ET5H5XX - High Input Very-Low IQ 300mA LDO

General Description

ET5H5XX series are the high input very low I_Q 300mA LDO with enable function that operates output from 1.8V、3.0V~13V, is designed specifically for portable battery-powered applications which require ultra-low quiescent current. The very-low consumption of type 2.8μA ensures long battery life and dynamic transient boost feature improves device transient response for wireless communication applications.

ET5H5XX series are offered SOT89-3, SOT89-5, SOT23-5, SOT23-3, DFN4(1×1) packages.

Features

- Wide Input Voltage Range: 3.0V to 40V
- Up to 300mA Load Current
- Very Low I_Q: 2.8μA
- Fixed Output Voltage: 1.8V or 3.0V~13V@50mV/Step
- Low Dropout: 1000mV Typical @ 300mA / V_{OUT}=5.0V
- Excellent Load / Line Transient Response
- High Ripple Rejection: 52dB Typical at 1KHz
- Packages are SOT89-3, SOT89-5, SOT23-5, SOT23-3, DFN4(1mm×1mm)

Device information

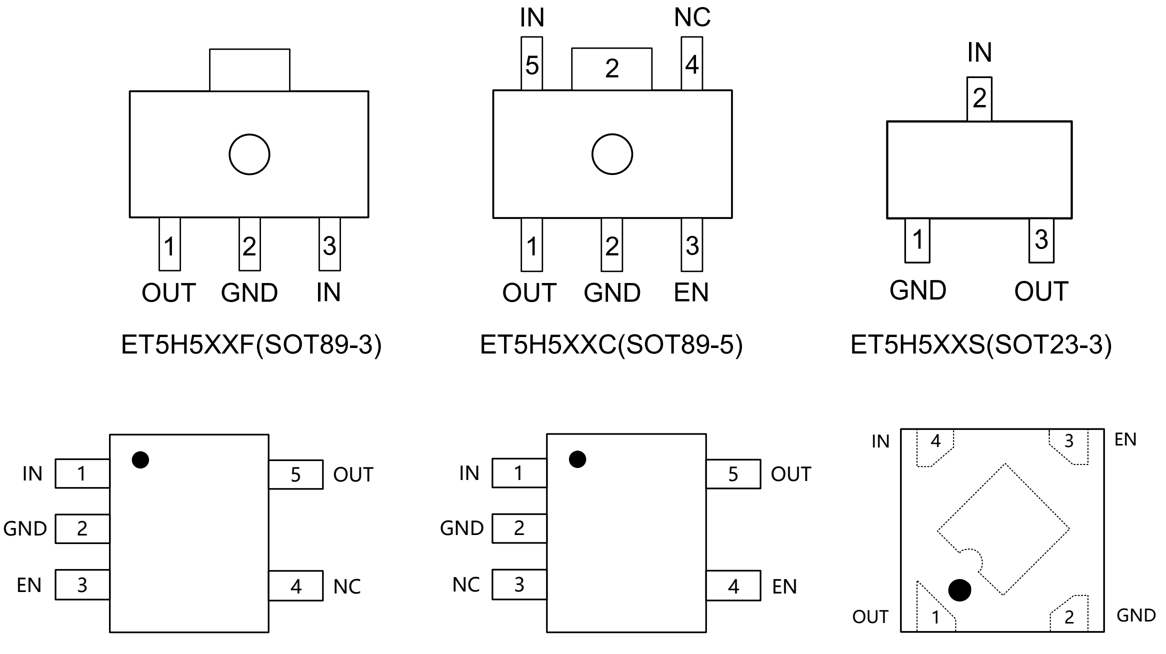
ET 5H5 XX X

XX Output Voltage		**X Package**	
XX	Output X.XV For example, 50 is 5.0V output	F	SOT89-3
		Y	DFN4(1×1)
		S	SOT23-3
		T	SOT23-5
		/	SOT23-5 (Default)

Mark Specification Label

Part No.	Marking						V_{OUT}
	SOT89-3	SOT23-3	DFN4	SOT89-5	SOT23-5		
	XXF	XXS	XXY	XXC	XX	XXT	
ET5H518	18F	18S	XX	18C	18	18T	1.8V
ET5H530	30F	30S	XX	30C	30	30T	3.0V
ET5H533	33F	33S	XX	33C	33	33T	3.3V
ET5H536	36F	36S	XX	36C	36	36T	3.6V
ET5H540	40F	40S	XX	40C	40	40T	4.0V
ET5H550	50F	50S	XX	50C	50	50T	5.0V
ET5H553	53F	53S	XX	53C	53	53T	5.3V
ET5H560	60F	60S	XX	60C	60	60T	6.0V
ET5H570	70F	70S	XX	70C	70	70T	7.0V
ET5H580	80F	80S	XX	80C	80	80T	8.0V
ET5H590	90F	90S	XX	90C	90	90T	9.0V
ET5H5120	120F	120S	XX	120C	120	120T	12.0V

Pin Configuration



ET5H5XXF(SOT89-3) ET5H5XXC(SOT89-5) ET5H5XXS(SOT23-3)

