ITE9601

5.5V, 2.5A Low Loss Power Distribution Switch

Features

- Integrated PMOSFET RDSON=55mΩ (typ.)
- Operating input voltage range: 2.4V to 5.5V
- Adjustable current limit: 0.4A to 2.5A
- Reverse blocking (No body diode)
- Low quiescent current: 30uA
- Build internal soft-start
- Short-circuit protection
- Over temperature protection
- SOT23-5L package
- Green Product RoHS Compliant and Halogen Free
- IEC Recognized, File No.DK-173174-UL
- UL Approved-E550019
- CB IEC62368-1

Applications

- USB 3.1 Applications
- USB Charger
- PC and Notebooks
- USB Dongle
- USB 3G Data Card
- Mini PCI Accessories

Description

The ITE9601 is a low voltage, low loss power distribution switch with programmable current limit function. This IC can operate over an input voltage range of 2.4V to 5.5V. A 55mΩ (typ.) ultra-low switch-on resistance and 30uA low quiescent current are realized in the device.

Integrating many function circuits, such as, current limit circuit, short-circuit protection circuit and thermal shutdown circuit, the ITE9601 can provide a good performance to protect the power source from over current and short-circuit conditions. Besides, building internal soft-start minimizes stress on the input power source by reducing capacities inrush current during start-up time. Furthermore, owning reverse blocking (no body diode) function, the output voltage can be forced higher than input voltage. Those abilities make the ITE9601 to be an ideal solution for USB power supply applications.

The ITE9601 is available in SOT23-5L package.

Typical Application

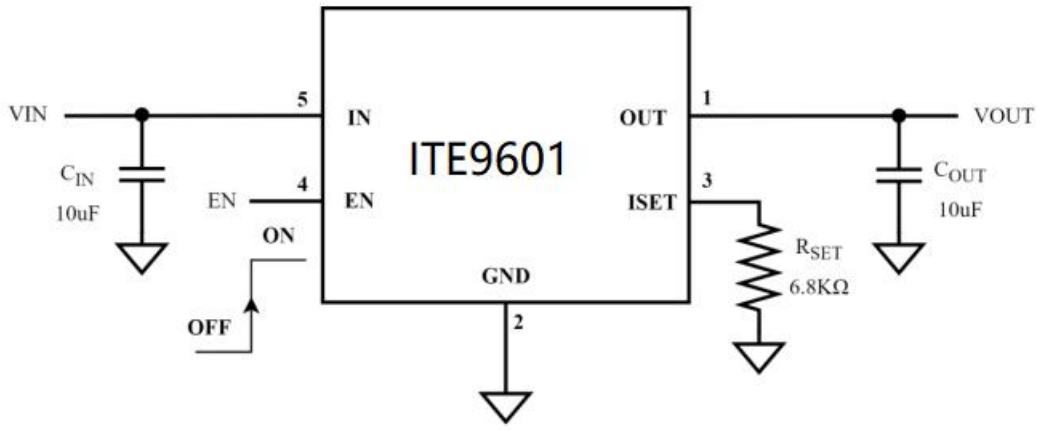


Figure 1. Typical Application

Pin Configuration

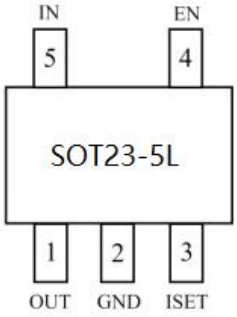


Figure 2. SOT23-5L package

Pin Description

NO.	NAME	DESCRIPTION
1	OUT	Output pin. A 10μF ceramic capacitor is recommended at this pin.
2	GND	IC Ground.
3	ISET	Current limit programming pin. Connect a resistor R_{SET} from this pin to ground to program the current limit: I_{LIM} (A)=6800/R_{SET} (Ω)
4	EN	Enable control input (active high), don't leave this pin open.
5	IN	Supply input voltage. A 10μF ceramic capacitor is recommended at this pin.

