High PSRR Low Noise 300mA LDO

General Description

The ET533XX family are the 300mA LDO with auto discharge function, it uses an advanced CMOS process and a PMOSFET pass device to achieve high power supply rejection ratio (PSRR), low noise, low dropout, low ground current, fast start-up and excellent output accuracy.

The ET533XX family are stable with a 1.0μF ceramic output capacitor, uses a precision voltage reference and feedback loop to achieve excellent regulation and transient response.

The ET533XX family offered in a small SOT23-5 / SC70-5 / SOT343 / DFN4 / SOT23-3 / SOT89-3 package, which are ideal for small form factor portable equipment.

The ET533XX is available in standard fixed output voltages of 1.2V (ET53312), 1.8V (ET53318), 2.5V (ET53325), 2.8 (ET53328), 3.0V (ET53330), 3.3V (ET53333) and custom voltage options (50mV step options between 0.8V and 5.0V are available upon request).

Features

- Wide Input Voltage Range from 2.0V to 6.0V
- Up to 300mA Load Current
- Standard Fixed Output Voltage Options:1.2V, 1.8V, 2.5V, 2.8V, 3.0V and 3.3V etc
- Very Low IQ is 42μA typical
- Low Dropout is typical 240mV@2.8V at 300mA Load
- Very Low Noise is 45uVrms at 1.2V output
- Ultra-Fast Start-Up Time is 25μs typical
- Excellent Load/Line Transient Response
- Part No. and Package

Part No.	Package	MSL
ET533XX(B)	SOT23-5	Level 3
ET533XXSC	SC70-5	Level 3
ET533XXY(B)	DFN4(1×1)	Level 1
ET533XXYD	DFN4(1.2×1.6)	Level 1
ET533XXS4	SOT343	Level 3
ET533XXE/F	SOT23-3	Level 3
ET533XXC/D	SOT89-3	Level 3

Applications

- Smart Phones and Cellular Phones
- Digital Still Cameras
- Portable Instruments

Device information

ET 533 XX XX B

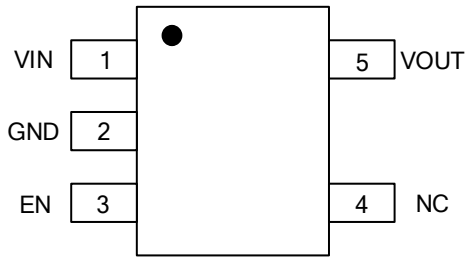
XX Output Voltage		**XX** Package		**B** Auto-discharge Function	
Fixed V_{OUT}	0.8~5.0V (0.05V Steps)	/	SOT23-5(Default)	B	Auto-discharge
		SC	SC70-5		
		Y	DFN4(1×1)		
		YD	DFN4(1.2×1.6)		
		S4	SOT343		
		E/F	SOT23-3		
		C/D	SOT89-3		

Pin Function

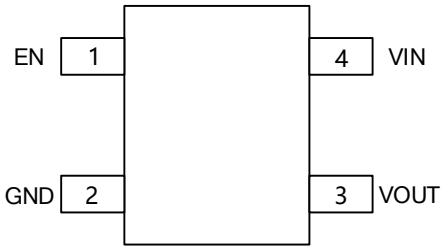
Pin No.				**Pin Name**	**Pin Function**
SOT23-5 SC70-5	**DFN4(1×1)**	**SOT343**	**DFN4(1.2×1.6)**		
1	4	4	4	VIN	Supply input pin.
2	2	2	2	GND	Ground.
3	3	1	3	EN	Enable control input, active high. Do not leave EN floating.
4		-		NC	No connection.
5	1	3	1	VOUT	Output pin.
	Thermal pad				Connect to GND or leave floating. Do not connect to any potential other than GND.

Label	**Package**	**Pin No. and Pin Name**		
		1	**2**	**3**
ET533XXC	SOT89-3	GND	VIN	VOUT
ET533XXD	SOT89-3	VOUT	GND	VIN
ET533XXE	SOT23-3	VIN	GND	VOUT
ET533XXF	SOT23-3	GND	VOUT	VIN

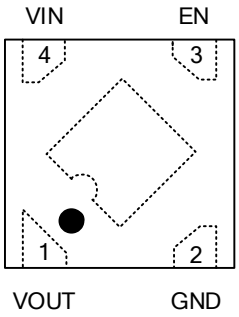
Pin Configuration



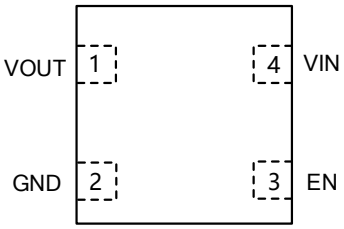
ET533XX(SOT23-5)/
ET533XXSC(SC70-5)



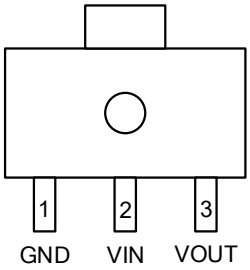
ET533XXS4(SOT343)



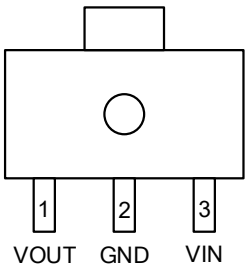
ET533XXY(DFN4(1×1))



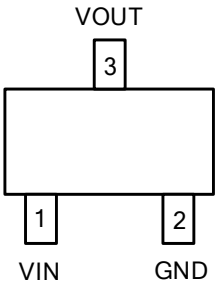
ET533XXYD(DFN4(1.2×1.6))



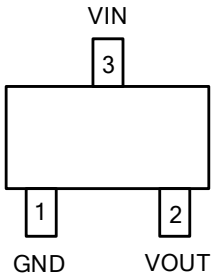
ET533XXC(SOT89-3)



ET533XXD(SOT89-3)



