

2A Line Switch with Low On-Resistance

DESCRIPTION

The EUP3512A/B is a low dropout line switch IC with ON/OFF control and output current protection which integrates a P-channel MOSFET. It can deliver current up to 2A.

By connecting the EUP3512A/B to the output pin of a step-down DC/DC converter, the EN pin controls ON/OFF for each distribution switch to deliver power per requirements and maximize total power efficiency. As a result, the EUP3512A/B helps to extend battery life and product operation time.

The EUP3512A/B contains a current limit and protection circuit so these are not required externally unlike discrete circuit solutions where MOSFETs and resistors are used.

When a low signal is input to the EN pin, the IC enters shutdown mode. Even where a load capacitor is connected to the output pin during shutdown, the electric charge stored at the load capacitor is discharged through the internal switch. As a result, the VOUT pin voltage falls quickly to the GND level. The EUP3512A/B contains over current protection.

The device has a SS pin dedicated to soft-start ramp-up rate control that can be used in application where the inrush current is concerned. The EUP3512A/B eliminates any reversed current flow across the switch when it is powered off.

The EUP3512A/B is available in SOT23-5 packages, operates over the extended (-40°C to +85°C) temperature range.

FEATURES

- 80mΩ(typ.) Power MOSFET
- Operating Range : 2.7V to 5.5V
- Deliver Current up to 2A
- Under Voltage Lockout
- 24μA Quiescent Current
- 1μA Maximum Shutdown Current
- No Reverse Current when Power Off
- Soft_Start Time Programmable by External capacitor
- Output Shutdown Pull-low Resistor
- Enable Active-High
- Available in SOT23-5
- RoHS Compliant and 100% Lead(Pb)-Free Halogen-Free

APPLICATIONS

- Portable Equipment
- Laptop, Palmtops, Notebook Computers
- LCD Monitor TV

Typical Application Circuit

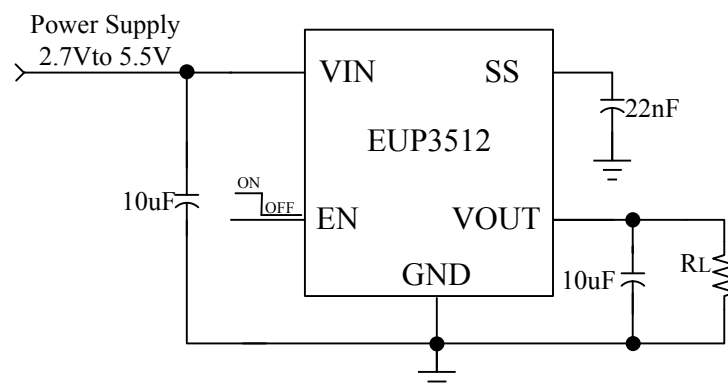
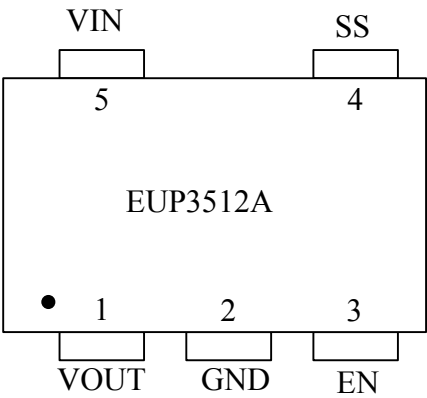
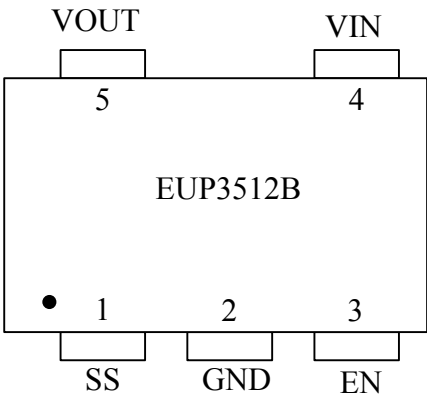


Figure 1

Pin Configurations

Package Type	Pin Configurations	Package Type	Pin Configurations
SOT23-5	Top View  EUP3512A	SOT23-5	Top View  EUP3512B