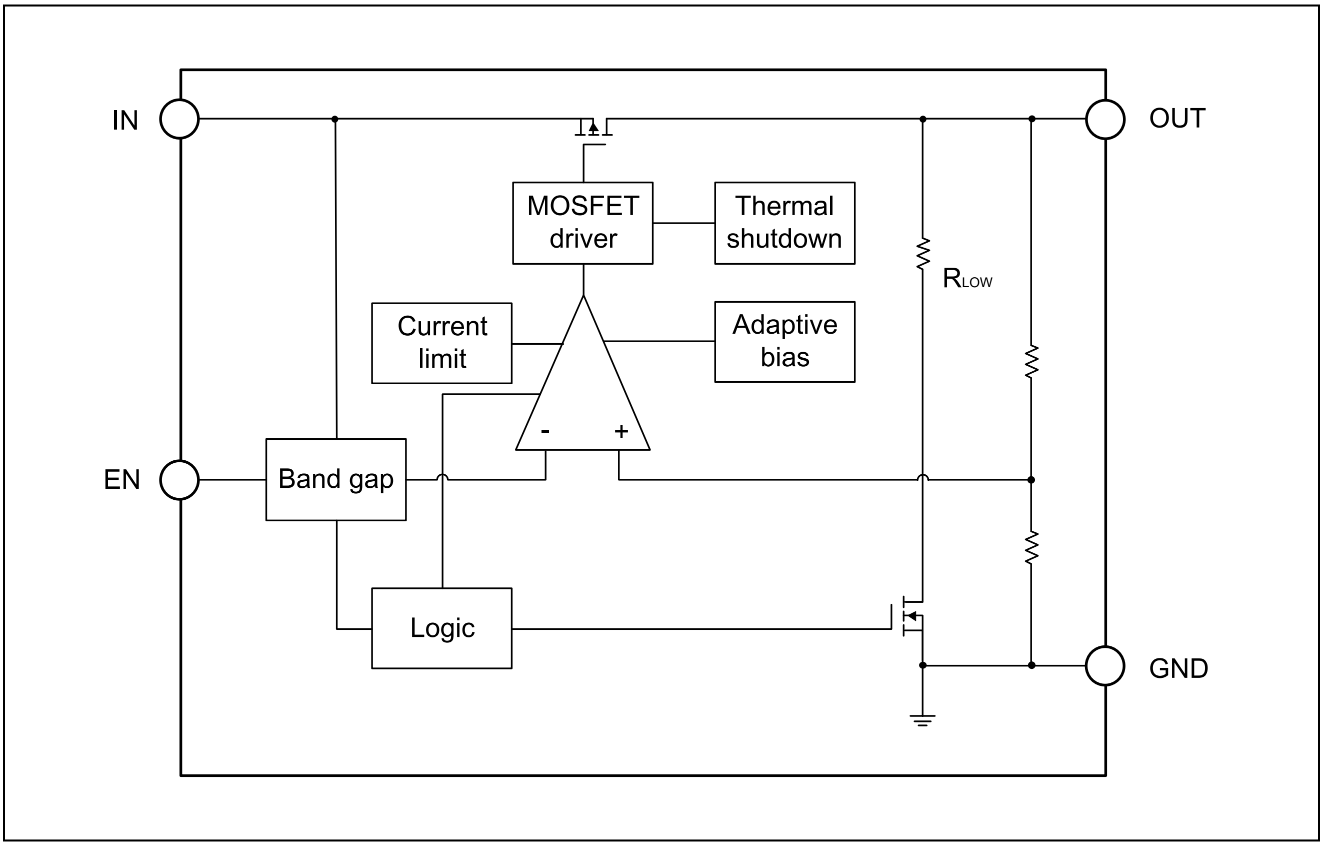
ET5H5XX(SOT23-5) ET5H5XXT(SOT23-5) ET5H5XXY(DFN4)

Top View

Pin Function

Pin No.						Pin Name	Pin Function
SOT89-3	SOT23-3	DFN4	SOT89-5	SOT23-5			
XXF	XXS	XXY	XXC	XX	XXT		
2	1	2	2	2	2	GND	Ground.
3	2	4	5	1	1	IN	Supply input pin.
1	3	1	1	5	5	OUT	Output pin.
		3	3	3	4	EN	Enable control input, active high.
			4	4	3	NC	No connection.

Block Diagram



Functional Description

Input Capacitor

A 0.47μF~10μF ceramic capacitor is recommended to connect between 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 IN and GND.

Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended output capacitance is from 0.47μF to 10μF, 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.

Enable

The ET5H5XX delivers the output power when it is set to enable state. When it works in disable state, there is no output power and the operation quiescent current is almost zero. The enable pin (EN) is active high.

Dropout Voltage

The ET5H5XX uses a PMOS pass transistor to achieve low dropout. When (V_{IN} – V_{OUT}) is less than the dropout voltage (V_{DROP}), the PMOS pass device is in the linear region of operation and the input-to-output resistance is the $R_{DS(ON)}$ of the PMOS pass element. V_{DROP} scales approximately with output current because the PMOS device behaves like a resistor in dropout mode. As with any linear regulator, PSRR and transient response degrade as (V_{IN} – V_{OUT}) approaches dropout operation.

Thermal Shutdown

Thermal shutdown protection disables the output when the junction temperature rises to approximately 155°C.Disabling the device eliminates the power dissipated by the device, allowing the device to cool. When the junction temperature cools to approximately 125°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 the LDO 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.

Thermal Considerations

For continuous operation, do not exceed absolute maximum junction temperature. The maximum power dissipation depends on the thermal resistance of the IC package, PCB layout, rate of surrounding airflow, and difference between junction and ambient temperature. The maximum power dissipation can be calculated by the following formula :

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

where $T_{J(MAX)}$ is the maximum junction temperature, T_A is the ambient temperature, and θ_{JA} is the junction to ambient thermal resistance.The maximum power dissipation depends on the operating ambient temperature for fixed $T_{J(MAX)}$ and thermal resistance, θ_{JA}.

Current-Limit Protection

The ET5H5XX provides current limit function to prevent the device from damages during over-load or shorted-circuit condition. This current is detected by an internal sensing transistor.

Layout Guidelines

- Place input and output capacitors as close to the device as possible.
- Use copper planes for device connections in order to optimize thermal performance.
- Place thermal vias around the device to distribute heat.

Absolute Maximum Ratings

Symbol	Rating	Value	Unit
V_{IN}	Input Voltage[(1)]	-0.3~43	V
V_{OUT}	Output Voltage	-0.3~16	V
V_{EN}	Chip Enable Input	-0.3~43	V
$T_{J(MAX)}$	Maximum Junction Temperature	150	°C
T_{STG}	Storage Temperature	-65~150	°C
V_{ESD} [(2)]	HBM Capability	±2000	V
	CDM Capability	±1500	V
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 HBM tested per EIA/JESD22-A114;

ESD CDM tested per JESD22-C101;

Latch up tested per JEDEC78.

Thermal Characteristics

Symbol	Package	Ratings	Value	Unit
$R_{\theta JA}$	SOT89-3	Thermal Characteristics, Thermal Resistance, Junction-to-Air	135	°C/W
	SOT89-5		80	
	SOT23-5		250	
	SOT23-3		360	
	DFN4		250	
P_D	SOT89-3	Power Dissipation@25°C PCB board dimension : 50mm x 50mm (2layer) Copper :1oz	920	mW
	SOT89-5		1500	
	SOT23-5		500	
	SOT23-3		420	
	DFN4		500	

Recommended Operating Conditions

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	3.0 to 40	V
I_{OUT}	Output Current	0 to 300	mA
T_A	Operating Ambient Temperature	-40 to 85	°C
T_J	Operating Junction Temperature	-40 to 125	°C
C_{IN}	Effective Input Ceramic Capacitor Value	0.47 to 10	μF
C_{OUT}	Effective Output Ceramic Capacitor Value	0.47 to 10	μF
ESR	Input and Output Capacitor Equivalent Series Resistance (ESR)	5 to 100	mΩ

Electrical Characteristics

(V_{IN} =V_{OUT}+2V; I_{OUT} = 10mA, C_{IN} = C_{OUT} = 1.0µF, unless otherwise noted.Typical values are at T_A = +25°C.)