Marking Information

MODEL	PACKAGE	OCP (TYP)	PRINTING	FUNCTION
ITE9601HA5L	SOT23-5L	0.4-2.5A	SOH WYVXXC	First row: Product model H: High level effective L: Low level effective Second row: Y: Year code W: Week code V: Version XX: Batch number C: Factory
ITE9601LA5L			SOL WYVXXC	

Ordering Information

ITE	9601	X	X	5L
①	②	③	④	⑤

①: Abbreviation of product company name

②: Series model

③: Effective level selection:

H: High level active L: Low level active

④: Version model

⑤: Package code

Functional Block Diagram

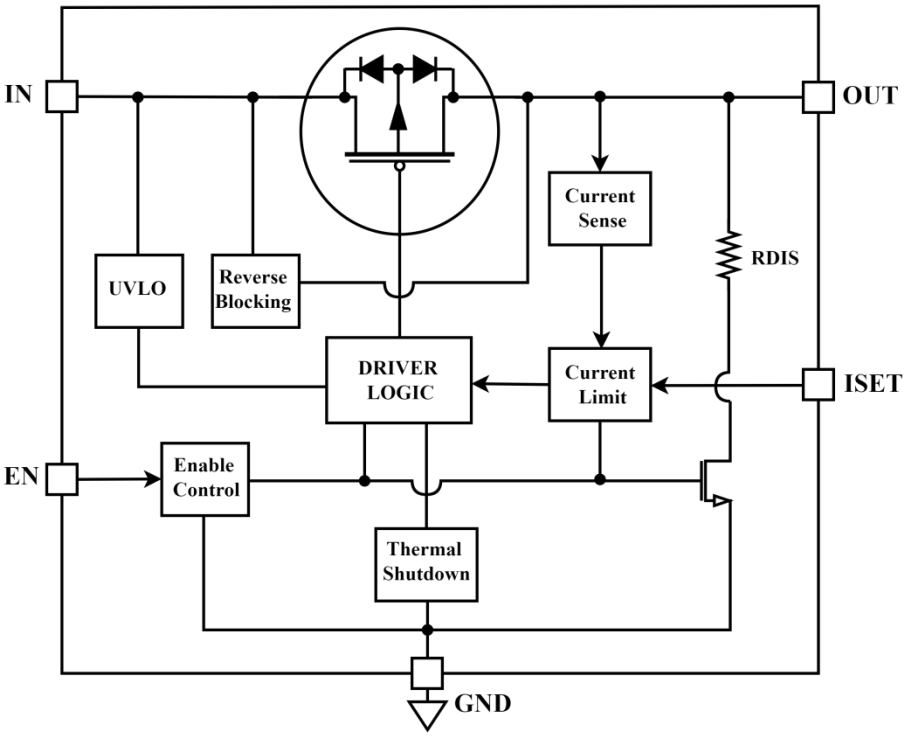


Figure 3. Functional Block Diagram

Absolute Maximum Ratings (Note 1)

SYMBOL	PARAMETER	MIN	MAX	UNIT
IN	Supply Voltage	-0.3	6	V
OUT	Output Voltage	-0.3	6	V
ISET	Current Limit Set Voltage	-0.3	6	V
EN	Enable Voltage	-0.3	6	V
T_J	Junction Temperature	-40	150	°C
T_{STG}	Storage Temperature	-65	150	°C
T_{LEAD}	Lead Temperature Soldering Time		260, 10s	°C
V_{ESD_HBM}	ESD (Human Body Mode) (Note 2)		2000	V
V_{ESD_MM}	ESD (Machine Mode) (Note 2)		200	V

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions. Extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Thermal Information (Note 3)

SYMBOL	PARAMETER	LIMITS	UNIT
θ_{JA_SOT23}	Thermal Resistance Junction to Ambient	238	°C/W
θ_{JC_SOT23}	Thermal Resistance Junction to Case	60	°C/W

Recommended Operating Conditions (Note 4)

SYMBOL	PARAMETER	LIMITS	UNIT
IN	Supply Voltage	2.4 to 5.5	V
EN	Enable Voltage	0 to 5.5	V
OUT	Output Voltage	2.4 to 5.5	V
ISET	Current Limit Set Voltage	0 to 5.5	V
T_J	Junction Temperature	-40 ~ 125	°C
T_A	Operating Temperature Range	-40 ~ 85	°C