Pin Description

NAME	EUP3512A	EUP3512B	DESCRIPTION
VOUT	1	5	Power Output. Bypass V_{OUT} to GND with a 10uF ceramic capacitor. Load conditions might require additional bulk capacitance.
GND	2	2	Ground. The exposed pad must be soldered to a large PCB and connected to GND for maximum power dissipation.
EN	3	3	Enable: Logic level enable input. Make sure EN pin never floating. EN: Logic high turns on power switch.
SS	4	1	Soft-start control. Connect a capacitor from SS to GND to set the soft-start period.
V_{IN}	5	4	Power Input. Connect all V_{IN} inputs together and bypass with a 10uF or greater ceramic capacitor to GND. Load conditions might require additional bulk capacitance to prevent pulling V_{IN} down.

Ordering Information

Order Number	Package Type	Marking	Current Limit	Quantity per Reel
EUP3512A VIR1	SOT23-5	XXXXXX Bm00	2.5A	3000
EUP3512B VIR1	SOT23-5	XXXXXX Bn00	2.5A	3000

EUP3512A/B □ □ □ □

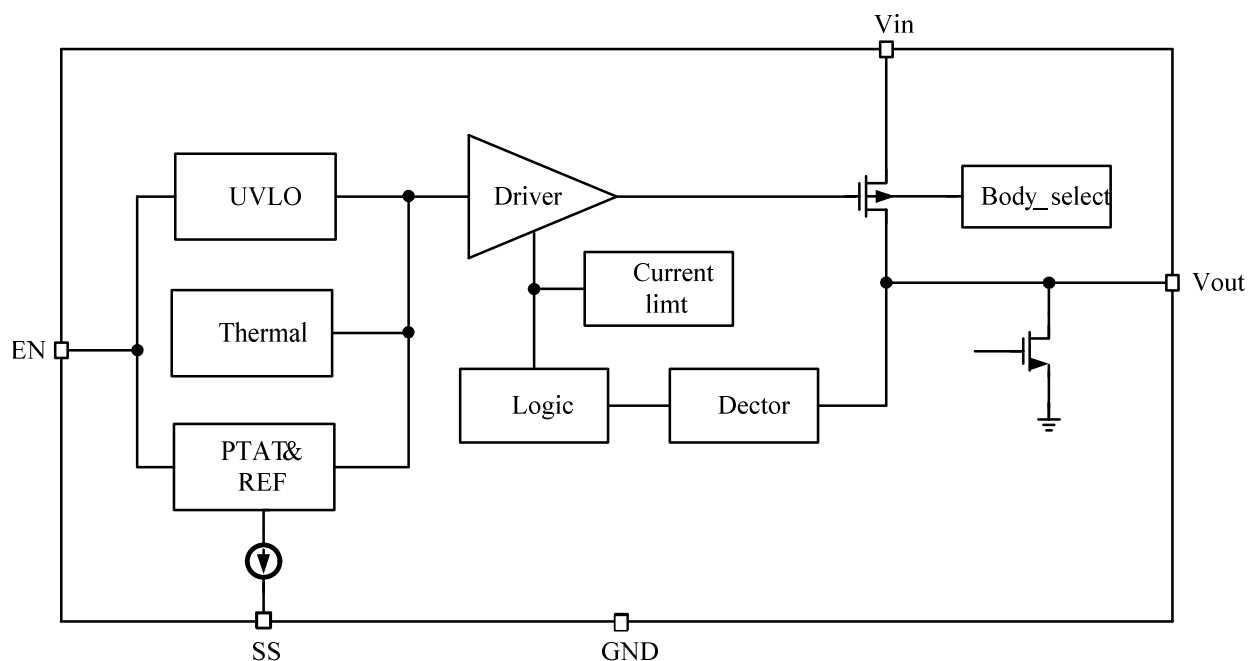
Lead Free Code
1: Lead Free, Halogen Free

Packing
R: Tape & Reel

Operating temperature range
I: Industry Standard

Package Type
V: SOT23

Pin Configurations

Block Diagram**Figure 2**

Absolute Maximum Ratings

- VIN, VEN ----- -0.3 to 6V
- VOUT ----- -0.3 to (VIN+0.3)
- IOUT ----- internally Limited
- Junction Temperature ----- 150°C
- Storage Temperature (T_S) ----- -65°C to +150°C
- Lead Temperature ----- 260°C
- Thermal Resistance θ_{JA} (SOT23-5) ----- 205°C/W
- ESD Rating Human Body Model ----- 8kV

Recommend Operating Conditions

- V_{IN} ----- 2.5 to 5.5V
- V_{EN} ----- 0 to 5.5V
- Operating Temperature Range ----- -40°C to +85°C

Note (1): Stress beyond those listed under “Absolute Maximum Ratings” may damage the device.

