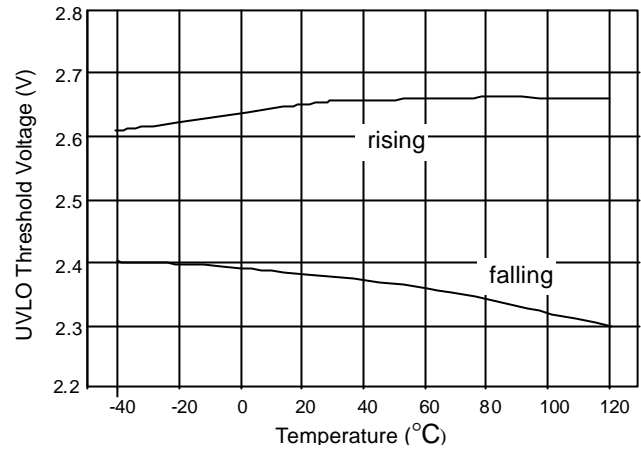
■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

ON-State Supply Current vs. Temperature
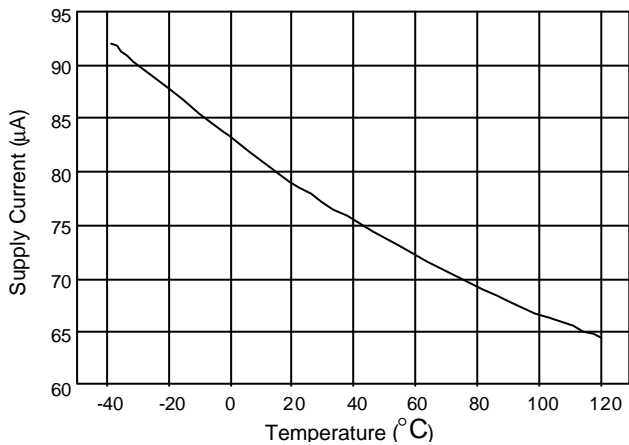
OFF-State Supply Current vs. Temperature
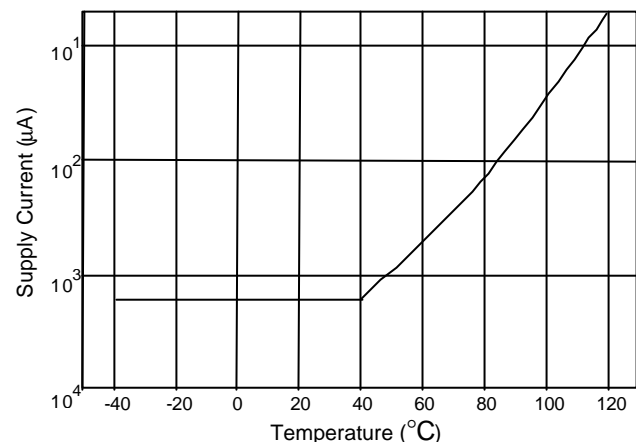
OFF State Current vs. Supply Voltage
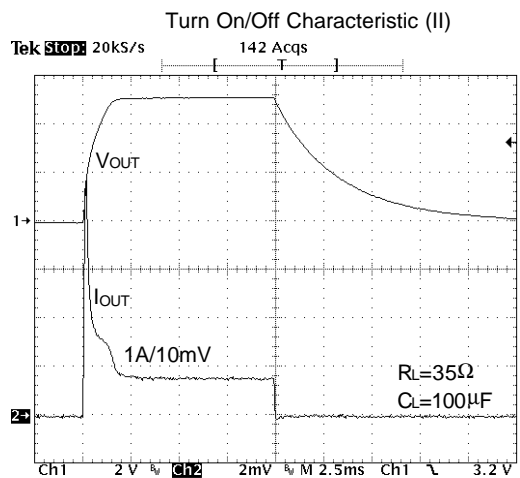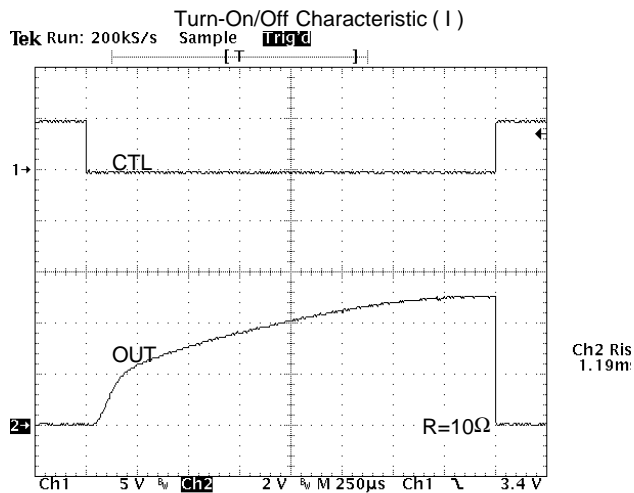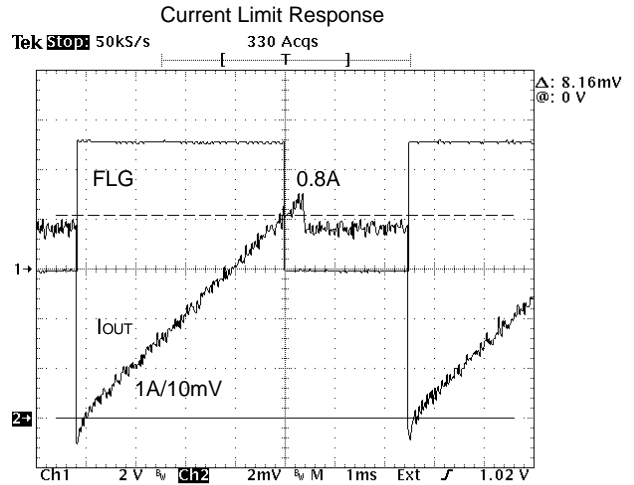

