ET635XX - Ultra-Low I_Q 300mA LDO

General Description

The ET635XX series of CMOS low dropout regulators are designed specifically for portable battery-powered applications which require ultra-low quiescent current. The ultra-low consumption of type 0.20μA ensures long battery life and dynamic transient boost feature improves device transient response for wireless communication applications.

The ET635XX has fast response to input voltage transients and load current transients, and ensures no over voltage during startup and short-circuit recovery. The ET635XX series integrates short-circuit protection and current limiting protection functions. Activate the shutdown mode by pulling down the EN pin.

The ET635XX family offered in small SOT23-5, DFN4 packages.

Features

- Operating Input Voltage Range from 2.0V to 5.5V
- Standard Fixed Output Voltage: 1.2V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V and 3.6V etc.
- Ultra-Low Quiescent Current Typical 0.20μA
- Low Dropout is Typical 100mV at 100mA@V_{OUT}=3.3V
- High Output Voltage Accuracy ±2%
- Over-Current Protection
- Short-Current Protection
- Thermal Shutdown Protection
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant
- Auto-Discharging Function

Device Information

ET 635 XX XX

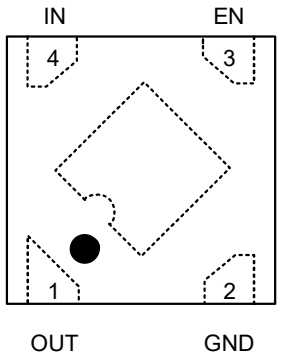
XX Output Voltage		**XX** Package Information	
XX	Output Voltage X.XV For example, 18 is 1.8V output	YB	DFN4 (1mm × 1mm)
		Blank	SOT23-5

Part No.	Package	Packing Option	MSL
ET635XXYB	DFN4 (1mm × 1mm)	Tape and Reel, 10K/Reel	1
ET635XX	SOT23-5 (1.6mm × 2.9mm)	Tape and Reel, 3K/Reel	3

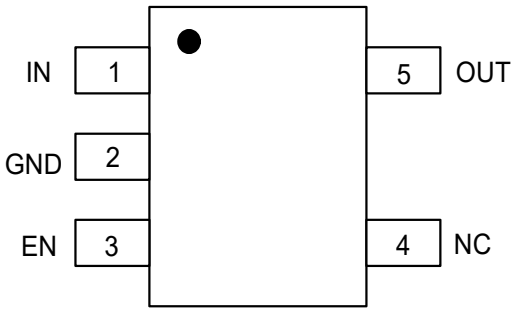
Applications

- Battery Powered Equipment
- Portable Communication Equipment
- Cameras, Image Sensors and Camcorders
- Label Information