Note (2): The device is not guaranteed to function outside the recommended operating conditions.

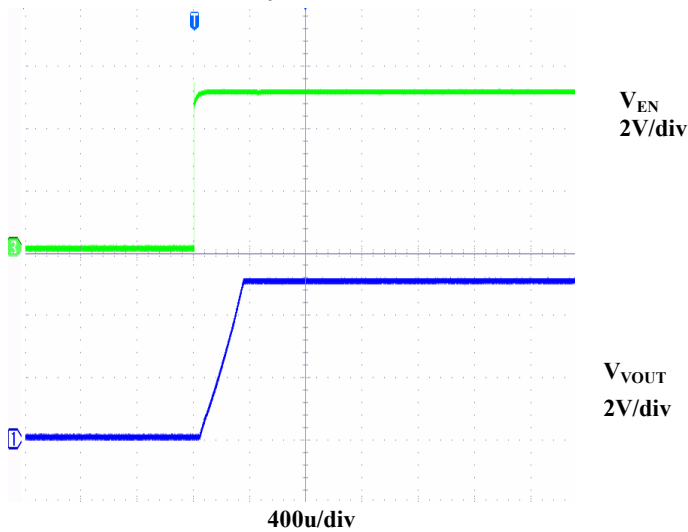
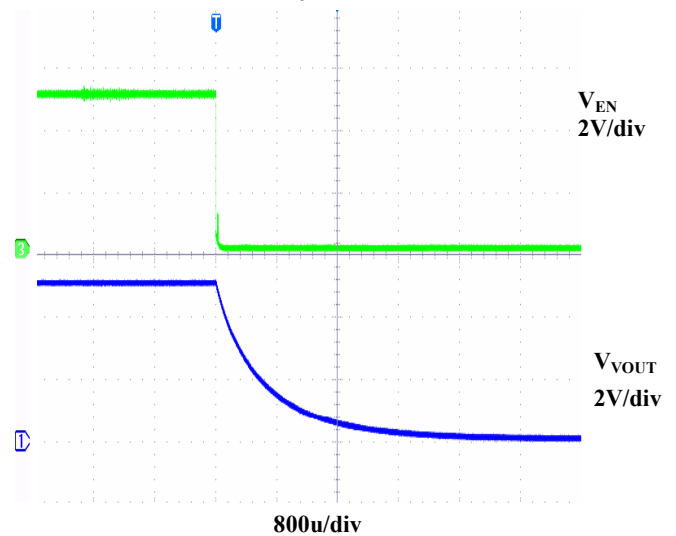