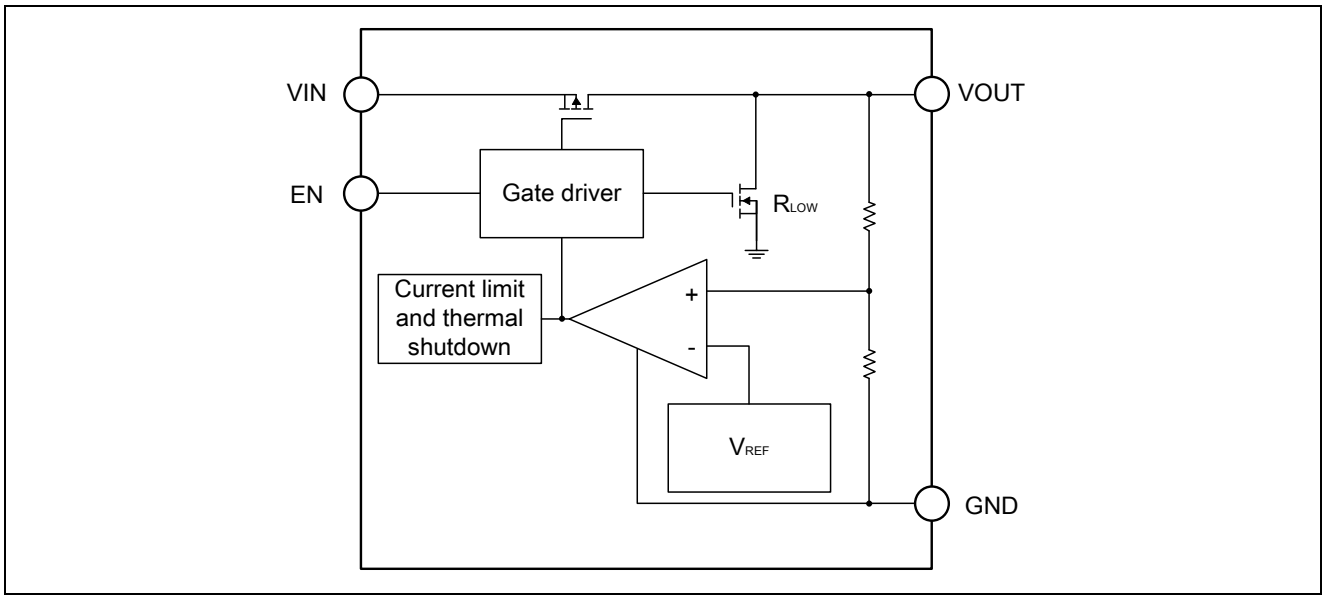
ET533XXE(SOT23-3)



ET533XXF(SOT23-3)

Top View

Block Diagram



Functional Description

Input Capacitor

A 1μF ceramic capacitor is recommended to connect between VIN 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 VIN and GND.

Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended output capacitance is from 0.47μF to 4.7μF, Equivalent Series Resistance (ESR) is from 5mΩ to 100mΩ, and temperature characteristics is 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 VOUT and GND pins.

ON/OFF Input Operation

The ET533XX 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 V_{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.

In order to provide good audio quality, the audio power supply for hand-free, game, Hi-Fi, and multimedia applications in cellular phones, require low-noise and high PSRR at audio frequency range (20Hz-20kHz).

The ET533XX, with PSRR of 75dB at 100Hz, is suitable for most of these applications that require high PSRR and low noise.

Ultra Fast Start-up

After enabled, the ET533XX is able to provide full power in as little as tens of microseconds, typically 25μs. 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 .

The ET533XX's fast transient response from 0 to 300mA provides stable voltage supply for fast DSP and GSM chipset with fast changing load.

Low Quiescent Current

Cellular phone baseband internal digital circuits typically operate all the time. That requires LDO stays on at all times. However, in the standby mode, the microprocessor consumes only around 100~300μA. Since the phone stays in standby for the longest percentage of time, using a 42μA quiescent current LDO, instead of 100μA, saves 60μA and can substantially extends the battery standby time.

The ET533XX, consuming only around 42μA 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 V_{OUT} pin is higher than current limit threshold or the V_{OUT} pin, the current limit protection will be triggered and clamp the output current to approximately 500mA 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}	Input Voltage Range	-0.3 to 6.5	V
V_{OUT}	Output Voltage Range	-0.3 to V_{IN} + 0.3	V
V_{EN}	Enable Voltage Range	-0.3 to 6.5	V
I_{MAX}	Maximum Load Current	500	mA
$T_{J(MAX)}$	Maximum Junction Temperature	-40 to 150	°C
T_{STG}	Storage Temperature	-65 to 150	°C

Thermal Characteristics

Symbol	Package	Parameters	Value	Unit
$R_{\theta JA}$	SOT23-3	Thermal Resistance, Junction-to-Air	360	°C/W
	DFN4		250	
	SOT23-5/SOT70-5		250	
	SOT343		200	
	SOT89-3		135	
P_{DMAX}	SOT23-3	Power Dissipation	280	mW
	DFN4		400	
	SOT23-5/SOT70-5		400	
	SOT24		500	
	SOT89-3		750	

Recommended Operating Conditions

Symbol	Parameters	Min	Max	Unit
V_{IN}	Input Voltage	2.0	6.0	V
I_{OUT}	Output Current	0	300	mA
T_A	Operating Ambient Temperature	-40	85	°C
C_{IN}	Input Ceramic Capacitor Value	0.47	4.7	μF
C_{OUT}	Output Ceramic Capacitor Value	0.47	4.7	μF
ESR	Input and Output Capacitor Equivalent Series Resistance	5	100	mΩ

Electrical Characteristics

(V_{IN}= V_{EN} = V_{OUT} +1V, T_A = 25°C unless otherwise noted)

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
V_{IN} (1)	Input Voltage Operation Range		2.0		6.0	V
V_{DROP}(2)	Dropout Voltage	V_{OUT} = 1.2V, I_{OUT} = 300mA		790	950	mV
		V_{OUT} = 1.8V, I_{OUT} = 300mA		350	420	mV
		V_{OUT} = 2.5V, I_{OUT} = 300mA		270	330	mV
		V_{OUT} = 2.8V, I_{OUT} = 300mA		240	300	mV
		V_{OUT} = 3.0V, I_{OUT} = 300mA		230	270	mV
		V_{OUT} = 3.3V, I_{OUT} = 300mA		210	250	mV
I_{Q_ON}	DC Supply Quiescent Current	Active mode: V_{EN} = V_{IN}		42	70	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 5.5V, I_{OUT} = 10mA		0.03	0.2	%/V
Reg_{LOAD}	Output Voltage Load Regulation	I_{OUT} from 0mA to 300mA		20	40	mV
T_{ON}	Soft-start Time	From enable to power on		25		μs
I_{LIMIT}	Current Limit	R_{LOAD} = 1Ω	300			mA
I_{SHORT}	Output Turn-on Delay Time	V_{OUT} = 0V		60		mA
PSRR(3)	Power Supply Rejection Ratio	f = 1kHz, C_{OUT} = 1μF, I_{OUT} = 20mA		75		dB
		f = 10kHz, C_{OUT} = 1μF, I_{OUT} = 30mA		65		dB
e_N(3)	Output Noise	10Hz to 100kHz, I_{OUT} = 200mA,V_{OUT} = 2.8V, C_{OUT} = 1μF		75		μVRMS
		10Hz to 100kHz, I_{OUT} = 200mA,V_{OUT} = 1.2V, C_{OUT} = 1μF		45		
V_{IL}	EN Low Threshold	V_{IN} = 2.0V to 6.0V, V_{EN} falling until the output is disabled			0.3	V
V_{IH}	EN High Threshold	V_{IN} = 2.0V to 6.0V, V_{EN} rising until the output is enabled	1.2			V
I_{EN}	EN Pin Input Current	V_{EN} = 0V		0	0.1	μA

Electrical Characteristics (Continued)

(V_{IN}= V_{EN} = V_{OUT} +1V, T_A = 25°C unless otherwise noted)

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
R_{PD}	EN pull-down resistance		0.8	1	1.3	MΩ
R_{LOW}	Output resistance of auto discharge at off state	V_{EN} = 0V, V_{IN} = 4V		30		Ω
T_{TSD}(3)	Over-temperature Shutdown Threshold	T_J rising		155		°C
T_{HYS}(3)	Over-temperature Shutdown Hysteresis	T_J falling from shutdown		20		°C