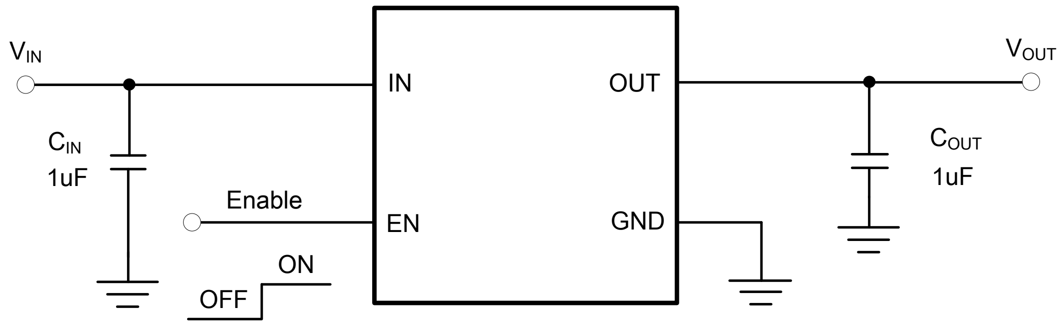
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}(3)	Operating Input Voltage		3.0		40	V
V_{OUT}	Output Voltage	T_A = +25°C	-2%		+2%	V
I_Q	Quiescent Current	I_{OUT} = 0mA		2.8	6.5	µA
I_{Q_OFF}	Standby Current	V_{EN} = 0V, T_A = +25°C			1	µA
Reg_{Line}	Line Regulation	V_{IN} = V_{OUT} +1V to 40V, I_{OUT} = 10mA		40	90	mV
V_{DROP}(4)	Dropout Voltage I_{OUT}=300mA	V_{OUT}=1.8V		950	1450	mV
		V_{OUT} = 3.0~13V		1000	1500	
Reg_{LOAD}	Load Regulation	1mA ≤ I_{OUT} ≤ 300mA, V_{IN} =V_{OUT}+2V		90	180	mV
I_{LMT}	Current Limit	V_{IN} =V_{OUT}+2V		450	800	mA
I_{SHORT}	Short Current Limit	V_{OUT}=0V		55	120	mA
V_{ENH}	EN Pin Threshold Voltage	EN Input Voltage "H"	1.4			V
V_{ENL}	EN Pin Threshold Voltage	EN Input Voltage "L"			0.4	V
I_{EN}	EN Pin Current	V_{EN}=0~40V		1		µA
PSRR(5)	Power Supply Rejection Ratio	f = 1 kHz,V_{IN} =V_{OUT}+2V I_{OUT} = 20mA		52		dB
e_N(5)	Output Noise Voltage	V_{IN} = V_{OUT}+2V, I_{OUT} = 1mA, f = 10Hz to 100KHz, V_{OUT} =3V,C_{OUT} = 1µF		30* V_{OUT}		µVrms
T_{ON}	Turn-On Time	From assertion of V_{EN} to V_{OUT}=90%$V_{OUT(NOM)}$		1		ms
V_{TRLN}	Line transient	V_{IN}= V_{OUT}+2V to V_{OUT}+10V in 10µs, I_{OUT}=1mA,T_A= +25 ºC		50		mV
		V_{IN}= V_{OUT}+10V to V_{OUT}+2V in 10µs, I_{OUT}=1mA,T_A= +25 ºC		50		mV
V_{TRLD}	Load transient	I_{OUT}=1mA to 300mA in 10µs V_{IN}= V_{OUT}+2V,T_A= +25 ºC		210		mV
		I_{OUT}=300mA to 1mA in 10µs V_{IN}= V_{OUT}+2V, T_A= +25 ºC		160		mV
T_{TSD} (5)	Thermal Shutdown Temperature	Temperature Increasing from T_A= +25°C		155		°C
T_{HYS} (5)	Thermal Shutdown Hysteresis	Temperature Falling from T_{TSD}		25		°C

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

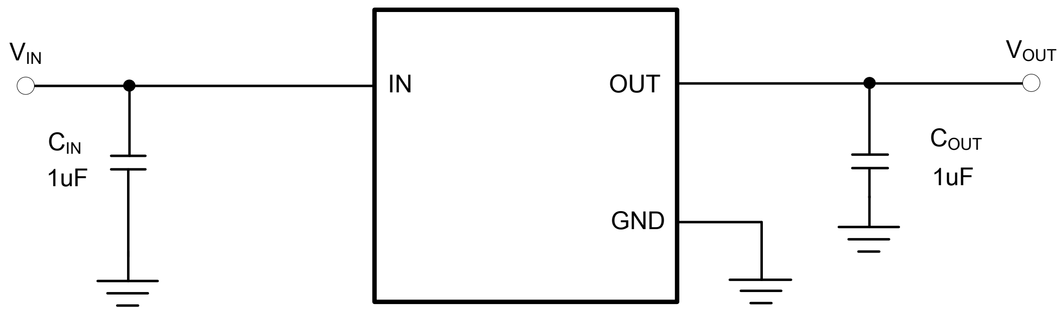
Note4. V_{DROP} FT test method: test the V_{OUT} voltage at V_{OUT}+$V_{DROPMAX}$ with 300mA output current.

