

**Current Limited**

**Load Switch**

**CE1715**

*Preliminary*

■ **INTRODUCTION**

The CE1715 is an integrated 100mΩ power switch for self-powered and bus-powered Universal Serial Bus (USB) applications. A built-in charge pump is used to drive the N-Channel MOSFET that is free of parasitic body diode to eliminate any reverse current flow across the switch when it is powered off. Its low quiescent current (23uA) and small package (SOT-23-5) is particularly suitable in battery-powered portable equipment. Several protection functions include soft start to limit inrush current during plug-in, current limiting at 1.5A to meet USB power requirement, and thermal shutdown to protect damage under over current conditions.

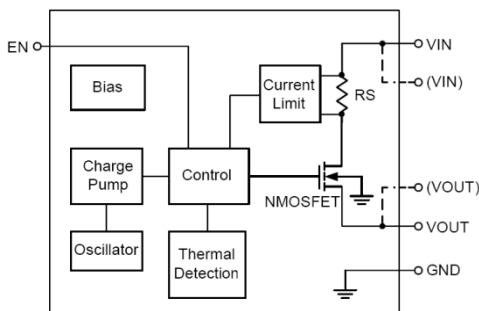
■ **FEATURES**

- Low quiescent current: 23μA(Typ.)
- Guaranteed 1.1A Continuous Current
- 1.5A Current Limit
- Shutdown Current: <1μA
- Wide Input Voltage Range: 2.2V~6V
- Low R<sub>DS(ON)</sub> Internal Switches: 100mΩ
- Only 2.5V Needed for ON/OFF Control
- Under-Voltage Lockout
- Thermal Fault Protection
- Soft Start
- Temperature Range: -40°C to +85°C
- Package: SOT-23-5

■ **APPLICATIONS**

- Hot-Plug Power Supplies
- Battery-Charger Circuits
- Motherboard USB Power Switch
- Notebook Computers
- Personal Communication Devices
- USB Device Power Switch

■ **BLOCK DIAGRA**



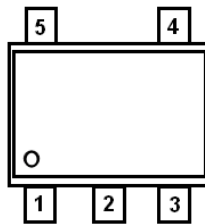
■ **ORDER INFORMATION**

**CE1715**①②③

DESIGNATOR	SYMBOL	DESCRIPTION
①	A	Standard
	B	With Shutdown Function
②	-	For Standard
	H	CE High Active
	L	CE Low Active
③	M	Package: SOT-23-5

## ■ PIN CONFIGURATION

SOT-23-5  
(Top View)



### CE1715AM

PIN NUMBER	SYMBOL	FUNCTION
1	VOUT	Output Voltage
2	GND	Ground
3	VIN	Power Input Voltage
4	VIN	Power Input Voltage
5	VOUT	Output Voltage

### CE1715BH/LM

PIN NUMBER	SYMBOL	FUNCTION
1	VOUT	Output Voltage
2	GND	Ground
3	VIN	Power Input Voltage
4	CE	Chip Enable (Active High)
5	VOUT	Output Voltage

## ■ ABSOLUTE MAXIMUM RATINGS

(Unless otherwise specified, Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNITS
Input Voltage	$V_{IN}$	-0.3~ 7	V
CE, VOUT Voltage	$V_{CE}, V_{OUT}$	-0.3~ $V_{IN}+0.3$	V
Maximum Continuous Switch Current	$I_{MAX}$	2	A
Power Dissipation	SOT-23-5	400	mW
Operating Temperature Range	$T_{opr}$	-40~+85	°C
Junction Temperature	$T_j$	125	°C
Storage Temperature	$T_{stg}$	-40~+125	°C
ESD Rating2 - HBM 4000 V	$V_{ESD}$	4000	V
Soldering Temperature & Time	$T_{solder}$	260°C, 10s	