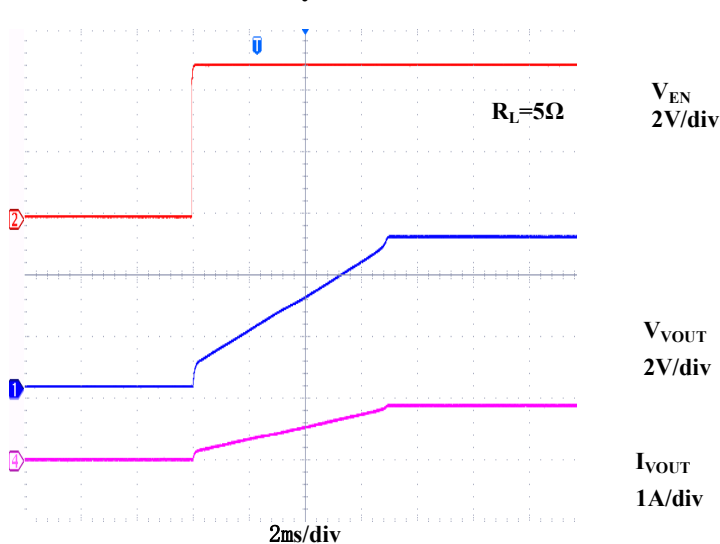
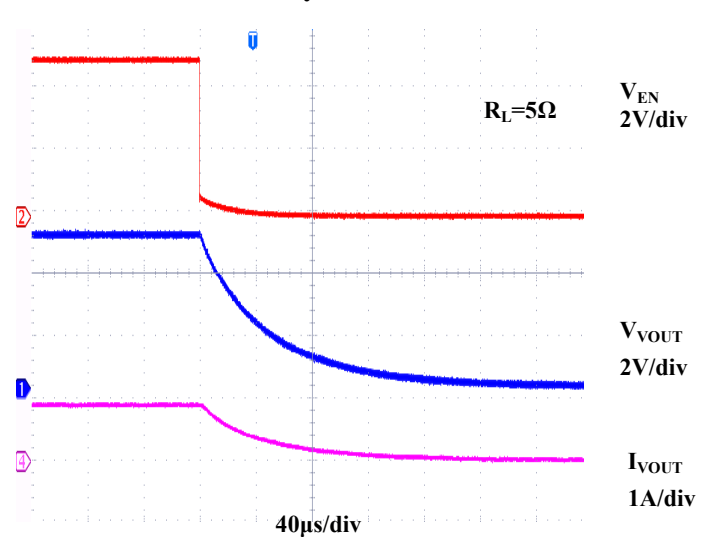
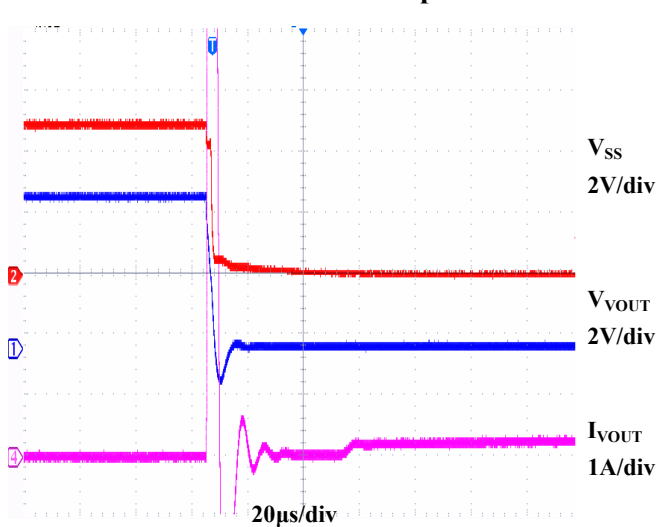
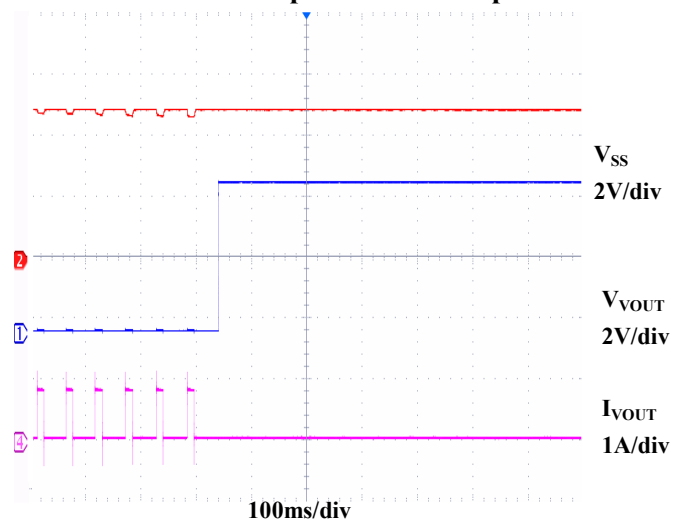
Electrical Characteristics

