

ET5H2XX - High Input Very-Low IQ 300mA LDO

General Description

ET5H2XX series are the high input very low IQ 300mA LDO with enable function that operates from 1.8V~5V, is designed specifically for portable battery-powered applications which require ultra-low quiescent current. The very-low consumption of type 2.5uA ensures long battery life and dynamic transient boost feature improves device transient response for wireless communication applications.

ET5H2XX series are offered SOT89-3, SOT89-5, SOT23-5, SOT23-3, DNF4(1x1) packages

Features

- Wide input voltage range from 2.5V to 36V
- Up to 300mA Load Current
- Very low I_Q is 2.5 μ A typical
- Fixed Output Voltage are 1.8V,2.5V,2.8V,3.0V,3.3V,3.6V,5V,etc
- Low dropout is 1000mV at 300mA Load @ $V_{OUT}=3.3V$
- Excellent load/line transient response
- High Ripple Rejection: 60dB at 1KHz
- Packages are SOT89-3, SOT89-5, SOT23-5, SOT23-3, DFN4 (1x1)

Device information

ET 5H2 XX X

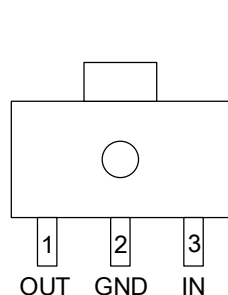
<u>XX</u> Output Voltage		<u>X</u> Package	
XX	Output X.X-V For example, 18 is 1.8V output	F	SOT89-3
		C	SOT89-5
		Y	DFN4(1X1)
		S	SOT23-3
		T	SOT23-5
		/	SOT23-5 (Default)

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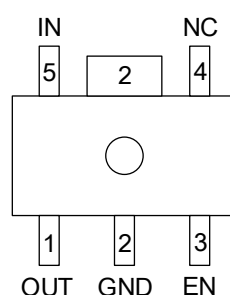
Mark Specification Label

Part No.	Marking						V _{OUT}
	SOT89-3	SOT23-3	DFN4	SOT89-5	SOT23-5		
	XXF	XXS	XXY	XXC	XX	XXT	
ET5H218	18F	18S	CX	18C	18	18T	1.8V
ET5H225	25F	25S	FX	25C	25	25T	2.5V
ET5H228	28F	28S	FX	28C	28	28T	2.8V
ET5H230	30F	30S	GX	30C	30	30T	3.0V
ET5H233	33F	33S	EX	33C	33	33T	3.3V
ET5H236	36F	36S	EX	36C	36	36T	3.6V
ET5H250	50F	50S	ZX	50C	50	50T	5.0V

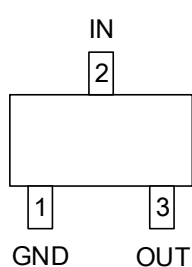
Pin Configuration



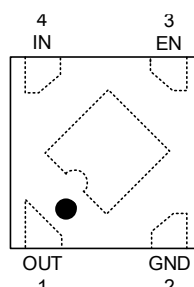
ET5H2XXF (SOT89-3)



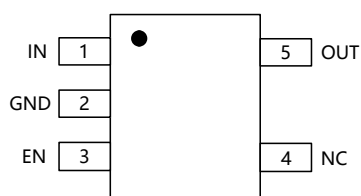
ET5H2XXC (SOT89-5)



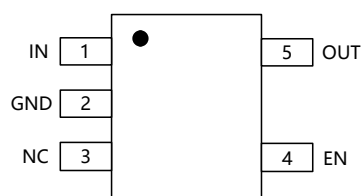
ET5H2XXS (SOT23-3)



ET5H2XXY (DFN4)



ET5H2XX (SOT23-5)



ET5H2XXT (SOT23-5)

