

ET5H7XX - High Input Very-Low I_Q 300mA LDO

General Description

ET5H7XX series are the high input very low I_Q 300mA LDO with enable function that operates from 1.8V~15V, is designed specifically for portable battery-powered applications which require ultra-low quiescent current. The very-low consumption of type 3.0μA ensures long battery life and dynamic transient boost feature improves device transient response for wireless communication applications.

ET5H7XX series are offered SOT89-3, SOT23-5, SOT23-3, ESOP8 packages.

Features

- Wide Input Voltage Range: 2.8V to 60V
- Up to 300mA Load Current
- Very low I_Q: 3.0μA
- Fixed Output Voltage are 1.8V, 3.0V, 3.3V, 3.6V, 5.0V, 8.0V, 12V, etc
- Low dropout: 1200mV @ 300mA / V_{OUT}=3.0V
- Excellent Load/Line Transient Response
- High Ripple Rejection: 75dB at 1KHz
- Packages are SOT89-3, SOT23-5, SOT23-3, ESOP8

Device information

ET 5H7 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
		S	SOT23-3
		T	SOT23-5
		/	SOT23-5 (Default)
		M	ESOP8
		M1	ESOP8
		M2	ESOP8

ET5H7XX

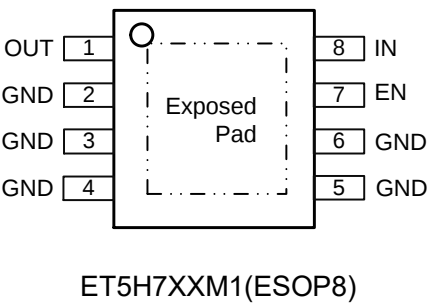
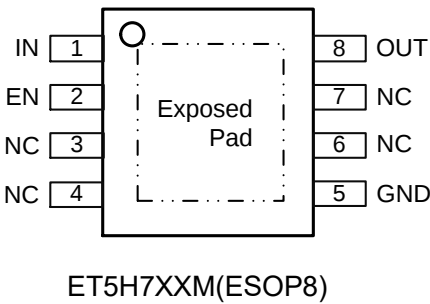
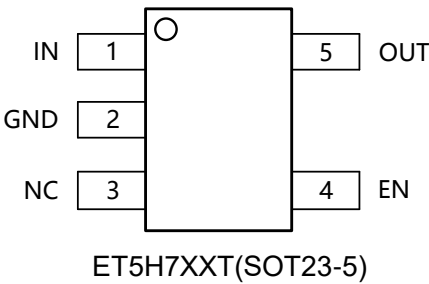
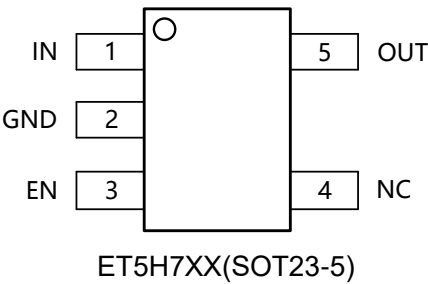
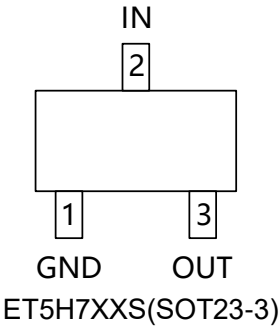
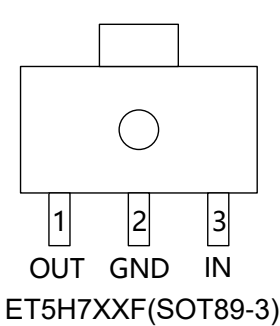
Mark Specification Label

Part No.	Marking				V _{OUT}
	SOT89-3	SOT23-3	SOT23-5		
	ET5H7XXF	ET5H7XXS	ET5H7XX	ET5H7XXT	
ET5H718	18F	18S	18	18T	1.8V
ET5H730	30F	30S	30	30T	3.0V
ET5H733	33F	33S	33	33T	3.3V
ET5H736	36F	36S	36	36T	3.6V
ET5H750	50F	50S	50	50T	5.0V
ET5H780	80F	80S	80	80T	8.0V
ET5H7120	120F	120S	120	120T	12V