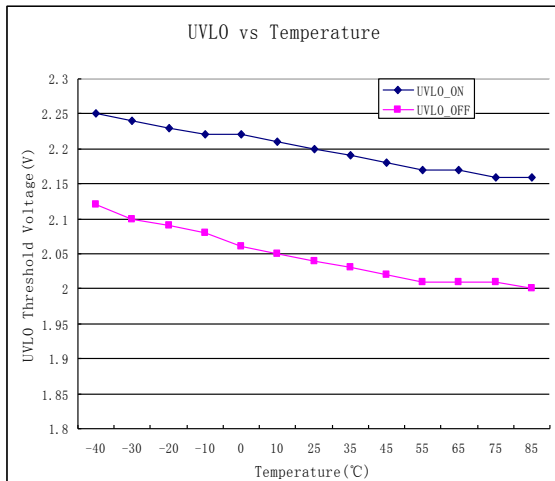
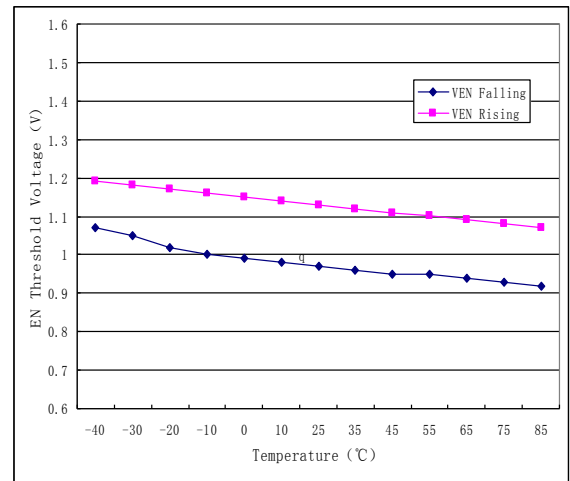
V_{IN}=5V, C_{IN}=10μF, C_L=10μF, C_{SS}=22nF, V_{EN}=V_{IN}, T_A=+25°C, unless otherwise noted.

Symbol	Parameter	Conditions	EUP3512A/B			Units
			Min.	Typ.	Max.	
V _{IN}	Operating Voltage		2.7		5.5	V
R _{ON}	Output MOS R _{DS(ON)}	IC Enable, I _{OUT} =1A		80		mΩ
I _Q	Supply Current	IC Enable		24	35	μA
T _{RISE}	Output Turn-on Rising Time	R _L =10K		350		us
I _{LIMIT}	Current Limit Threshold	V _{OUT} =4V	2.1	2.5	3.2	A
I _{SHORT}	Short-Circuit Current	V _{OUT} =0V		0.75		A
V _{IL}	Low-Level Input Voltage		0.6	0.85	1.1	V
V _{IL-Hys}	Low -Level Input Voltage Hysteresis		100	150	200	mV
I _{SHDN}	Shutdown Supply Current	IC Disable		0.4	1	μA
I _{SS}	Soft-start current			0.9		μA
R _{SHDN}	Shutdown Pull Low Resistance			72		Ω
I _{LEAK}	Output Leakage Current	IC Disable, V _{OUT} =0V		0	1	μA
V _{UVLO}	V _{IN} Under Voltage Lockout			2.05		V
V _{UVLO-Hys}	V _{IN} Under Voltage Hysteresis		100	150	200	mV
T _{SD}	Thermal Limit			145		°C
T _{SDH}	Thermal Limit Hysteresis			20		°C

Typical Operating Characteristics

($V_{IN}=5V$, $C_{IN}=10\mu F$, $C_{SS}=22nF$, $C_{OUT}=10\mu F$, $V_{EN}=5V$, $T_A=+25^\circ C$, unless otherwise noted.)

Turn on Delay Time and Rise Time**Turn off Delay Time and Fall Time****Turn on Delay Time and Rise Time****Turn off Delay Time and Fall Time****Inrush Short Circuit Response****Short Circuit Response at Start Up**

UVLO Voltage vs. Temperature**EN Threshold vs. Temperature**

Functional Description**Input and Output**

V_{IN} (input) is the power supply connection to the logic circuitry and the source of the power MOSFET. V_{OUT} (output) is the drain of the power MOSFET. In a typical application, current flows through the switch from V_{IN} to V_{OUT} toward the load. All V_{OUT} pins must connect together to the load.