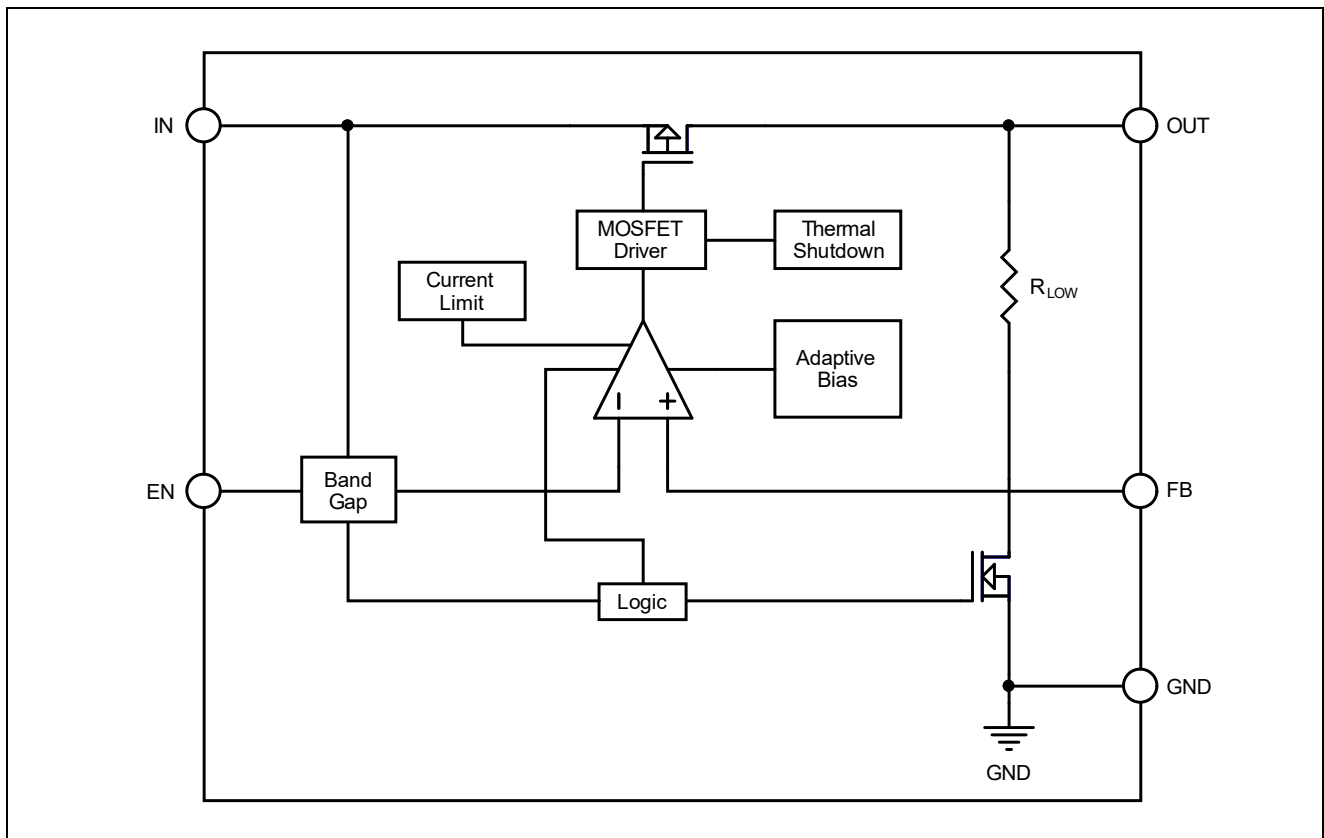
Top View

ET5H2XX

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



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Functional Description

Input Capacitor

A 1 μ F~10 μ F 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 1 μ F to 10 μ F, Equivalent Series Resistance (ESR) is from 5m Ω to 100m Ω , 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 ET5H2XX 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 ET5H2XX uses a PMOS pass transistor to achieve low dropout. When ($V_{IN} - V_{OUT}$) is less than the dropout voltage (VDO), 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. VDO 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.

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For recommended operating condition specifications the maximum junction temperature is 150°C and T_A is the ambient temperature. The junction to ambient thermal resistance (θ_{JA}) is layout dependent.

For SOT89-3 package, the thermal resistance (θ_{JA}) is 135°C/W on the test board. The maximum power dissipation at $T_A = 25^\circ\text{C}$ can be calculated by the following formula:

$$P_{D(MAX)} = (150^\circ\text{C} - 25^\circ\text{C}) / (135^\circ\text{C/W}) = 0.925\text{W for SOT89-3 package}$$

The maximum power dissipation depends on the operating ambient temperature for fixed $T_{J(MAX)}$ and thermal resistance (θ_{JA}). The derating curve in Figure 6 allows the designer to see the effect of rising ambient temperature on the maximum power dissipation.

Current-Limit Protection

The ET5H2XX 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.
- Do not place a thermal via directly beneath the thermal pad of the DRV package. A via can wick solder or solder paste away from the thermal pad joint during the soldering process, leading to a compromised solder joint on the thermal pad.

Absolute Maximum Ratings

Symbol	Rating	Value	Unit
V_{IN}	Input Voltage ⁽¹⁾	0~44	V
V_{OUT}	Output Voltage	0.8~6	V
V_{EN}	Chip Enable Input	-0.3~44	V
$T_{J(MAX)}$	Maximum Junction Temperature	150	°C
T_{STG}	Storage Temperature	-55~150	°C
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 Human Body Model tested per EIA/JESD22-A114 ;

CDM tested per JESD22-C101;

Latch up Current Maximum Rating tested per JEDEC78.