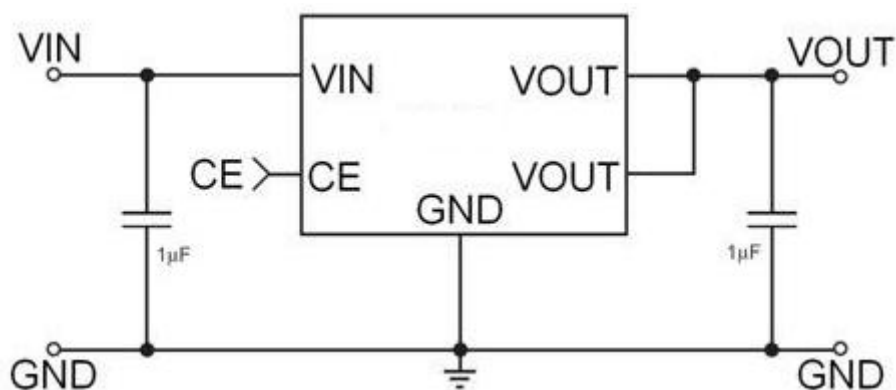
## ■ ELECTRICAL CHARACTERISTICS

CE1715

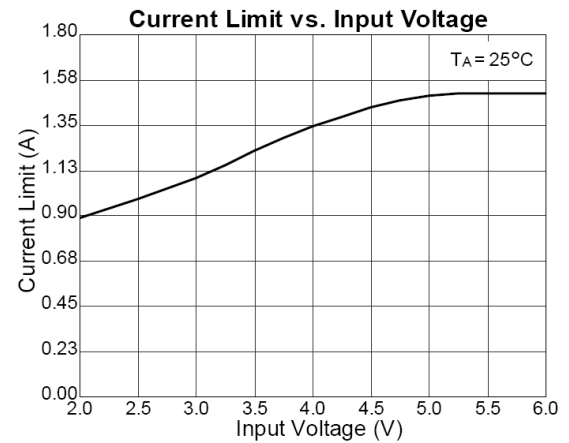
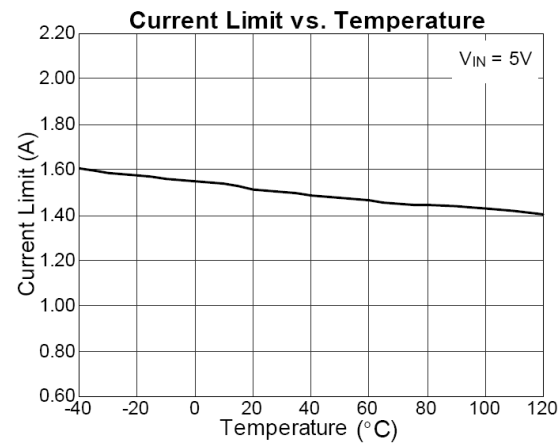
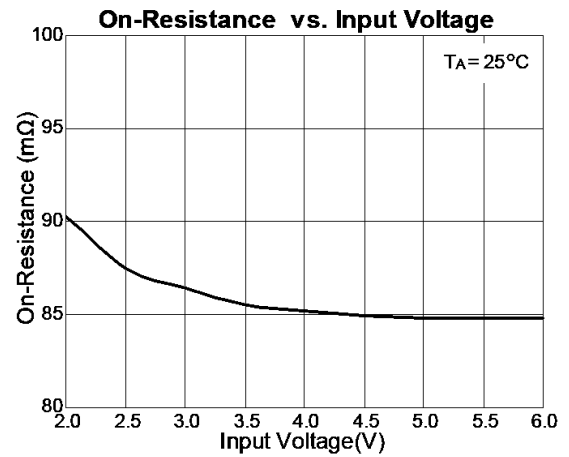
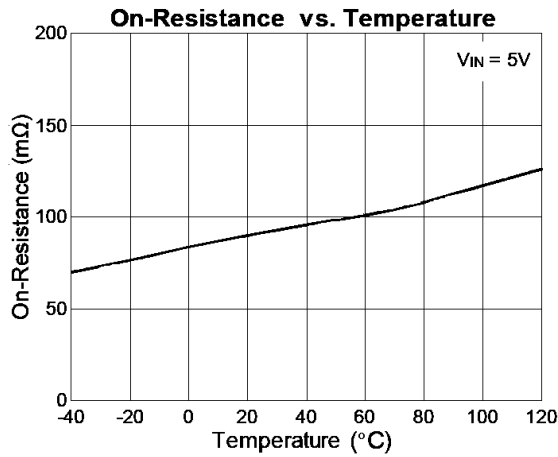
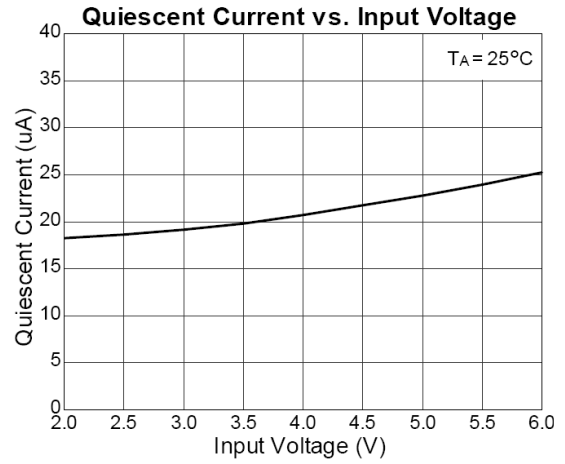
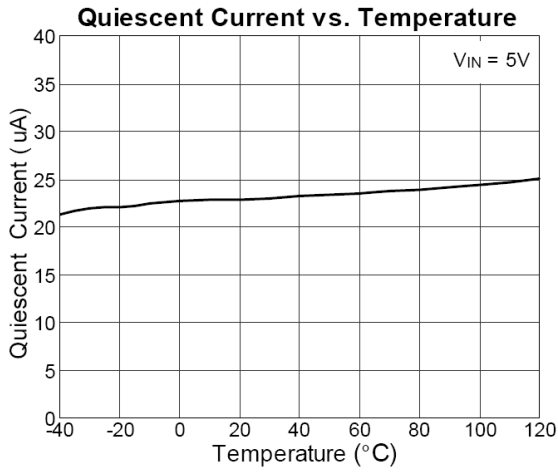
(V<sub>IN</sub>=5.0V, T<sub>a</sub>=25°C, unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operation Voltage	V <sub>IN</sub>		2.2		6	V
Quiescent Current	I <sub>Q</sub>	V <sub>IN</sub> =3V		19	40	μA
		V <sub>IN</sub> =5V		23	45	
Off Supply Current	I <sub>SD</sub>	V <sub>CE</sub> =0V			1	μA
Under-Voltage Lockout	V <sub>UVLO</sub>		1.3	1.8		V
On Resistance	R <sub>DS(ON)</sub>	I <sub>L</sub> =1A		100	130	mΩ
Current Limit Threshold	I <sub>LIM</sub>	R <sub>L</sub> =2Ω	1.1	1.5	2	A
Short-circuit Fold Back Current	I <sub>OS</sub>	V <sub>OUT</sub> = 0V, measured prior to thermal shutdown		1.0		A
CE Input Low Voltage	V <sub>CE(L)</sub>				0.8	V
CE Input High Voltage	V <sub>CE(H)</sub>		2.0			V
Turn-On Time	T <sub>ON</sub>	V <sub>IN</sub> =5.0V, R <sub>L</sub> =10Ω, 90% Setting		400		μs
Over-Temperature Threshold	T <sub>SD</sub>	V <sub>IN</sub> =5.0V	T <sub>J</sub> Increasing	130		°C
			T <sub>J</sub> Decreasing	110		

