Very High PSRR Low Noise 500mA RF LDO

General Description

The ET559XX is the high performance 500mA LDO with auto discharge function, it uses an advanced CMOS process and a PMOSFET pass device to achieve very high-power supply rejection ratio (PSRR), very low noise, very low dropout, very low ground current, fast start-up and excellent output accuracy.

The ET559XX is stable with a 1.0μF ceramic input and output capacitor, uses a precision voltage reference and feedback loop to achieve high excellent Regulation and transient response.

The ET559XX is offered small DFN4(1x1) and SOT23-5 package, which is ideal for small form factor portable equipment.

Features

- Wide Input Voltage Range: 1.9V to 6.5V
- Up to 500mA Load Current
- Standard Output Voltage: 3.6V, 5.0V and etc
- Very Low IQ: 60μA
- Ultra Low Dropout: 330mV at 500mA Load @V_{OUT}=3.6V
- Very High PSRR: 75dB at 1KHz
- Ultra Low Noise: 45uVrms at 3.6V output
- Ultra-Fast Start-Up Time: 80μs
- Excellent Load/Line Transient Response
- Line Regulation: 0.03% typical
- Package:

Part No.	Package	Packing Option	MSL
ET559XXYB	DFN4(1mm x 1mm)	Tape and Reel,10K	Level 1
ET559XXB	SOT23-5	Tape and Reel,3K	Level 3

Applications

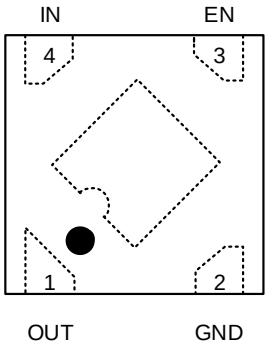
- Smart Phones and Cellular Phones
- Portable instruments

Device Information

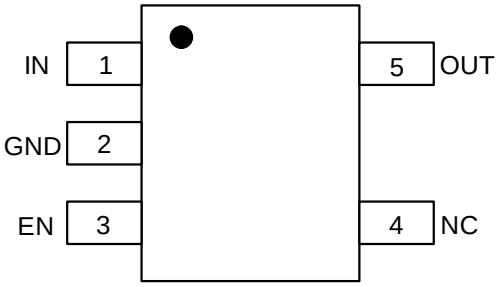
ET 559 XX X B

XX Output Voltage		X Package		B Auto-discharge Function	
XX	Output Voltage is X.XV	Y	DFN4-1.0×1.0	B	Auto-discharge
		/	SOT23-5		

Pin Configuration



DFN4(1×1)



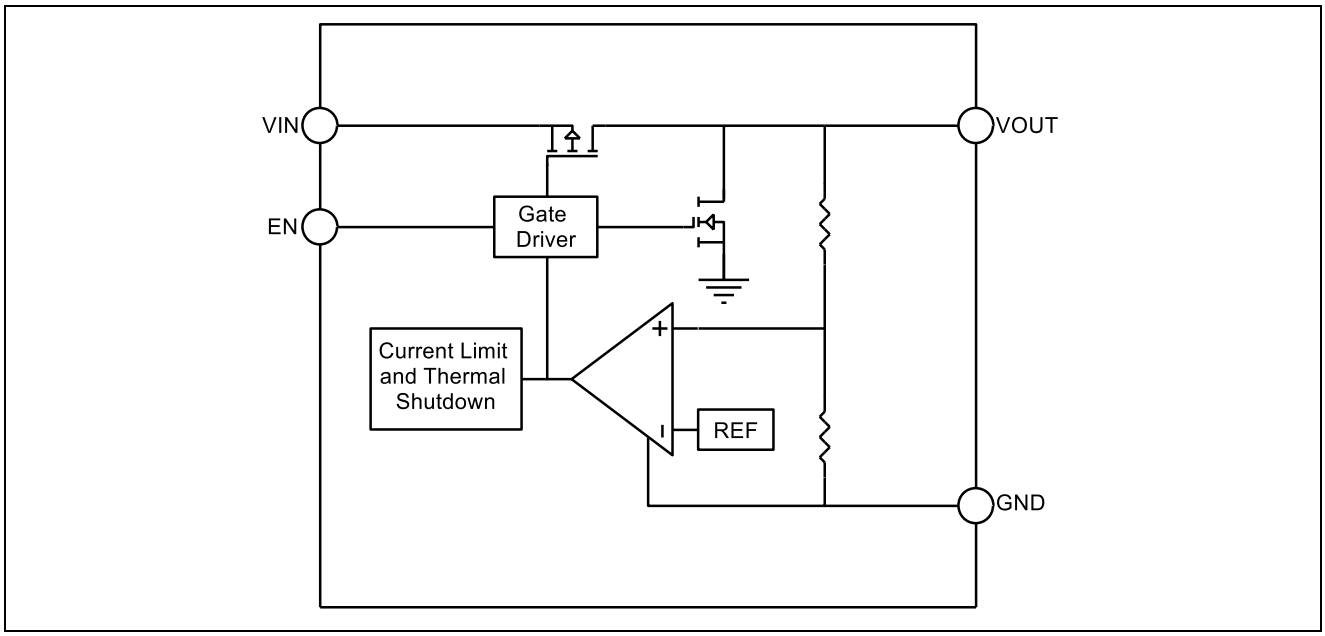
SOT23-5

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(1×1) 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

Input Capacitor

A 1μF ceramic capacitor is recommended to connect between V_{IN} and GND pins to decouple input power supply glitch and noise. The amount of the capacitance may be increased without limit. This input capacitor must be located as close as possible to the device to assure input stability and less noise. For PCB layout, a wide copper trace is required for both V_{IN} and GND.

Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended output capacitance is from 1μF to 4.7μF, Equivalent Series Resistance (ESR) is from 5mΩ to 100mΩ, and temperature characteristics are X7R or X5R. Higher capacitance values help to improve load/line transient response. The output capacitance may be increased to keep low undershoot/overshoot. Place output capacitor as close as possible to OUT and GND pins.

ON/OFF Input Operation

The ET559XX is turned on by setting the EN pin high, and is turned off by pulling it low. If this feature is not used, the EN pin should be tied to IN pin to keep the regulator output on at all time.

High PSRR and Low Noise

RF circuits such as LNA (low-noise amplifier), up/down-converter, mixer, PLL, VCO, and IF stage, require low noise and high PSRR LDOs. The temperature-compensated crystal oscillator circuit requires very high PSRR at RF power amplifier burst frequency. For instance, minimum 65dB PSRR at 217Hz is recommended for the GSM handsets.