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Thermal Characteristics

Symbol	Package	Ratings	Value	Unit
R _{θJA}	SOT89-3	Thermal Characteristics, Thermal Resistance, Junction-to-Air	135	°C/W
	SOT89-5		80	
	SOT23-5		250	
	SOT23-3		360	
	DFN4		250	
Power Dissipation @25°C	SOT89-3	PCB board dimension : 40mm x 40mm (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	2.5 to 36	V
I _{OUT}	Output Current	0 to 300	mA
T _A	Operating Ambient Temperature	-40 to 85	°C
C _{IN}	Effective Input Ceramic Capacitor Value	1 to 10	uF
C _{OUT}	Effective Output Ceramic Capacitor Value	1 to 10	uF
ESR	Input and Output Capacitor Equivalent Series Resistance (ESR)	5 to 100	mΩ

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Electrical Characteristics

($V_{IN} = V_{OUT} + 2V$; $I_{OUT} = 10mA$, $C_{IN} = C_{OUT} = 1.0\mu F$, unless otherwise noted. Typical values are at $T_A = +25^\circ C$.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Operating Input Voltage ⁽³⁾		2.5		36	V
V_{OUT}	Output Voltage	$T_A = +25^\circ C$	-2%		+2%	V
		$-40^\circ C \leq T_A \leq 85^\circ C$	-3%		+3%	
I_Q	Quiescent Current	$I_{OUT} = 0mA$		2.5	4.5	μA
I_{Q_OFF}	Standby Current	$V_{EN} = 0V$, $T_A = 25^\circ C$		0.1	1	μA
Line _{REG}	Line Regulation	$V_{IN} = V_{OUT} + 1V$ to 36V, $I_{OUT} = 10mA$ ($\Delta V_{OUT} / \Delta V_{IN} / V_{OUT}$)		0.05	0.20	%/V
V_{DROP}	Dropout Voltage $I_{OUT} = 300mA$ ⁽⁴⁾	$V_{OUT} = 1.8V$		1350	1650	mV
		$V_{OUT} = 2.5V$		1150	1450	
		$V_{OUT} = 2.8V$		1100	1400	
		$V_{OUT} = 3.0V$		1050	1350	
		$V_{OUT} = 3.3V$		1000	1300	
		$V_{OUT} = 3.6V$		950	1250	
		$V_{OUT} = 5V$		900	1200	
Load _{REG}	Load Regulation	$1mA \leq I_{OUT} \leq 300mA$, $V_{IN} = V_{OUT} + 3V$			40	mV
I_{LMT}	Current Limit	$V_{IN} = V_{OUT} + 2V$	300	450		mA
V_{ENH}	EN Pin Threshold Voltage	EN Input Voltage "H"	1.2			V
V_{ENL}	EN Pin Threshold Voltage	EN Input Voltage "L"			0.4	V
I_{EN}	EN Pin Current	$V_{EN} = 0 \sim 36V$		1		μA
PSRR	Power Supply Rejection Ratio ⁽⁵⁾	$f = 1\text{ kHz}$, $V_{IN} = V_{OUT} + 1V$ $I_{OUT} = 20mA$		60		dB
eN	Output Noise Voltage ⁽⁵⁾	$V_{IN} = V_{OUT} + 2V$, $I_{OUT} = 1mA$, $f = 10Hz$ to 100KHz, $V_{OUT} = 3V$, $C_{OUT} = 1\mu F$		100		μV_{rms}
R_{LOW}	Output discharge resistance	$V_{IN} = 4V$, $EN = 0V$, $V_{OUT} = 0.5V$		5		K Ω
T_{SD}	Thermal Shutdown Temperature ⁽⁵⁾	Temperature Increasing from $T_A = +25^\circ C$		155		$^\circ C$
T_{SDH}	Thermal Shutdown Hysteresis ⁽⁵⁾	Temperature Falling from TSD		30		$^\circ C$

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 $V_{SET} + V_{DROP_MAX}$ with 300mA output current.

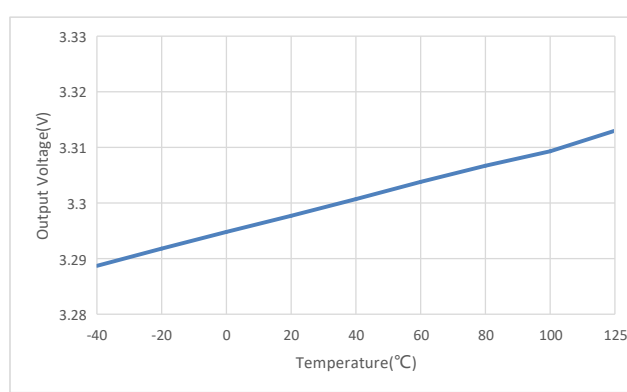
Note5. Guaranteed by design and characterization. not a FT item.

