Features

- Integrated NMOSFET RDSON=65mΩ(typ.)
- Operating input voltage range: 2V to 5.5V
- Reverse leakage current less than 10μA
- Low quiescent current: 35μA
- 1.5ms typical rise time and fast turn off
- Over current protection with fold-back
- 2μs response for short circuit protection
- Over temperature protection
- IEC Recognized, File No.DK-173174-UL
- UL Approved-E550019
- CB IEC62368-1

Applications

- USB Peripherals
- Notebook PCs
- Mini PCI Accessories

Package: SOT-23-5L

Description

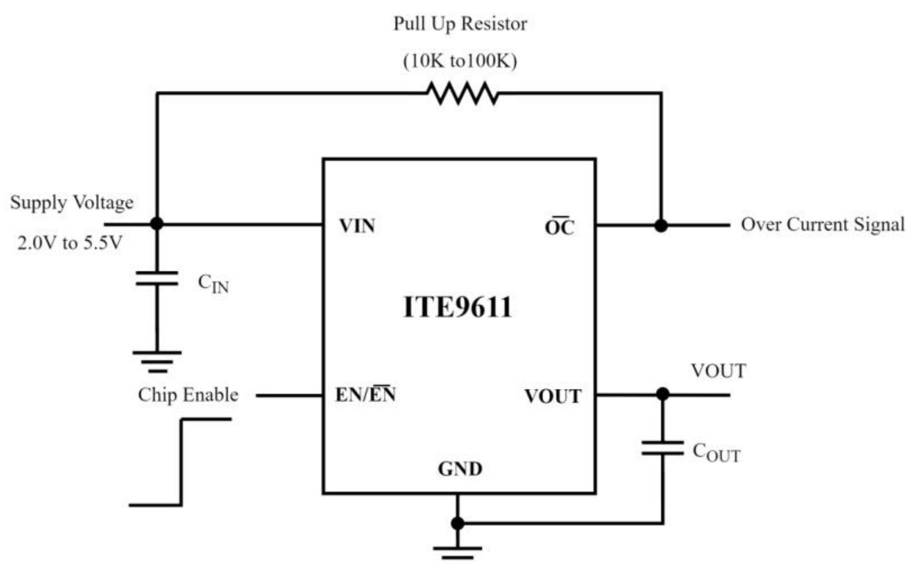
The ITE9611XX is a low-voltage, fast turn on, single NMOSFET high-side power switch. The typical rise time is 1ms. This IC can operate over an input voltage range of 2V to 5.5V. A 65mΩ (typ.) ultra-low switch-on resistance and 35μA low quiescent current are realized in the device.

By integrating many function circuits, such as, current limit circuit, short circuit protection circuit and thermal shutdown circuit, the ITE9611XX can provide a good performance to protect the power source from over current and short circuit conditions. Besides, built-in soft-start minimizes stress on the input power source by reducing capacities inrush current during start-up.

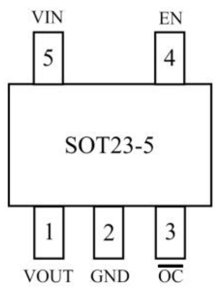
Furthermore, owning $\overline{OC}$ fault flag output with embedded delay time function can indicate fault conditions correctly. Those abilities make the ITE9611XX an ideal solution for USB power supply applications.

The ITE9611XX is available in SOT23-5L package.

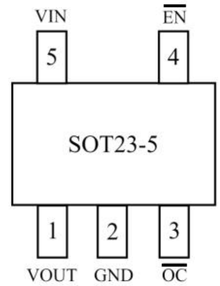
Typical Application Circuit



Pin Configuration



SOT23-5L



SOT23-5L

Pin Assignment

NO.	NAME	FUNCTION
1	VOUT	Output Voltage.
2	GND	Ground.
3	$\overline{OC}$	Open Drain Fault Flag.
4	EN/$\overline{EN}$	Chip Enable (Active High/ Low).
5	VIN	Power Input Voltage. Internal integrated VIN OVP function, once VIN rises to 5.5V(typ.), the chip will be shutdown.