The ET559XX, with PSRR of 75dB at 1KHz, is suitable for most of these applications that require high PSRR and low noise.

Ultra-Fast Start-up

After enabled, the ET559XX is able to provide full power in as little as tens of microseconds, typically 80μs. This feature will help load circuitry move in and out of standby mode in real time, eventually extend battery life for mobile phones and other portable devices.

Fast Transient Response

Fast transient response LDOs can also extend battery life. To meet this load requirement, the LDO must react very quickly without a large voltage drop or overshoot — a requirement that cannot be met with conventional, general-purpose LDOs.

The ET559XX's fast transient response from 1 to 500mA provides stable voltage supply for fast DSP and GSM chipset with fast changing load.

Low Quiescent Current

The ET559XX, consuming only around 40μA for all input range and output loading, provides great power saving in portable and low power applications.

Current Limit Protection

When output current at the OUT pin is higher than current limit threshold or the OUT pin is short circuit to GND, the current limit protection will be triggered and clamp the output current to approximately 700mA to prevent over-current and to protect the regulator from damage due to overheating.

Thermal Shutdown Protection

Thermal protection disables the output when the junction temperature rises to approximately +155°C, allowing the device to cool down. When the junction temperature reduces to approximately +130°C the output circuitry is enabled again. Depending on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This cycling limits the heat dissipation of the regulator, protecting it from damage due to overheating.

Absolute Maximum Ratings

Symbol	Parameters (Items)	Value	Unit
V_{IN}	IN Voltage	-0.3 to 7.0	V
V_{EN}	Input Voltage (EN Pin)	-0.3 to V_{IN}+0.3	V
V_{OUT}	Output Voltage	-0.3 to V_{IN}+0.3	V
I_{MAX}	Maximum Load Current	500	mA
V_{ESD}	Human Body Model (JEDEC JS-001)	±4000	V
	Charged Device Model(JESD22-C101)	±1500	V
I_{LU}	Latch up Current Maximum Rating (JESD78E)	±200	mA
P_{D_MAX}	Maximum Power Consumption	900	mW
$R_{\theta JA}$	Junction-to-ambient Thermal Resistance	110	°C/W
T_J	Operating Junction Temperature	-40 to 150	°C
T_{STG}	Storage Temperature	-65 to 150	°C
T_{SLOD}	Lead Temperature (Soldering, 10 sec)	300	°C

Recommended Operating Conditions

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	1.9 to 6.5	V
I_{OUT}	Output Current	0 to 500	mA
T_A	Operating Ambient Temperature	-40 to 85	°C
C_{IN}	Effective Input Ceramic Capacitor Value	0.47 to 4.7	uF
C_{OUT}	Effective Output Ceramic Capacitor Value	0.47 to 4.7	uF
ESR	Input and Output Capacitor Equivalent Series Resistance	5 to 100	mΩ

Electrical Characteristics

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}(1)	Input Voltage Operation Range		1.9		6.5	V
V_{DROP}(2)	Dropout Voltage	V_{OUT}=3.6V, I_{OUT} = 500mA		330	500	mV
		V_{OUT}=5.0V, I_{OUT} = 500mA		600	780	
I_{Q_ON}	DC Supply Quiescent Current	Active mode: V_{EN}=V_{IN}		60	90	μA
I_{Q_OFF}	DC Supply Shutdown Current	V_{EN}=0V		0.01	1	μA
V_{OUT}	Regulated Output Voltage	I_{OUT}=1mA, -40°C≤T_A≤85°C	-2		2	%
Reg_{LINE}	Output Voltage Line Regulation	V_{IN} = V_{OUT} + 1V to 6.5V, I_{OUT} = 10mA		0.03	0.2	%/V
Reg_{LOAD}	Output Voltage Load Regulation	I_{OUT} from 1mA to 500mA		10	50	mV
V_{TRLN}(3)	Line Transient	I_{OUT} = 1mA, V_{IN} =V_{OUT} + 1V to 6.5V in 10us, T_A=25°C		10	25	mv
		I_{OUT} = 1mA, V_{IN} =6.5V to V_{OUT} + 1V in 10us, T_A=25°C		10	25	
V_{TRLD}(3)	Load Transient	I_{OUT} from 1mA to 500mA in 10us, T_A=25℃		50	160	mv
		I_{OUT} from 500mA to 1mA in 10us, T_A=25℃		50	160	
T_{ON}	Soft-start Time	From Enable to Power On, T_A=25℃,IOUT=20mA		80		μs
I_{OUT}	Output Current Limit		500			mA
I_{LIMIT}	Current Limit		510	600	900	mA
I_{SHORT}	Short Circuit Current Limit	V_{OUT} = 0V	60	120	180	mA
PSRR(3)	Power Supply Rejection Ratio	f = 1kHz, C_{OUT} = 1μF, I_{OUT} = 30mA, V_{IN}=4.6V, T_A =25°C		75		dB
e_N(3)	Output Noise	10Hz to 100kHz, I_{OUT} = 100mA, V_{IN} = 4.6V, C_{OUT} = 1μF, T_A =25°C		45		μV_{RMS}
V_{ENL}	EN Low Threshold	V_{IN}= 1.9 to 6.5V			0.3	V
V_{ENH}	EN High Threshold	V_{IN}= 1.9 to 6.5V	1.5			V
R_{PD}	EN Pull-down Resistance		0.7	1	1.3	MΩ
R_{LOW}	Output Resistance of Auto Discharge at Off State	V_{EN}=0V, V_{IN}=4V, I_{OUT}=10mA		80		Ω

Electrical Characteristics (Continued)