ET5H2XX

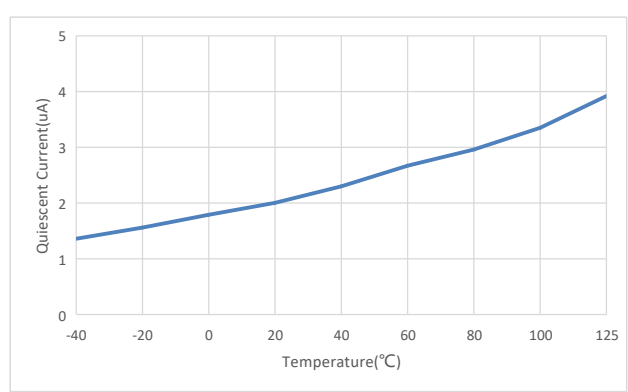
Typical Characteristics

VOLTAGE VERSION 3.3V

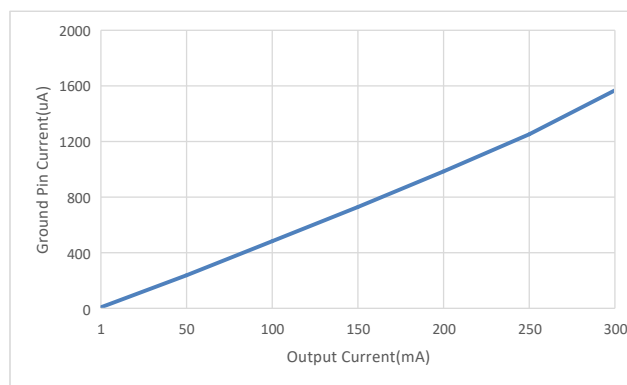
($V_{IN} = V_{OUT} + 2V$, $I_{OUT} = 10mA$, $C_{IN} = C_{OUT} = 1.0\mu F$, Typical values are at $T_A = 25^\circ C$, unless otherwise noted.)