Electrical Characteristics

(V_{IN}=5.0V, C_{IN}=10uF, C_{OUT}=10μF, T_A=25°C, unless otherwise specified)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage Section						
V_{IN}	Supply Input Voltage		2.4		5.5	V
I_Q	Quiescent Current	V_{IN}=5V, I_{LOAD}=0A		30	50	uA
I_{SHDN}	Shutdown Current	EN=0, V_{IN}=5V, I_{LOAD}=0		0.2	1	uA
Power MOS ON Resistance						
$R_{DS(ON)}$	On Resistance	V_{IN}=5V		55		mΩ
EN Input Voltage						
V_{IH}	EN Input High	V_{IN}=5V, I_{LOAD}=0A	1.2			V
V_{IL}	EN Input Low	V_{IN}=5V, I_{LOAD}=0A			0.4	V
I_{EN}	EN Input Current	EN=0V to 5.5V			1	uA
Under Voltage Threshold						
V_{UVLO}	Under Voltage Lockout	V_{IN} Rising		2.1	2.3	V
$\triangle V_{UVLO}$	Under Voltage Hysteresis	V_{IN} Falling Hysteresis		0.1		V
Current Limit						
I_{LIM}	Current Limit	R_{SET}=2.2KΩ, V_{OUT}=0.95*V_{IN}		3.1		A
Reverse Current/Voltage						
	Reverse Leakage Current	EN=0V, V_{IN}=1V, V_{OUT}=5V			5	uA
	Output Reverse Voltage Threshold	V_{IN}=5V		50		mV
Turn On and Turn Off Time						
T_{ON}	Turn On Rising Time	10% to 90% of V_{OUT} Rising V_{IN}=5V, R_{LOAD}=10Ω		130		us
T_{Delay}	Turn On Delay Time	From EN rising to 0.1×V_{OUT}		60		us
Output Discharge Resistance						
R_{DIS}	Shutdown Auto-Discharge Resistance	EN=0V, V_{IN}=5V		120		Ω
Thermal Shutdown						
T_{SD}	Thermal Shutdown Threshold	T_J Rising, VOUT=5V		150		°C
	Thermal Shutdown Threshold	T_J Rising, VOUT=0V		135		°C
T_{SD_HYS}	Thermal Shutdown Recover			105		°C

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. Devices are ESD sensitive. Handling precaution recommended.

Note 3. θ_{JA} is measured in the natural convection at T_A=25°C on a high effective thermal conductivity test board (4 Layers, 2S2P) of JEDEC 51-7 thermal measurement standard.

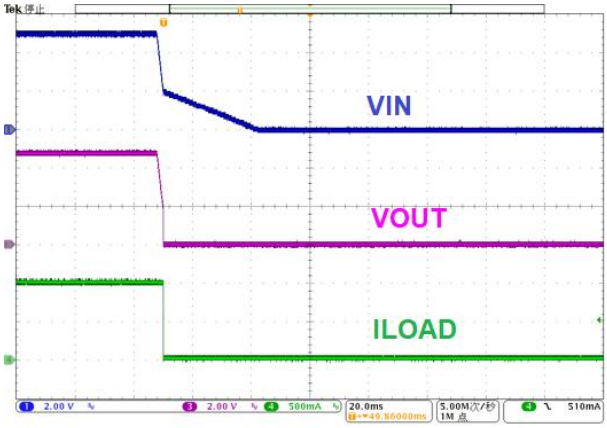
Note 4. The device is not guaranteed to function outside its operating conditions.