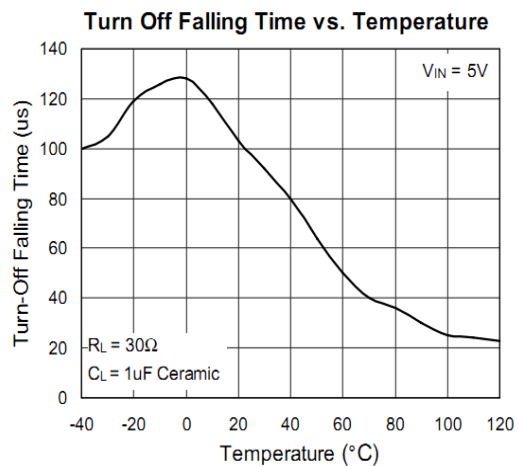
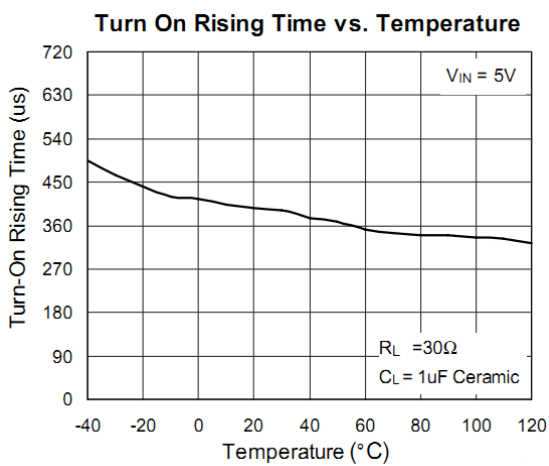
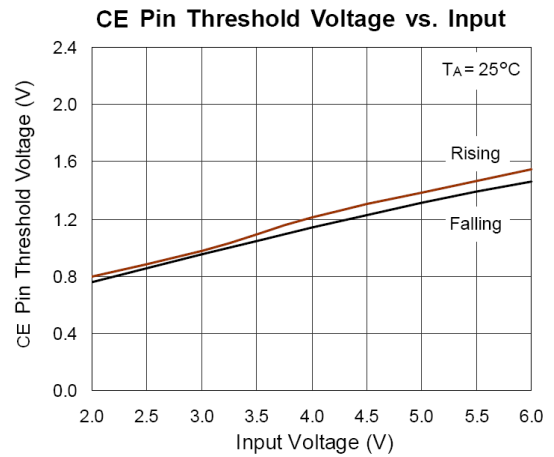
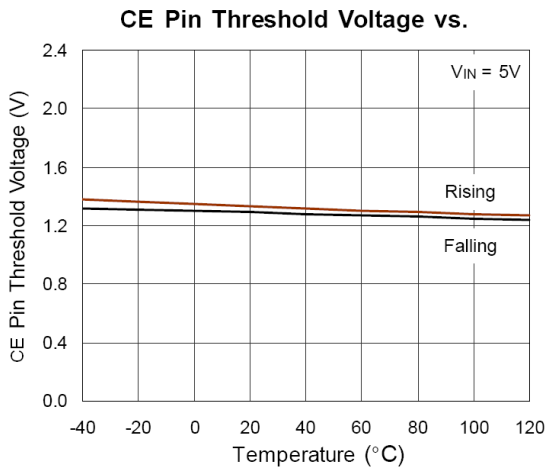
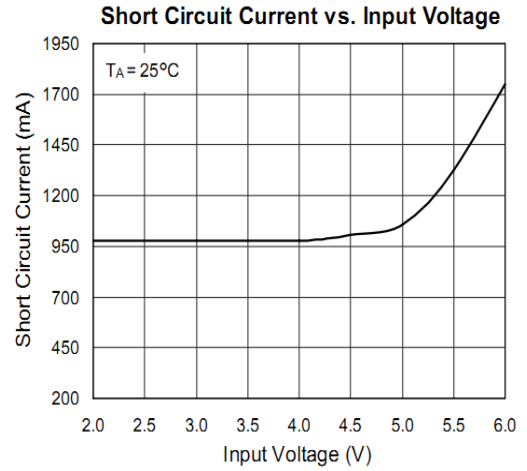
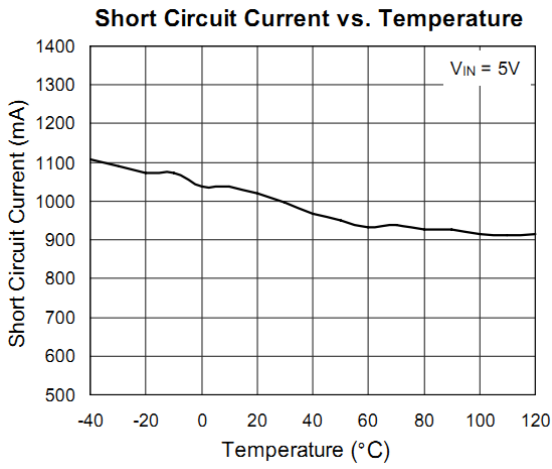
## ■ TYPICAL APPLICATION