Notes:

1: The maximum input voltage should take into account the maximum power consumption ($P_{D(MAX)}$).The calculation formula is as follows:

$$P_{D(MAX)} = (V_{IN(MAX)} - V_{IN}) \times I_{OUT}$$

The maximum power consumption of the DFN4 is 400mW.

$$V_{IN(MAX)} = 400mW / I_{OUT} + V_{IN}$$

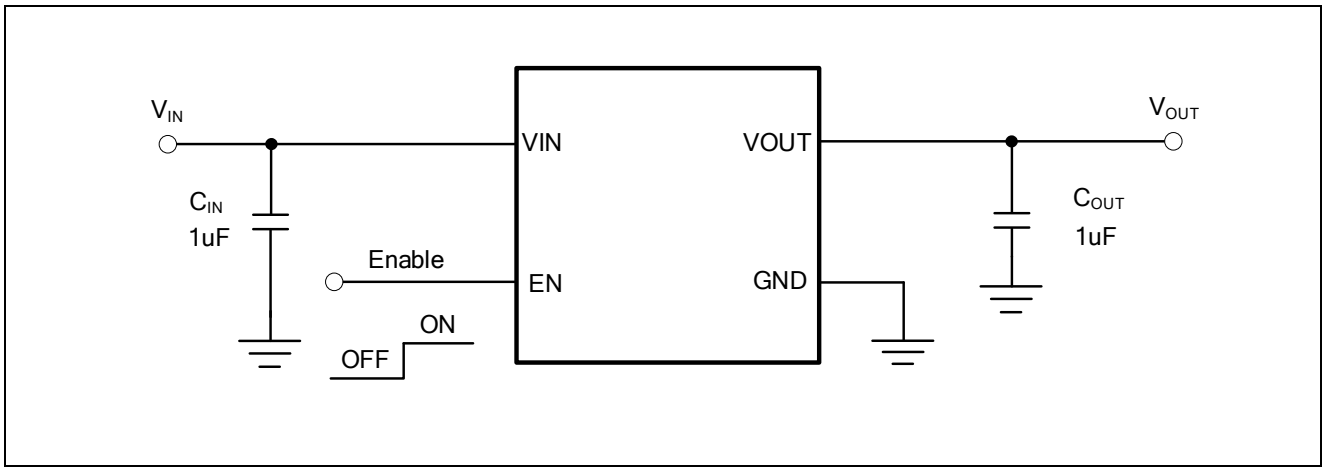
For example, ET53312YB:

If I_{OUT} = 200mA, The maximum input voltage is $V_{IN(MAX)}$=400mW / 200mA+1.2=3.2V

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

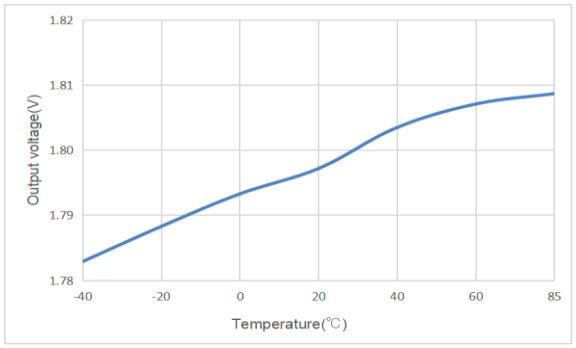
3: Guaranteed by design and characterization. not a FT item.

Application Circuits

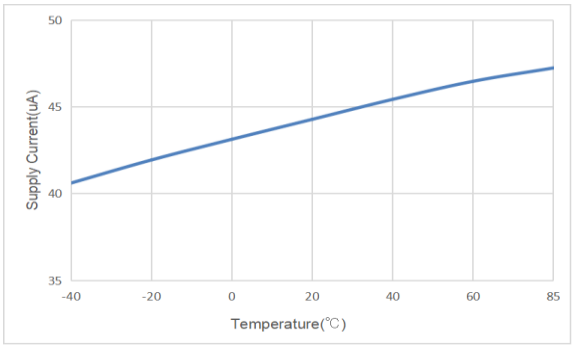


Typical Characteristics

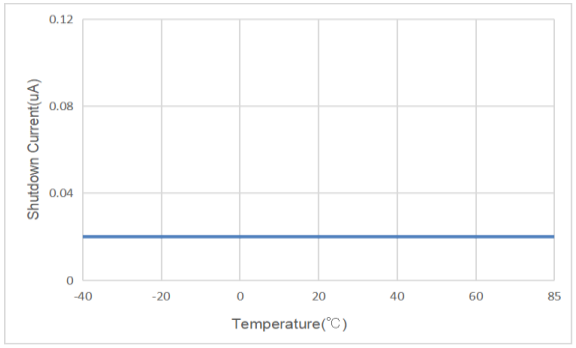
(V_{OUT} = 1.8V, V_{IN} = 2.8V, I_{OUT} = 1mA, C_{IN} = Ceramic 1.0μF, C_{OUT} = Ceramic 1.0μF, T_A = -40°C~85°C)