Typical Performance Characteristics

Power On from VIN With ILOAD=1.0A

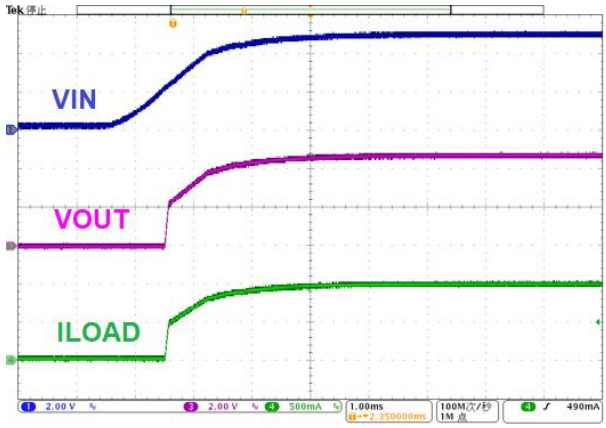
VIN=0V-5.0V, ILOAD=1.0A

Power Off from VIN With ILOAD=1.0A



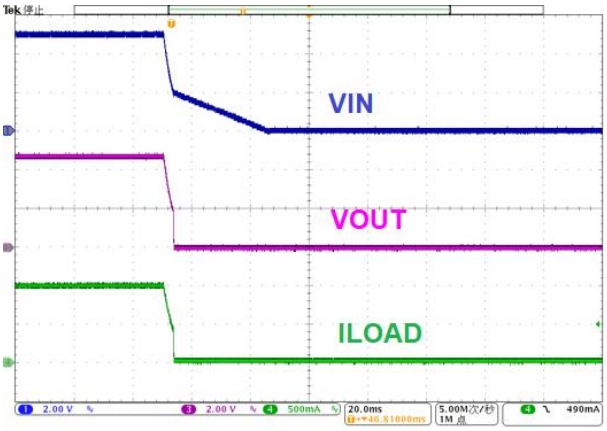
VIN=5.0V-0V, ILOAD=1.0A

Power On from VIN With RLOAD=5ohm



VIN=0V-5.0V, RLOAD=5ohm

Power Off from VIN With RLOAD=5ohm

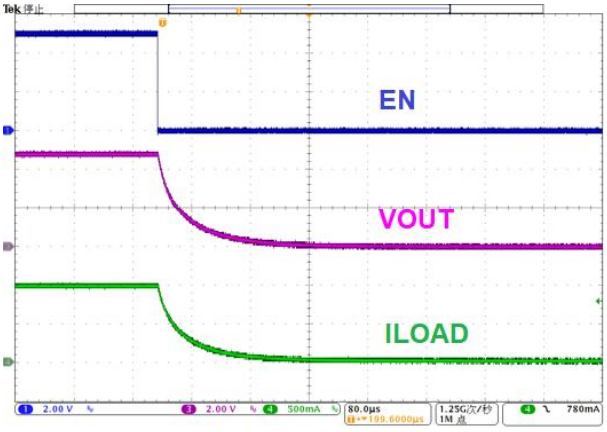


VIN=5.0V-0V, RLOAD=5ohm