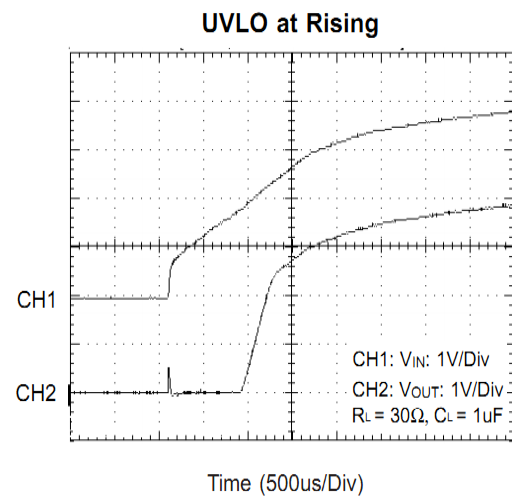
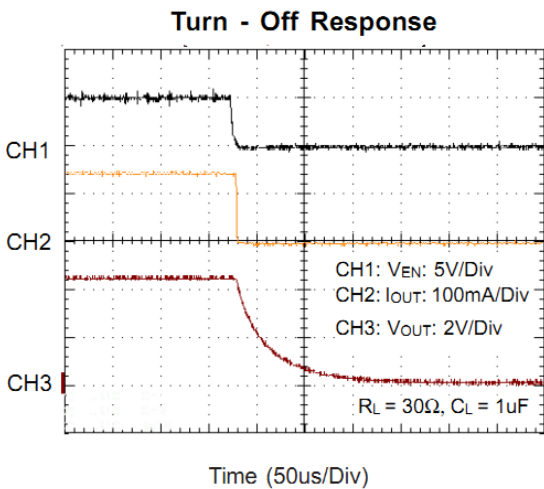
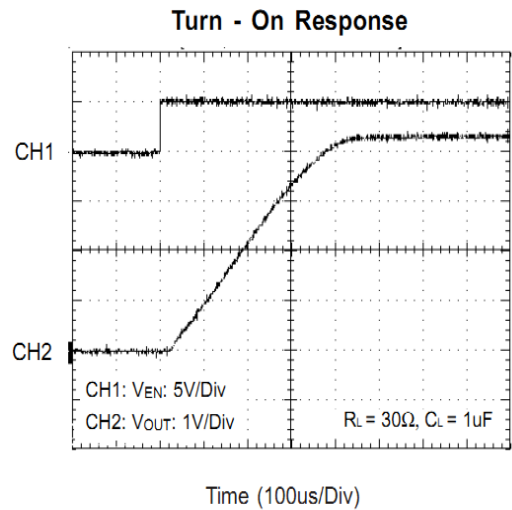
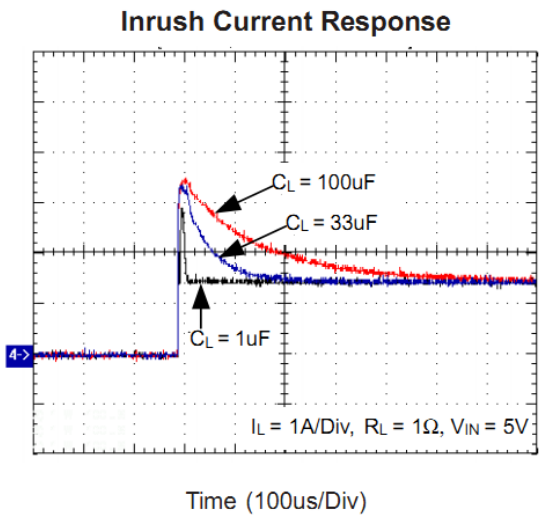
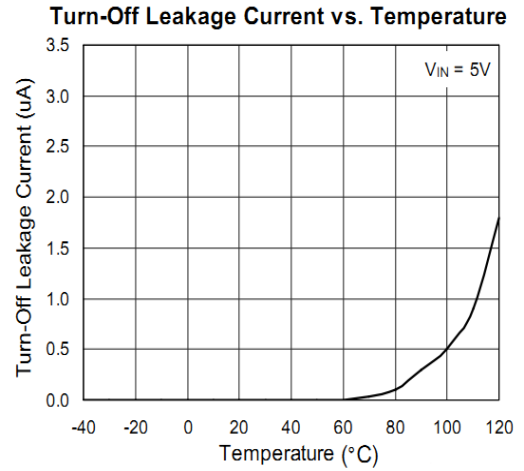
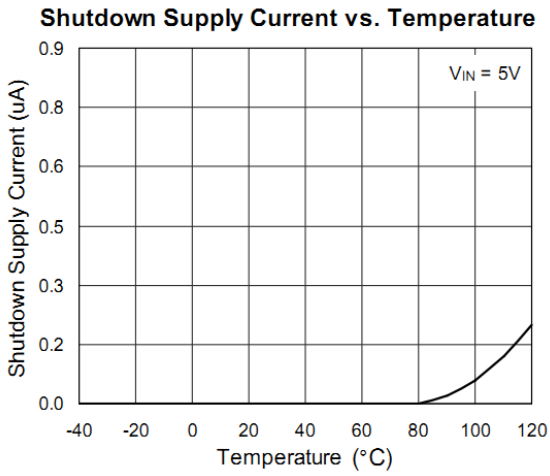
■ TYPICAL PERFORMANCE CHARACTERISTICS