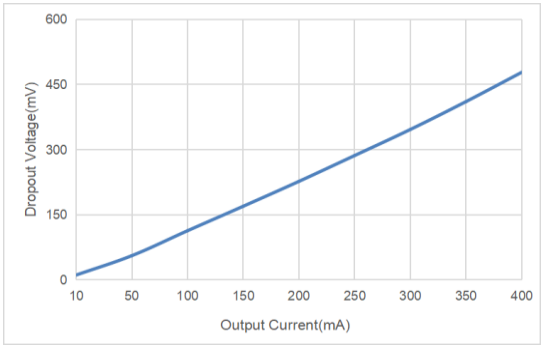
Output Voltage VS Temperature



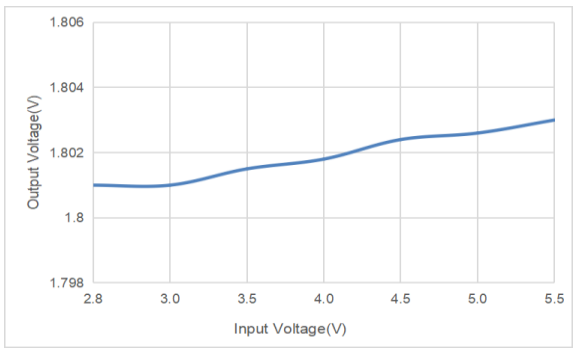
Supply Current VS Temperature



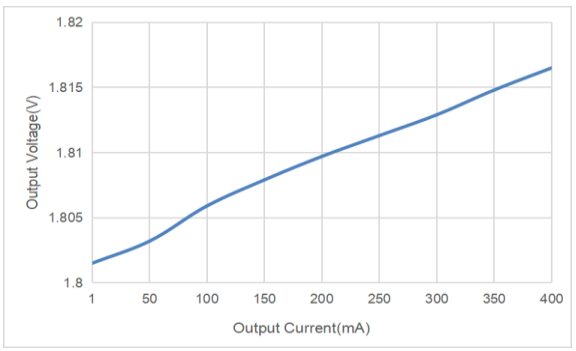
Shutdown Current VS Temperature



Dropout Voltage VS Output Current



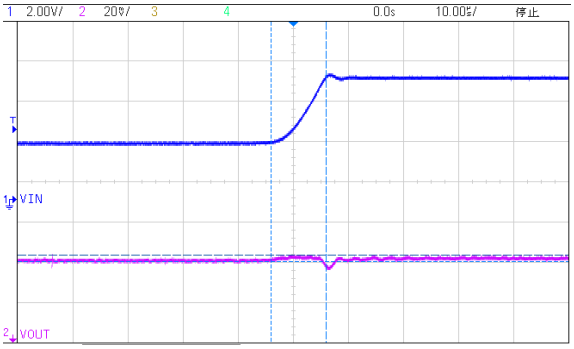
Output Voltage VS Input Voltage



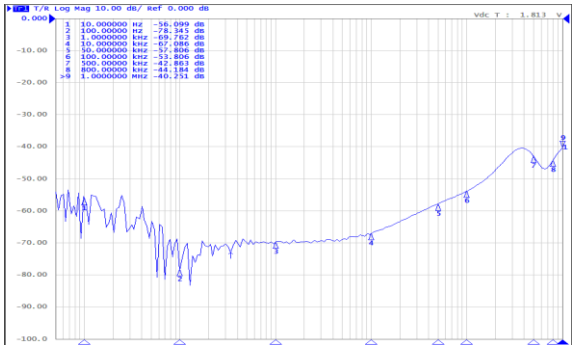
Output Voltage VS Output Current

Typical Characteristics (Continued)

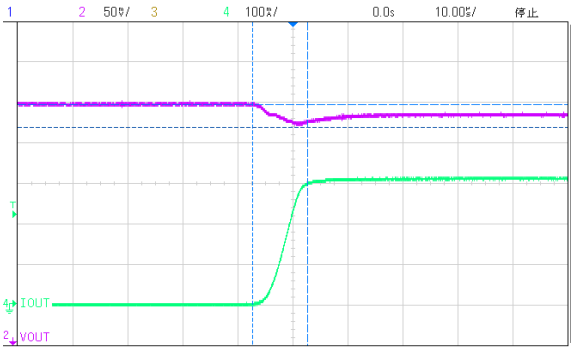
(V_{OUT} = 1.8V, V_{IN} = 2.8V, I_{OUT} = 1mA, C_{IN} = Ceramic 1.0μF, C_{OUT} = Ceramic 1.0μF, T_A = -40°C~85°C)



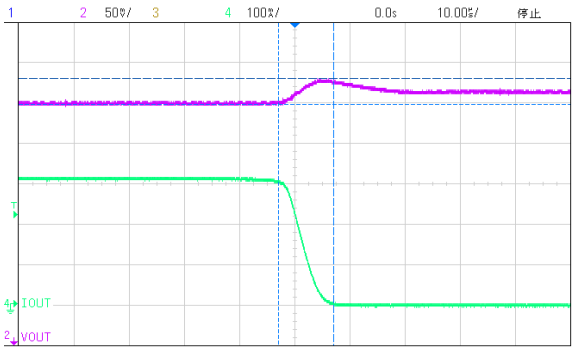
Input Transient(2.8~6.0V t=10μs 1mA)



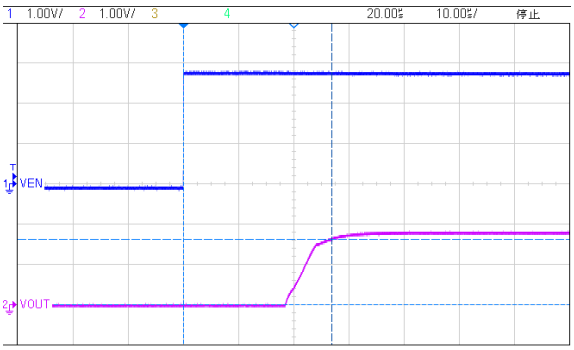
PSRR VS Output Current



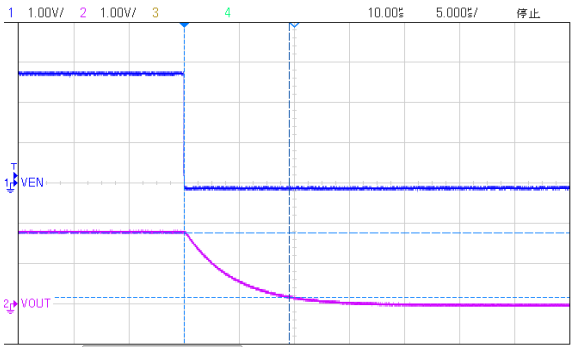
Load Transient(0mA~300mA t=10μs)



Load Transient(300mA~0mA t=10μs)