Current Limiting

The EUP3512A/B continuously monitors the output current for over-current protection to protect the system power, the power switch, and the load from damage during output short circuit. Under over-current condition, the device maintains a constant output current and reduces the output voltage accordingly. Complete shutdown occurs only if the fault is presented long enough to activate thermal limiting. There are several possible over-current conditions can occur.

- The output has been shorted before the device is enabled or before V_{IN} has been applied, the EUP3512A/B senses the short immediately switches into a constant-current limit mode.
- A short or an overload occurs while the device is enabled. At the instant the overload occurs, high currents may flow for a short period of time before the current-limit circuit can react. After the current limit circuit has tripped (reached the over-current trip threshold), the device switches into constant current mode.
- The load has been gradually increased beyond the recommended operating current. The current is permitted to rise until the current limit threshold is reached or until the thermal limit of the device is exceeded. The EUP3512A/B is capable of delivering current up to the current limit threshold without

damaging the device. Once the threshold has been reached, the device switches into its constant current mode.

The current limit value refers to typical operating characteristics.

Thermal Shutdown

Thermal shutdown protector is built in EUP3512A/B. When the die temperature exceeds 145°C, the MOSFETS switch is shut off. 20°C of hysteresis prevents the switch from turning on until the die temperature drops to 125°C. Thermal shutdown circuit functions only when the switch is enabled.

Under-Voltage Lockout

A voltage-sense circuit monitors the input voltage. When the input voltage falls below approximately 2.05V, the power switch is quickly turned off. The UVLO also keeps the switch from being turned on until the power supply has reached at least 2.2V, even if the switch is enabled.

Soft-start Capacitor

EUP3512A/B integrates a current soft-start function to avoid the inrush current at turn-on time. When EUP3512A/B is powered on or enabled, its current limit threshold is raised slowly to realize the current soft-start. The soft-start capacitor connected from SS pin to GND sets the soft-start time. Larger soft-start capacitor gives longer soft-start time. The soft start time can be calculated by the following equation:

$$t_{ss} = 1V \times C_{ss} \times 1.1 \times 10^6$$

t_{ss} is soft-start time of SS pin from 0 to 1V (current limit point). C_{ss} is the value of the capacitor connected from SS pin to GND, of which unit is micro-Farad

Application Information

Input Power Supply and Capacitance

A 10 μ F bypass capacitor from V_{IN} to GND, located near the EUP3512A/B, is strongly recommended to prevent the input voltage drooping during hot-plug events. When the device is powered by long leads or PC traces, it is quit to driver inductive loads or operate from inductive sources, larger input bypass capacitance is required to prevent voltage spikes from exceeding the EUP3512A/B's absolute maximum ratings ($V_{INMAX}=6V$) during short-circuit events.

Output Capacitor

A 10 μ F ceramic capacitor between V_{OUT} and GND is recommended to reduce the voltage droop, when the output load is heavy. This precaution reduces power-supply transients that may cause ringing on the input and reduces output voltage transients under dynamic load conditions.

EN, the Enable Logic Input

EN must be driven logic low or logic high for a clearly defined input. Floating the input may cause unpredictable operation. EN should not be allowed to go negative with respect to GND.

Driving Inductive Loads

To the USB port with cables is typically connected A wide variety of devices (mice, keyboards, cameras, and printers), which might add an inductive component to the load. This inductance causes the output voltage at the USB port to oscillate during a load step. The EUP3512A/B drives inductive loads, but avoid exceeding the device's absolute maximum ratings. Usually, the load inductance is relatively small, and the EUP3512A/B's input includes a substantial bulk capacitance from an upstream regulator as well as local bypass capacitors, limiting overshoot.

Layout and Thermal Dissipation

Keep all traces as short as possible to reduce the effect of undesirable parasitic inductance and optimize the switch response time to output short circuit conditions. Place input and output capacitors no more than 5mm from device leads. Connect V_{IN} and V_{OUT} to the power bus with short traces. Wide power bus planes at V_{IN} and V_{OUT} provide superior heat dissipation as well.