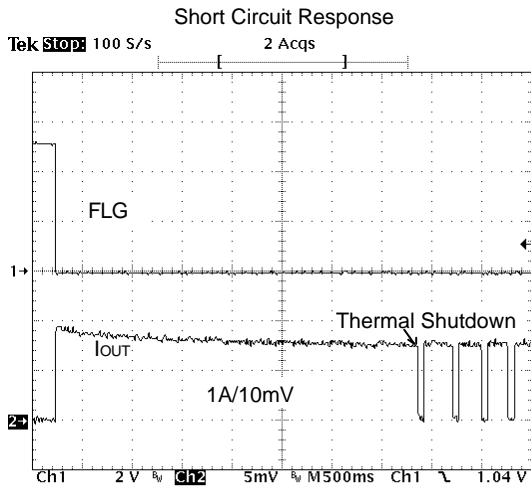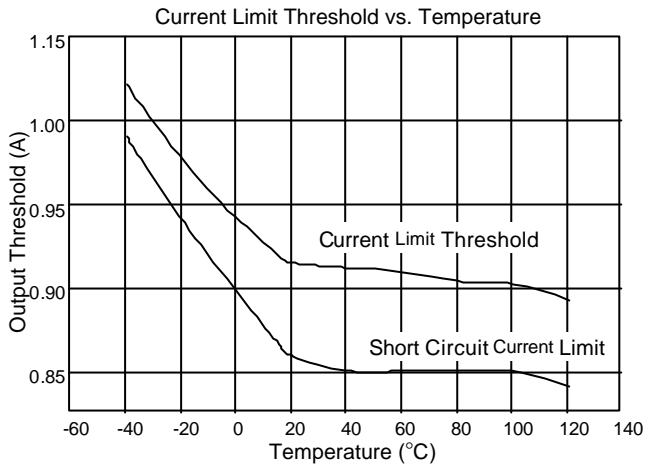CTL Threshold Voltage vs. Supply Voltage

5

Output Rise Time vs. Temperature

Output fall Time vs. Temperature

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

Current Limit Threshold vs. Temperature

Short Circuit Response

Current Limit Response

Turn-On/Off Characteristic (I)

Turn On/Off Characteristic (II)

7

AIC1525

■ PIN DESCRIPTION

PIN 1: CTL — TTL compatible control input. It controls the power switch turn-on/turn-off. Active High for AIC1525-1 and active low for AIC1525-0.

PIN 2: FLG — An active-low and open-drain fault flag output for power switch. It can indicate current limit if CTL is active. In normal mode operation, it also can indicate thermal shutdown or undervoltage.

PIN 3: GND — Chip power ground.

PIN 4: NC — Not internally connected.

PIN 5, 7: IN — Power supply Input.

PIN 6, 8: OUT — MOSFET switch output.

■ APPLICATION INFORMATIONS

● **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 due to undesirable short circuit conditions or excess inrush current often encountered during hot plug-in. The low limit of the current limit threshold of the AIC1525 allows a minimum current of 0.5A through the MOSFET switches. A current limit condition will signal the error flag.