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

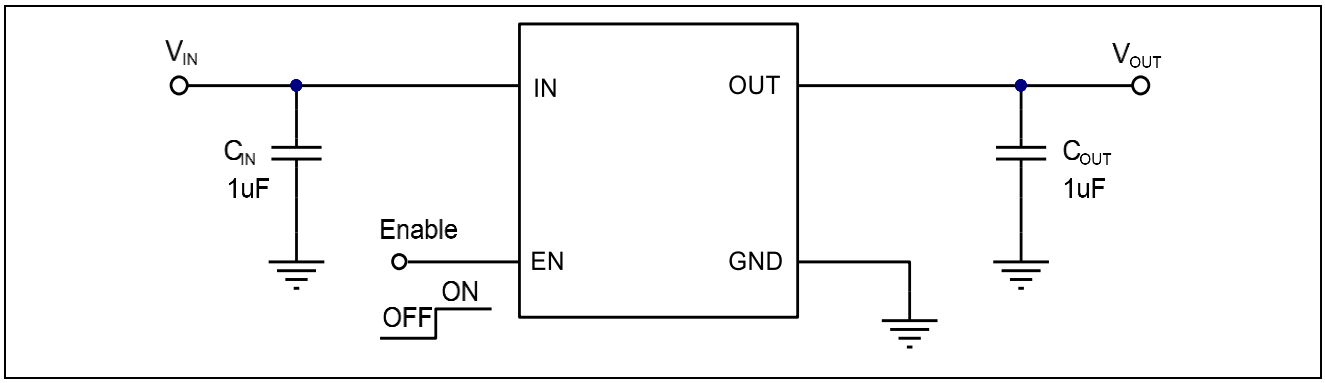
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
T_{TSD}	Over-temperature Shutdown Threshold	T_J Rising		155		°C
T_{HYS}	Over-temperature Shutdown Hysteresis	T_J falling from shutdown		25		°C

Note1: 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.

Note2: V_{DROP} FT test method: test the V_{OUT} voltage at V_{SET} +$V_{DROPMAX}$ with output current.

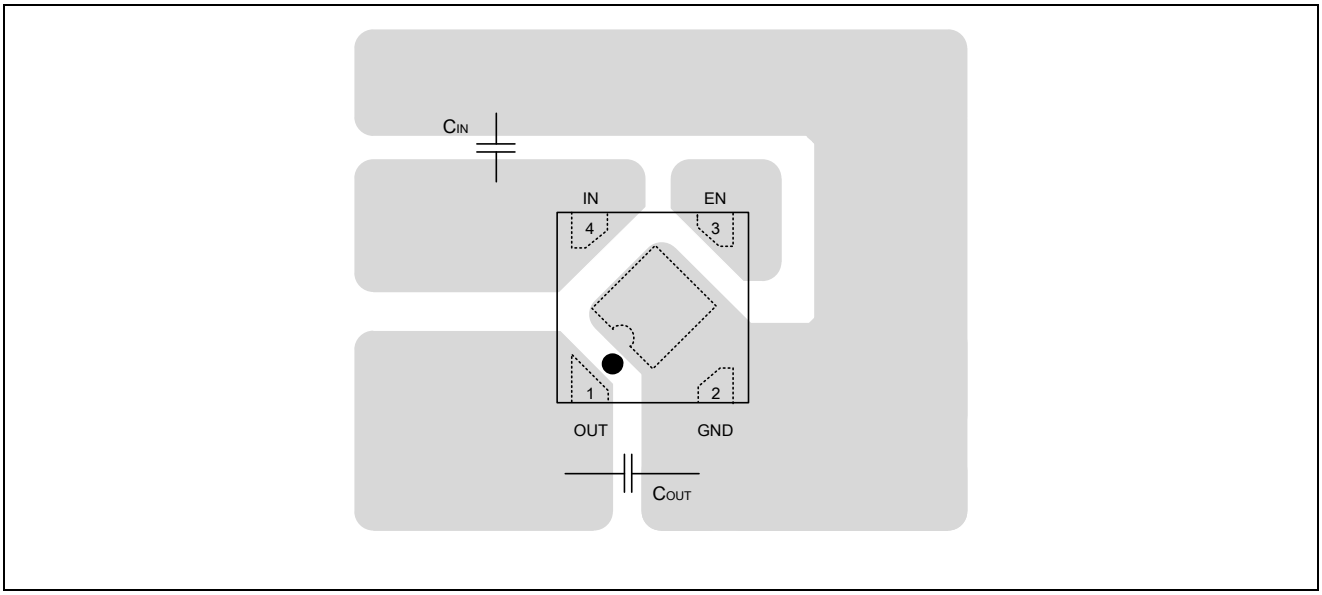
Note3: Guaranteed by design and characterization. not a FT item.