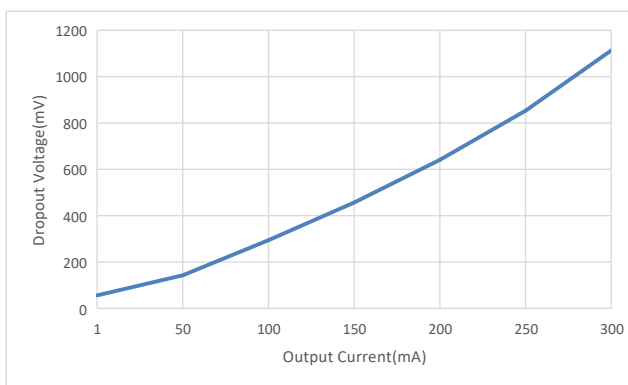
Output Voltage VS Temperature



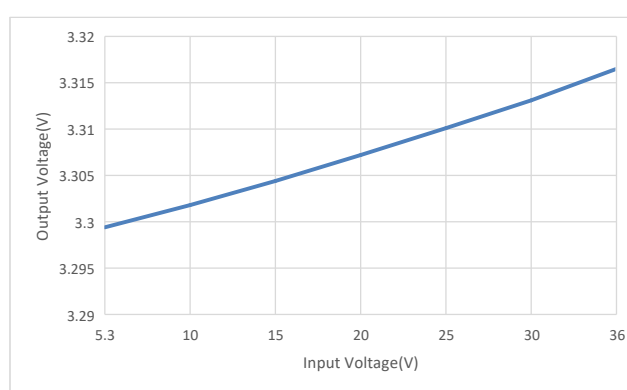
Quiescent Current VS Temperature



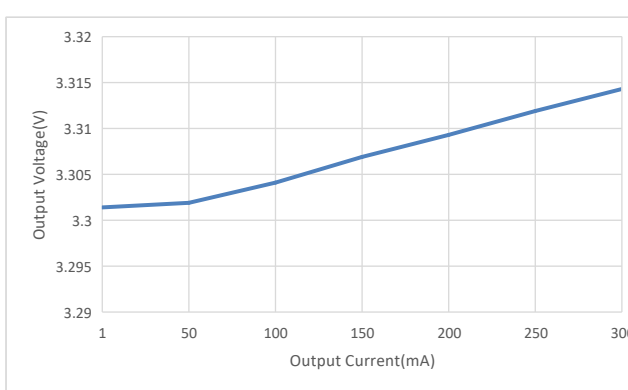
Ground Pin Current VS Output Current



Dropout Voltage VS Output Current

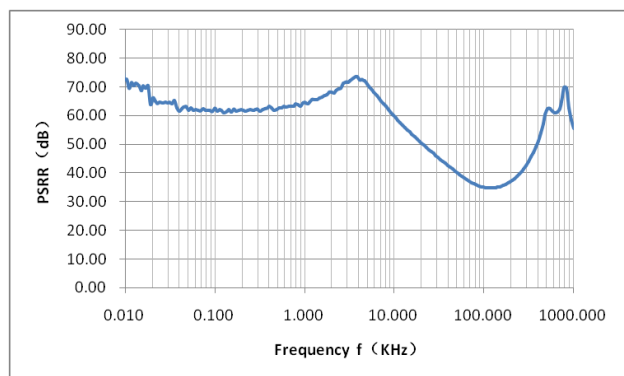


Output Voltage VS Input Voltage

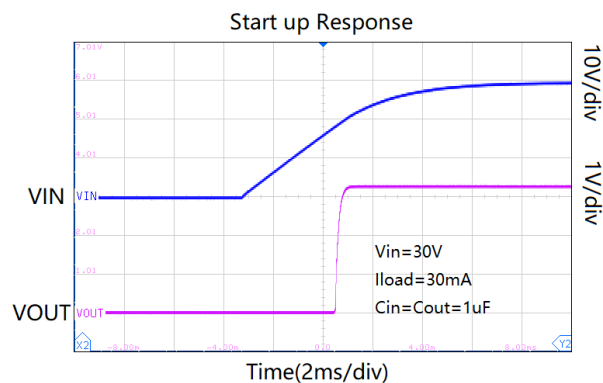


Output Voltage VS Output Current

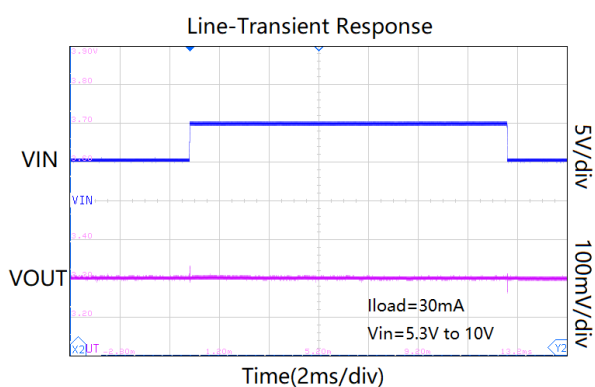
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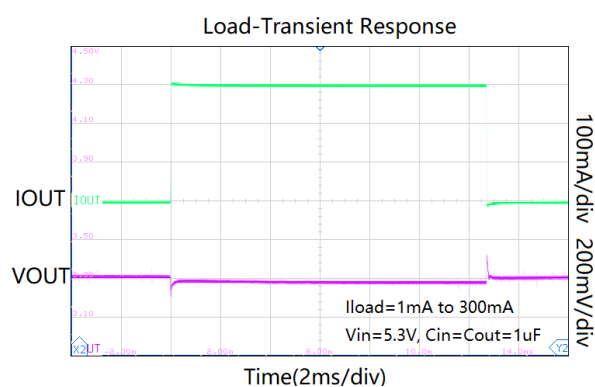
PSRR