Ordering Information

PART NUMBER	OVER-CURRENT	EN/$\overline{EN}$
ITE9611AD	1.5A	EN (Active High)
ITE9611BD	1.5A	$\overline{EN}$ Bar (Active Low)
ITE9611AE	2.5A	EN (Active High)
ITE9611BE	2.5A	$\overline{EN}$ Bar (Active Low)
ITE9611AF	3.5A	EN (Active High)
ITE9611BF	3.5A	$\overline{EN}$ Bar (Active Low)

Model Introduction

<table>
<tr><th>MODEL</th><th>PACKAGE</th><th>DEFINITION</th><th>RECOMMENDED CONTINUOUS CURRENT</th><th>PRINTING</th><th>FUNCTION</th></tr>
<tr><td>ITE9611AD</td><td rowspan="6">SOT23-5L</td><td>EN</td><td rowspan="2">1.5A</td><td rowspan="6">ITE9611XX
WYVXXC</td><td rowspan="6">First row: product model
Second row:
The first letter indicates the year
The second digit indicates the week number
The third digit indicates the version number
The fourth and fifth digits indicate the last two digits of the batch number
The sixth digit indicates the factory</td></tr>
<tr><td>ITE9611BD</td><td>$\overline{EN}$ Bar</td></tr>
<tr><td>ITE9611AE</td><td>EN</td><td rowspan="2">2.5A</td></tr>
<tr><td>ITE9611BE</td><td>$\overline{EN}$ Bar</td></tr>
<tr><td>ITE9611AF</td><td>EN</td><td rowspan="2">3.5A</td></tr>
<tr><td>ITE9611BF</td><td>$\overline{EN}$ Bar</td></tr>
</table>

Universal Naming Convention

ITE 9611 X X

① ② ③ ④

①: Abbreviation of product company name

②: Series model

③: Effective level selection

A: High level active B: Low level active

④: Recommended continuous current

D: 1.5 E: 2.5A F: 3.5A

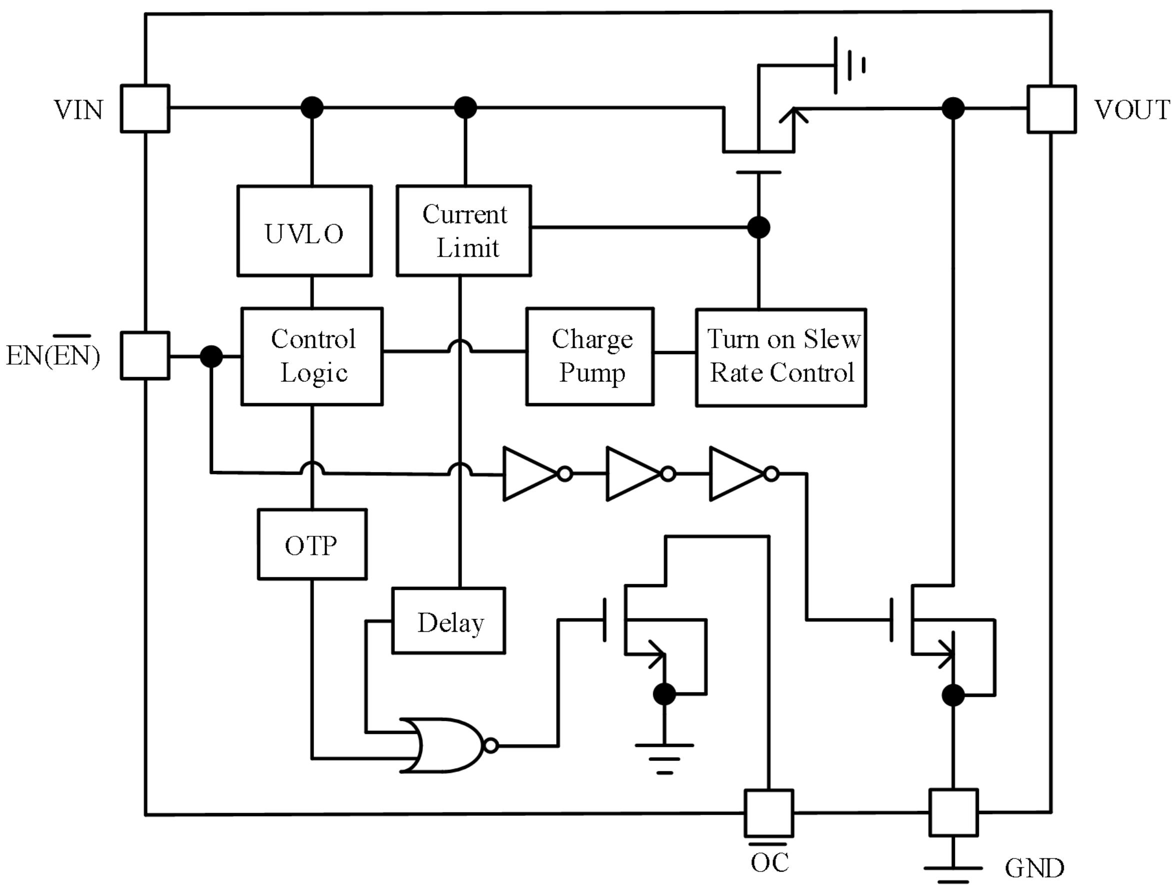
Absolute Maximum Ratings (Note 1)