Application Circuits

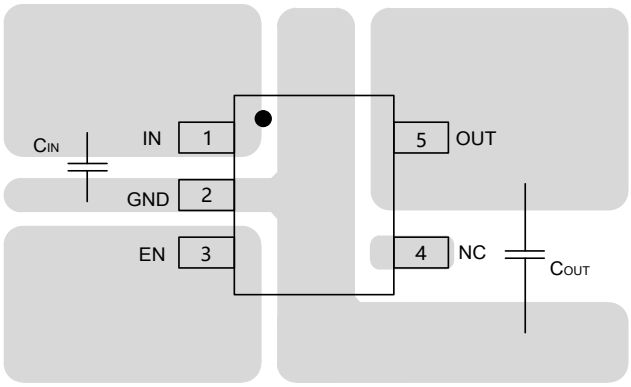


PCB Layout Guide

DFN4



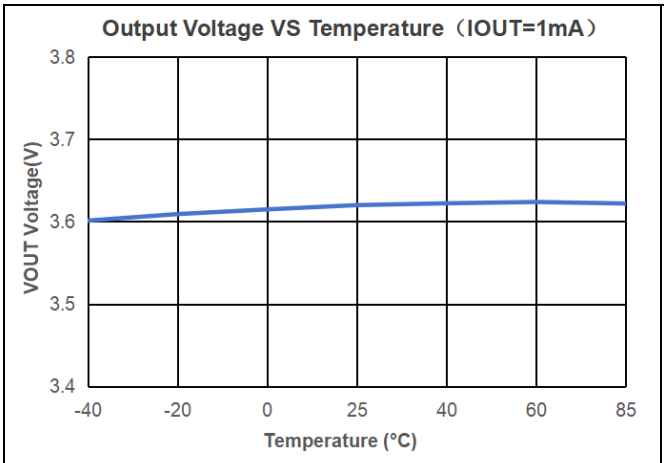
SOT23-5



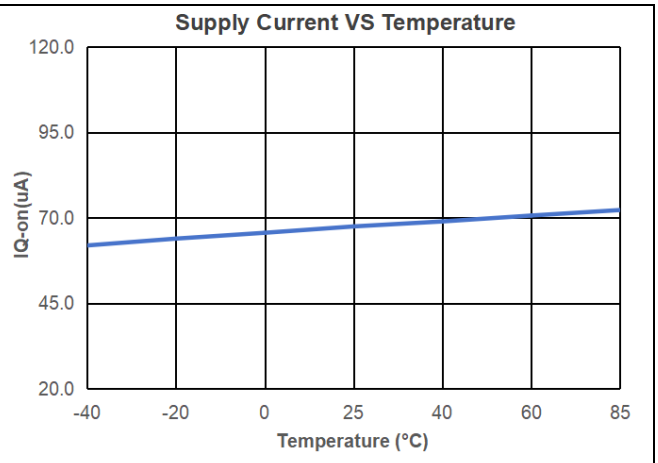
Typical Characteristics

ET55936

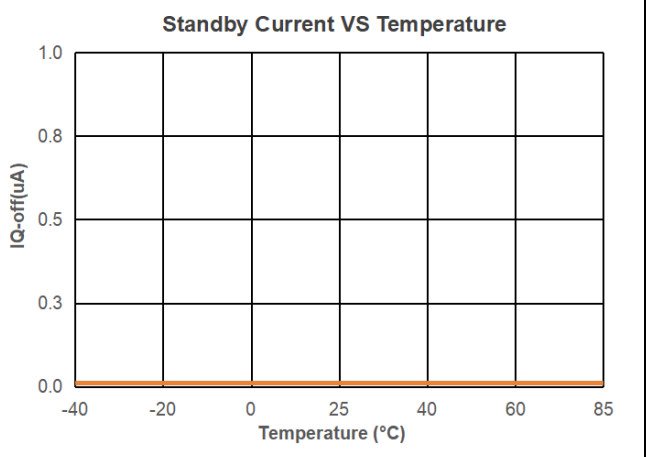
(V_{IN} = 4.6V, I_{OUT} = 1mA, C_{IN} = Ceramic 1.0μF, C_{OUT} = Ceramic 1.0μF, T_A= 25°C)



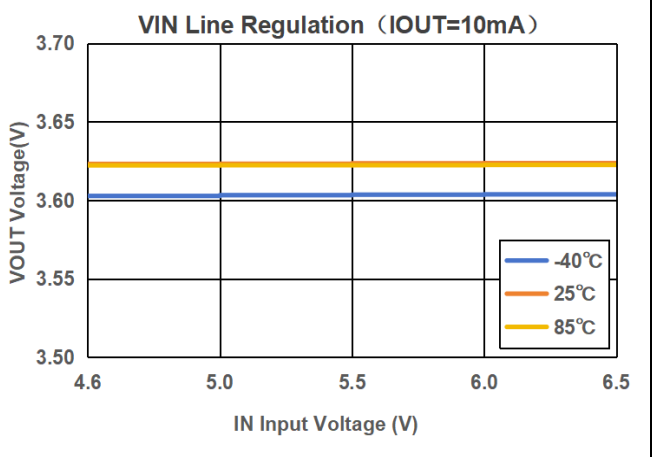
Output Voltage VS Temperature



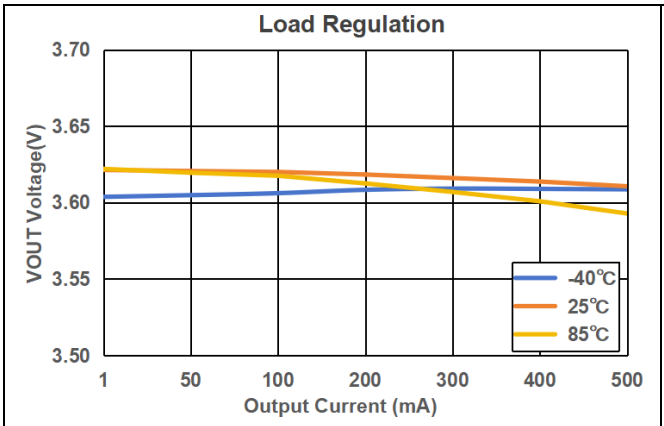
Supply Current VS Temperature



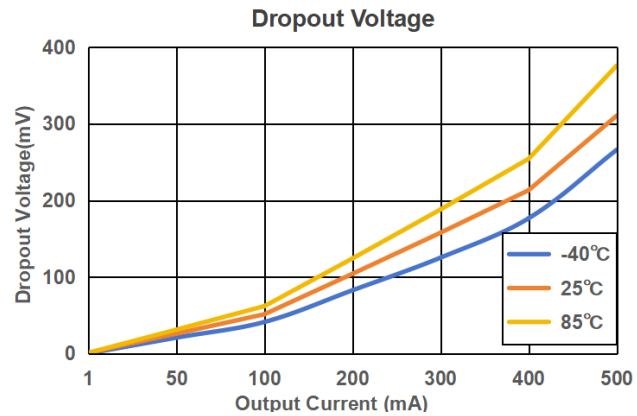
Standby Current VS Temperature



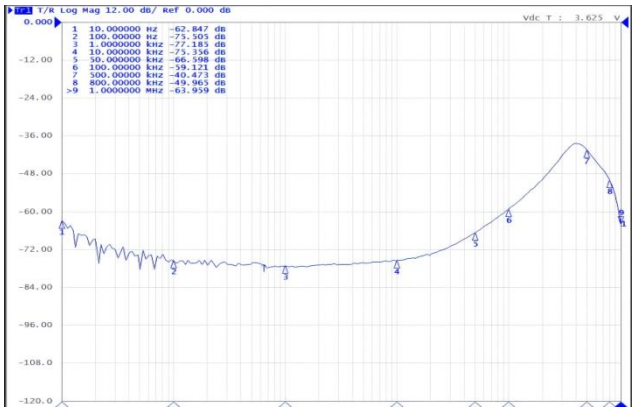
Output Voltage VS Input Voltage(I_{OUT}=1mA)