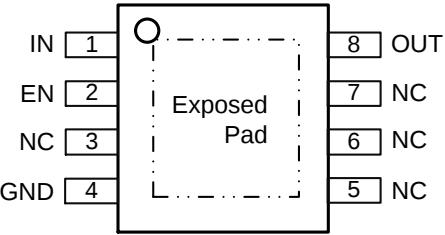
Part No.	Marking			V _{OUT}
	ESOP8			
	ET5H7XXM	ET5H7XXM1	ET5H7XXM2	
ET5H718	18M	18M1	18M2	1.8V
ET5H730	30M	30M1	30M2	3.0V
ET5H733	33M	33M1	33M2	3.3V
ET5H736	36M	36M1	36M2	3.6V
ET5H750	50M	50M1	50M2	5.0V
ET5H780	80M	80M1	80M2	8.0V
ET5H7120	120M	120M1	120M2	12V

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Pin Configuration



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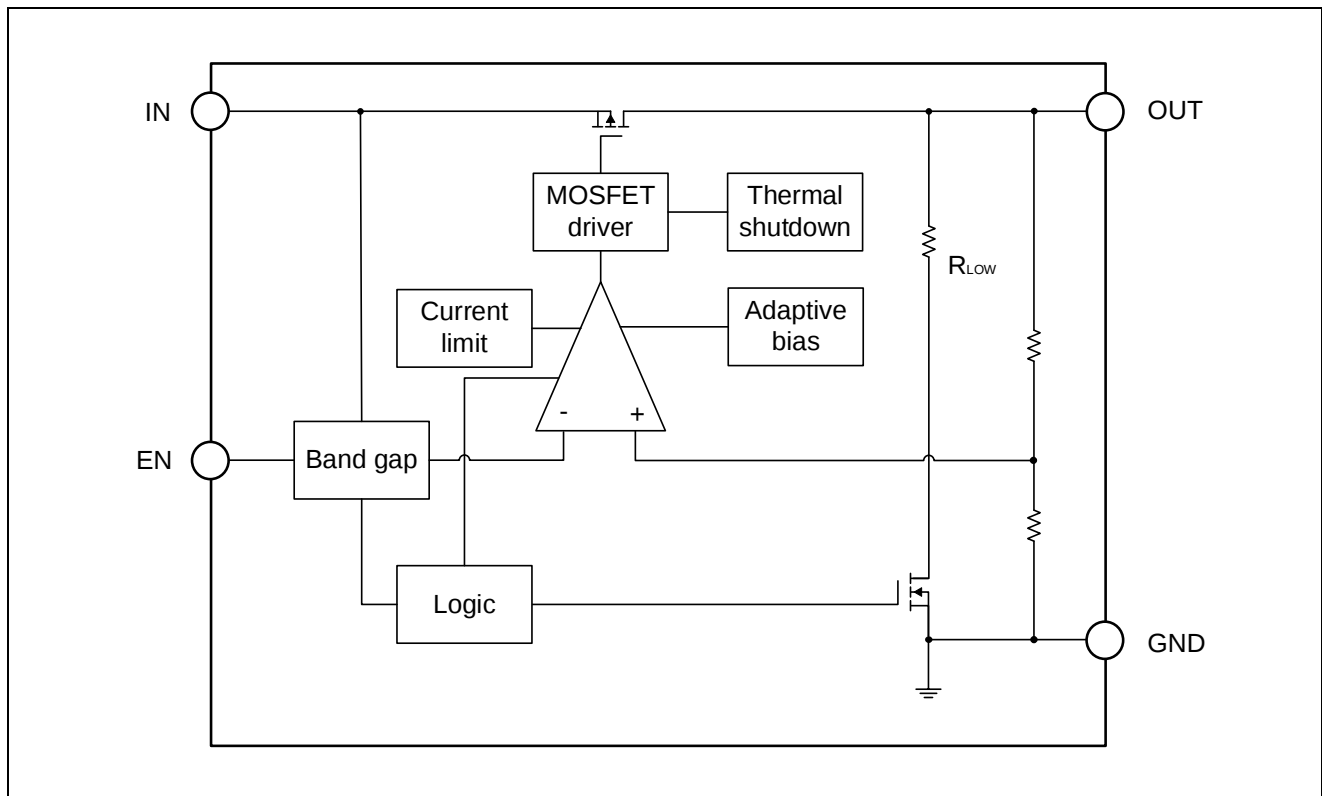
ET5H7XXM2(ESOP8)