Power On from EN With RLOAD=5ohm

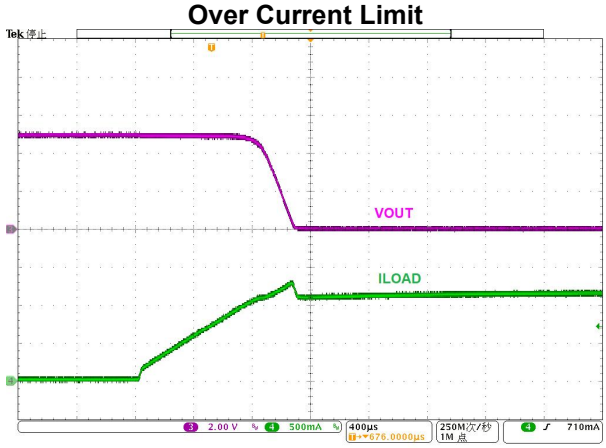
VIN=5.0V, EN=0V-5.0V, RLOAD=5ohm

Power Off from EN With RLOAD=5ohm



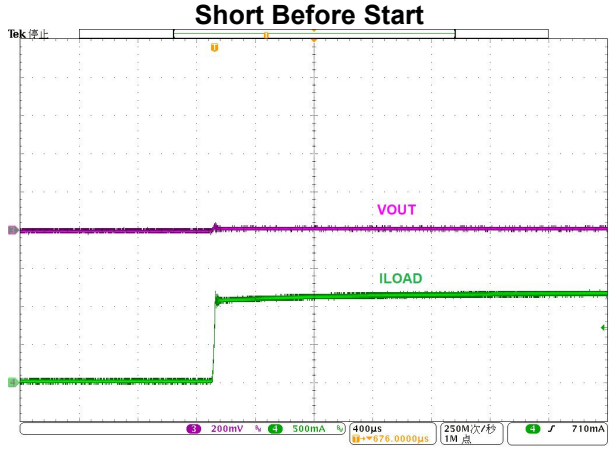
VIN=5.0V, EN=5.0V-0V, RLOAD=5ohm

Over Current Limit



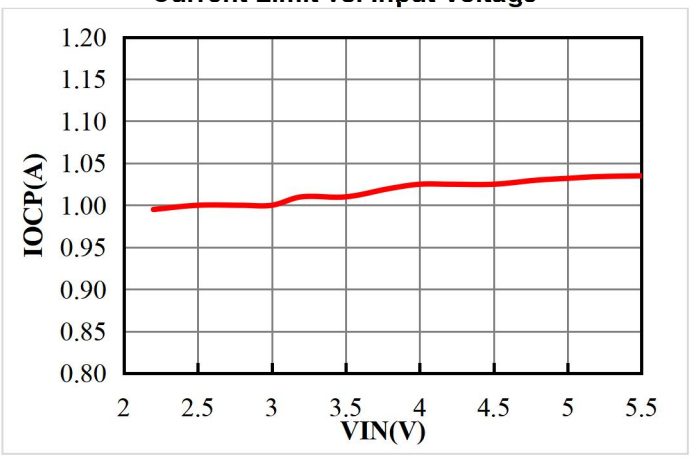
VIN=5.0V, RISET=6.8Kohm

Short Before Start



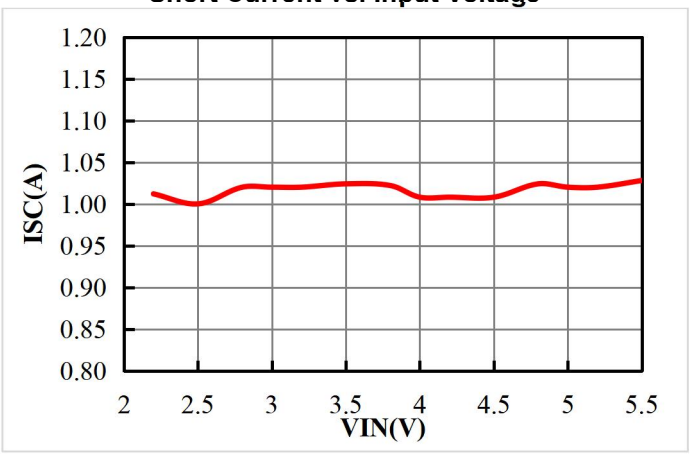
VIN=5.0V, VOUT=0V, EN=0V-5V, RISET=6.8Kohm