Pin Configuration



DFN4



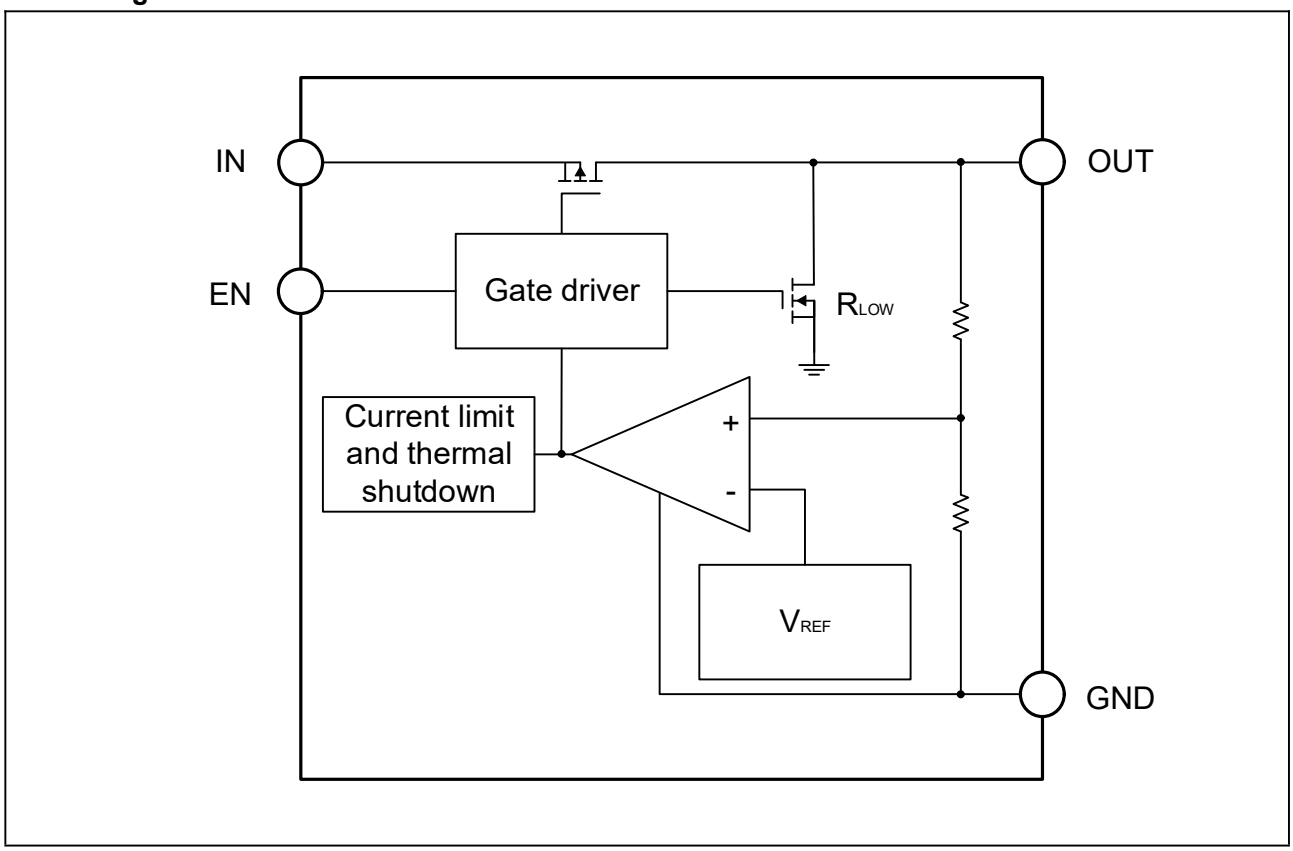
SOT23-5

Top View

Pin Function

Pin No.		Pin Name	Pin Function
DFN4	SOT23-5		
1	5	OUT	Output Pin. A low-ESR capacitor should be connected to this pin to GND.
2	2	GND	Ground Pin.
3	3	EN	Enable Control Input Pin, Active High. Do not leave EN floating
4	1	IN	Supply Input Pin. Must be closely decoupled to GND with a ceramic capacitor
-	4	Thermal Pad or NC	Thermal Pad for DFN4 Package, Connect to GND or Leave Floating. Do not connect to any potential other than GND. NC for SOT23-5 no connection.

Block Diagram



Functional Description

General

The ET635XX is a high performance 300mA linear regulator with ultra-Low I_Q. This device delivers low Noise and high-Power Supply Rejection Ratio with excellent dynamic performance due to employing the Dynamic Quiescent Current adjustment which assure ultra-low I_Q consumption at no-load state. These parameters make this device very suitable for various battery powered applications.

Input Capacitor

It is recommended to connect at least a 1.0μF Ceramic X5R or X7R capacitor between IN and GND pins of the device. This capacitor will provide a low impedance path for any unwanted AC signals or Noise superimposed onto constant Input Voltage. The good input capacitor will limit the influence of input trace inductances and source resistance during sudden load current changes.

Higher capacitance and lower ESR Capacitors will improve the overall line transient response.

Output Capacitor

It is recommended to connect at least a 1.0μF Ceramic X5R or X7R capacitor between OUT and GND pins of the device. This capacitor will provide a low impedance path for any unwanted AC signals or Noise superimposed onto constant Input Voltage.

There is recommended connect the output capacitor as close as possible to the output pin of the regulator.

ON/OFF Input Operation

The ET635XX uses the EN pin to enable /disable its device and to activate /deactivate the active discharge function at devices with this feature. If the EN pin voltage is pulled below 0.4V the device is guaranteed to be disable. The active discharge transistor at the devices with Active Discharge Feature is activated and the output voltage V_{OUT} is pulled to GND through an internal circuitry with effective resistance about 80Ω.

If the EN pin voltage is higher than 1.0V the device is guaranteed to be enabled. The internal active discharge circuitry is switched off and the desired output voltage is available at output pin. In case the Enable function is not required the EN pin should be connected directly to input pin.

Current Limit Protection

When output current at the OUT pin is higher than current limit threshold, the current limit protection will be triggered and clamp the output current to approximately 550mA to prevent over-current and to protect the regulator from damage due to overheating.

Thermal shutdown Protection

When the die temperature exceeds the Thermal Shutdown point (T_{TSD} = 150°C typical) the device goes to disabled state and the output voltage is not delivered until the die temperature decreases to 125°C. The Thermal Shutdown feature provides a protection from a catastrophic device failure at accidental overheating. This protection is not intended to be used as a substitute for proper heat sinking.

Power Dissipation and Heat sinking

The maximum power dissipation supported by the device is dependent upon board design and layout. Mounting pad configuration on the PCB, the board material and the ambient temperature affect the rate of junction temperature rise for the part. The maximum power dissipation the ET635XX device can handle is given by:

$$\mathbf{P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}}$$

Absolute Maximum Ratings

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

Symbol	Parameters (Items)	Value	Unit
V_{IN}	IN Pin Voltage(1)	-0.3 to 6.0	V
V_{EN}	EN Pin Voltage	-0.3 to 6.0	V
V_{OUT}	OUT Pin Voltage	-0.3 to 6.0	V
T_J	Junction Temperature	-40 to 150	°C
T_{STG}	Storage Temperature	-65 to 150	°C
V_{ESD}(2)	Human Body Model ESD	±2000	V
	Charged Device Model ESD	±1000	
I_{LU}(2)	Latch Up Current Maximum Rating	±200	mA

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

Note1: Refer to Electrical Characteristics and Application Information for Safe Operating Area.

Note2: This device series incorporates ESD protection and is tested by the following methods:

ESD Human Body Model tested per JEDEC JS-001;

CDM tested per JEDEC JS-002;

Latch up Current Maximum Rating tested per JEDEC JESD78F.

Thermal Characteristics

Symbol	Package	Ratings	Value	Unit
$R_{\theta JA}$	DFN4	Thermal Characteristics, Thermal Resistance, Junction-to-Air	250	°C/W
	SOT23-5		250	
P_D	DFN4	Power Dissipation in Still Air at 25°C	400	mW
	SOT23-5		400	

Recommended Operating Conditions

Symbol	Parameters	Rating	Unit
V_{IN}	Input Voltage	2.0 to 5.5	V
I_{OUT}	Output Current	0 to 300	mA
T_A	Operating Ambient Temperature	-40 to 85	ºC
C_{IN}	Effective Input Ceramic Capacitor Value	1.0 to 10	μF
C_{OUT}	Effective Output Ceramic Capacitor Value	1.0 to 10	μF
ESR	Input and Output Capacitor Equivalent Series Resistance (ESR)	5 to 100	mΩ

