Capacitor-Free, 300mA, Low-Dropout Regulator

General Description

The ET519XX series of low-dropout linear regulators (LDOs) are ultra-small, low quiescent current LDOs that can source 300 mA with good line and load transient performance. These devices provide a typical accuracy of 1%.

The ET519XX series is designed with a modern capacitor-free architecture to ensure stability without an input or output capacitor. The removal of the output capacitor allows for a very small solution size, and can eliminate inrush current at startup. However, the ET519XX series is also stable with ceramic output capacitors if an output capacitor is necessary. The ET519XX also provides foldback current control during device power-up and enabling if an output capacitor is used. This functionality is especially important in battery-operated devices.

The ET519XX provides an active pull-down circuit to quickly discharge output loads when disabled..

The ET519XX family offered in a small SOT23-5 package, which are ideal for different equipment.

The ET519XX family are available in standard fixed output voltages of 1.2V (ET51912), 1.8V (ET51918), 3.0V (ET51930), etc .

Features

- Wide Input Voltage Range from 1.4V to 5.5V
- Up to 300mA Load Current
- Available in Fixed-Output Voltages: 1.2 V to 3.3 V.
- Very Low I_Q is 60μA typical
- Low Dropout is typical 120mV@3.0V at 300mA Load
- High PSRR: 60dB at 100Hz
- With Auto Discharging Function
- Package Information:

Part No.	Package	MSL
ET519XXTB	SOT23-5 (2.9mm×1.6mm)	Level 3

Applications

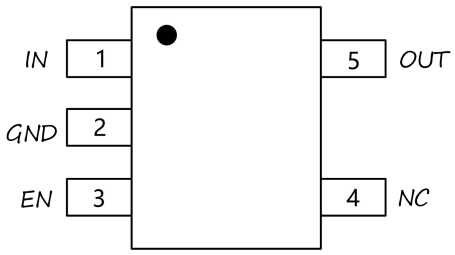
- Tablets and Smartphones
- Notebook and Desktop Computers
- Portable Industrial and Consumer Products
- WLAN and Other PC Add-On Cards
- Camera Modules

Device Information

ET 519 XX X B

XX Output Voltage		**X** Package		**B** Auto-Discharging Function
XX	Output Voltage For example, 18 is 1.8V output	T	SOT23-5	B: with Auto-discharging Function