Start-up Response

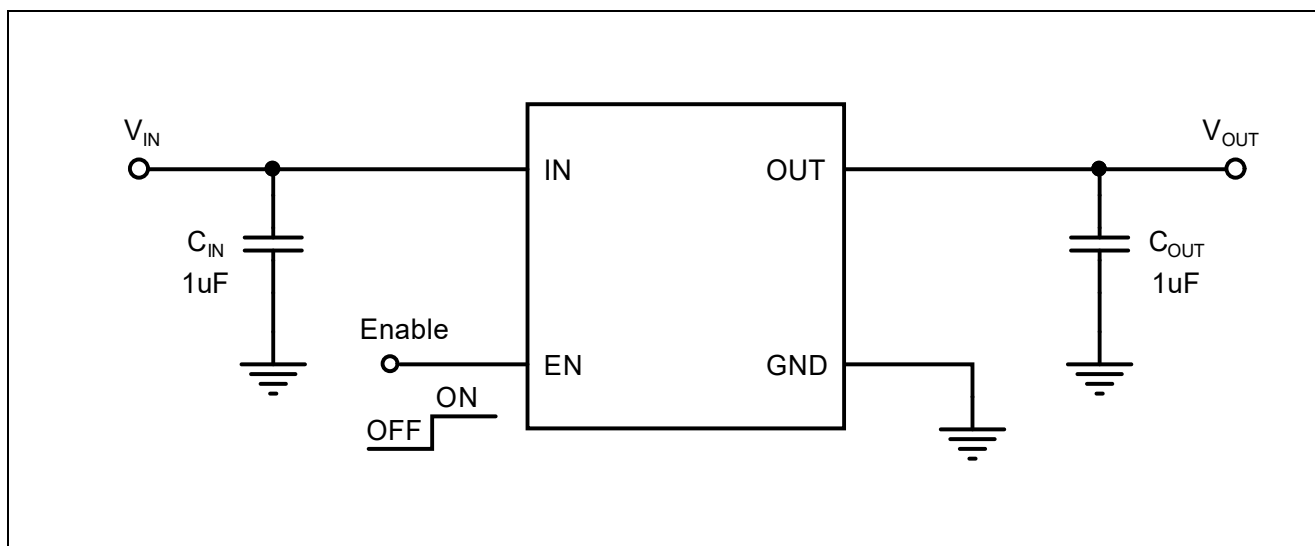


Line-Transient Response



Load-Transient Response

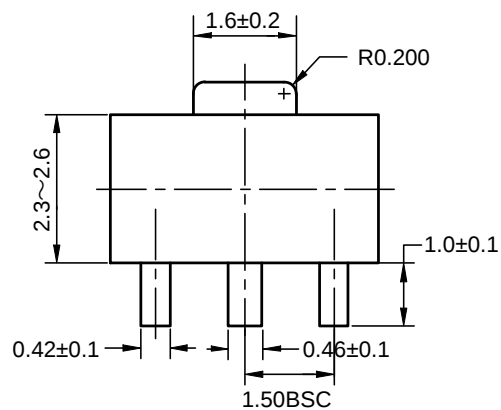
Application Circuits



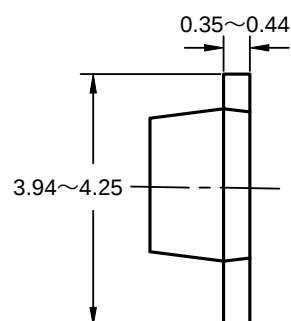
ET5H2XX

Package Dimension

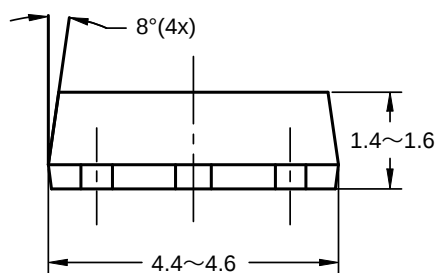
SOT89-3



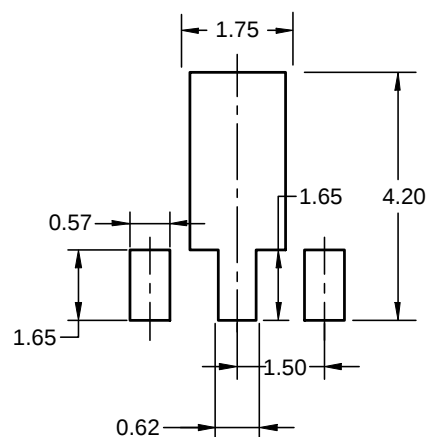
Top View



Side View



Side View

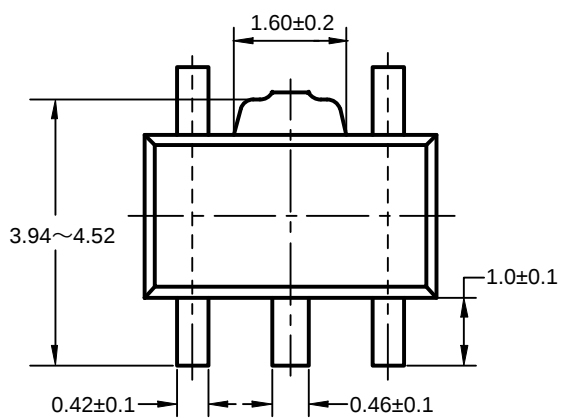