PARAMETER	RANGE
VIN	-0.3 to 6V
EN, $\overline{EN}$	-0.3 to 6V
Other Pins	-0.3 to (VIN+0.3V)
Junction Temperature	125℃
Lead Temperature (Soldering, 10 sec.)	300℃
Storage Temperature	-65℃ to 150℃

Recommended Operating Conditions (Note 2)

SYMBOL	PARAMETER	LIMITS	UNIT
V_{IN}	Supply Voltage	2 to 5.5	V
EN	Enable Voltage	0 to 5.5	V
V_{OUT}	Output Voltage	2 to 5.5	V
T_J	Junction Temperature	-40 ~ 125	℃
T_A	Operating Temperature Range	-40 ~ 85	℃

Functional Block Diagram



Functional Block Diagram (With Discharge Function)

Electrical Characteristics

V_{IN} = 5V, C_{IN} = 10μF, C_{OUT} = 10μF, T_J = 25℃, unless otherwise specified

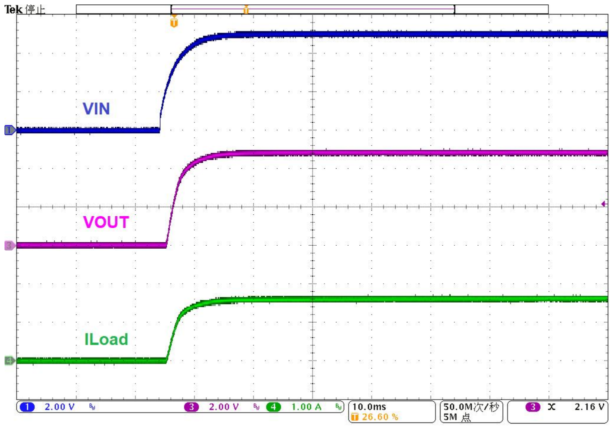
SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
VIN	Input voltage VIN range		2		5.5	V
VIN POR	VIN POR Threshold			1.7	1.95	V
IQ	Quiescent Current	IOUT = 0mA		35		uA
ISD	Shutdown Current	ENB = 5V		0.1	2	uA
RDSON	RDSON			65		mΩ
IREV	Reverse Leakage Current	VIN = 0V, VOUT = 5V		0.1	10	μA
T_{ON}	Turn ON Rising Time	10% to 90% of V_{OUT} Rising		1.5		ms
V_{IH}	EN Input High (Active High)	V_{IN} = 5V, I_{LOAD} = 0A	1.2			V
V_{IL}	EN Input Low (Active High)	V_{IN} = 5V, I_{LOAD} = 0A			0.4	V
V_{IH}	EN Input High (Active Low)	V_{IN} = 5V, I_{LOAD} = 0A			0.4	V
V_{IL}	EN Input Low (Active Low)	V_{IN} = 5V, I_{LOAD} = 0A	1.2			V
I_{EN}	EN Input Current	EN = 5.5V		0.3	1	μA
RDIS	VOUT Discharge Resistor			100		Ω
IOCP	Over Current Threshold	(ITE9611XD)	1.8		2.8	A
		(ITE9611XE)	2.6		4.2	A
		(ITE9611XF)	3.6		5.1	A
ISC	VOUT Short Circuit Current	(ITE9611XD)		1.6		A
		(ITE9611XE)		2.2		A
		(ITE9611XF)		2.8		A
R_{OC}	$\overline{OC}$ Output Resistance	I_{SINK} = 1mA, V_{IN} = 5V			100	Ω
I_{OC_OFF}	$\overline{OC}$ Off Current	V_{OC} = 5V			1	μA
T_D	$\overline{OC}$ Delay Time	From fault condition to $\overline{OC}$ assertion, V_{IN} = 5V	5	10	16	ms
TSD	Thermal Shutdown Temperature			135		℃
TSDHY	Thermal Shutdown Hysteresis			30		℃