Pin Configuration



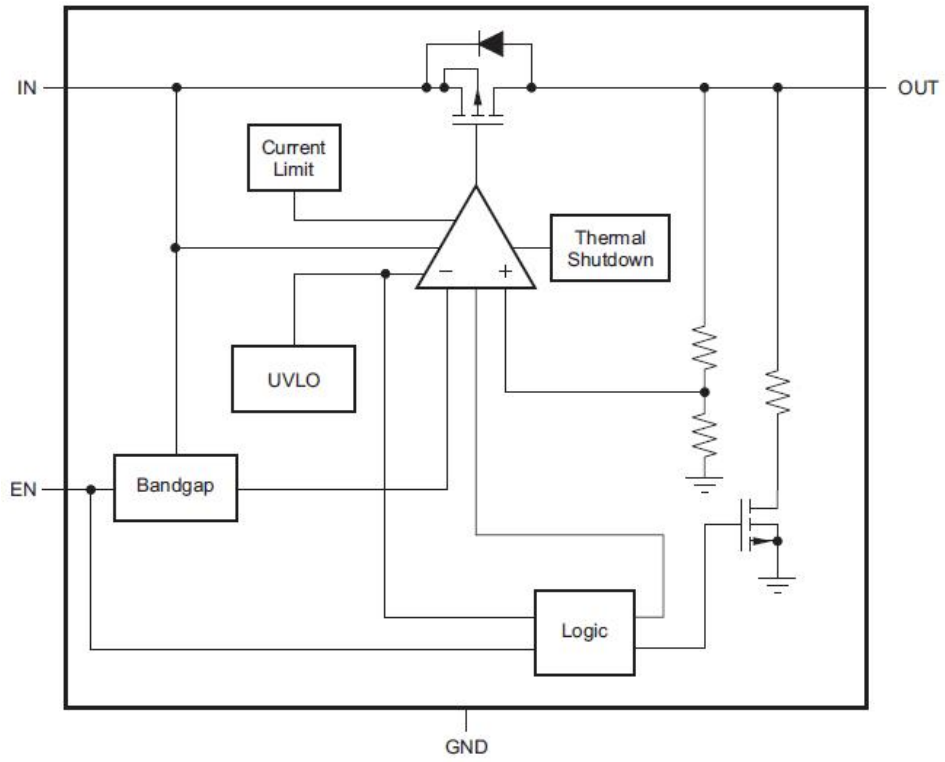
SOT23-5

Top View

Pin Function

Pin No. SOT23-5	Pin Name	Pin Function
1	IN	Supply input pin. Must be closely decoupled to GND with a ceramic capacitor.
2	GND	Ground pin.
3	EN	Enable control input pin, active high. Do not leave EN floating.
4	NC	NC for SOT23-5 no connection.
5	OUT	Output pin. A low-ESR capacitor should be connected to this pin to GND.

Block Diagram



Functional Description

Undervoltage Lockout (UVLO)

The ET519XX uses an undervoltage lockout (UVLO) circuit that disables the output until the input voltage is greater than the rising UVLO voltage, $UVLO_{RISE}$. This circuit ensures that the device does not exhibit any unpredictable behavior when the supply voltage is lower than the operational range of the internal circuitry. During UVLO disable, the output is connected to ground with a 120-Ω pulldown resistor.

Shutdown and Output Enable

A The enable pin (EN) is active high. Enable the device by forcing the EN pin to exceed $V_{EN(HI)}$. Turn off the device by forcing the EN pin to drop below $V_{EN(LO)}$. If shutdown capability is not required, connect EN to IN. There is no internal pulldown resistor connected to the EN pin.

Internal Foldback Current Limit

The ET519XX has an internal foldback current limit that protects the regulator during fault conditions. The current allowed through the device is reduced as the output voltage falls. When the output is shorted, the LDO supplies a typical current of 150 mA. The output voltage is not regulated when the device is in current limit. In this condition, the output voltage is the product of the regulated current and the load resistance. When the device output is shorted, the PMOS pass transistor dissipates power [$(V_{IN} – V_{OUT}) \times I_{OS}$] until thermal shutdown is triggered and the device turns off. After the device cools down, the internal thermal shutdown

circuit turns the device back on. If the fault condition continues, the device cycles between current limit and thermal shutdown. See the Thermal Information table for more details.

The foldback current-limit circuit limits the current allowed through the device to current levels lower than the minimum current limit at nominal V_{OUT} current limit (I_{LIM}) during startup. See Figure 18 to Figure 20 for typical foldback current limit values. If the output is loaded by a constant-current load during startup, or if the output voltage is negative when the device is enabled, then the load current demanded by the load may exceed the foldback current limit and the device may not rise to the full output voltage. For constant-current loads, disable the output load until the ET519XX has fully risen to its nominal output voltage.

The ET519XX PMOS pass element has an intrinsic body diode that conducts current when the voltage at the OUT pin exceeds the voltage at the IN pin. Do not force the output voltage to exceed the input voltage because excessively high current may flow through the body diode.

Thermal Shutdown

Thermal shutdown protection disables the output when the junction temperature rises to approximately 165°C. Disabling the device eliminates the power dissipated by the device, allowing the device to cool. When the junction temperature cools to approximately 140°C, the output circuitry is again enabled. Depending on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This cycling limits regulator dissipation, protecting it from damage as a result of overheating.

Activating the thermal shutdown feature usually indicates excessive power dissipation as a result of the product of the (V_{IN} –V_{OUT}) voltage and the load current. For reliable operation, limit junction temperature to 125°C maximum. To estimate the margin of safety in a complete design, increase the ambient temperature until the thermal protection is triggered; use worst-case loads and signal conditions. The ET519XX internal protection circuitry protects against overload conditions but is not intended to be activated in normal operation. Continuously running the ET519XX into thermal shutdown degrades device reliability.