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

Application Circuits



With EN Function

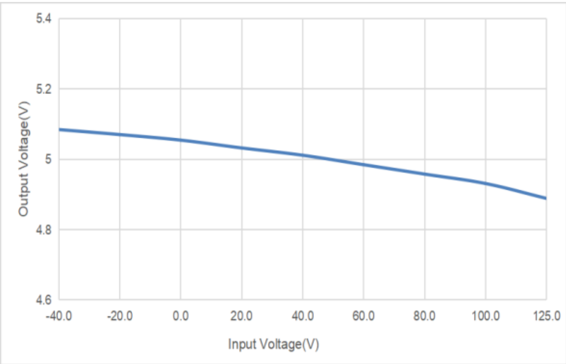


Without EN Function

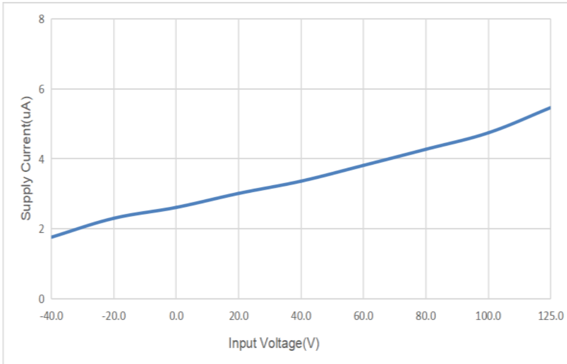
Typical Characteristics

VOLTAGE VERSION 5V

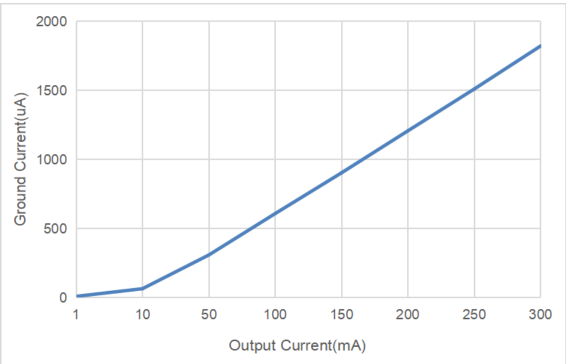
(V_{OUT} =5V, V_{IN} =7V, C_{IN} = C_{OUT} = 1.0μF, unless otherwise noted.Typical values are at T_A = +25°C.)



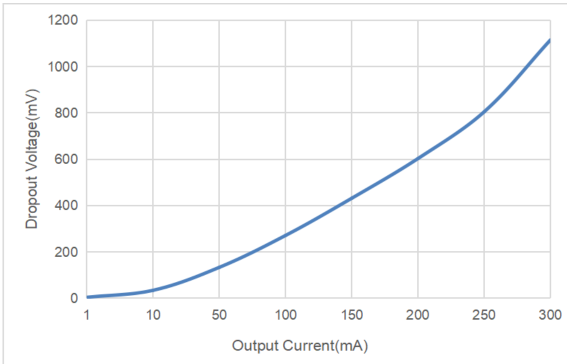
Output Voltage VS Temperature



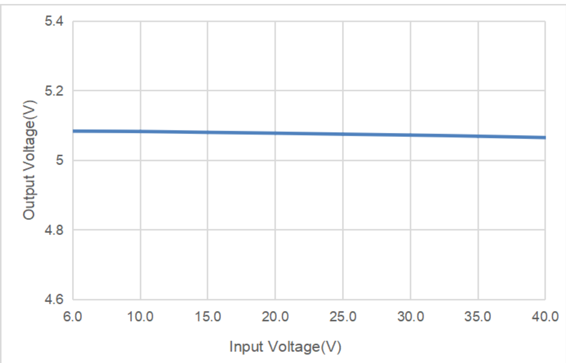
Quiescent Current VS Temperature



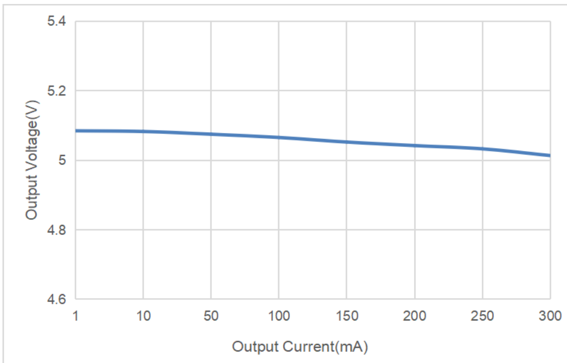
Ground Current VS Output Current



Dropout Voltage VS Output Current



Output Voltage VS Input Voltage

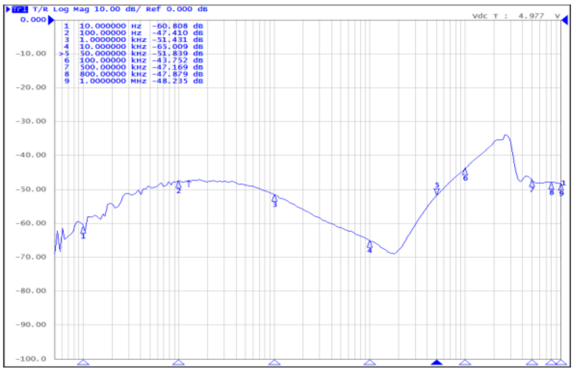


Output Voltage VS Output Current

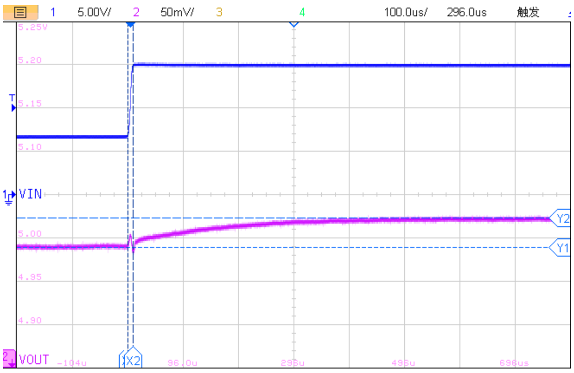
Typical Characteristics(Continued)

VOLTAGE VERSION 5V

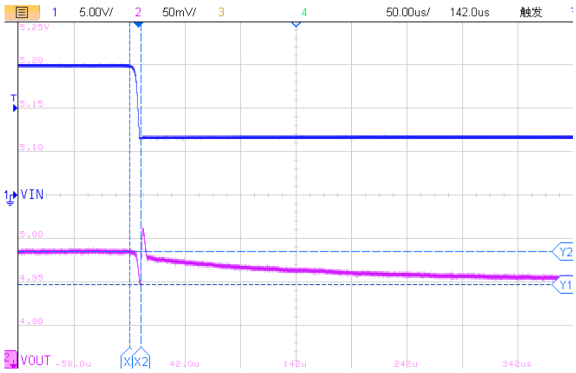
(V_{OUT} =5V, V_{IN} =7V, C_{IN} = C_{OUT} = 1.0μF, unless otherwise noted.Typical values are at T_A = +25°C.)