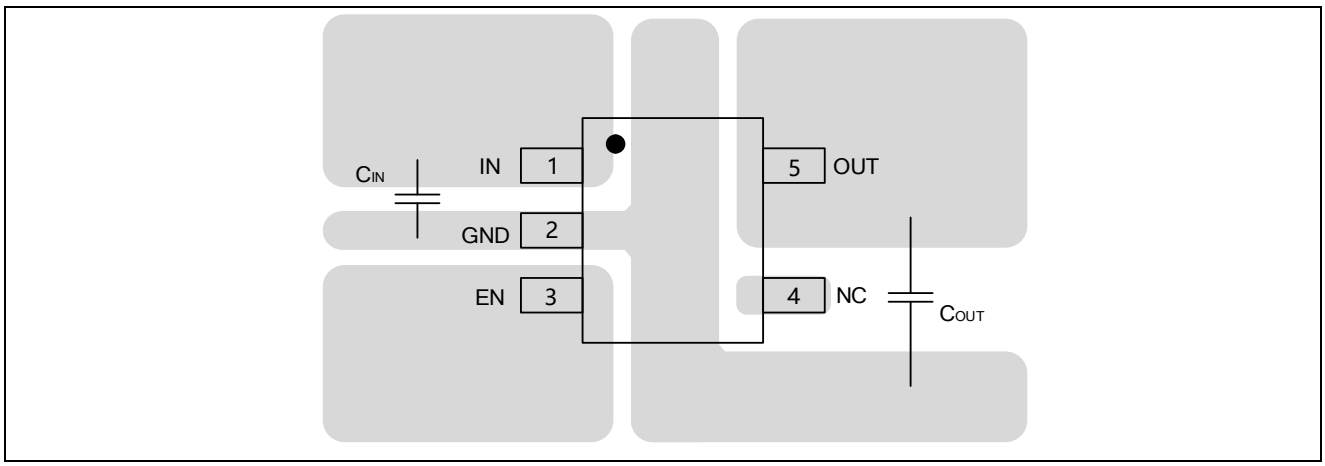
T_{ON} I_{OUT}=1mA



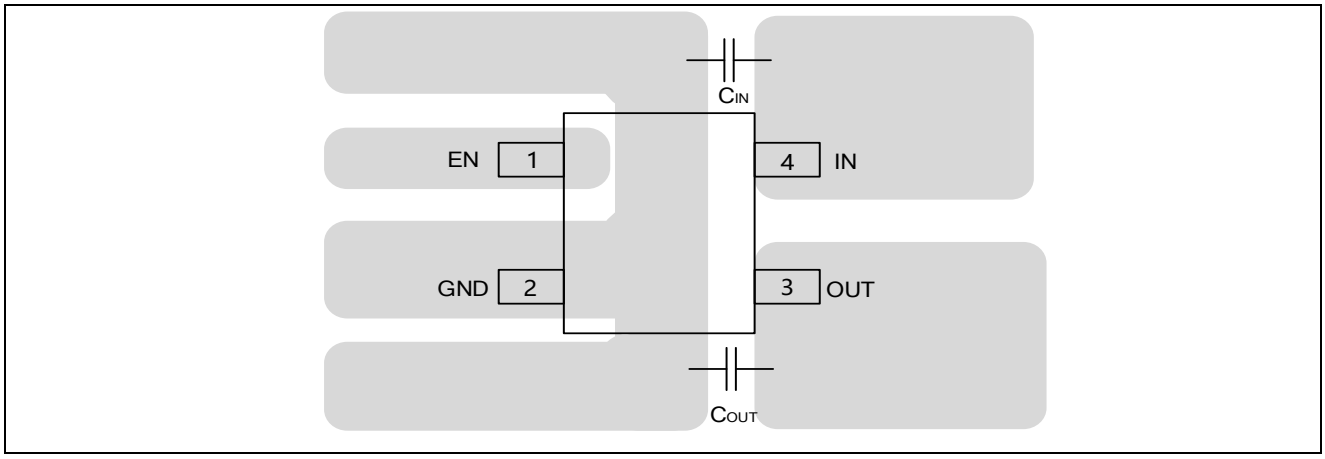
T_{OFF} I_{OUT}=1mA

PCB Layout Guide

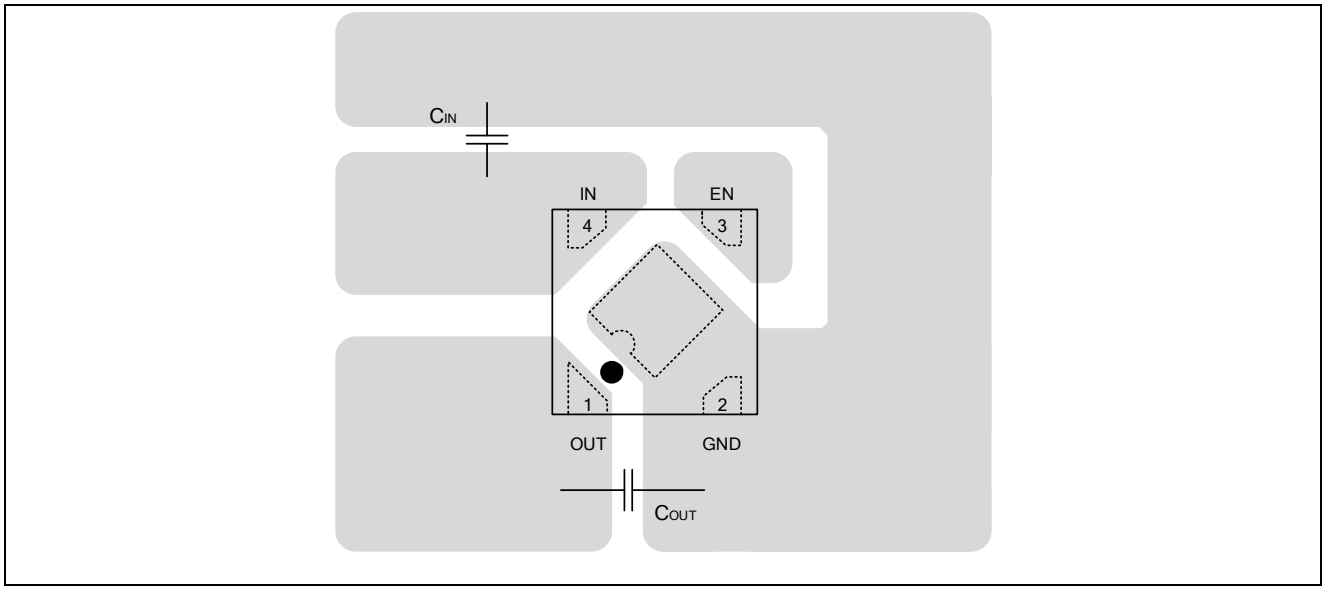
SOT23-5/SC70-5



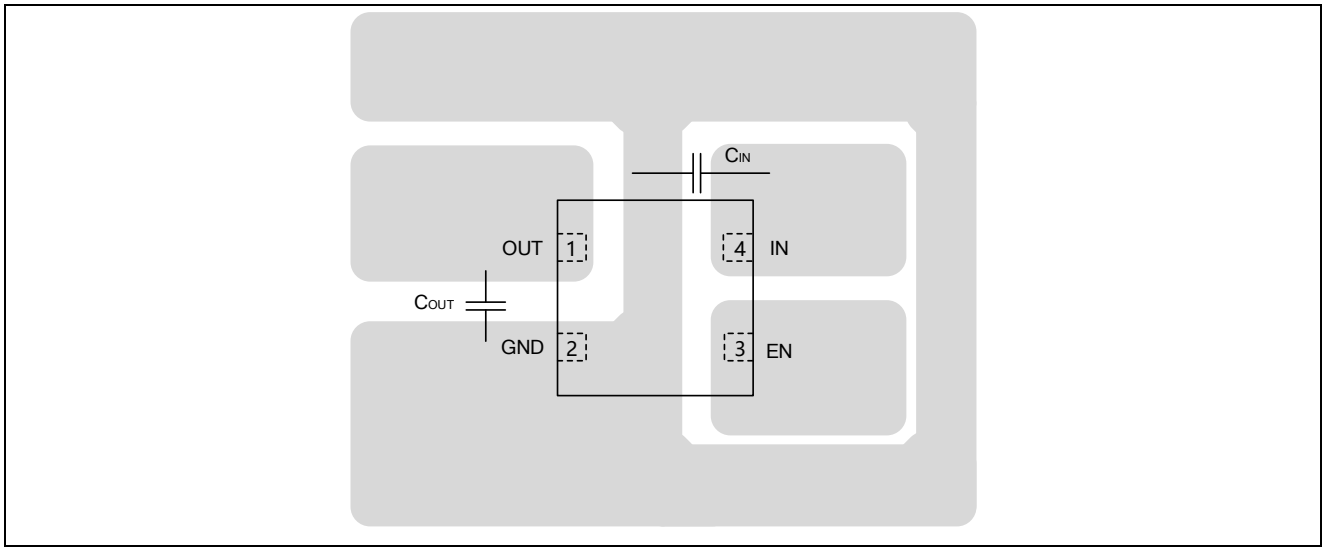
SOT343



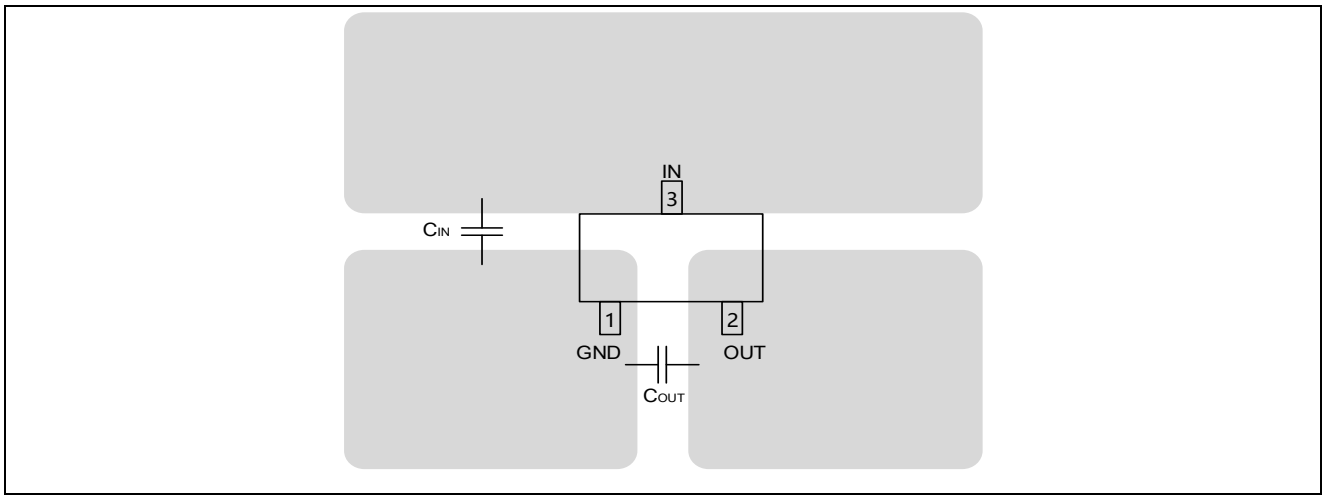