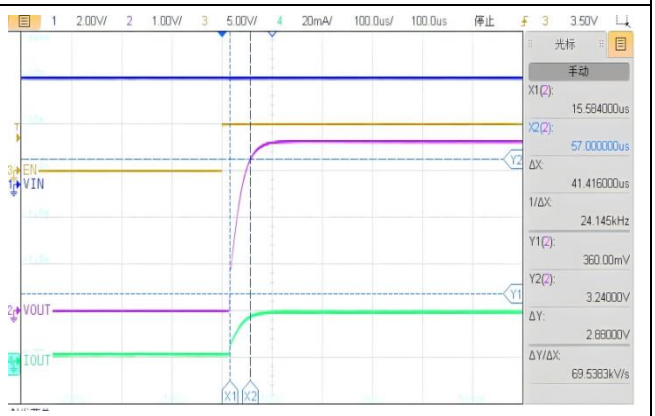
Output Voltage VS Output Current



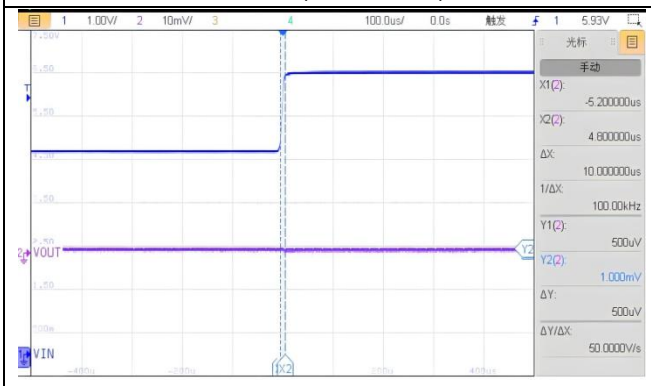
Dropout Voltage VS Output Current



PSRR (I_{OUT}=20mA)

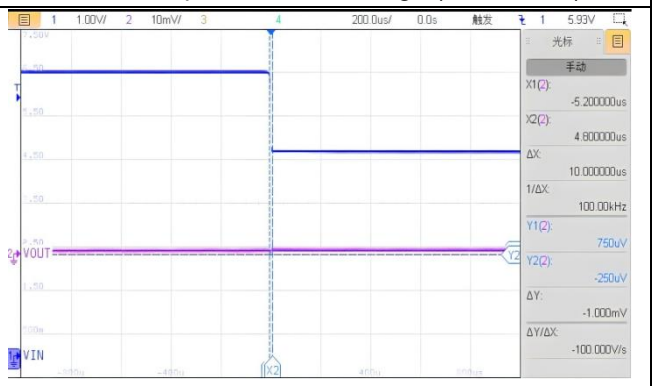


Turn On Speed VS EN Voltage (I_{OUT}=20mA)



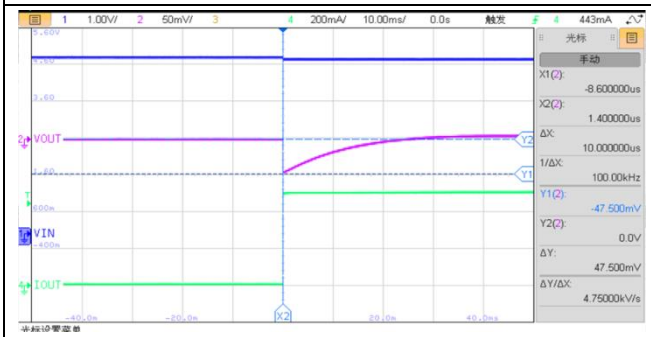
Line Transient Response

V_{IN}=4.6V~6.5V, V_{OUT}=3.6V, I_{OUT}=1mA



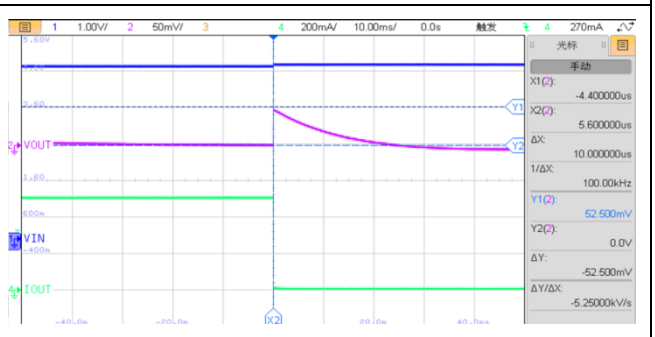
Line Transient Response

V_{IN}=6.5V~4.6V, V_{OUT}=3.6V, I_{OUT}=1mA



Load Transient Response

V_{IN}=4.6V, V_{OUT}=3.6V, I_{OUT}=1mA~500mA



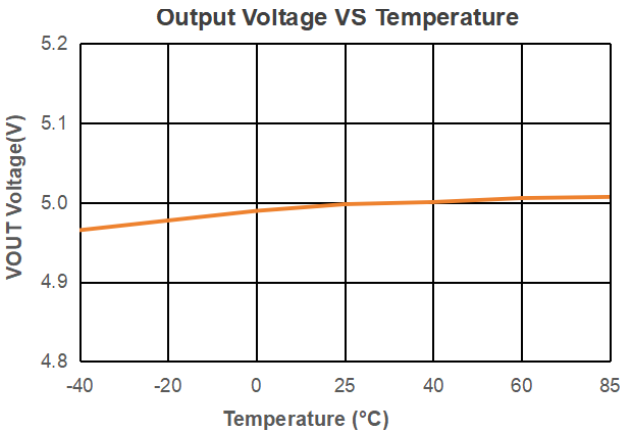
Load Transient Response

V_{IN}=4.6V, V_{OUT}=3.6V, I_{OUT}=500mA~1mA

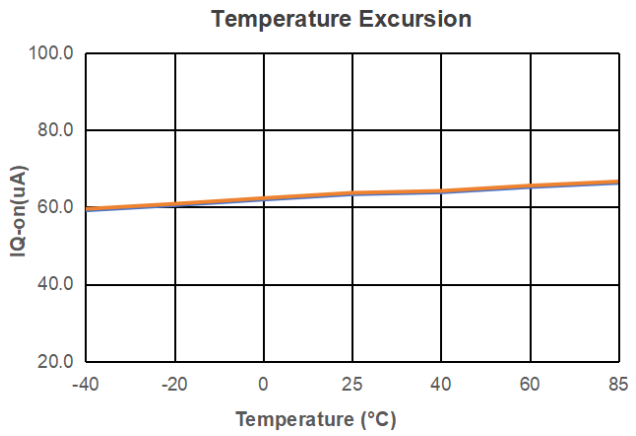
Typical Characteristics

ET55950

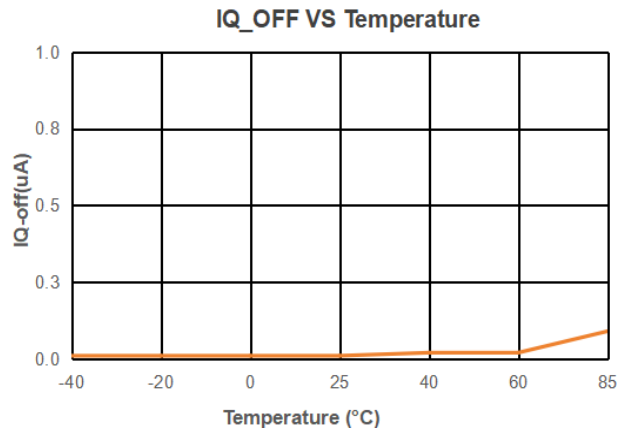
(V_{IN} = 6.0V, I_{OUT} = 1mA, C_{IN} = Ceramic 1.0μF, C_{OUT} = Ceramic 1.0μF, T_A= 25°C)