Electrical Characteristics

(V_{IN}=V_{OUT}+1V, V_{EN} =1.2V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1μF, T_A=25°C, unless otherwise stated)

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage Range(3)		2.0		5.5	V
I_{Q_ON}	Input Quiescent Current	Active Mode: V_{EN} = V_{IN}		0.20		μA
I_{Q_OFF}	Input Shutdown Current	V_{EN}=0V		0.01		μA
V_{OUT}	Regulated Output Voltage	I_{OUT} = 1mA, -40°C ≤ T_A ≤ 85°C	-2		2	%
Reg_{LINE}	Line Regulation(6)	V_{IN}=V_{OUT}+1V to 5.5V, I_{OUT}=10mA		0.01	0.2	%/V
Reg_{LOAD}	Load Regulation(6)	I_{OUT} from 0mA to 300mA		10	30	mV
V_{DROP}	Dropout Voltage	V_{OUT} = 1.8V, I_{OUT} = 100mA		135		mV
		V_{OUT} = 1.8V, I_{OUT} = 300mA		440		mV
		V_{OUT} = 3.3V, I_{OUT} = 100mA		100		mV
		V_{OUT} = 3.3V, I_{OUT} = 300mA		370		mV
I_{LIMIT}	Current Limit		300	550		mA
I_{SHORT}	Short Current Limit	V_{OUT} = 0V		80		mA
PSRR	Power Supply Rejection Ratio(5)	f = 1kHz, I_{OUT} = 20mA		60		dB
		f = 10kHz, I_{OUT} =20mA		48		dB
e_N	Output Noise(5)	10Hz to 100kHz, I_{OUT} = 20mA, V_{OUT} = 3.3V		70		$μV_{RMS}$
V_{IL}	EN Low Threshold	V_{IN} = 1.8V to 5.5V, V_{EN} Falling Until the Output is Disabled			0.4	V
V_{IH}	EN High Threshold	V_{IN} = 1.8V to 5.5V, V_{EN} Rising Until the Output is Enabled	1.0			V
I_{EN}	EN Pin Input Current	V_{EN} = 0V		0	0.1	μA
R_{LOW}	Output Resistance of Auto Discharge at Off State	V_{EN} = 0V, V_{IN} = 4V, I_{OUT} = 10mA		80		Ω
T_{ON}	Soft-start Time	V_{OUT} = 3.3V		500		μs
T_{TSD}	Over-temperature Shutdown Threshold(5)	T_J Rising		150		°C
T_{HYS}	Over-temperature Shutdown Hysteresis(5)	T_J Falling from Shutdown		25		°C

Note3: Here V_{IN} means internal circuit can work normal. If V_{IN} < V_{OUT}, Output voltage follows V_{IN} (I_{OUT} = 1mA), circuit is safety.

Note4: V_{DROP} FT test method: test the V_{OUT} voltage at V_{SET} + $V_{DROPMAX}$ with 300mA output current.

Note5: Guaranteed by design and characterization. not a FT item.

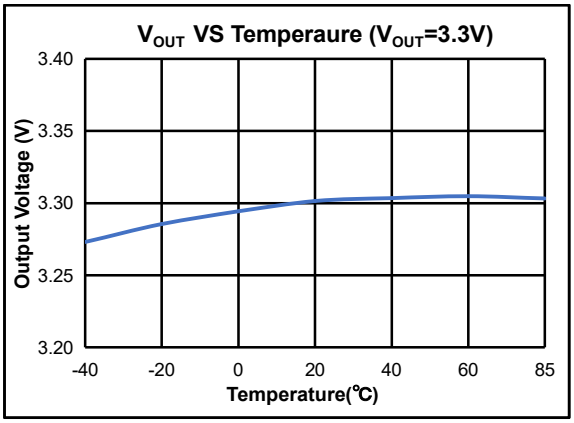
Note6: At high temperatures, the maximum load current can be calculated according to the following formula:

$$I_{OUT_MAX} = (T_J - T_A) / R_{\theta JA} / (V_{IN} - V_{OUT})$$

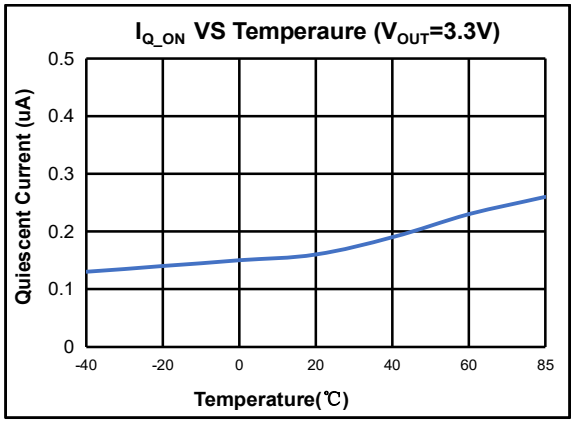
Typical Characteristics

VOLTAGE VERSION 3.3V

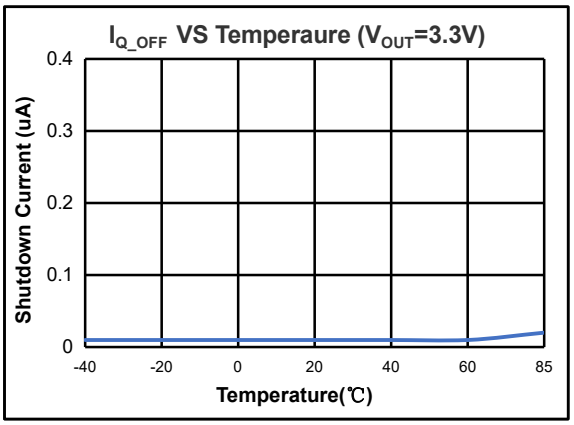
(V_{IN}=4.3V, I_{OUT}=1mA, C_{IN}=C_{OUT}=1μF, unless otherwise noted. Typical values are at T_A=+25°C.)