Note 1. Stresses listed as the above “Absolute Maximum Ratings” may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.
Note 2. The device is not guaranteed to function outside its operating conditions.

Typical Performance Characteristics

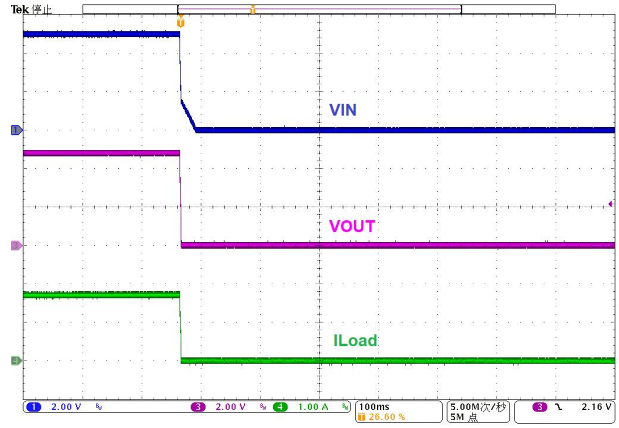
(T_A = 25℃, C_{IN} = 1.0μF, C_{OUT} = 10μF, unless otherwise specified)

Power On from V_{IN} With 3.125ohm LOAD



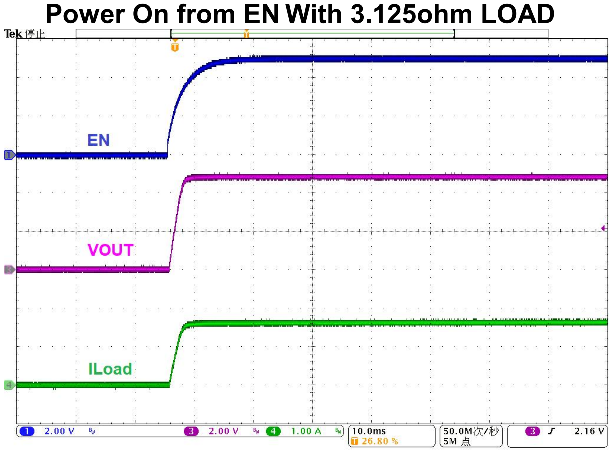
V_{IN} = 0V to 5V, R_{LOAD} = 3.125ohm

Power Off from V_{IN} With 3.125ohm LOAD



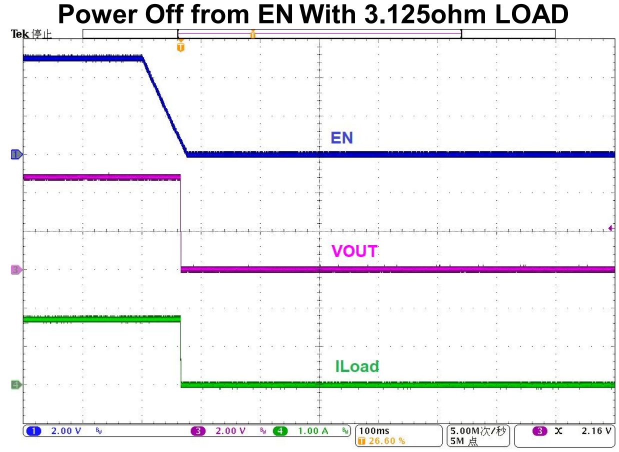
V_{IN} = 5V to 0V, R_{LOAD} = 3.125ohm

Power On from EN With 3.125ohm LOAD



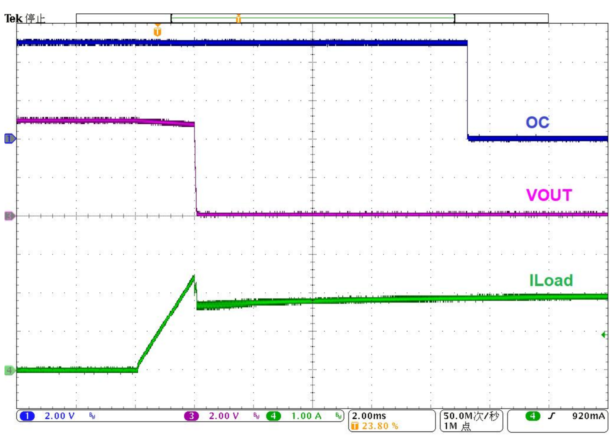
V_{IN} = 5.0V, EN=0V to 5.0V,R_{LOAD} = 3.125ohm

Power Off from EN With 3.125ohm LOAD



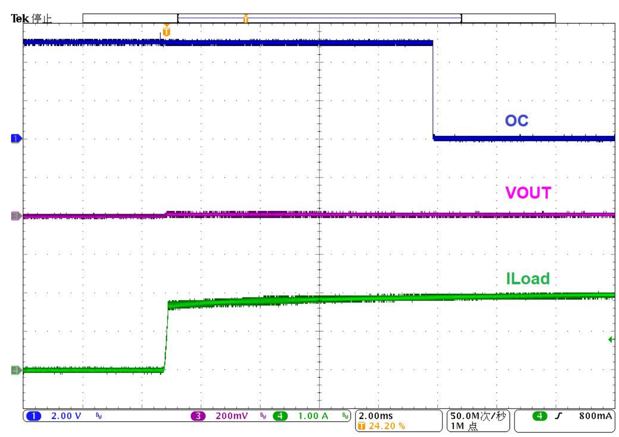
V_{IN} = 5.0V, EN=5V to 0V,R_{LOAD} = 3.125ohm