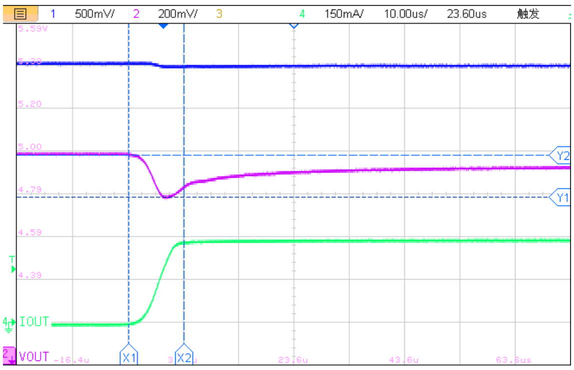
PSRR VS Output Current



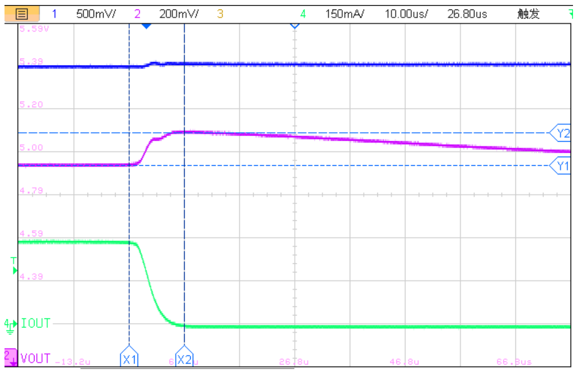
Input Transient(7~15V t=10μs 10mA)



Input Transient(15~7V t=10μs 10mA)



Load Transient(1mA~300mA t=10μs)

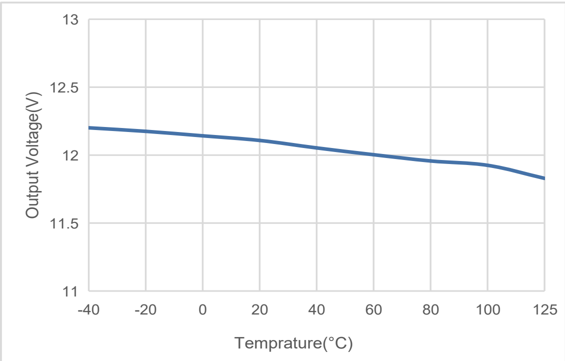


Load Transient(300mA~1mA t=10μs)

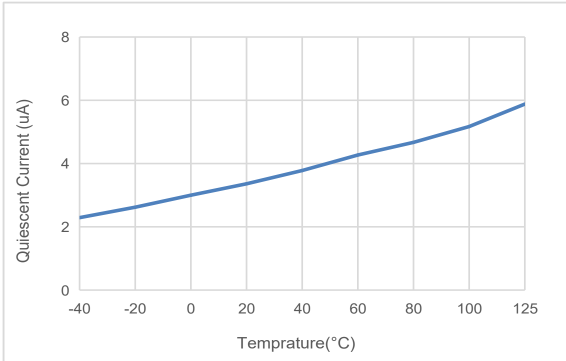
Typical Characteristics(Continued)

VOLTAGE VERSION 12V

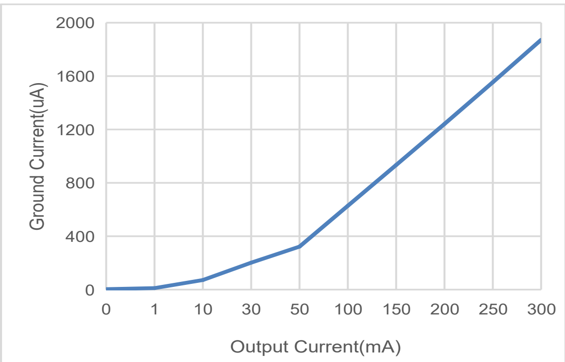
(V_{OUT} =12V, V_{IN} =14V, C_{IN} = C_{OUT} = 1.0μF, unless otherwise noted.Typical values are at T_A = +25°C.)



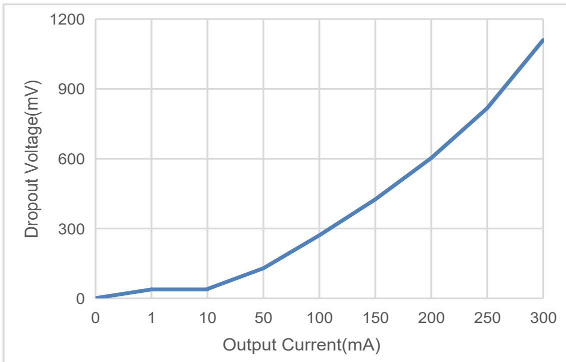
Output Voltage VS Temperature



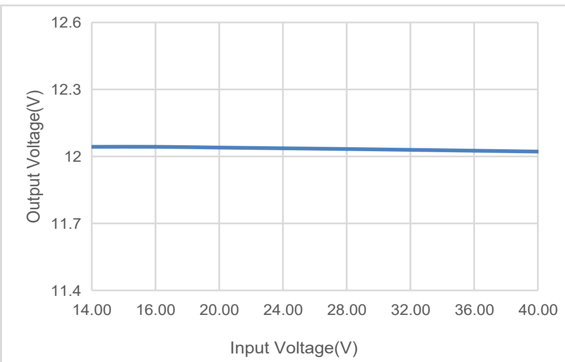
Quiescent Current VS Temperature



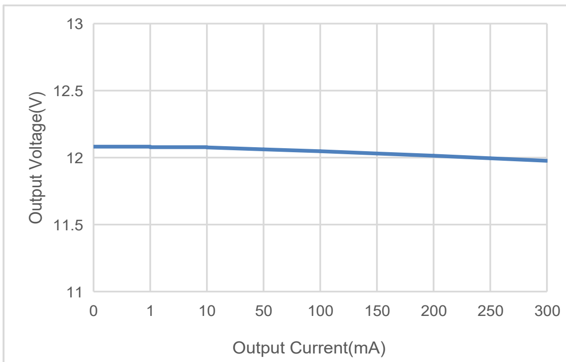
Ground Current VS Output Current



Dropout Voltage VS Output Current



Output Voltage VS Input Voltage

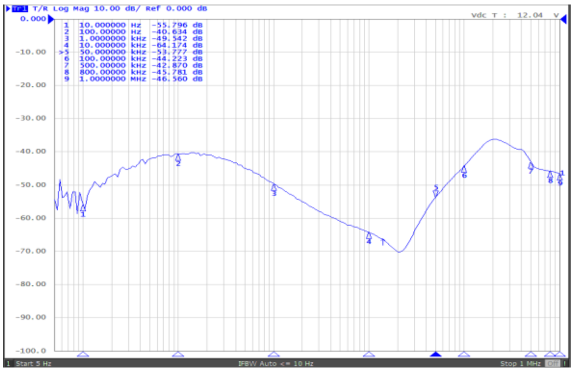


Output Voltage VS Output Current

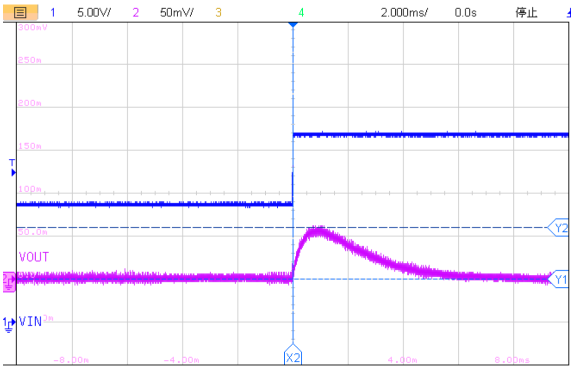
Typical Characteristics(Continued)