Absolute Maximum Ratings

Symbol	Parameters (Items)	Value	Unit
V_{IN}	IN Voltage	-0.3 to 6.5	V
V_{EN}	Input Voltage (EN Pin)	-0.3 to V_{IN}+0.3	V
V_{OUT}	Output Voltage	-0.3 to 3.6	V
I_{MAX}	Maximum Load Current	300	mA
V_{ESD}	Human Body Model (JESD22-A114)	±4000	V
	Charged Device Model (JESD22-C101)	±1500	
T_J	Operating Junction Temperature	-40 to 150	°C
T_{STG}	Storage Temperature	-65 to 160	°C
T_{SL}	Lead Temperature (Soldering, 10 sec)	300	°C

Thermal Characteristics

Symbol	Package	Parameters	Value	Unit
$R_{\theta JA}$	SOT23-5	Thermal Resistance, Junction-to-Air	228.4	°C/W
			218.6	
$R_{\Psi JC}$[(1)]	SOT23-5	Thermal Resistance, Junction-to-Top case	151.5	°C/W
			164.8	
P_{DMAX}	SOT23-5	Power Dissipation	800	mW

Note1: Test at T_A=25℃ with the component mounted on 5*5mm, FR4, 2layer, Top and Bottom layer 1oz.

Recommended Operating Conditions

Symbol	Parameters	Rating	Unit
V_{IN}	Input Voltage	1.4 to 5.5	V
V_{OUT}	Output Voltage	1.2 to 3.3	V
V_{EN}	Enable Voltage	0 to V_{IN}	V
I_{OUT}	Output Current	0 to 300	mA
T_A	Operating Ambient Temperature	-40 to 125	ºC

Electrical Characteristics[(2)]

(V_{IN}=V_{OUT}+0.5V or 2V (whichever is greater), V_{EN} = V_{IN}, I_{OUT}=1mA, T_A=25ºC, unless otherwise stated)

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage Range		1.4		5.5	V
V_{OUT}	DC output accuracy	T_A = 25°C	-1%		1%	
		-40°C ≤ T_A ≤ 125°C	-2%		2%	
UVLO	Undervoltage lockout	VIN rising		1.3	1.4	V
		VIN falling		1.25		V
V_{DROP}	Dropout Voltage VOUT=0.98 ×VOUT(nom), IOUT = 300 mA	V_{OUT}=1.2V[(3)]		250	450	mV
		V_{OUT} =1.8V [(3)]		180	260	mV
		V_{OUT}=3.0V[(3)]		120	180	mV
I_Q	Quiescent Current	I_{OUT}=0mA,V_{OUT}=3.0V		60	90	μA
I_{SHDN}	Shutdown Current	V_{EN} =0V, T_A = 25°C		0.1	1	μA
ΔV_{OUT}	Output Voltage Line Regulation	V_{IN}=V_{OUT}+0.5V to 5.5V, I_{OUT}=10mA,V_{OUT}=3.0V		0.1	0.5	%/V
	Output Voltage Load Regulation	I_{OUT} from 1mA to 300mA V_{OUT}=3.0V		20	40	mV

Electrical Characteristics (Continued)

(V_{IN}=V_{OUT}+0.5V or 2V (whichever is greater), V_{EN} = V_{IN}, I_{OUT}=1mA,T_A=25°C, unless otherwise stated)

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
I_{LIMIT}	Current Limit	V_{IN}=V_{OUT}+0.5V		500	700	mA
I_{SHORT}	Short Current Limit	VOUT=3.0V，VOUT shorted to GND		120		mA
PSRR	Power Supply Rejection Ratio	VOUT = 3.0V, f=100Hz, I_{OUT}=300mA		60		dB
e_N	Output Noise	10Hz to 100kHz, I_{OUT}=10mA, V_{OUT}=3.0V,		240		μV_{RMS}
V_{IL}	EN Low Threshold	V_{EN} falling until the output is disabled			0.35	V
V_{IH}	EN High Threshold	V_{EN} rising until the output is enabled	0.9			V
I_{EN}	EN Pin Input Current	V_{EN}=5.5V		0.01		μA
R_{LOW}	Output Resistance of Auto Discharge at Off State	VOUT = 3V, EN=0V, V_{IN}=3.5V, I_{OUT}=10mA		120		Ω
T_S	Soft-start Time	Time from EN assertion to 98% × V_{OUT}(nom), V_{OUT}=3.0V, I_{OUT} = 0 mA		350		μs
T_{TSD}	Over-temperature Shutdown Threshold	Temperature Increasing from T_A=+25°C		165		°C
T_{HYS}	Over-temperature Shutdown Hysteresis	Temperature Falling from T_{SD}		25		°C