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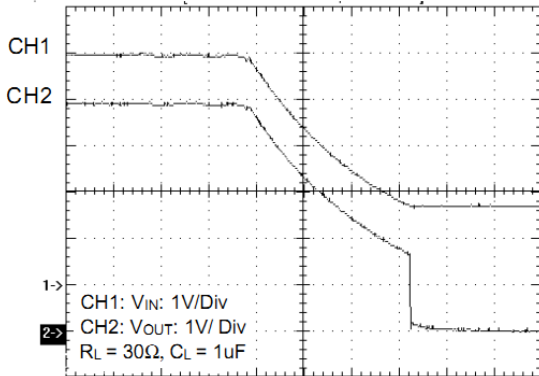


■ TYPICAL PERFORMANCE CHARACTERISTICS



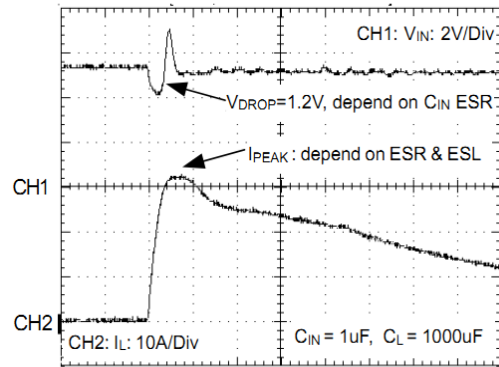
■ TYPICAL PERFORMANCE CHARACTERISTICS

UVLO at Falling



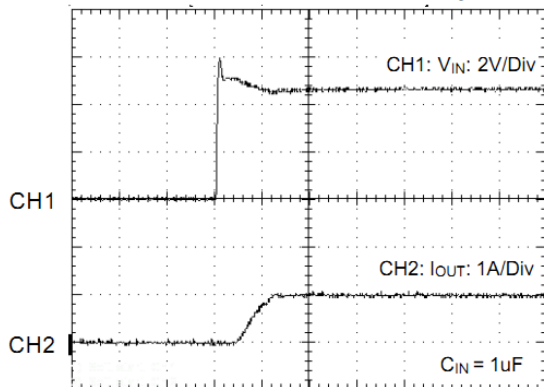
Time (100ms/Div)