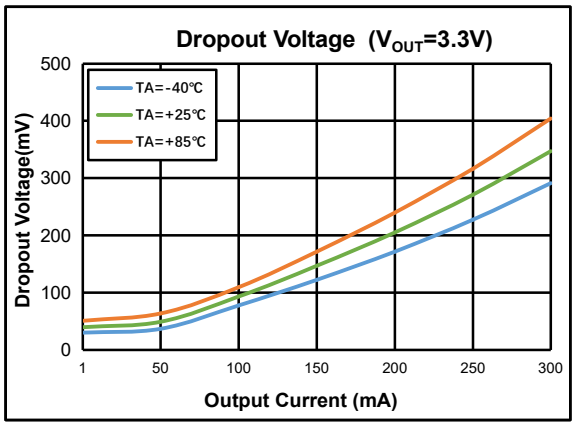
Output Voltage VS Temperature



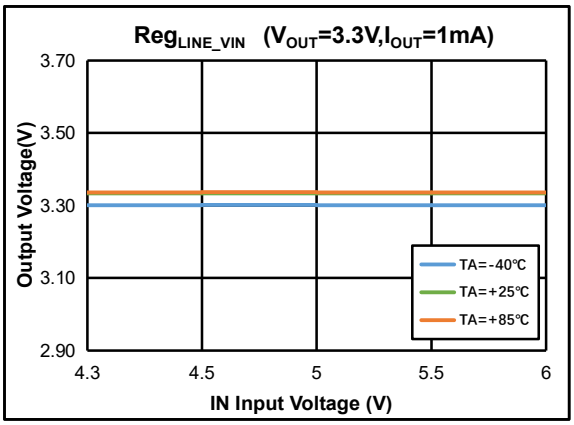
Quiescent Current VS Temperature



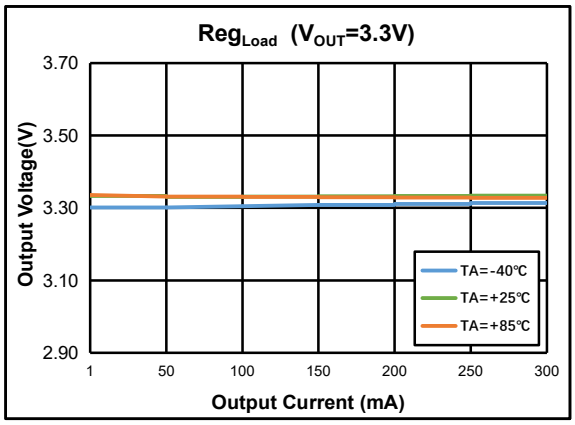
Standby Current VS Temperature



Dropout Voltage VS Output Current

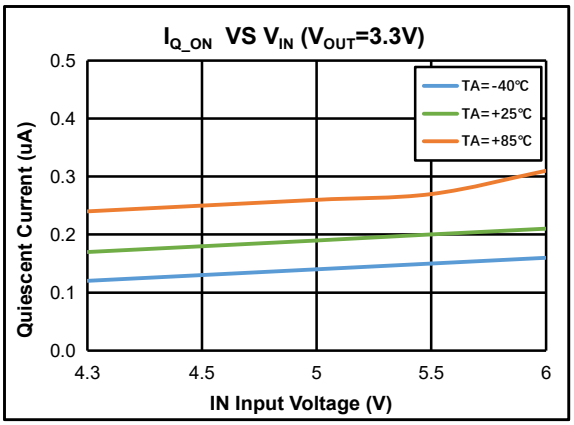


Output Voltage VS Input Voltage

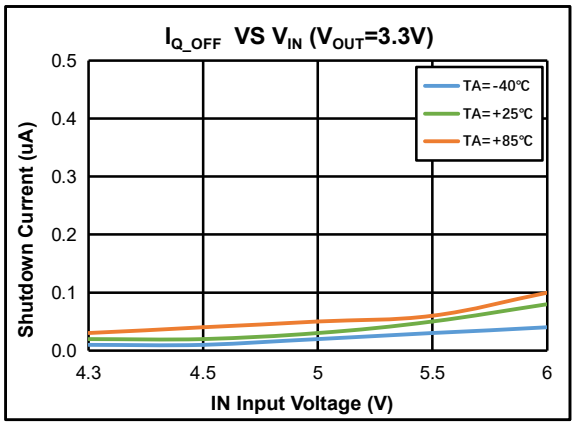


Output Voltage VS Output Current

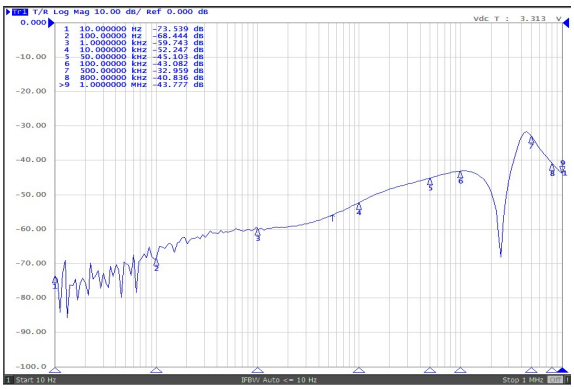
Typical Characteristics (Continued)