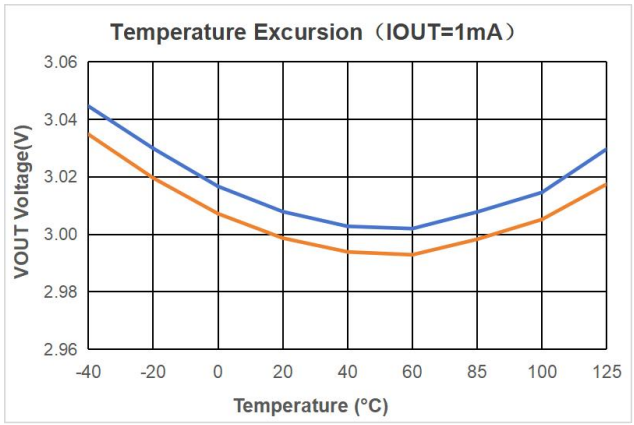
Note2: Production test at 25°C. Specifications over the temperature range are guaranteed by design and characterization.

Note3: The minimum operating voltage is 1.4V. V_{DROP}=V_{IN} (min)-V_{OUT}.

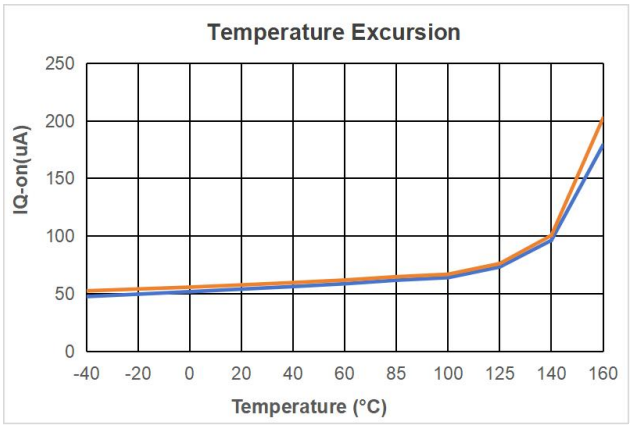
Typical Characteristics

(1) VOLTAGE VERSION 3.0 V

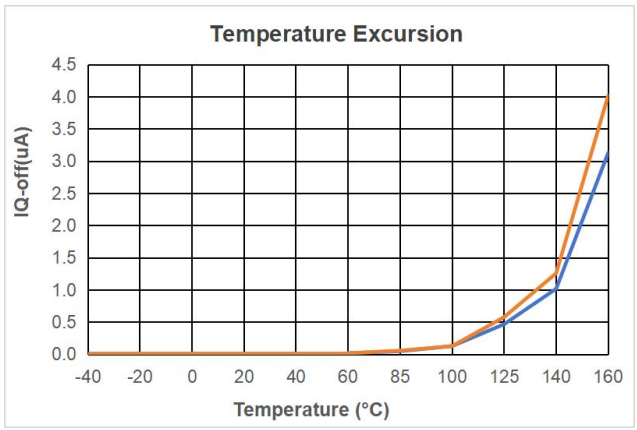
(V_{IN}=3.5V; I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted. Typical values are at T_A=25°C.)