Over Current and $\overline{OC}$ Delay



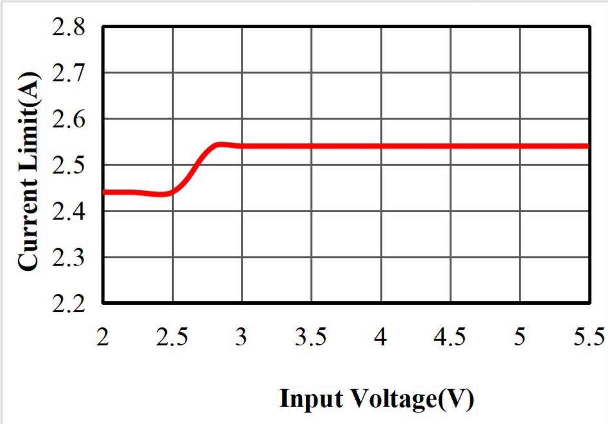
V_{IN} = 5V, I_{LOAD} = 0A to 3A

Short Circuit and $\overline{OC}$ Delay



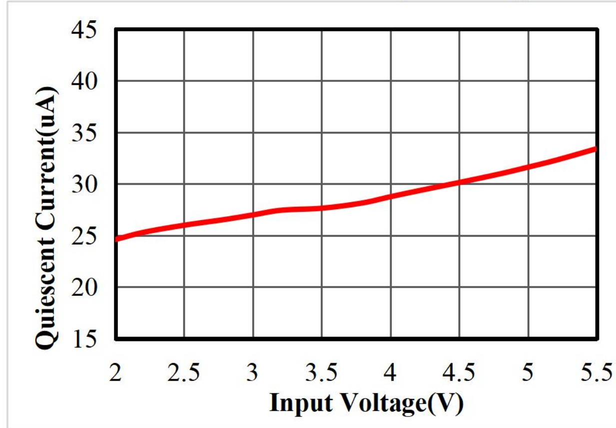
V_{IN} = 5V, V_{OUT} = 0V

Current Limit vs. Input Voltage



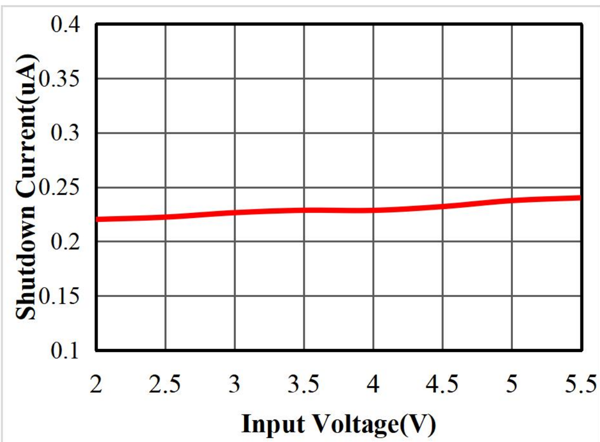
V_{IN} = 2.0V to 5.5V, Sweep ILoad

Quiescent Current vs. Input Voltage



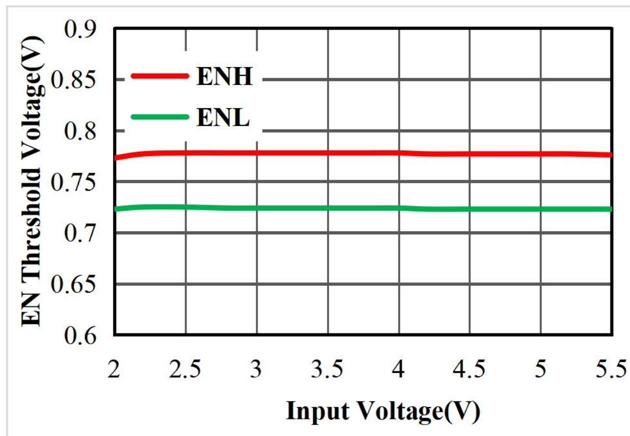
V_{IN} = 2.0V to 5.5V, ILoad=0A

Shutdown Current vs. Input Voltage



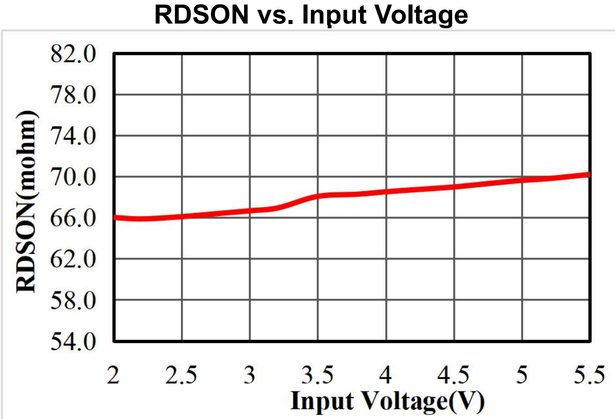
V_{IN} = 2.0V to 5.5V, EN=0 (Disable)

EN Threshold Voltage vs. Input Voltage



V_{IN} = 2.0V to 5.5V, EN = 0V to 1.2V to 0V

RDSON vs. Input Voltage



V_{IN} = 2.0V to 5.5V, ILoad=0.5A

Application Information

Input Capacitor

Good bypassing capacitor is recommended from input to ground to help improve IC ac performance, bypass VIN to ground with a 10μF or greater capacitor is recommended for normal operation in most applications. Ceramic, tantalum or aluminum electrolytic capacitors may be selected for input capacitor. However, ceramic capacitors are recommended due to their significant cost and space savings. Place the capacitors physically as close as possible to the device with wide and direct PCB traces.

Output Capacitor

To reduce the voltage droop during hot attachment of downstream peripheral, a minimum 10μF output capacitor at the output pin is recommended. Place the capacitors physically as close as possible to the device with wide and direct PCB traces.

Current Limit

The ITE9611XX contains an independent current limit and short circuit current protection to prevent unexpected applications. The current limit monitors and controls the pass transistor's gate voltage, allowing the output current to reach the value of 3.3A (ITE9611XE typical value). Then further decreases in the load resistance reduce both the load current and the load voltage. Once the output current is higher than current limit threshold, the current limit function will be triggered, clamping the output current at a pre designed level to prevent over current stress and thermal damage.

Built-In Soft-Start

The ITE9611XX contains an internal soft-start function that controls rise rate of the output voltage to limit the current surge during start-up. The typical soft-start interval is about 1ms.