An active switch dissipates little power with minimal change in package temperature. Calculate the power dissipation for this condition as follows:

$$P = I_{OUT}^2 \times R_{(DS)ON}$$

At the normal operating current ($I_{OUT}=2A$) and the maximum on resistance of the switch (80m Ω), the power dissipation is:

$$P = (2A)^2 \times 0.08\Omega = 320mW$$

The worst-case power dissipation occurs when the output current is just below the current limit threshold (2.5A typ) with a low output voltage 1.5V, for example. For a 5V input, the power dissipated is the voltage drop across the switch multiplied by the current limit:

$$P = I_{LIM} \times (V_{IN} - V_{OUT}) = 2.5A \times (5V - 1.5V) = 8.75W$$

In this case, the EUP3512A/B die temperature exceeds the 145°C thermal shutdown threshold, and the switch output shuts down until the junction temperature cools by 20°C. The duty cycle and period are strong functions of the ambient temperature and the PC board layout (see the Thermal Shutdown section).

Test Circuit

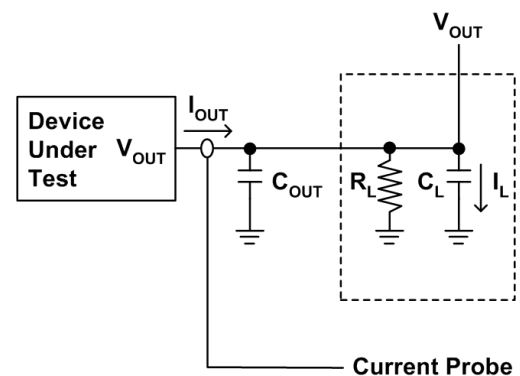


Figure 3.

Timing Diagrams

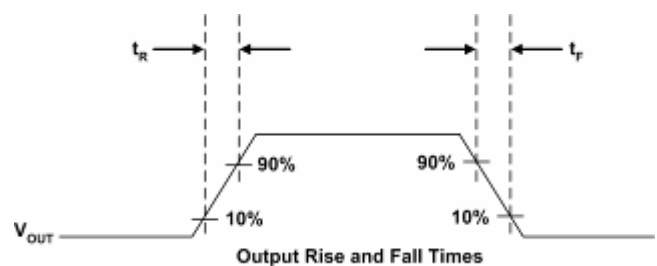
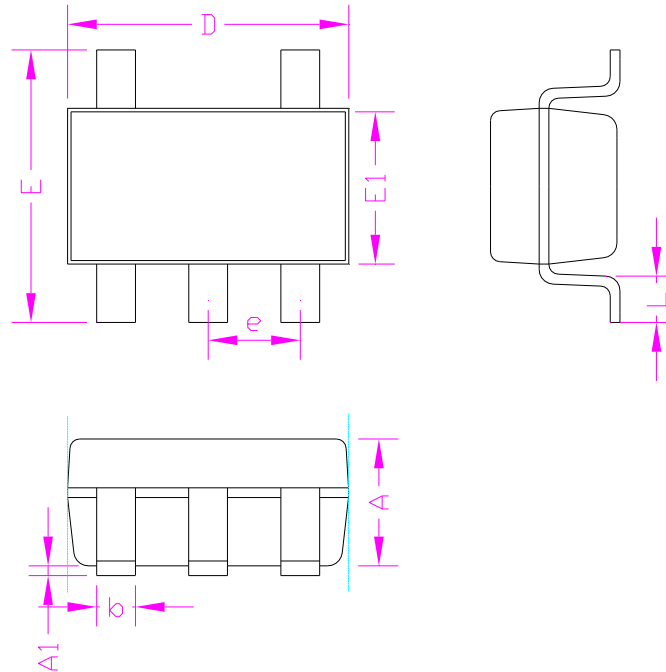


Figure4.

Packaging Information**SOT23-5**

SYMBOLS	MILLIMETERS			INCHES		
	MIN.	Normal	MAX.	MIN.	Normal	MAX.
A	-	-	1.40	-	-	0.055
A1	0.00	-	0.15	0.000	-	0.006
D	2.65	2.90	3.15	0.104	0.114	0.124
E1	1.40	1.60	1.80	0.055	0.063	0.071
E	2.60	2.80	3.00	0.102	0.110	0.118
L	0.30	0.45	0.60	0.012	0.018	0.024
b	0.30	-	0.50	0.012	-	0.020
e	0.95 REF			0.037REF		