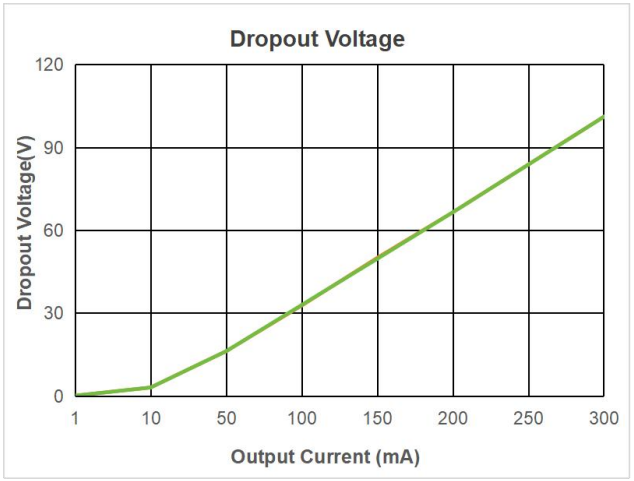
Output Voltage VS Temperature



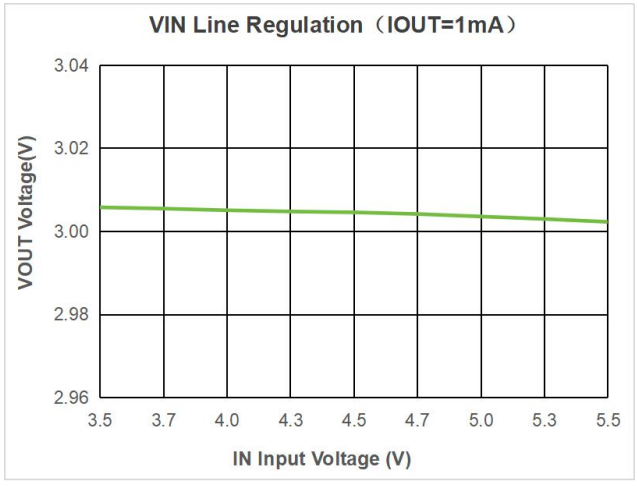
Supply Current VS Temperature



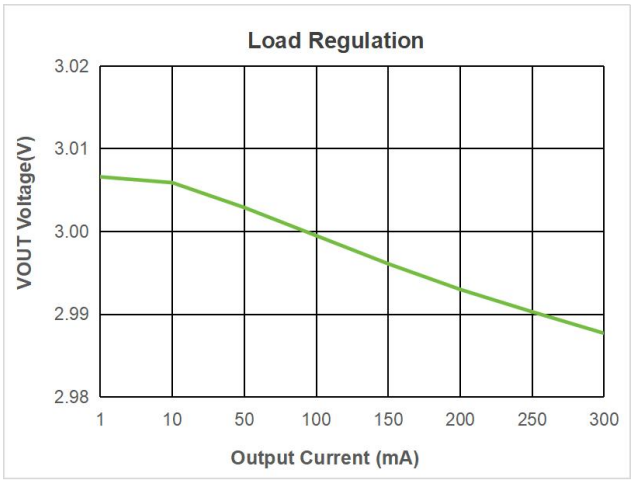
Shutdown Current VS Temperature



Dropout Voltage VS Output Current



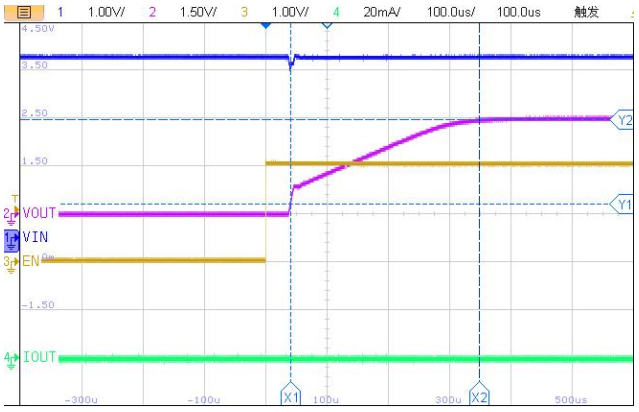
Output Voltage VS Input Voltage



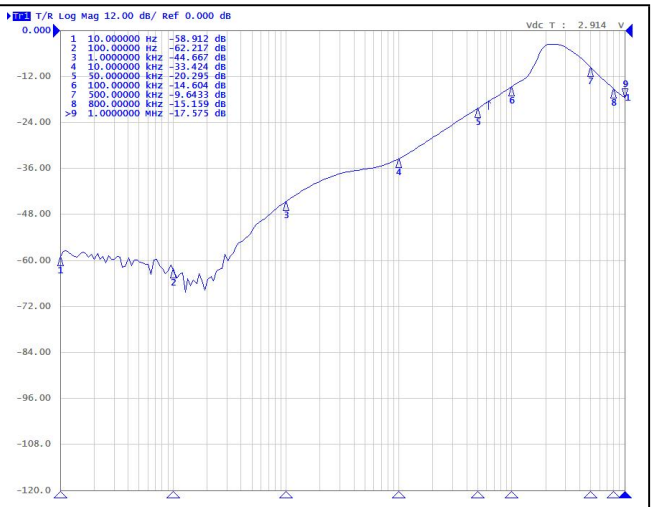
Output Voltage VS Output Current

Typical Characteristics (Continued)

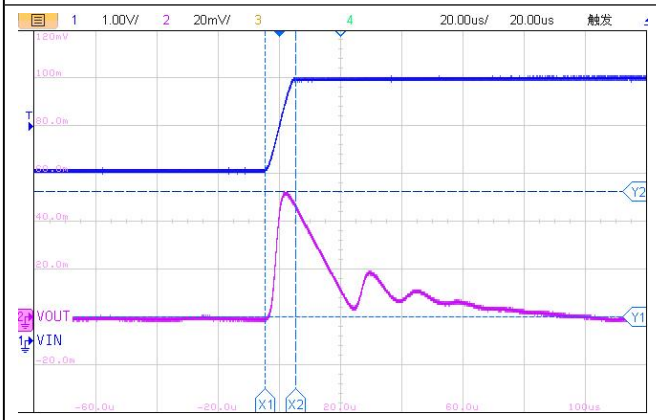
(V_{IN}=3.5V; I_{OUT}=1mA, C_{IN}=C_{OUT}=1.0μF, unless otherwise noted. Typical values are at T_A=25°C.)



Turn On Speed VS EN Voltage (I_{OUT}=0mA)