DFN4(1×1)



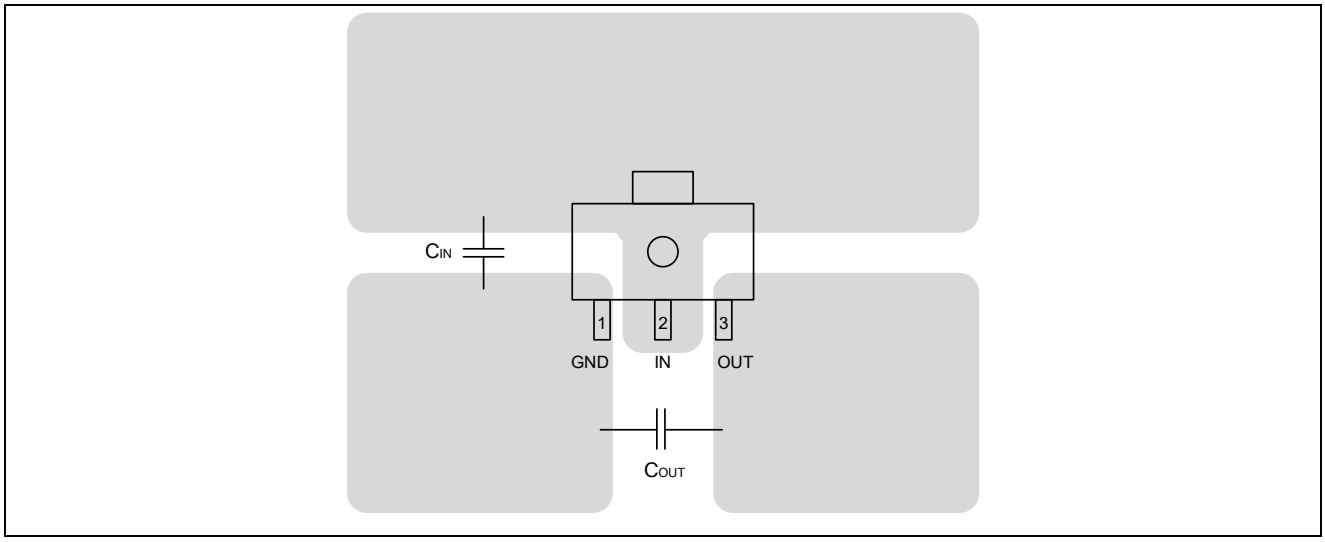
DFN4(1.2×1.6)



SOT23-3(ET533XXF)

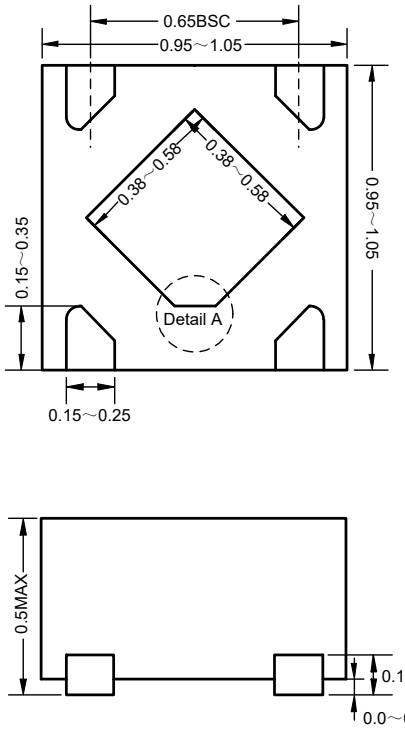


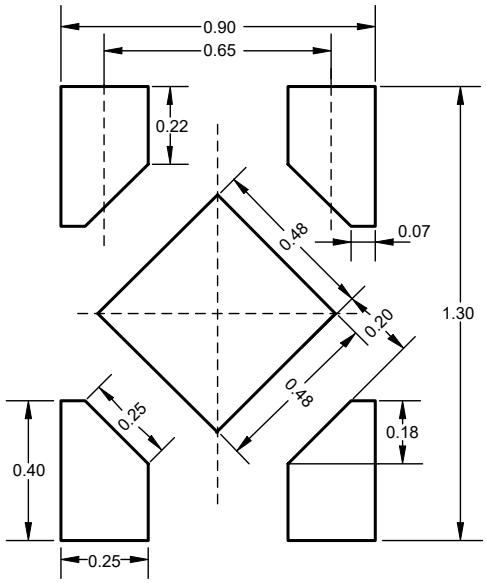
SOT89-3(ET533XXC)



Package Dimension

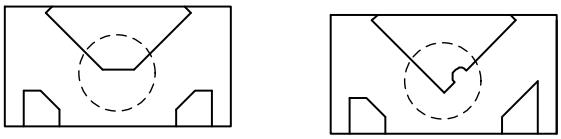
DFN4(1×1)