ET5H7XX

Pin Function

Pin No.							Pin Name	Pin Function
SOT89-3	SOT23-3	SOT23-5		ESOP8				
XXF	XXS	XX	XXT	XXM	XXM1	XXM2		
2	1	2	2	5	2,3,4,5,6	4	GND	Ground.
3	2	1	1	1	8	1	IN	Supply input pin.
1	3	5	5	8	1	8	OUT	Output pin.
		3	4	2	7	2	EN	Enable control input, active
		4	3	3,4,6,7		3,5,6,7	NC	No connection.

Block Diagram



Functional Description

Input Capacitor

A 1 μ F~10 μ F 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 1 μ F

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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 ET5H7XX 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 ET5H7XX 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 150°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.

For recommended operating condition specifications the maximum junction temperature is 125°C and T_A is the ambient temperature. The junction to ambient thermal resistance, θ_{JA} is layout dependent.

Current-Limit Protection

The ET5H7XX 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.

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Absolute Maximum Ratings

Symbol	Rating	Value	Unit
$V_{IN}^{(1)}$	Input Voltage	-0.3~70	V
V_{OUT}	Output Voltage	-0.3~20	V
V_{EN}	Chip Enable Input	-0.3~70	V
$T_{J(MAX)}$	Maximum Junction Temperature	150	°C
T_{STG}	Storage Temperature	-65~150	°C
$V_{ESD}^{(2)}$	HBM Capability	±4000	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.

Thermal Characteristics

Symbol	Package	Ratings	Value	Unit
$R_{\theta JA}$	SOT89-3	Thermal Characteristics, Thermal Resistance, Junction-to-Air	135	°C/W
	SOT23-5		250	
	SOT23-3		360	
	ESOP8		50	
P_D	SOT89-3	Power Dissipation@25°C PCB board dimension : 40mm x 40mm (2layer) Copper :1OZ	925	mW
	SOT23-5		500	
	SOT23-3		350	
	ESOP8		2500	

Recommended Operating Conditions

Symbol	Item	Rating	Unit
V_{IN}	Input Voltage	2.8 to 60	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	μF
C_{OUT}	Effective Output Ceramic Capacitor Value	1 to 10	μF
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
$V_{IN}^{(3)}$	Operating Input Voltage		2.8		60	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	$I_{OUT} = 0mA$		3.0	10.0	μA
I_{Q_OFF}	Standby Current	$V_{EN} = 0V$, $T_A = 25^\circ C$		0.1	1	μA
Reg_{LINE}	Line Regulation	$V_{IN} = V_{OUT} + 2V$ to 60V, $I_{OUT} = 10mA$ ($\Delta V_{OUT}/\Delta V_{IN}/V_{OUT}$)		0.2	200	mV
$V_{DROP}^{(4)}$	Dropout Voltage $I_{OUT} = 300mA$	$V_{OUT} = 1.8V$		1550	1950	mV
		$V_{OUT} = 3.0V$		1350	1750	
		$V_{OUT} = 5.0V$		1280	1650	
		$V_{OUT} = 12V$		1170	1550	
Reg_{LOAD}	Load Regulation	$1mA \leq I_{OUT} \leq 300mA$, $V_{IN} = V_{OUT} + 2V$		1.1	40	mV
I_{LMT}	Current Limit	$V_{IN} = V_{OUT} + 2V$	400	650		mA
V_{ENH}	EN Pin Threshold Voltage	EN Input Voltage "H"	1.2			V
V_{ENL}	EN Pin Threshold Voltage	EN Input Voltage "L"			0.5	V
I_{EN}	EN Pin Current	$V_{EN} = 0 \sim 60V$		1		μA
$PSRR^{(5)}$	Power Supply Rejection Ratio	$f = 1 kHz$, $V_{IN} = V_{OUT} + 2V$ $I_{OUT} = 20mA$		50		dB
$e_N^{(5)}$	Output Noise Voltage	$V_{IN} = V_{OUT} + 2V$, $I_{OUT} = 1mA$, $f = 10Hz$ to 100KHz, $V_{OUT} = 3V$, $C_{OUT} = 1\mu F$		$30 \cdot V_{OUT}$		μV_{rms}
$T_{TSD}^{(5)}$	Thermal Shutdown Temperature	Temperature Increasing from $T_A = +25^\circ C$		155		$^\circ C$
$T_{HYS}^{(5)}$	Thermal Shutdown Hysteresis	Temperature Falling from T_{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.