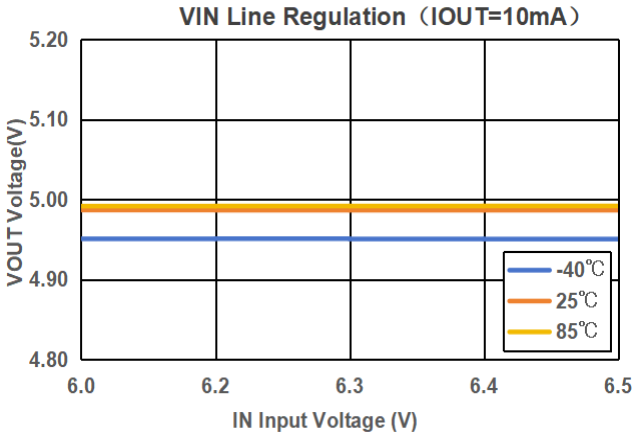
Output Voltage VS Temperature



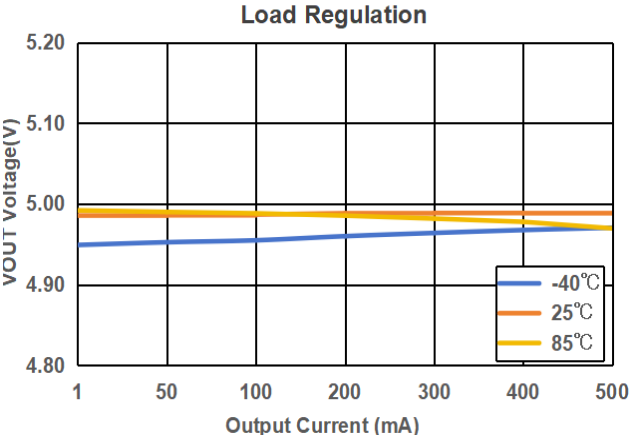
Supply Current VS Temperature



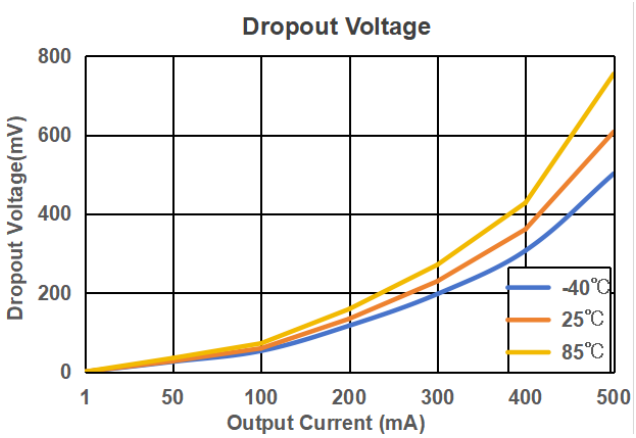
Standby Current VS Temperature



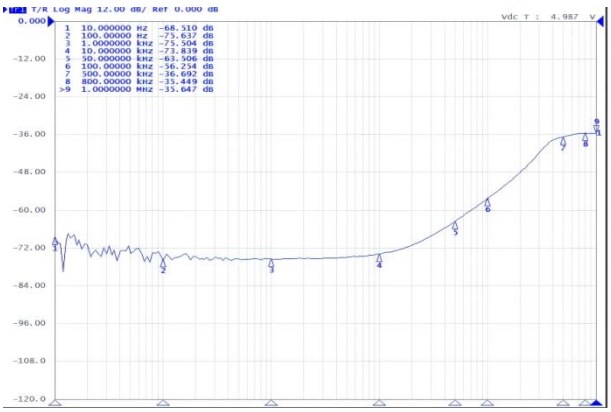
Output Voltage VS Input Voltage(I_{OUT}=1mA)



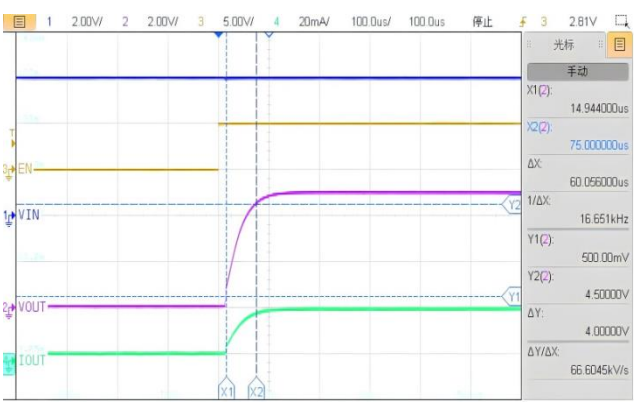
Output Voltage VS Output Current



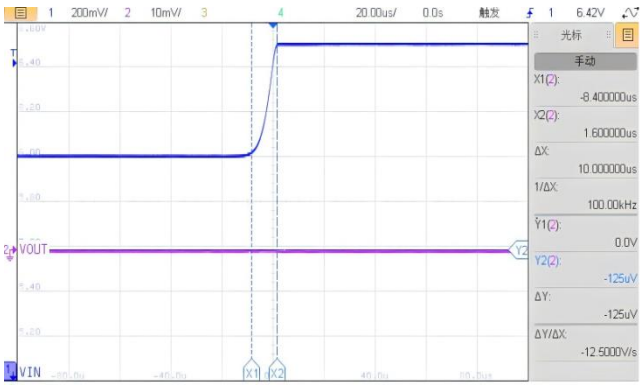
Dropout Voltage VS Output Current



PSRR (I_{OUT}=20mA)