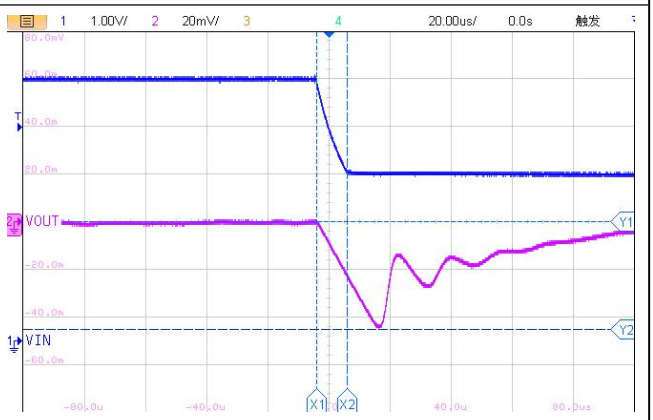


PSRR I_{OUT}=300mA



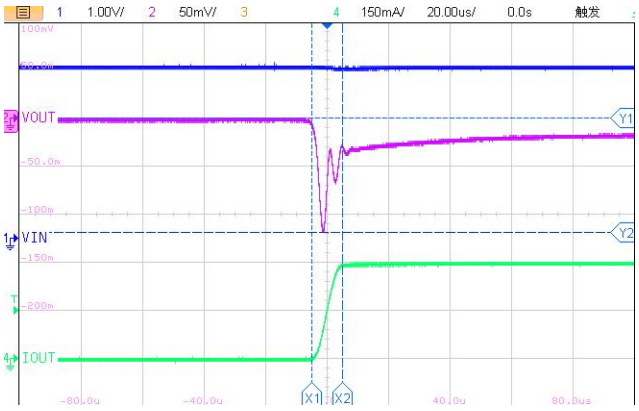
Line Transient Response

V_{IN}=3.5V~5.5V, V_{OUT}=3.0V, I_{OUT}=1mA



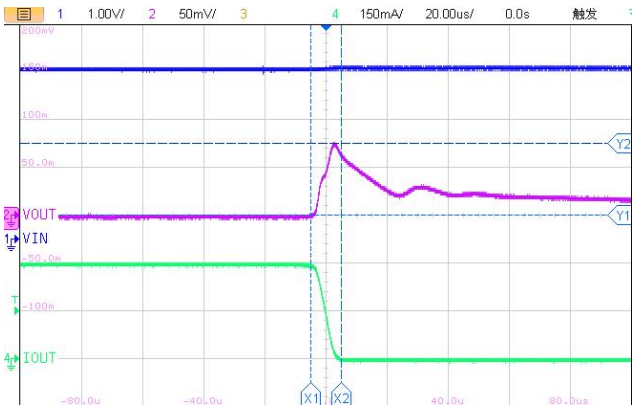
Line Transient Response