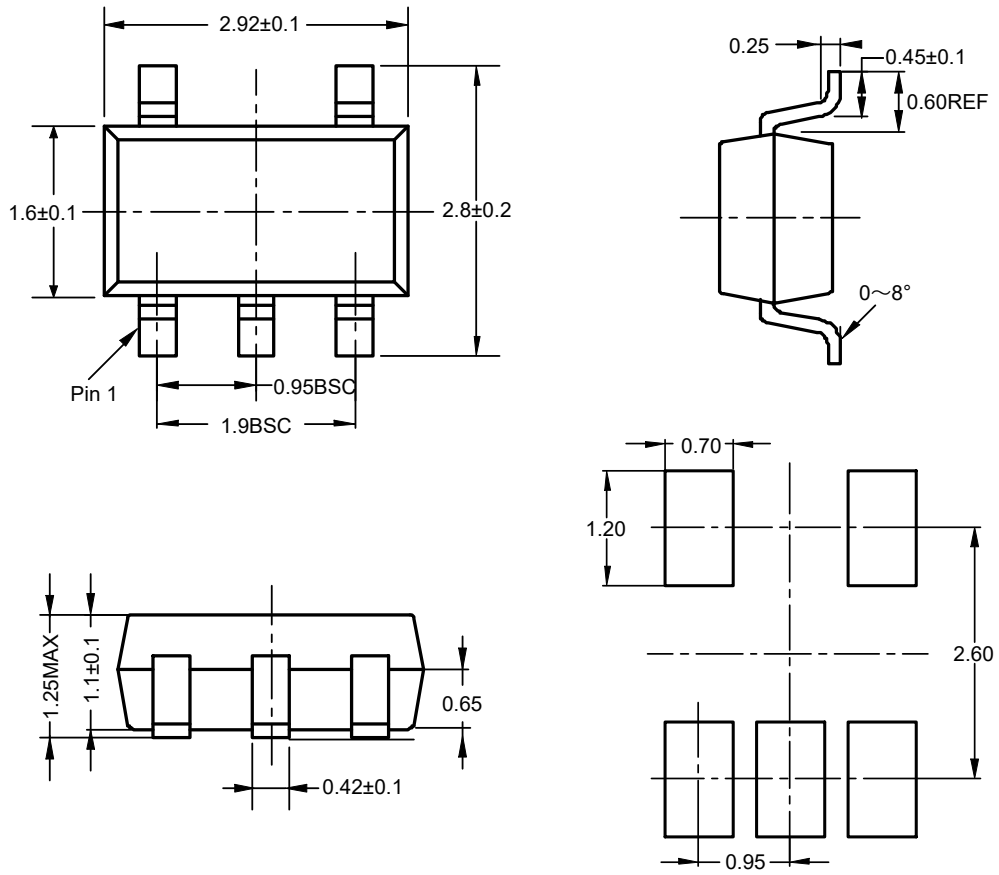
Recommended Land Pattern

Detail A: (PIN1 shape)