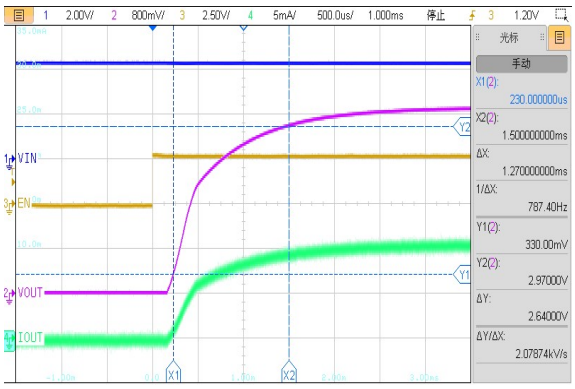
Supply Current VS Input Voltage



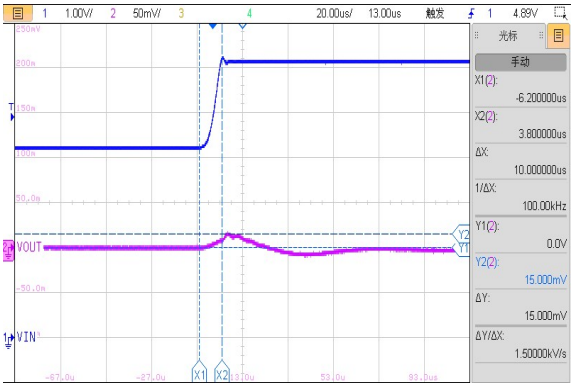
Shutdown Current VS Input Voltage



PSRR VS Output Current(I_{OUT}=20mA)

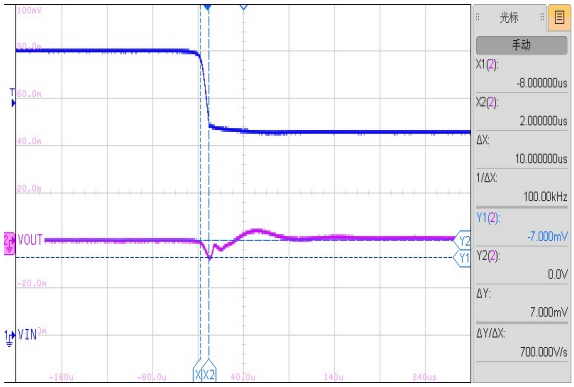


Turn On Speed VS EN Voltage (I_{OUT}=20mA)



Line Transient Response

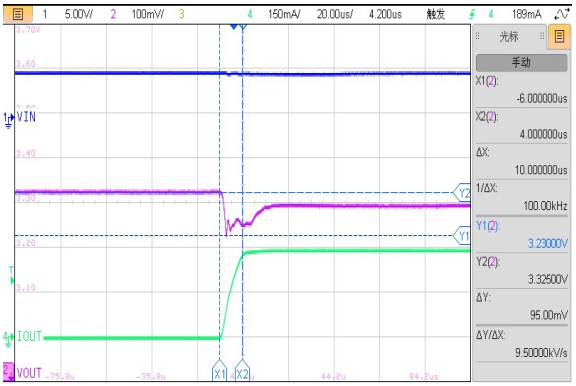
V_{IN}=4.3V~5.5V, V_{OUT}=3.3V, I_{OUT}=1mA, tr=10μs



Line Transient Response

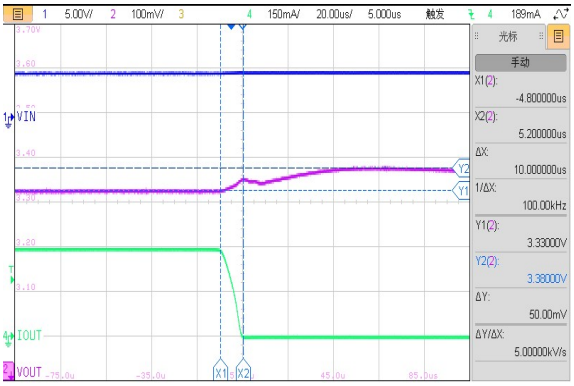
V_{IN}=5.5V~4.3V, V_{OUT}=3.3V, I_{OUT}=1mA, tf=10μs

Typical Characteristics (Continued)



Load Transient Response

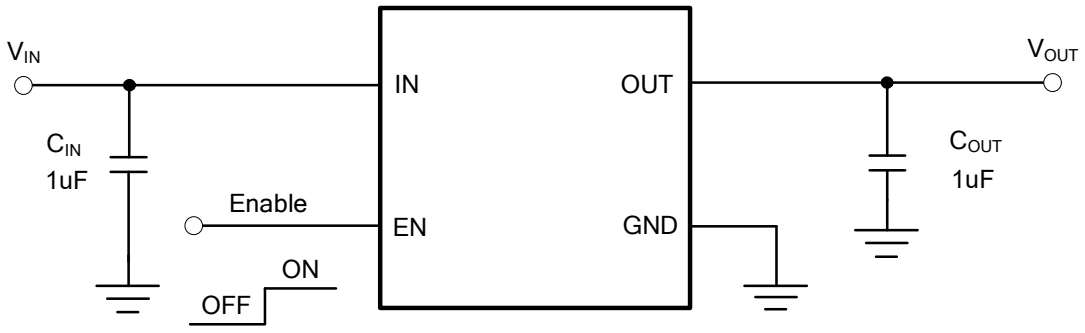
V_{IN}=4.3V, V_{OUT}=3.3V, I_{OUT}=1mA~300mA, tr=10μs