V_{IN}=5.5V~3.5V, V_{OUT}=3.0V, I_{OUT}=1mA



Load Transient Response

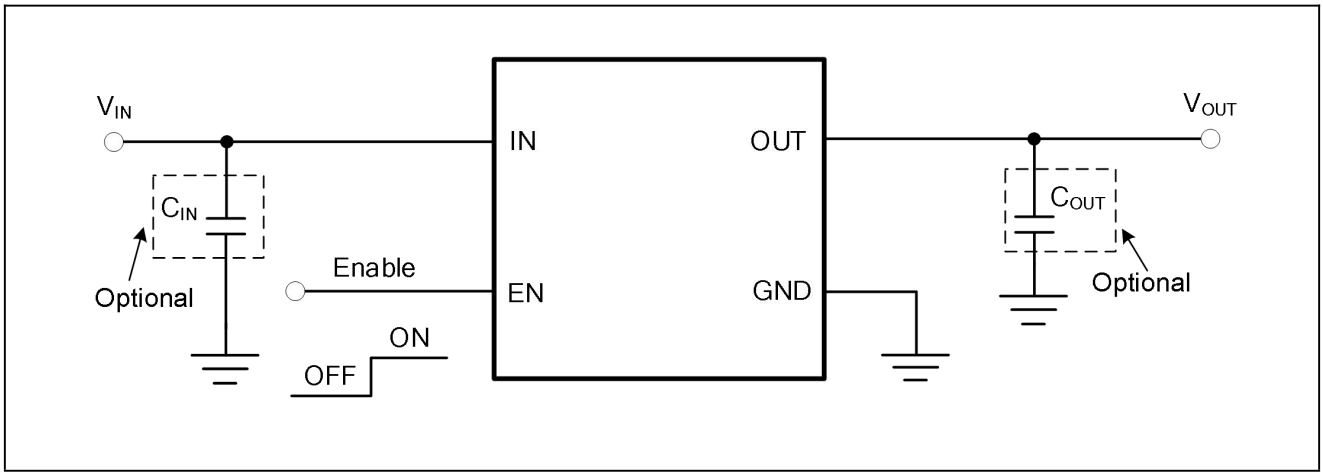
V_{IN}=3.5V, V_{OUT}=3.0V, I_{OUT}=1mA~300mA



Load Transient Response

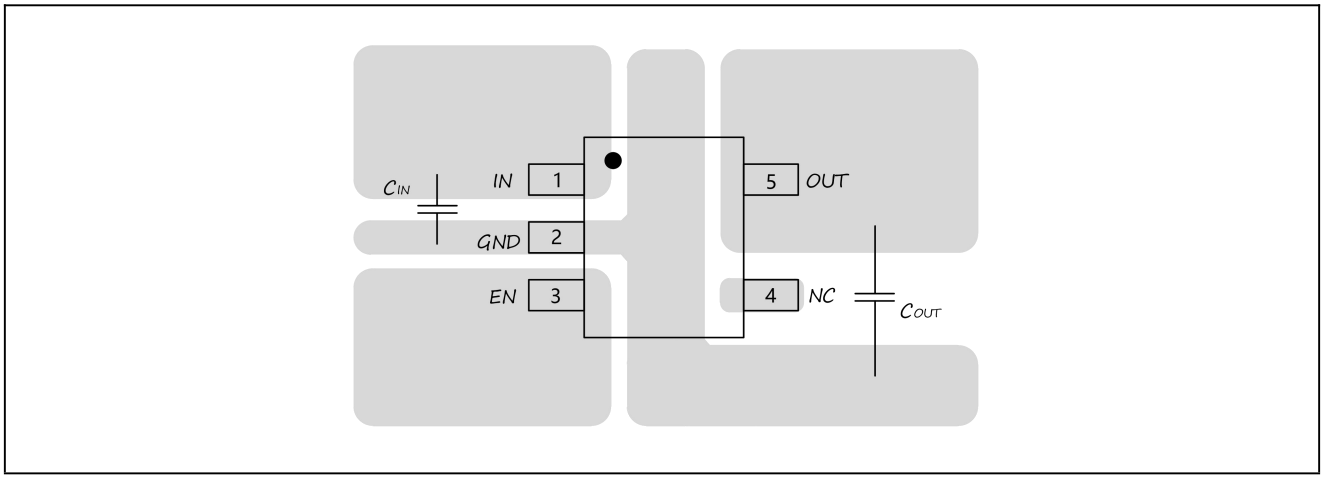
V_{IN}=3.5V, V_{OUT}=3.0V, I_{OUT}=300mA~1mA