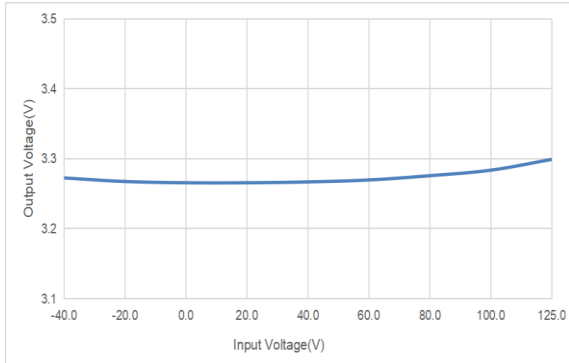
Note5. Guaranteed by design and characterization. not a FT item.

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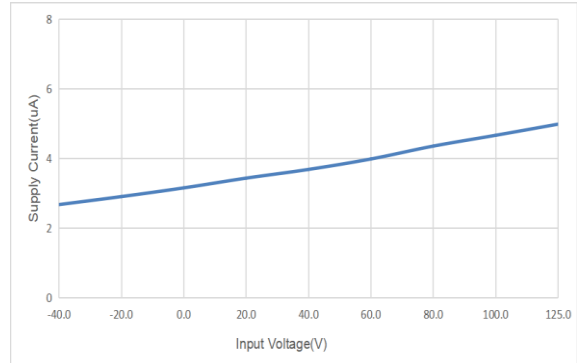
Typical Characteristics

VOLTAGE VERSION 3.3V

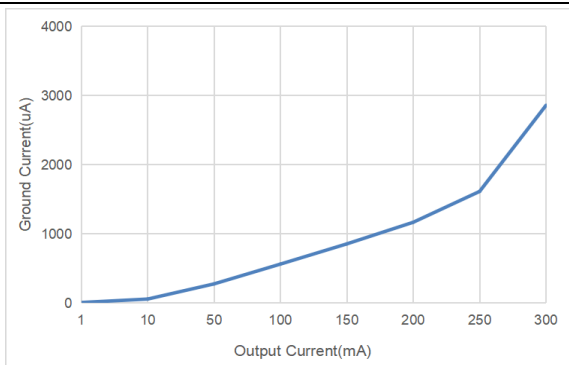
($V_{IN} = V_{OUT} + 2V$; $I_{OUT} = 10mA$, $C_{IN} = C_{OUT} = 1.0\mu F$, unless otherwise noted. Typical values are at $T_A = +25^\circ C$.)