OTP Protection

A Thermal shutdown protection circuit disables the ITE9611XX when the junction temperature of the pass transistor rises to 135℃ (typical). Thermal shutdown hysteresis assures that the device resets (turns on) when the temperature falls to 105℃ (typical).

The thermal shutdown feature provides the protection for IC against overheating power dissipation due to some application failure and it is not intended to be used as a normal working function.

Enable

The ITE9611XX uses the dedicated enable pin with active high(EN) or active low($\overline{EN}$). If the EN($\overline{EN}$) pin voltage is < 0.4V, the regulator will be turned off(on). If the EN($\overline{EN}$)pin voltage is > 1.2V, the regulator will be turned on(off) and undergoes a new soft-start cycle. Do not leave the EN pin in floating state when it is not used.

$\overline{\text{OC}}$ Function

The $\overline{\text{OC}}$ open-drain output is asserted (active low) when an over current or over temperature shutdown condition is encountered. The output remains asserted until the over current or over temperature condition is removed. The $\overline{\text{OC}}$ pin requires a pull-up resistor, this resistor should be large in value to reduce energy drain. A 100kΩ pull-up resistor works well for most applications.

Power Dissipation

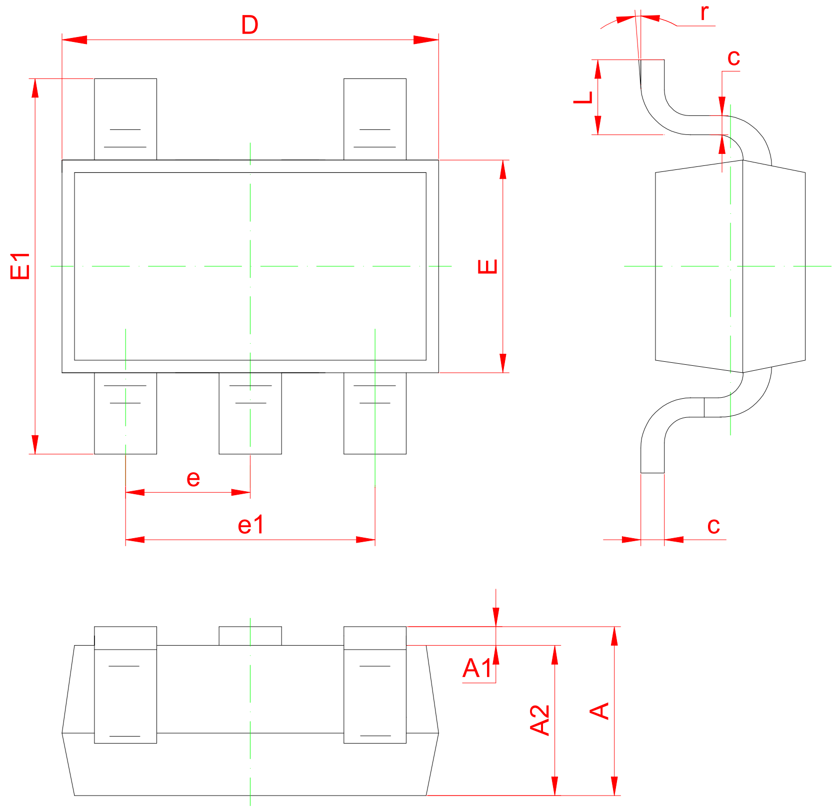
Power dissipation caused by voltage drop across the Power switches and by the output current flowing through the device needs to be dissipated out from the chip. The maximum power dissipation is dependent on the PCB layout, number of used Cu layers, Cu layers thickness and the ambient temperature.

Power dissipation in the regulator depends on the input-to-output voltage difference and load conditions.

$$PD = (V_{IN} - V_{OUT}) \times I_{OUT}$$

Power dissipation can be minimized, and thus greater efficiency achieved, by proper selection of the system voltage rails. To avoid thermally overloading the ITE9611XX, refrain from exceeding the absolute maximum junction temperature rating of 135℃ under continuous operating condition. Over-stressing the regulator with high loading currents and elevated input-to-output differential voltages can increase the IC die temperature significantly.

Package Information: SOT-23-5L



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
r	0º	8º	0º	8º