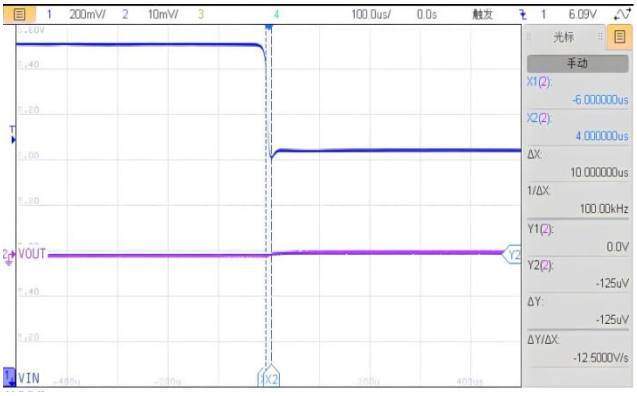


Turn On Speed VS EN Voltage (I_{OUT}=20mA)



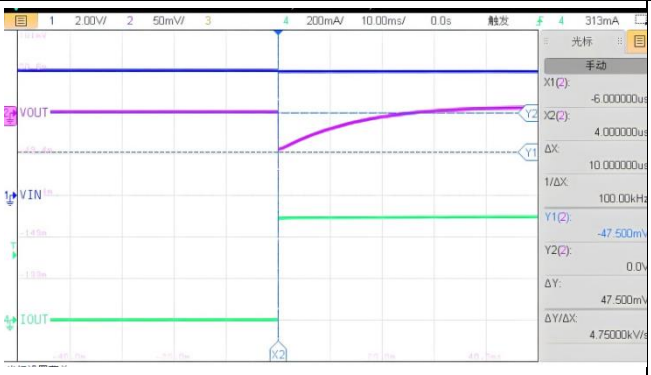
Line Transient Response

V_{IN}=6V~6.5V, V_{OUT}=5V, I_{OUT}=1mA



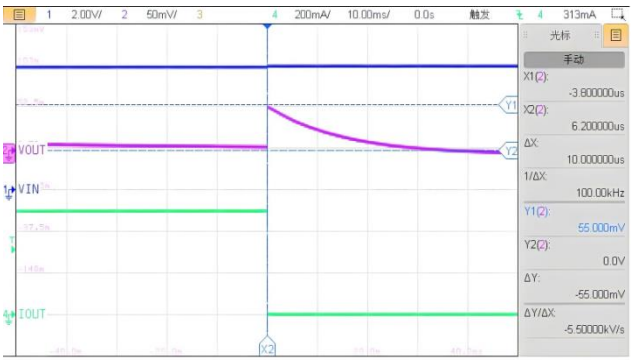
Line Transient Response

V_{IN}=6.5V~6V, V_{OUT}=5V, I_{OUT}=1mA



Load Transient Response

V_{IN}=6V, V_{OUT}=5V, I_{OUT}=1mA~500mA

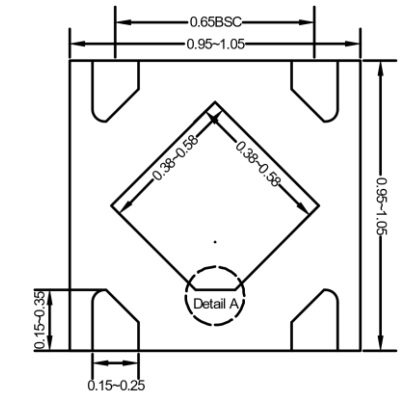


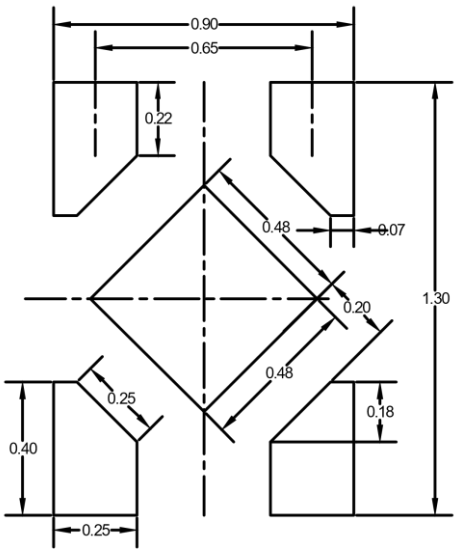
Load Transient Response

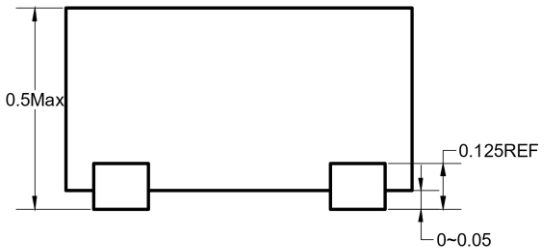
V_{IN}=6V, V_{OUT}=5V, I_{OUT}=500mA~1mA

Package Dimension

DFN4(1×1)