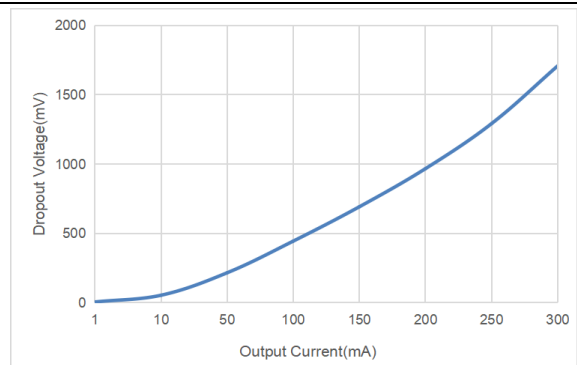
Output Voltage VS Temperature



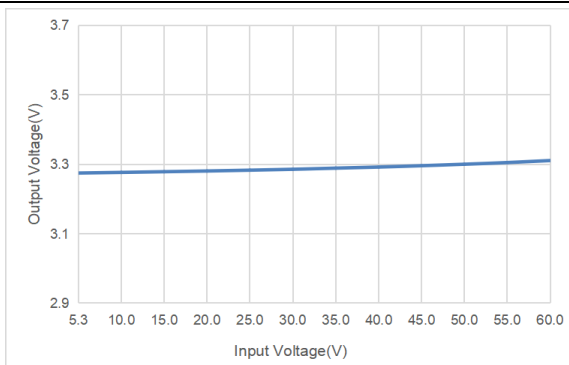
Quiescent Current VS Temperature



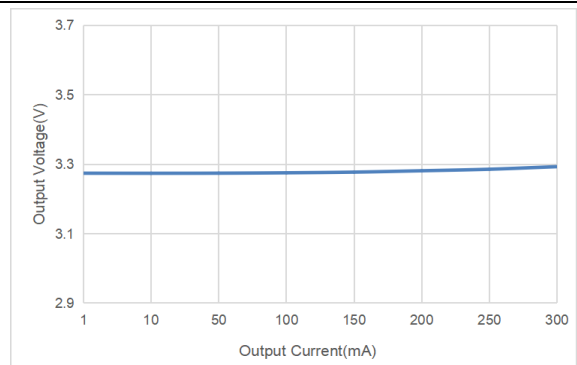
Ground Current VS Output Current



Dropout Voltage VS Output Current



Output Voltage VS Input Voltage



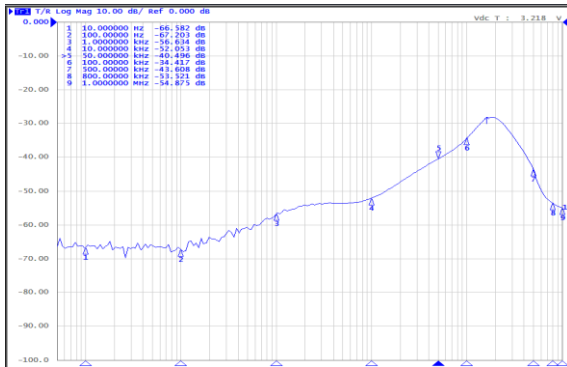
Output Voltage VS Output Current

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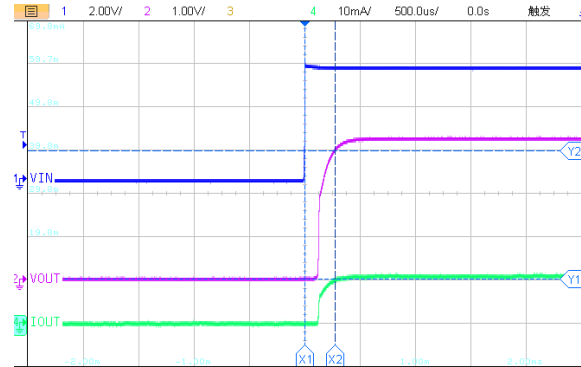
Typical Characteristics(Continued)

VOLTAGE VERSION 3.3V

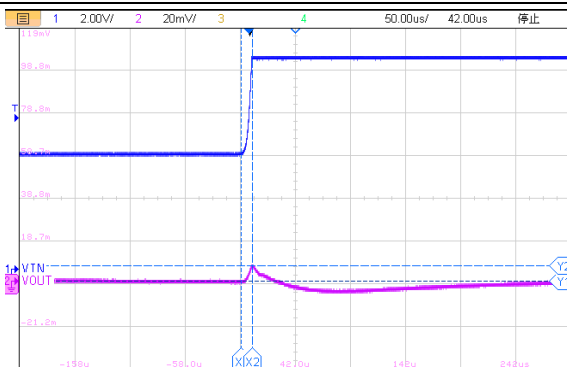
($V_{IN} = V_{OUT} + 2V$; $I_{OUT} = 10mA$, $C_{IN} = C_{OUT} = 1.0\mu F$, unless otherwise noted. Typical values are at $T_A = +25^\circ C$.)