Load Transient Response

V_{IN}=4.3V, V_{OUT}=3V, I_{OUT}=300mA~1mA, tf=10μs

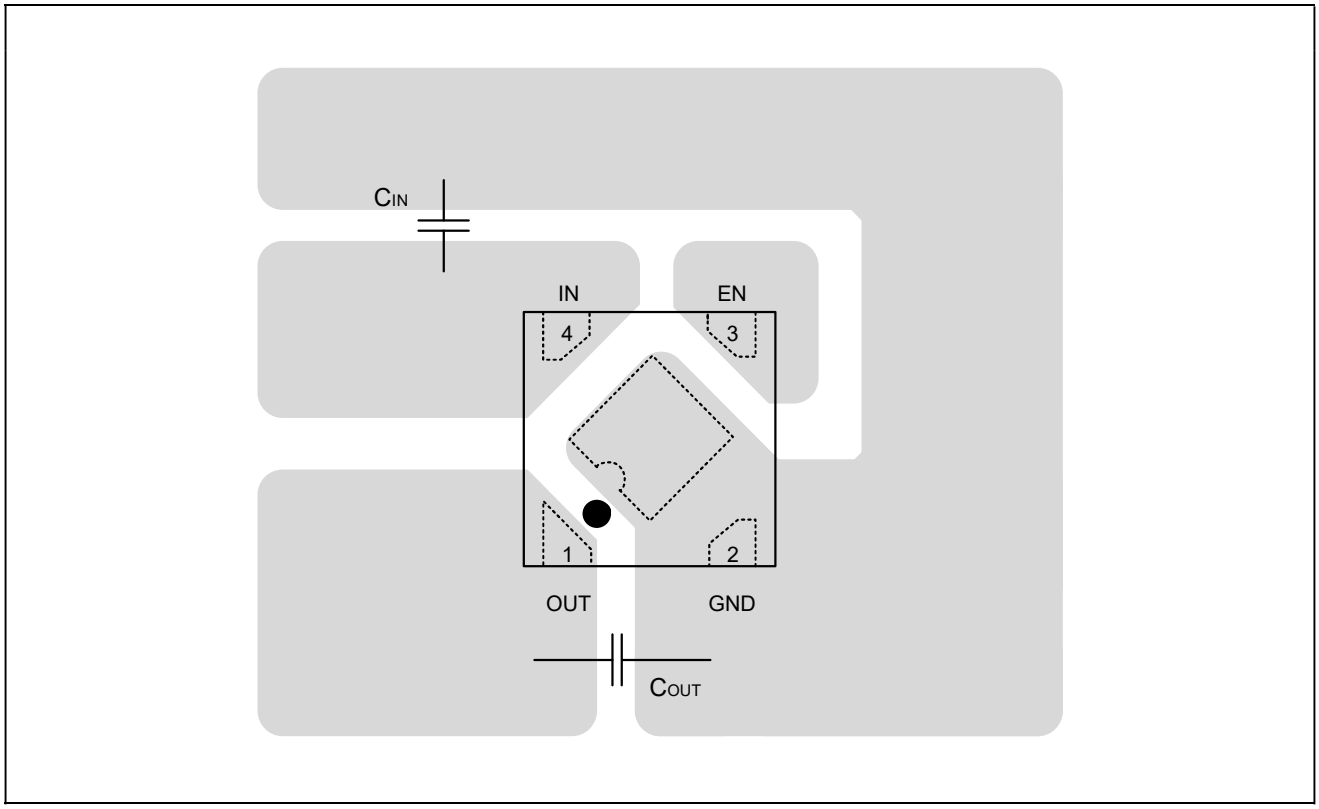
Application Circuits



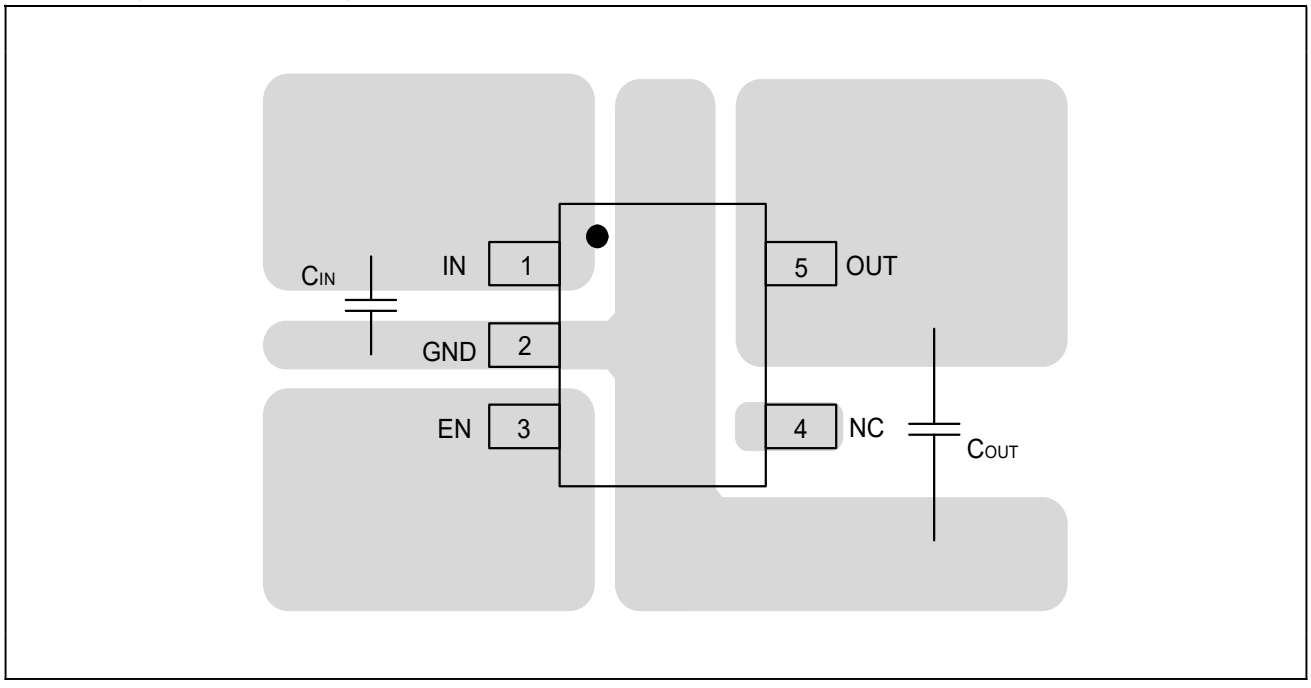
Reference Application Circuit

PCB Layout Guide

DFN4 (1mm × 1mm)