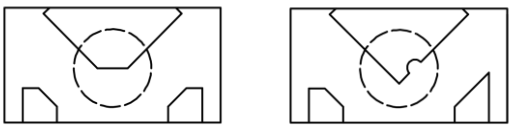




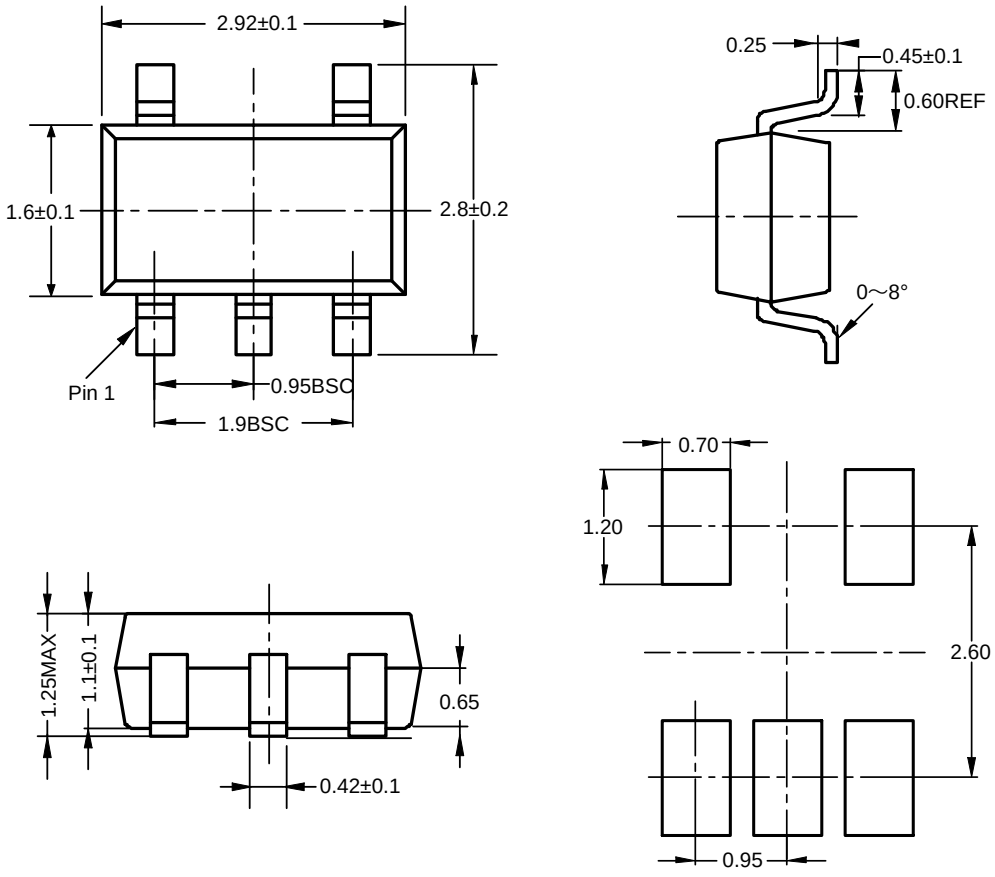


Unit: mm

Detail A: (PIN1 shape)



SOT23-5

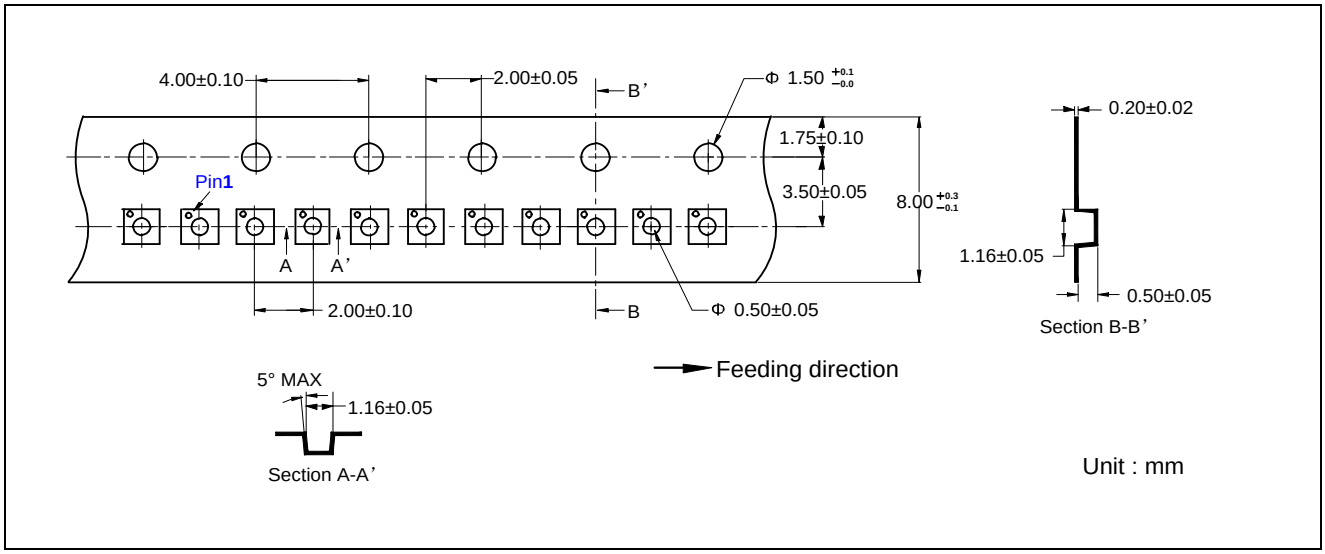


Recommended Land Pattern

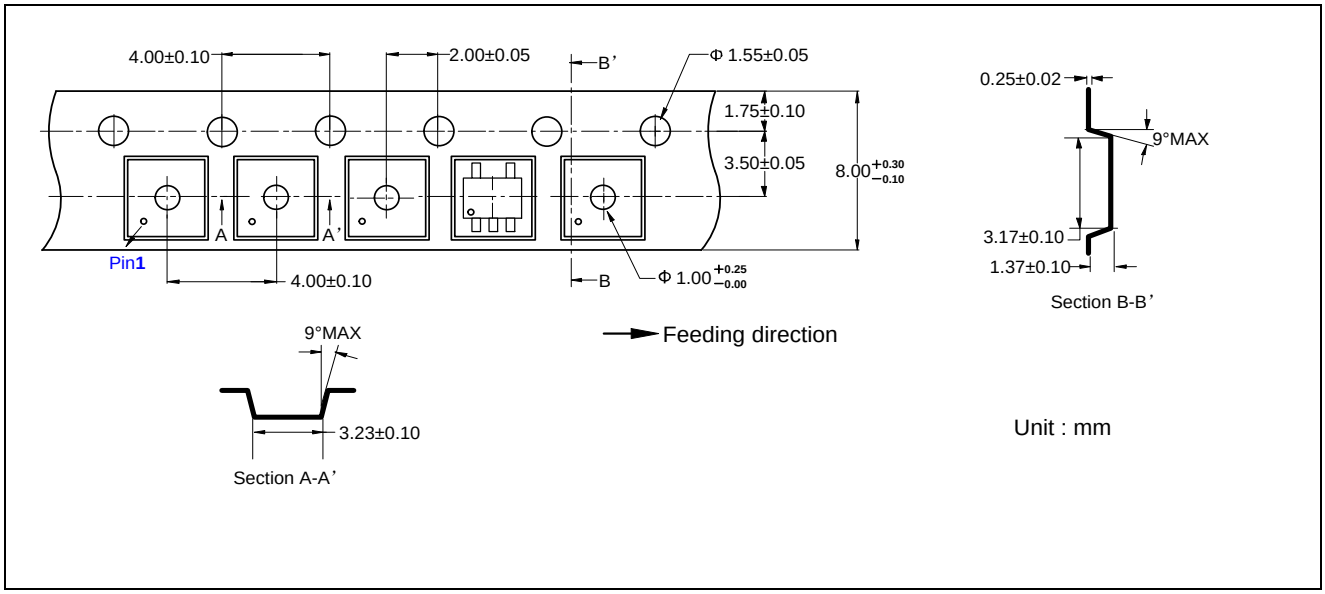
Unit: mm

Tape Information

DFN4 (1mm ×1mm)



SOT23-5



Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2025-06-20	Official Version	Hucy	Liuxm	Liujiaying