VOLTAGE VERSION 12V

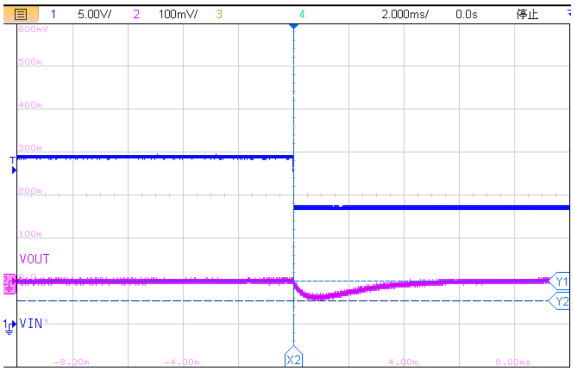
(V_{OUT} =12V, V_{IN} =14V, C_{IN} = C_{OUT} = 1.0μF, unless otherwise noted.Typical values are at T_A = +25°C.)



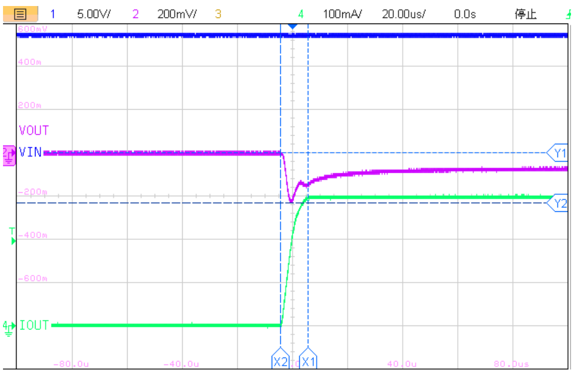
PSRR VS Output Current



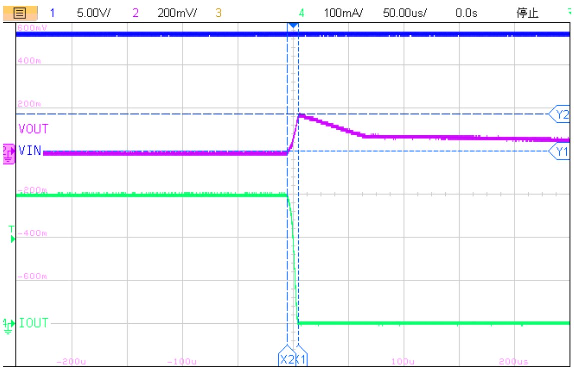
Input Transient(14~22V t=10μs 10mA)



Input Transient(22~14V t=10μs 10mA)



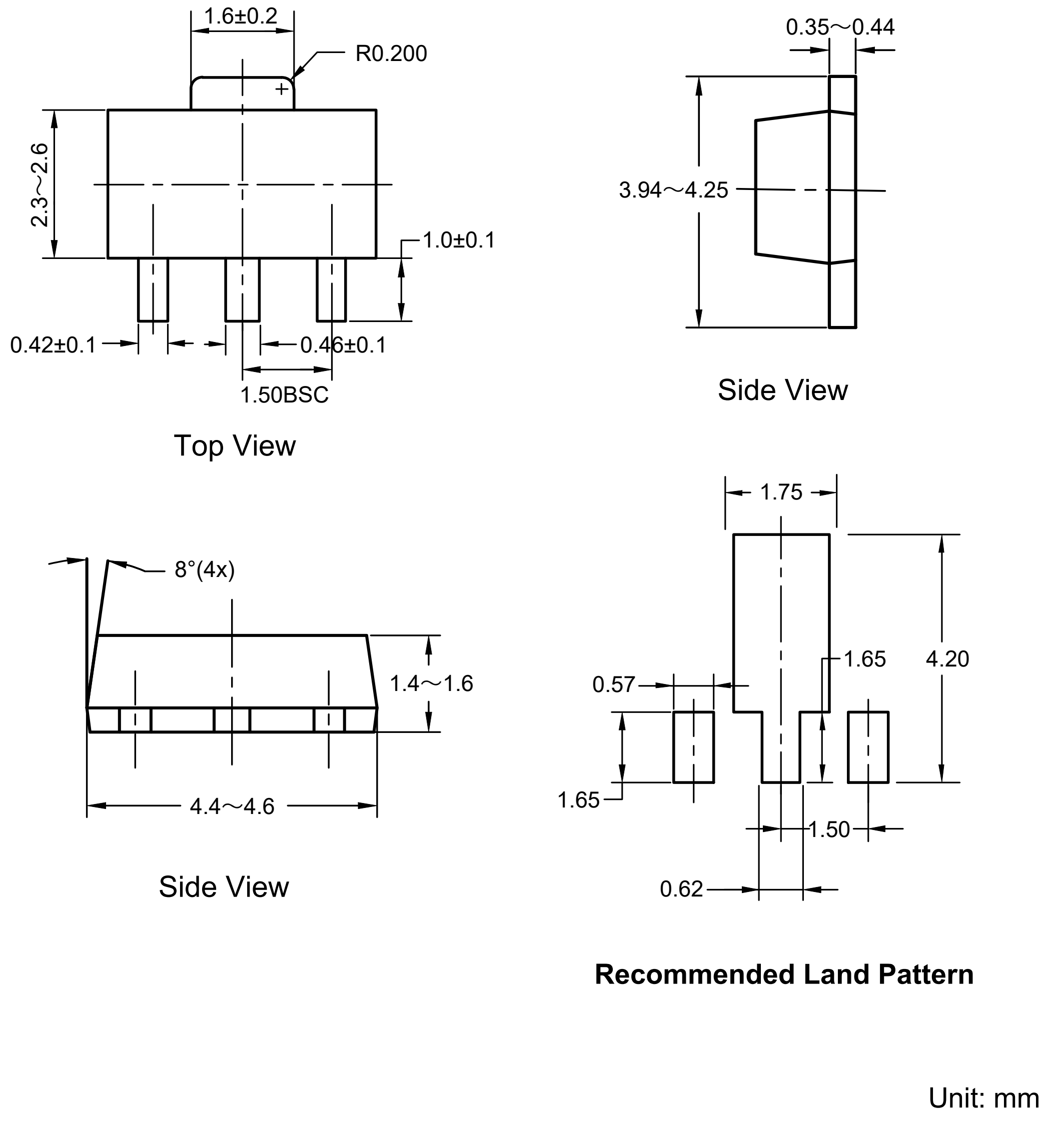
Load Transient(1mA~300mA t=10μs)