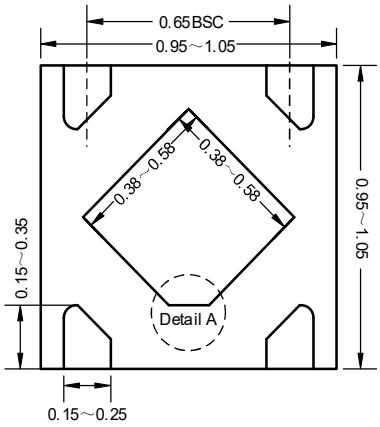


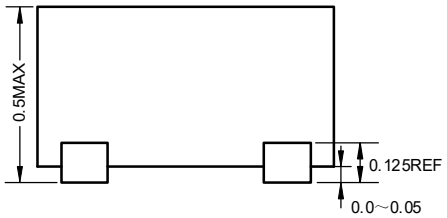
SOT23-5 (1.6mm × 2.9mm)

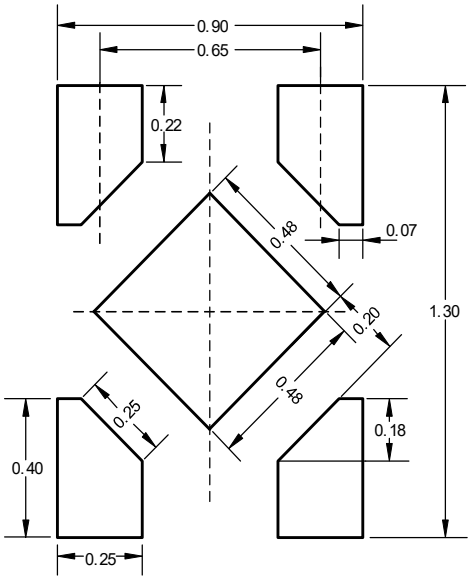


Package Dimension

DFN4 (1mm × 1mm)

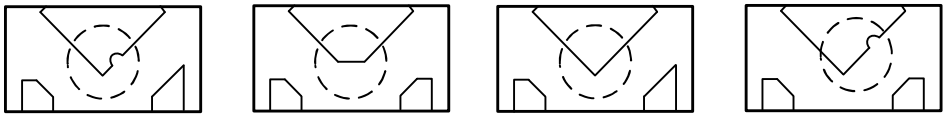






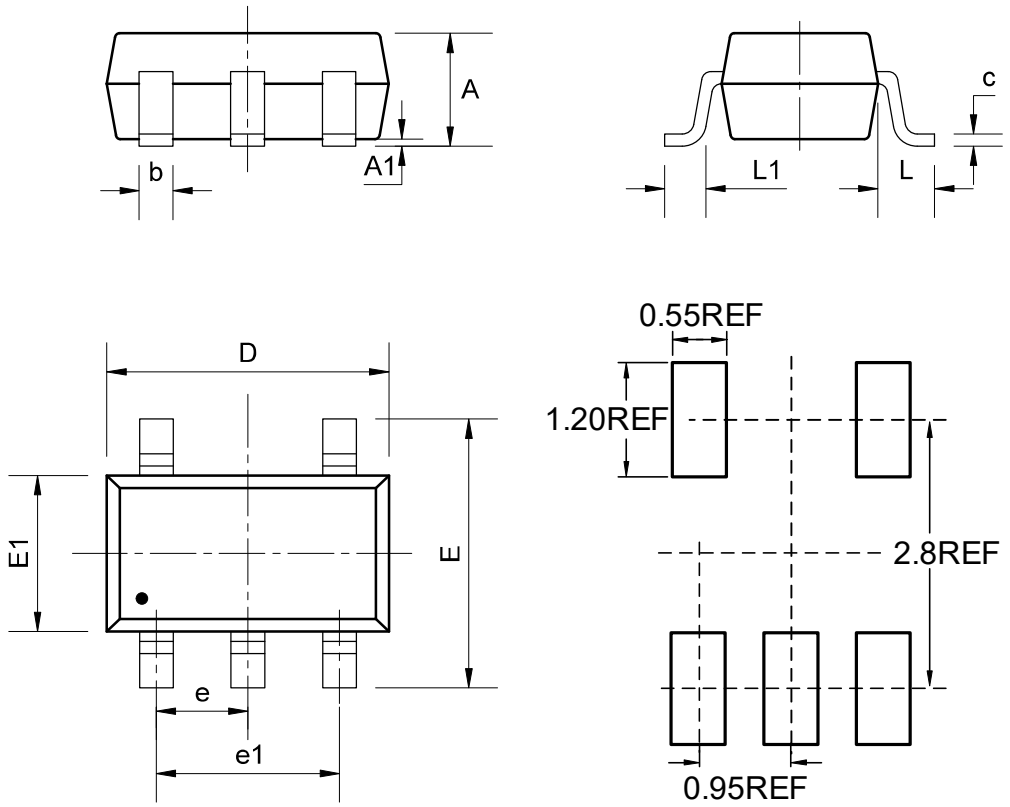
Recommended Land Pattern

Detail A: (PIN1 shape)