● **Thermal Shutdown**

When the chip temperature exceeds 135°C, the thermal shutdown function turns off MOSFET switch and signals the error flag. A hysteresis of 10°C prevents the MOSFET from turning back on until the chip temperature drops to below 125°C.

● **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 Droop Requirements**

USB support 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. With a 33μF, 16V tantalum or 100μF, 10V electrolytic capacitor mounted close to downstream connector should provide transient drop protection.
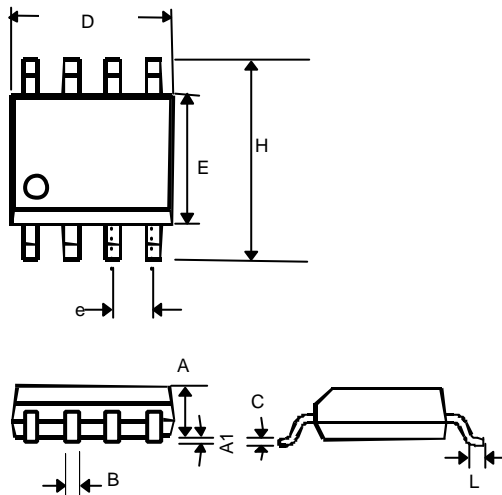
● **Printed Circuit Layout**

The power circuitry of USB printed circuit boards requires a customized layout to maximize thermal dissipation and to minimize voltage drop and EMI.
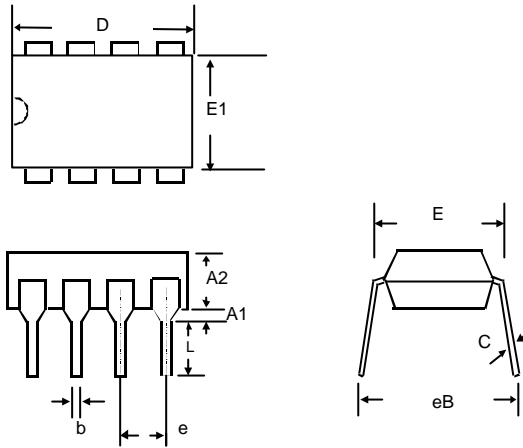
One-Port Self-Powered Hub

* 33µF, 16V Tantalum, or
100µF, 10V Electrolytic
Bold line indicate high- current traces
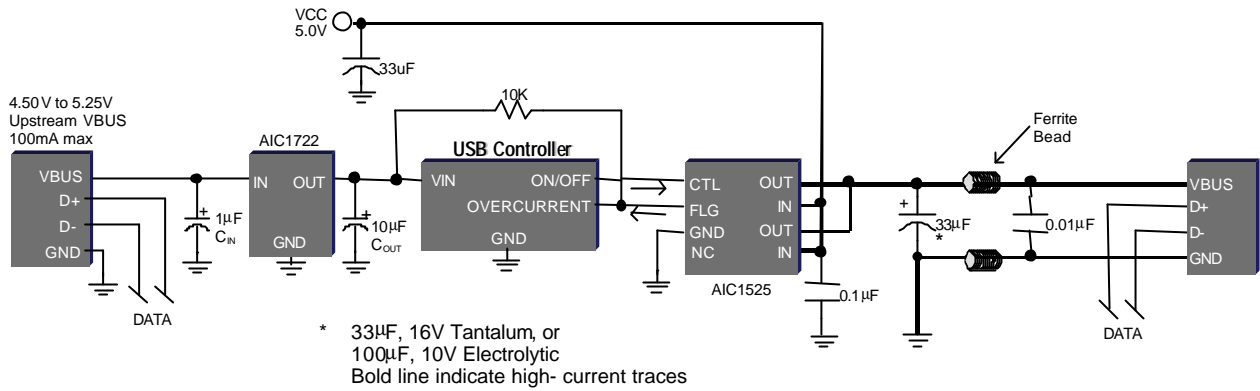
PHYSICAL DIMENSIONS

● **8 LEAD PLASTIC SO (unit: mm)**

SYMBOL	MIN	MAX
A	1.35	1.75
A1	0.10	0.25
B	0.33	0.51
C	0.19	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27(TYP)	
H	5.80	6.20
L	0.40	1.27

● **8 LEAD PLASTIC DIP (unit: mm)**

SYMBOL	MIN	MAX
A1	0.381	—
A2	2.92	4.96
b	0.35	0.56
C	0.20	0.36
D	9.01	10.16
E	7.62	8.26
E1	6.09	7.12
e	2.54 (TYP)	
eB	—	10.92
L	2.92	3.81