Recommended Land Pattern

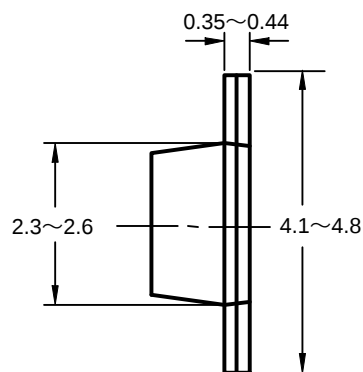
Unit: mm

ET5H2XX

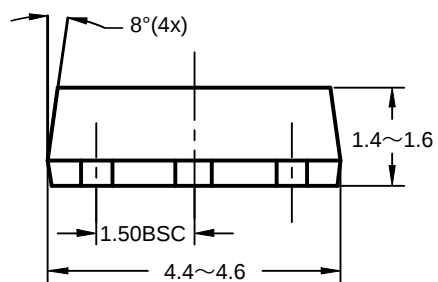
SOT89-5



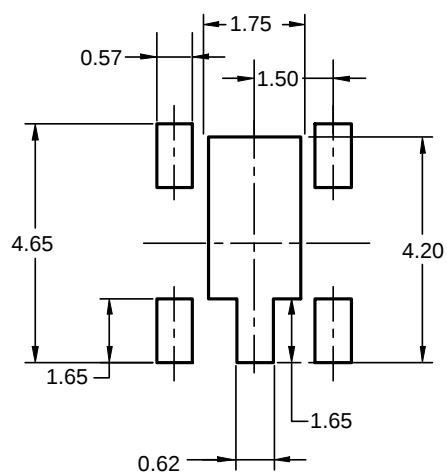
Top View



Side View



Side View

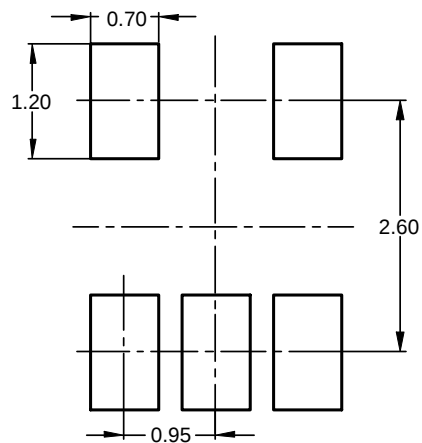
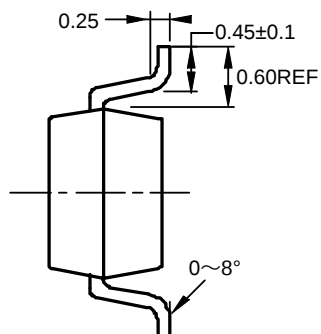
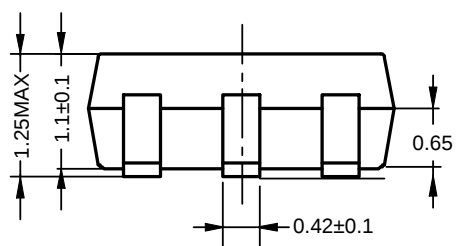
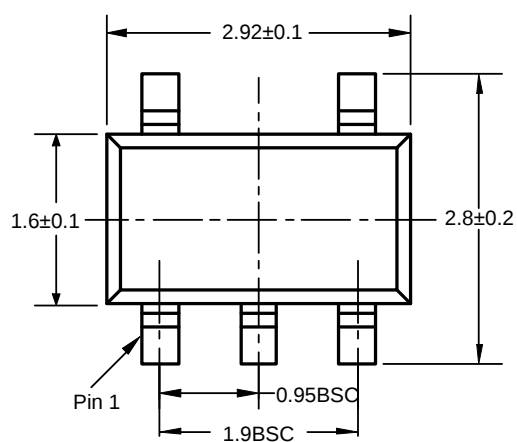