Inrush Short Circuit Response



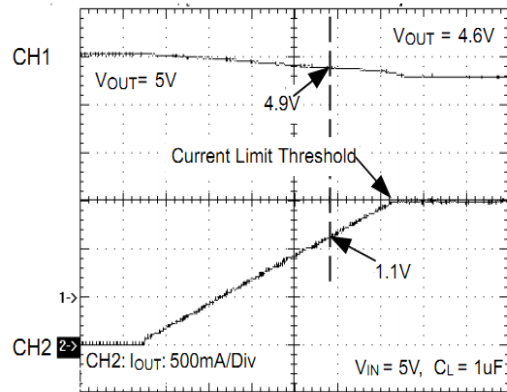
Time (25us/Div)

Soft - start Short Circuit Response



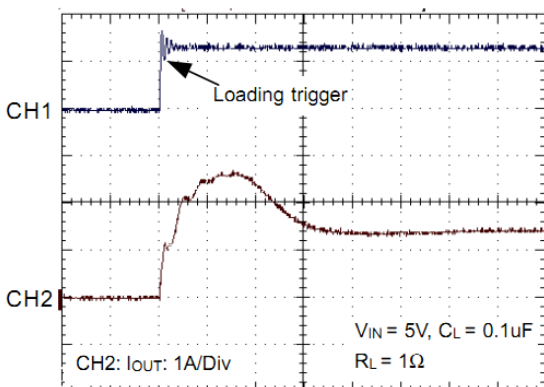
Time (5us/Div)

Ramped Load Response



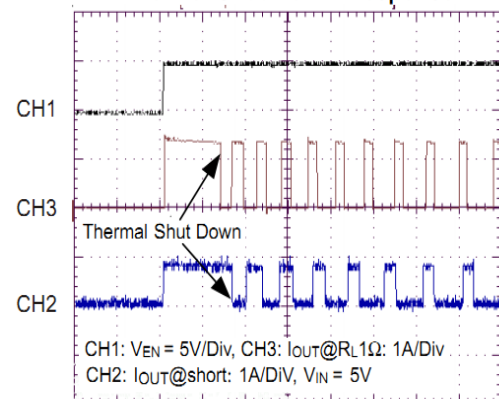
Time (1ms/Div)

Current Limit Response



Time (5us/Div)

Thermal Shut Down Response



Time (50ms/Div)

## Application Information

The CE1715 is a high-side single N-Channel MOSFET switch.

### Input and Output

VIN (input) is the power supply connection to the circuitry and the drain of the output MOSFET. VOUT (output) is the source of the output MOSFET. In a typical circuit, current flows through the switch from VIN to VOUT toward the load. Both VOUT pins must be short on the board and connected to the load and so do both VIN pins but connected to the power source.

### Thermal Shutdown

Thermal shutdown shuts off the output MOSFET if the die temperature exceeds 130°C and 20°C of hysteresis forces the switch turning off until the die temperature drops to 110°C.

### Soft Start

In order to eliminate the upstream voltage droop caused by the large inrush current during hot-plug events, the “soft-start” feature effectively isolates power supplies from such highly capacitive loads.

### Under-voltage Lockout

UVLO prevents the MOSFET switch from turning on until input voltage exceeds 1.8V (typical). If input voltage drops below 1.8V (typical), UVLO shuts off the MOSFET switch.

### Current Limiting and Short Protection

The current limit circuit is designed to protect the system supply, the MOSFET switch and the load from damage caused by excessive currents. The current limit threshold is set internally to allow a minimum of 1.1A through the MOSFET but limits

The current limit threshold is set internally to allow a minimum of 1.1A through the MOSFET but limits the output current to approximately 1.5A typical. When the output is short to ground, it will limit to a constant current 1A until thermal shutdown or short condition removed.

### Filtering

To limit the input voltage drop during hot-plug events, connect a 1uF ceramic capacitor from VIN to GND. However, higher capacitor values will further reduce the voltage drop at the input. Connect a sufficient capacitor from VOUT to GND. This capacitor helps to prevent inductive parasitic from pulling VOUT negative during turn-off or EMI damage to other components during the hot-detachment. It is also necessary for meeting the USB specification during hot plug-in operation. If CE1715 is implanted in device and application, minimum 1uF capacitor from VOUT to GND is recommended and higher capacitor values are also preferred.