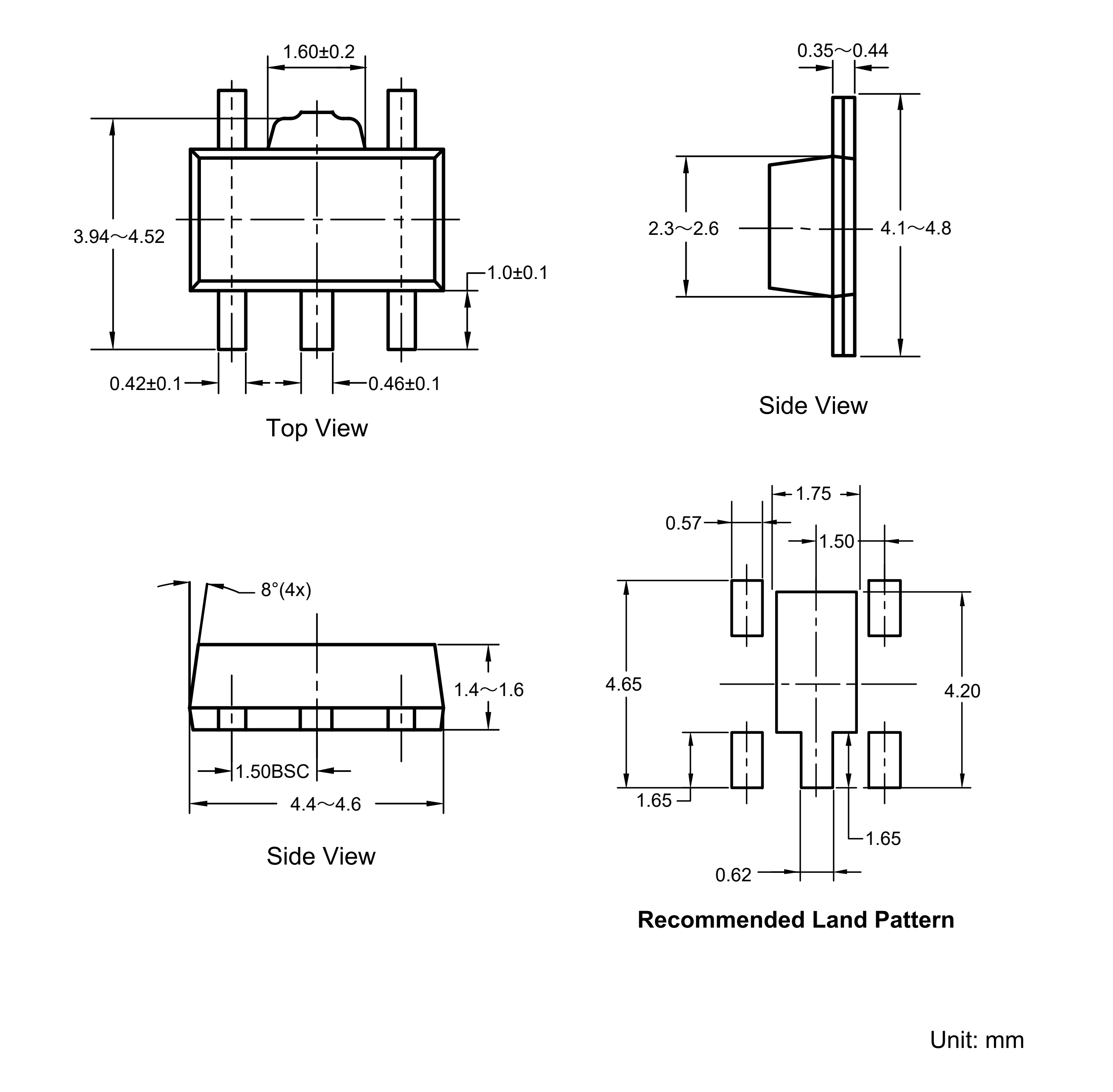
Load Transient(300mA~1mA t=10μs)

Package Dimension

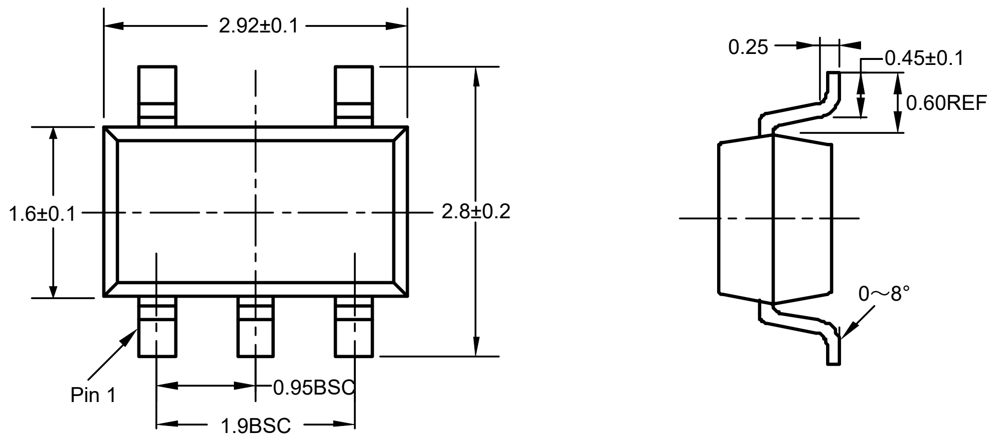
SOT89-3

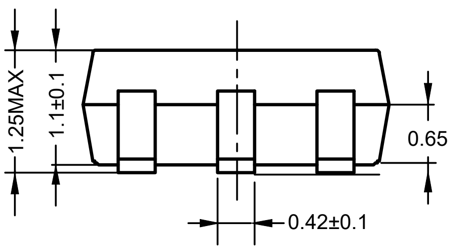


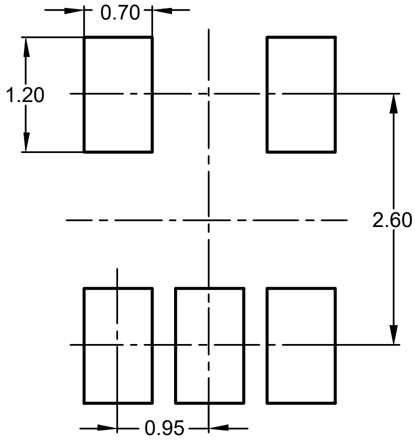
SOT89-5


1.60±0.2
3.94～4.52
1.0±0.1
0.42±0.1
0.46±0.1
Top View
0.35～0.44
2.3～2.6
4.1～4.8
Side View
8°(4x)
1.4～1.6
1.50BSC
4.4～4.6
Side View
1.75
0.57
1.50
4.65
4.20
1.65
1.65
0.62
Recommended Land Pattern
Unit: mm