Recommended Land Pattern

Unit: mm

ET5H2XX

SOT23-5

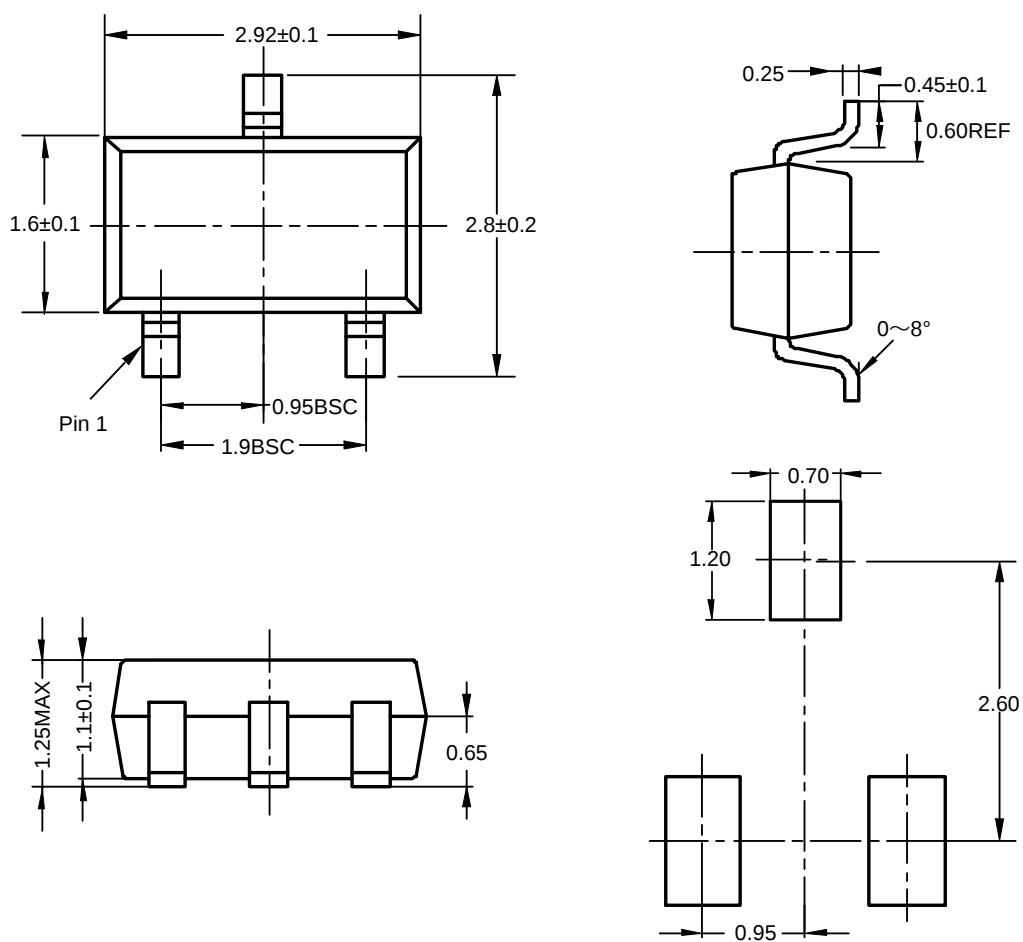


Recommended Land Pattern

Unit: mm

ET5H2XX

SOT23-3

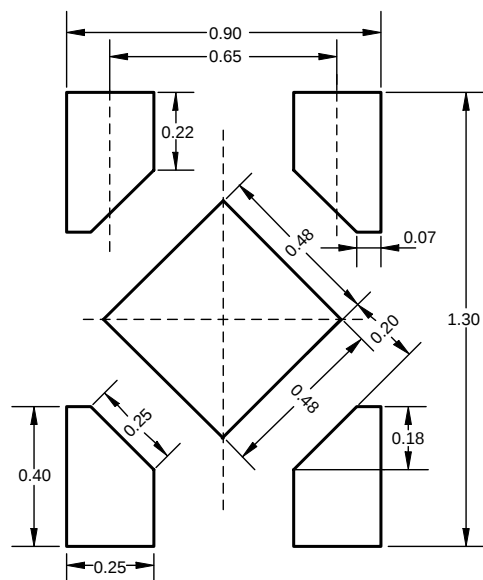
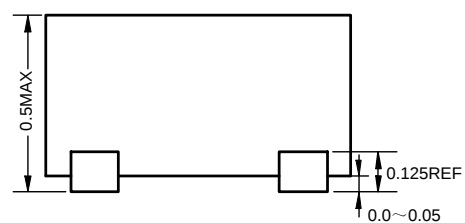
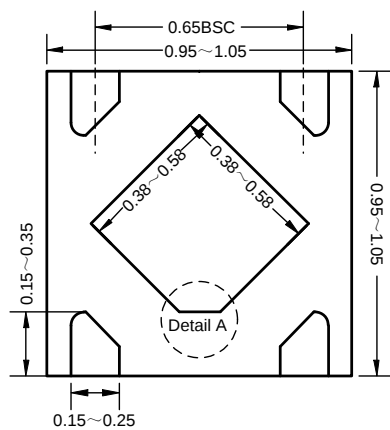


Recommended Land Pattern

Unit: mm

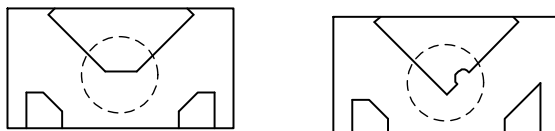
ET5H2XX

DFN4(1x1)



Recommended Land Pattern

Detail A: (PIN1 shape)



Unit: mm

ET5H2XX

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2019-05-13	Preliminary Version	Liuxm	Liuxm	Zhuji
1.0	2019-10-22	Released Version	Liuxm	Liuxm	Zhuji
1.1	2019-11-12	Add SOT89-5 Packge	Liuxm	Liuxm	Zhuji
1.2	2019-12-13	Update EC table	Liuxm	Liuxm	Liuji
1.3	2020-03-16	Document check and formalize	Shib	Shib	Liuji
1.4	2020-11-26	Update table	Shib	Shib	Liuji
1.5	2020-12-7	Add 3.6V voltage	Shib	Shib	Liuji
1.6	2021-6-4	Add new package type	Liuxm	Liuxm	Zhuji
1.7	2022-3-4	Update Marking Information	Liuxm	Liuxm	Liuji
1.8	2023-4-5	Update Typeset	Shibo	Liuxm	Liuji
1.9	2023-8-9	Update package	Shibo	Liuxm	Liuji
2.0	2024-5-14	Update R _{LOW}	Yangxx	Yangxx	Liuji