In choosing these capacitors, special attention must be paid to the Effective Series Resistance, ESR, of the capacitors to minimize the IR drop across the capacitor ESR. A lower ESR on this capacitor can get a lower IR drop during the operation.

Ferrite beads in series with all power and ground lines are recommended to eliminate or significantly reduce EMI. In selecting a ferrite bead, the DC resistance of the wire used must be kept to a minimum to reduce the voltage drop.



**Reverse current preventing**

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 ( $V_{OUT} > V_{IN} \geq 0$ ). To prevent reverse current from such condition, disable the switch (CE1715) or connect VIN to a fixed voltage under 1.3V.

**Layout and Thermal Dissipation**

Place the switch as close to the USB connector as possible. Keep all traces as short as possible to reduce the effect of undesirable parasitic inductance.

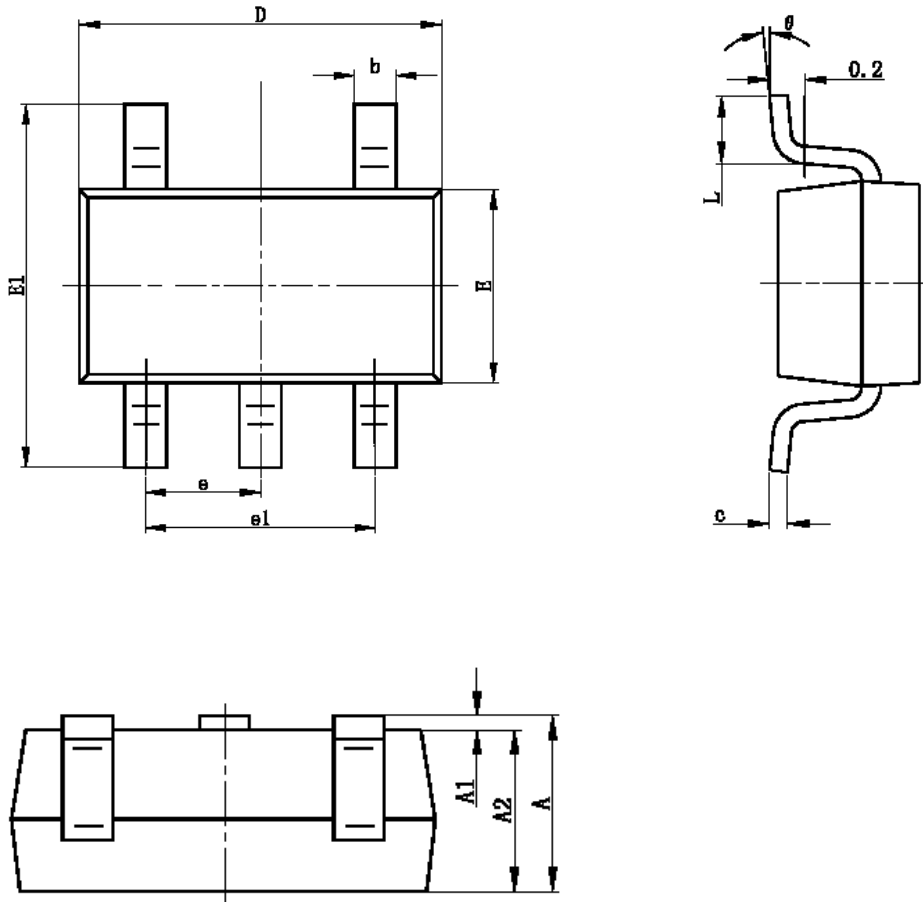
Place the capacitor and ferrite beads as close to the USB connector as possible.

If ferrite beads are used, use wires with minimum resistance and large solder pads to minimize connection resistance.

Under normal operating conditions, the package can dissipate the channel heat away. Wide power-bus planes connected to VIN and VOUT and a ground plane in contact with the device will help dissipate additional heat.

■ PACKAGING INFORMATION

- SOT-23-5 Package Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
theta	0°	8°	0°	8°

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