Unit: mm

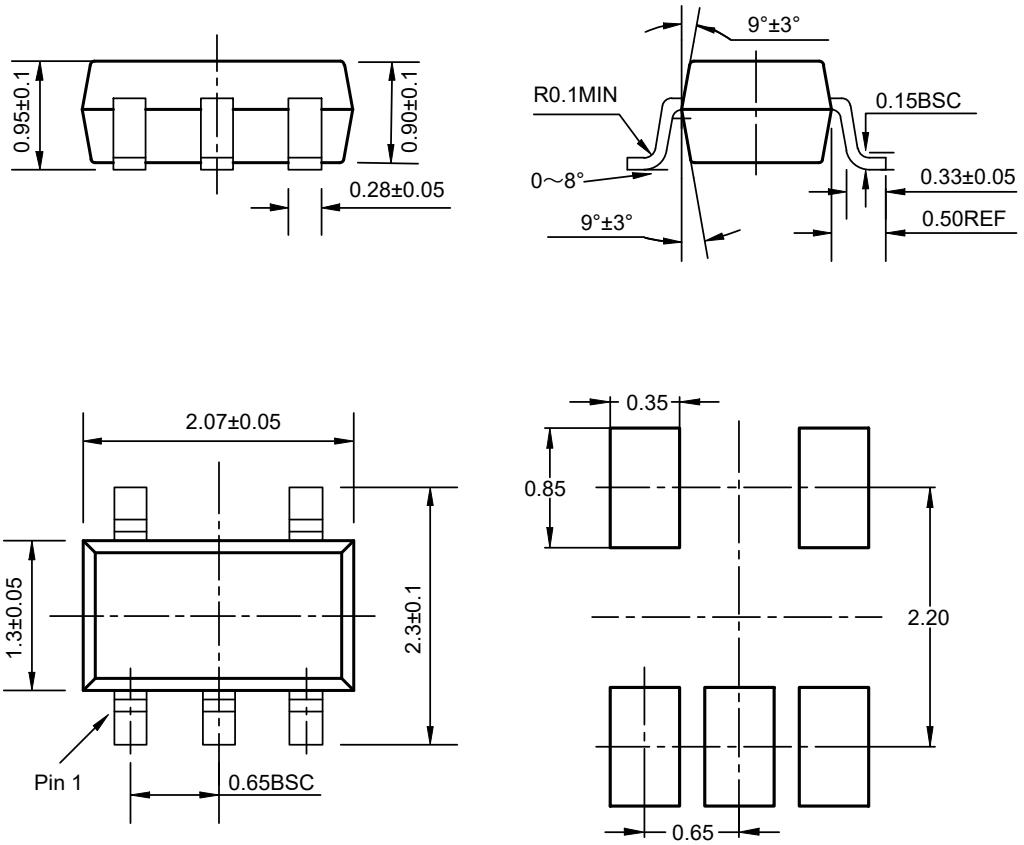
SOT23-5



Recommended Land Pattern

Unit: mm

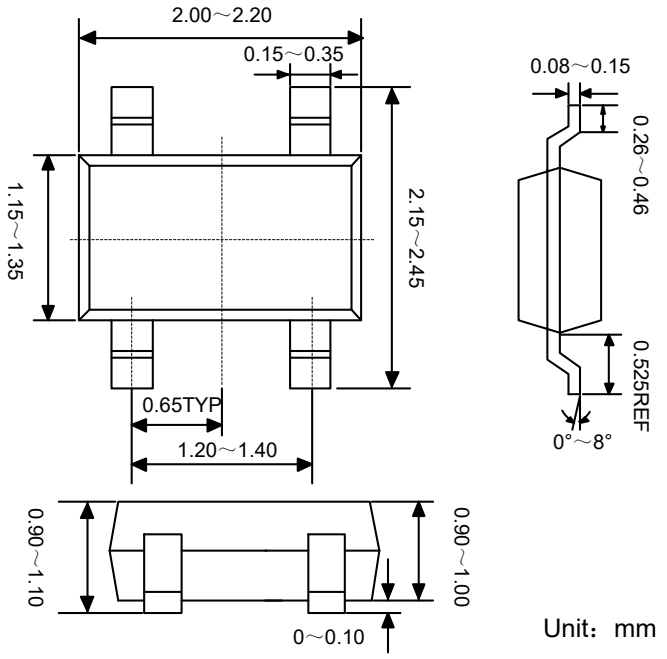
SC70-5



Recommended Land Pattern

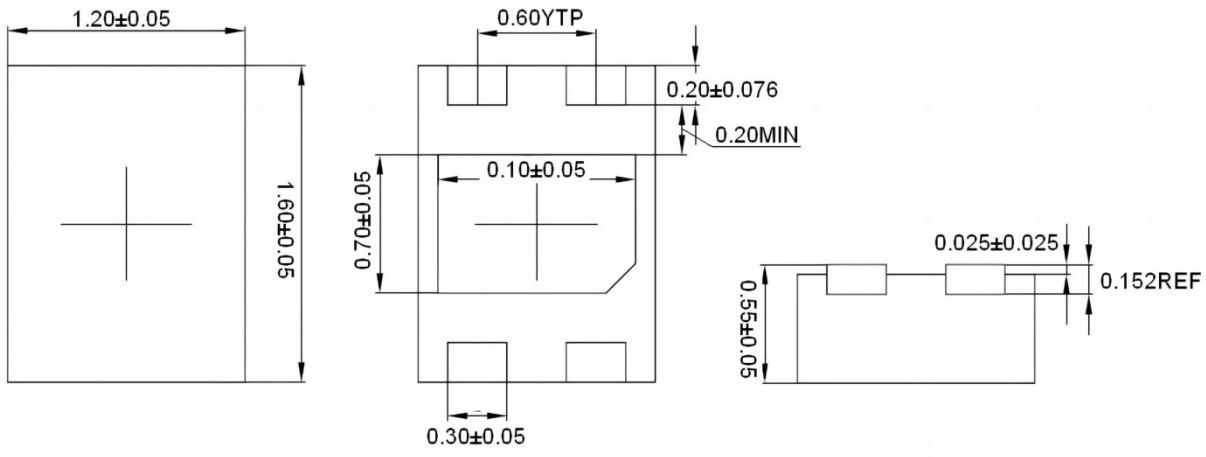
Unit: mm

SOT343



Unit：mm

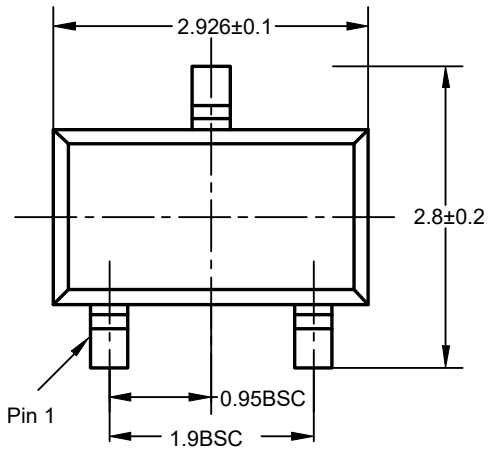
DFN4(1.2×1.6)

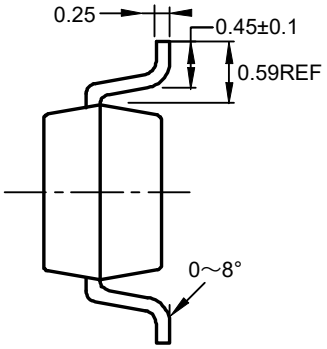


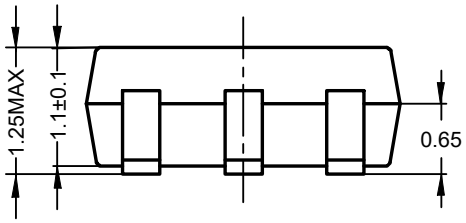
Top View　　Bottom View　　Side View

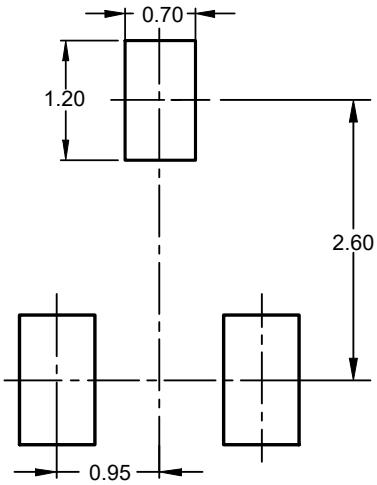
Unit: mm

SOT23-3





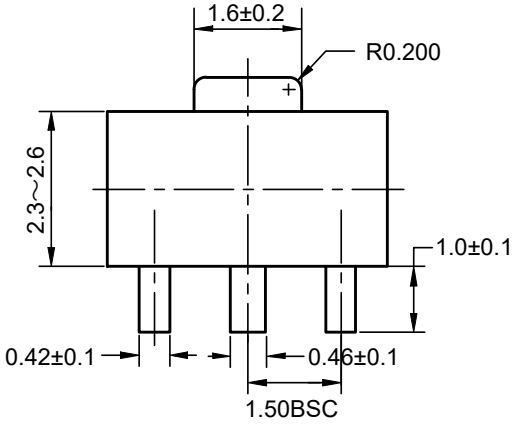




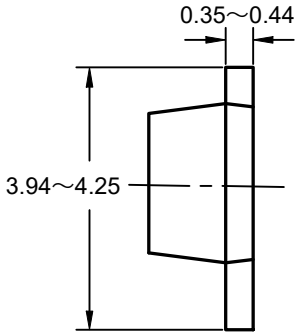
Recommended Land Pattern

Unit: mm

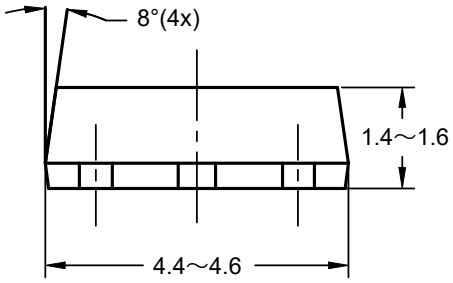
SOT89-3



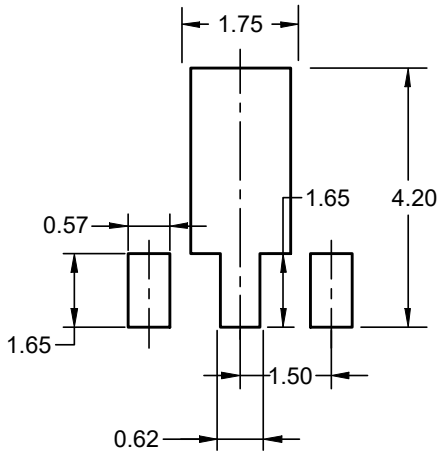
Top View



Side View



Side View



Recommended Land Pattern

Unit: mm

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
2.1	2018-01-17	Updated SOT89-3 Part No. from ET533**B to ET533**D.	Wuxj	Wuxj	Zhujl
2.2	2019-02-13	Change PSRR from 70 to 75	Wuxj	Wuxj	Zhujl
2.2	2020-06-16	Add characteristic chart	Wuxj	Wuxj	Zhujl
2.4	2021-01-12	Update Package size	Wuxj	Wuxj	Zhujl
2.5	2022-12-06	Update Typeset	Pengjj	Liuxm	Liujy
2.6	2023-10-26	Update package	Pengjj	Liuxm	Liujy