Application Circuits



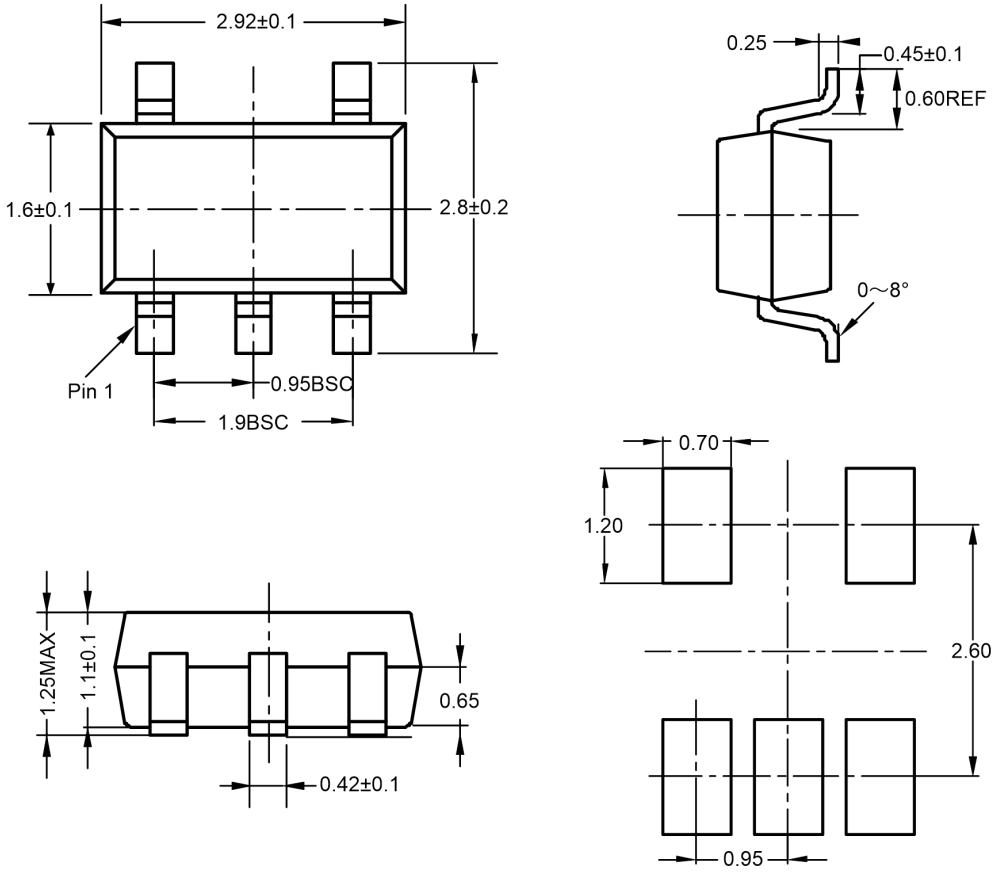
PCB Layout Guide

SOT23-5



Package Dimension

SOT23-5



Recommended Land Pattern

Unit: mm

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2024-10-21	Original Version	Zhangwang	Liuxm	
0.1	2024-11-30	Preliminary Version	CuiZw	Liuxm	