Current Limit vs. Input Voltage



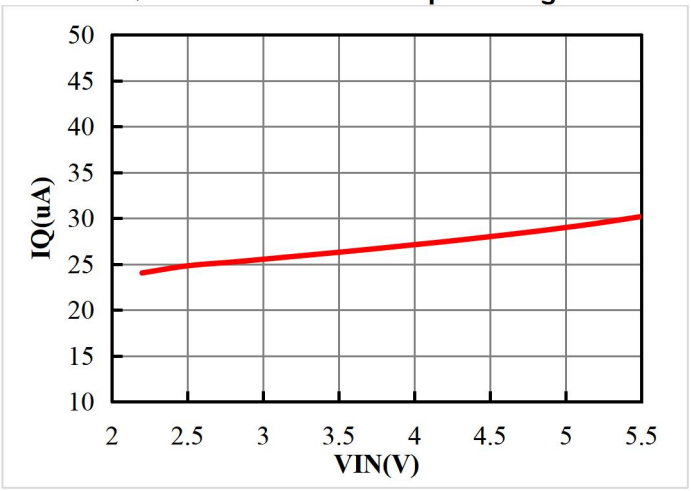
VIN=5.0V, RISET=6.8Kohm

Short Current vs. Input Voltage



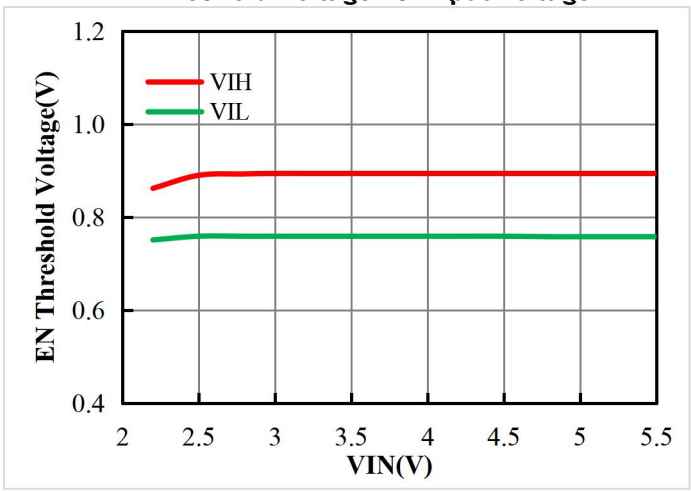
VIN=5.0V, RISET=6.8Kohm

Quiescent Current vs. Input Voltage



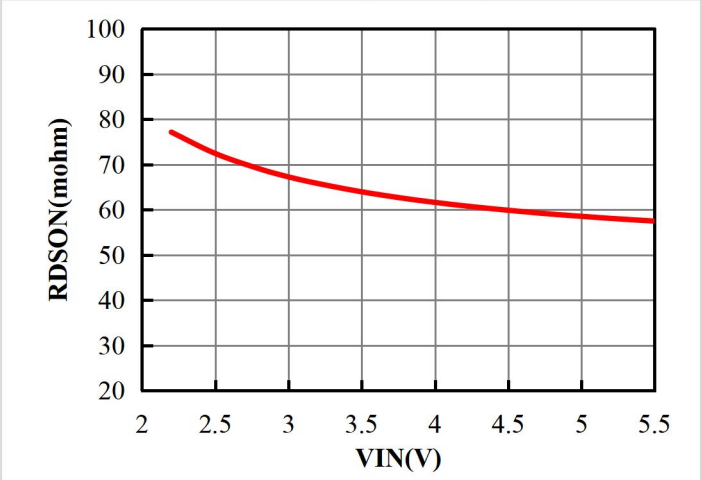
VIN=2.4V-5.5V, Iload=0A

EN Threshold Voltage vs. Input Voltage



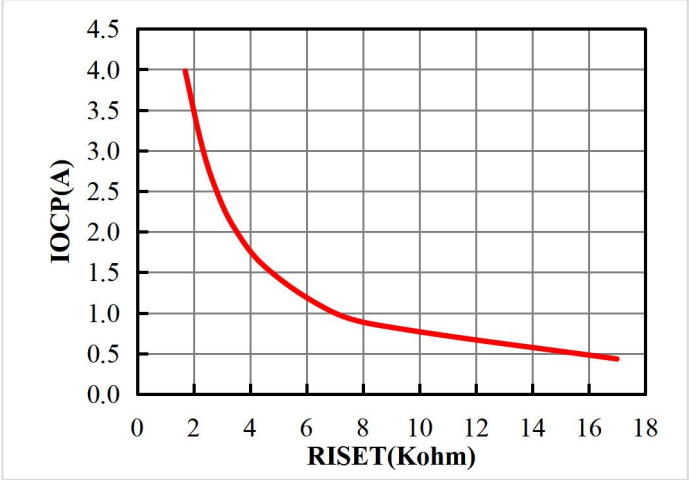
VIN=2.4V-5.5V, Iload=0A

RDSON vs. Input Voltage



VIN=2.4V-5.5V, RISET=6.8Kohm, Iload=0.5A

OCP Current vs. RISET



VIN=5.0V, RISET=1.7Kohm-17Kohm

Application Information

Input Capacitor

Good bypassing capacitor is recommended from input to ground to help IC ac performance, bypass IN to ground with a 10uF or greater capacitor 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 10uF 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 ITE9601 owns programmable current limit function. Connect a resistor RSET from ISET pin to ground to program the current limit value:

$$I_{LIM}(A) = {}^{6800}/_{R_{SET}(\Omega)}$$

The minimum current limit is 0.4A. Current limit beyond 4A is not recommended. Once the output current is higher than current limit threshold, the current limit function will be triggered and clamp the output current at a pre-designed level to prevent over current stress and thermal damage.