SOT23-5



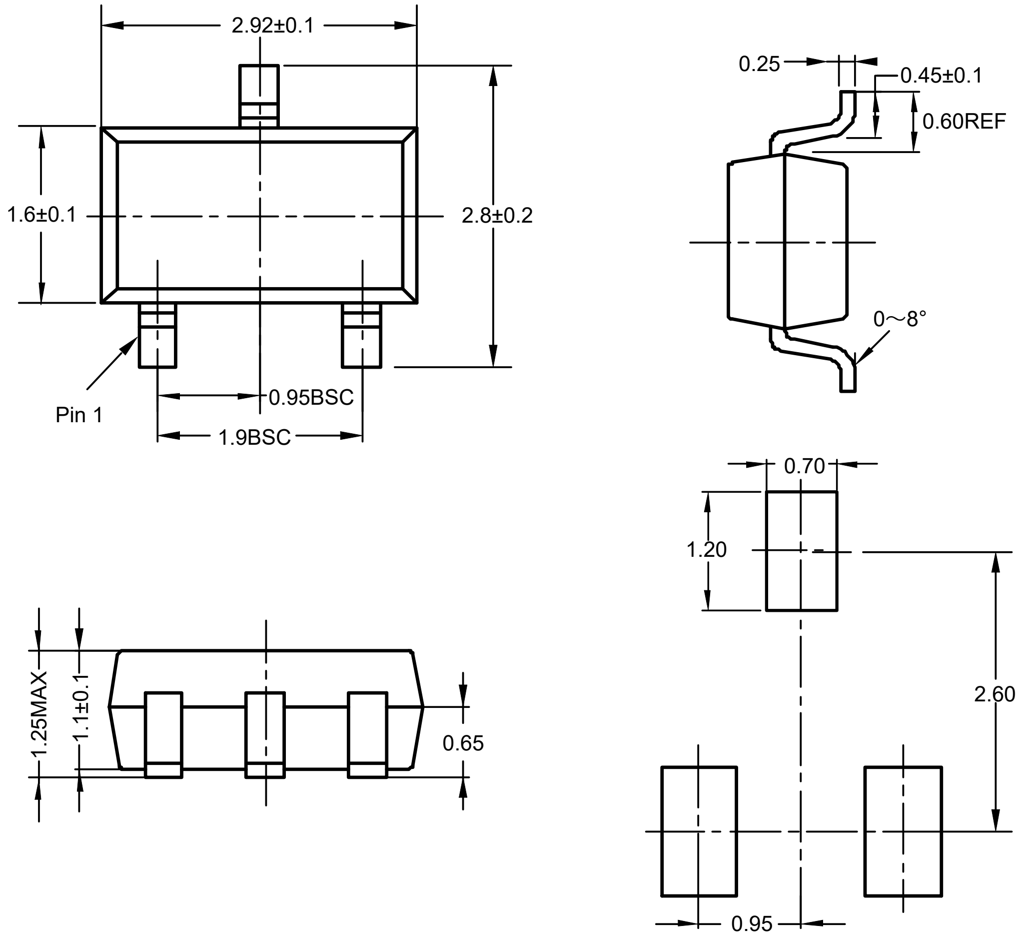




Recommended Land Pattern

Unit: mm

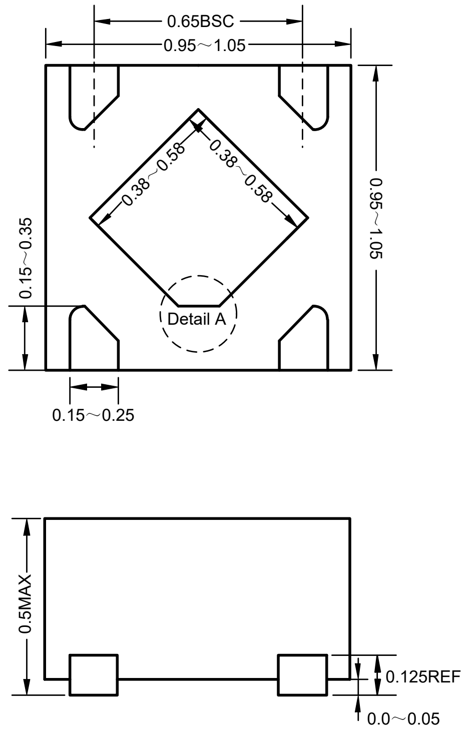
SOT23-3

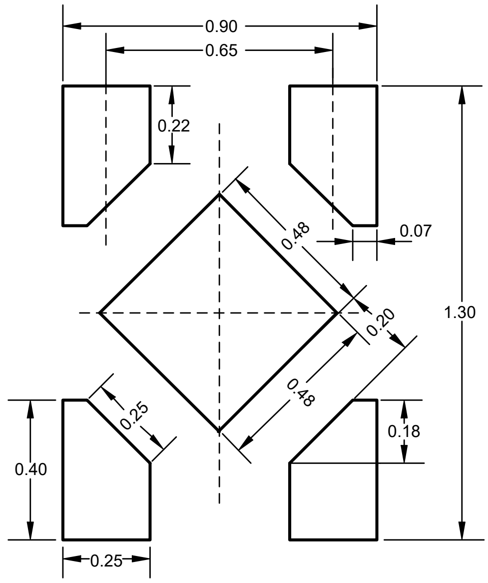


Recommended Land Pattern

Unit: mm

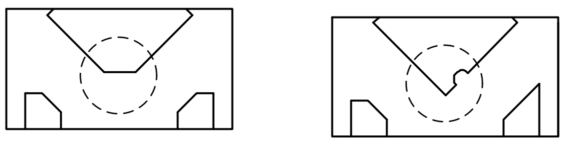
DFN4(1x1)





Recommended Land Pattern

Detail A: (PIN1 shape)



Unit：mm

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2022-11-13	Preliminary Version	Liuxm	Liuxm	Zhujl
1.0	2023-05-23	Official Version	Yangz	Tugz	Liujy
1.1	2023-10-7	Update package	Shibo	Shibo	Shibo
1.2	2024-3-10	Add 4.0V 5.3V version	Shibo	Shibo	Shibo