Unit: mm

SOT23-5 (1.6mm × 2.9mm)

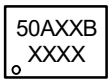


COMMON DIMENSIONS

(Unit: mm)

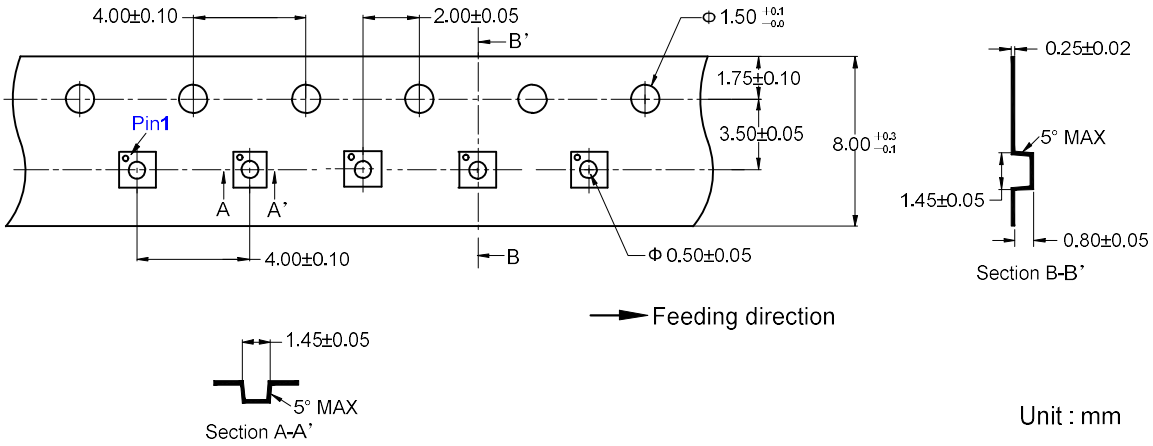
SYMBOL	MIN	NOM	MAX
A	-	-	1.45
A1	0.00	-	0.15
b	0.28	0.35	0.50
c	0.08	0.15	0.22
D	2.75	2.9	3.05
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
E	2.60	2.80	3.00
E1	1.45	1.6	1.75
L	0.60REF		
L1	0.30	0.45	0.60

Marking

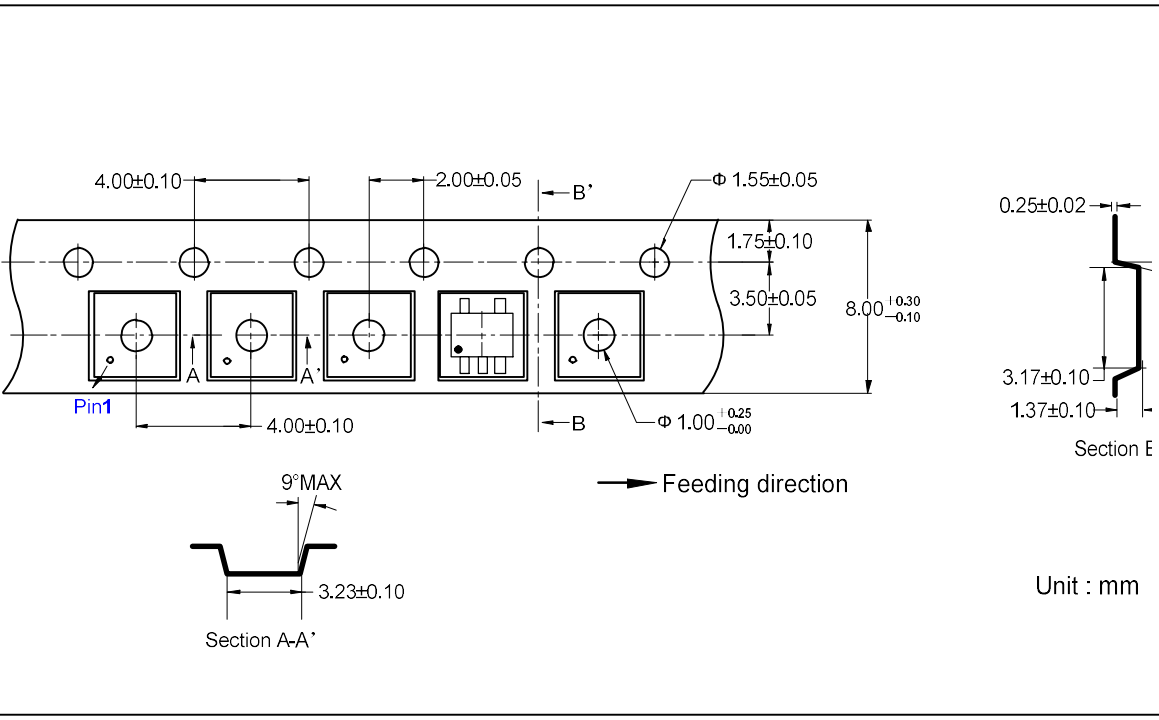
SOT23-5 Package	DFN4 Package
	
50A & B = Part Number	XX = V_{OUT} Version(1)
XX = V_{OUT} Version	XX = Tracking Number(2)
XXXX = Tracking Number	

Tape Information

DFN4 (1.0mm × 1.0mm)



SOT23-5 (1.6mm × 2.9mm)



Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2024-11-30	Preliminary Version	Tugz	Liuxm	Liujy
1.0	2025-02-19	Official Version	Pengjj	Liuxm	Liujy
1.1	2025-07-22	Update V_{IN} Range	Pengjj	Liuxm	Liujy
1.2	2025-12-24	Update Marking	Hucy	Liuxm	Liujy
1.2.a	2026-06-23	Update Marking	Yangxx	Liuxm	Liujy