Build-In Soft-Start

ITE9601 contains an internal soft-start function that controls rise rate of the output voltage to limit the current surge at start-up. The typical soft-start interval is about 130us.

OTP Protection

A Thermal shutdown protection circuit disables the ITE9601 when the junction temperature of the pass transistor rises to 150°C (typical). Thermal shutdown hysteresis assures that the device resets (turns on) when the temperature falls to 105°C (typical).

The thermal shutdown feature provides the protection 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 ITE9601 uses the dedicated enable pin with active high (EN) . If the EN pin voltage is < 0.4V, the regulator will be turned off. If the EN pin voltage is > 1.2V, the regulator will be turned on and undergoes a new soft-start cycle. Do not leave the EN pin in floating state when this pin is not used.

Reverse Blocking Function

The ITE9601 supports reverse blocking function. Once the deviation voltage of OUT-IN exceeds a preset value, the reverse block function is triggered. The power MOS will be shut down and block the reverse current flow from OUT to IN immediately.

Power Dissipation

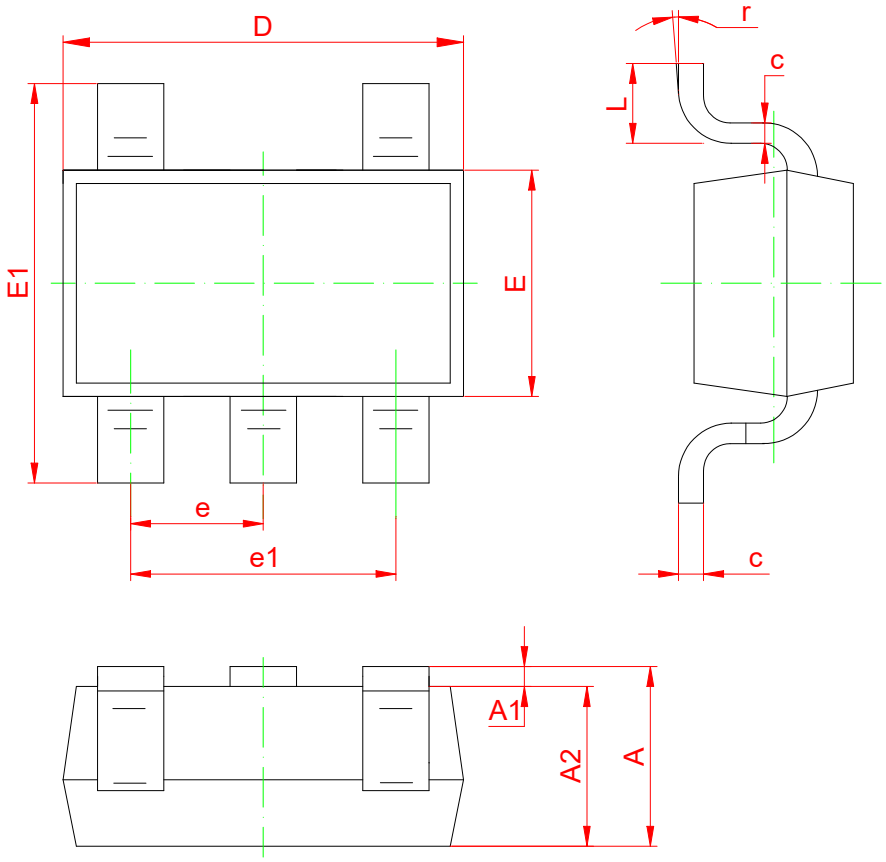
Power dissipation caused by voltage drop across the LDO and by the output current flowing through the device needs to be dissipated out from the chip. The maximum power dissipation is dependent on the PCB layout, number of used Cu layers, Cu layers thickness and the ambient temperature.

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 ITE9601, 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 Outline: 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	0°	8°	0°	8°

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