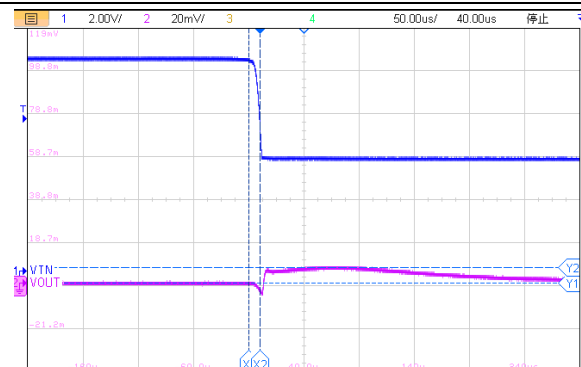
PSRR



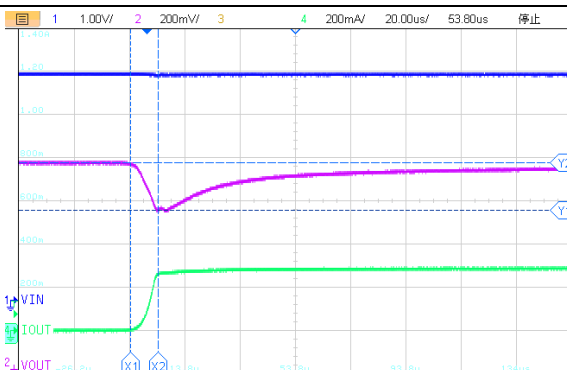
$T_{ON}(I_{OUT} = 10mA)$



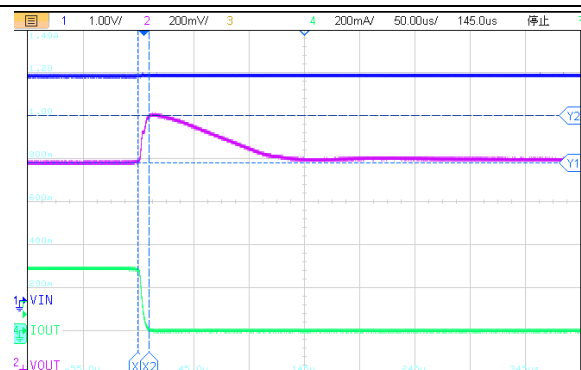
Input Transient(7~15V $t=10\mu s$ 10mA)



Input Transient(15~7V $t=10\mu s$ 10mA)



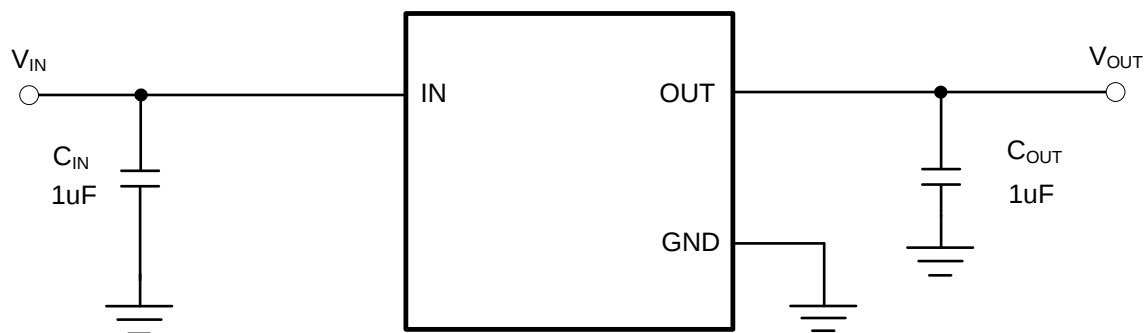
Load Transient(1mA~300mA $t=10\mu s$)



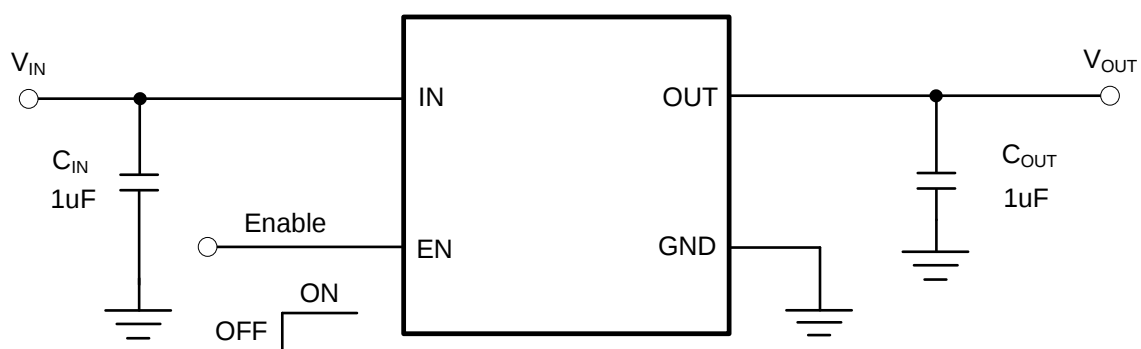
Load Transient(300mA~1mA $t=10\mu s$)

ET5H7XX

Application Circuits



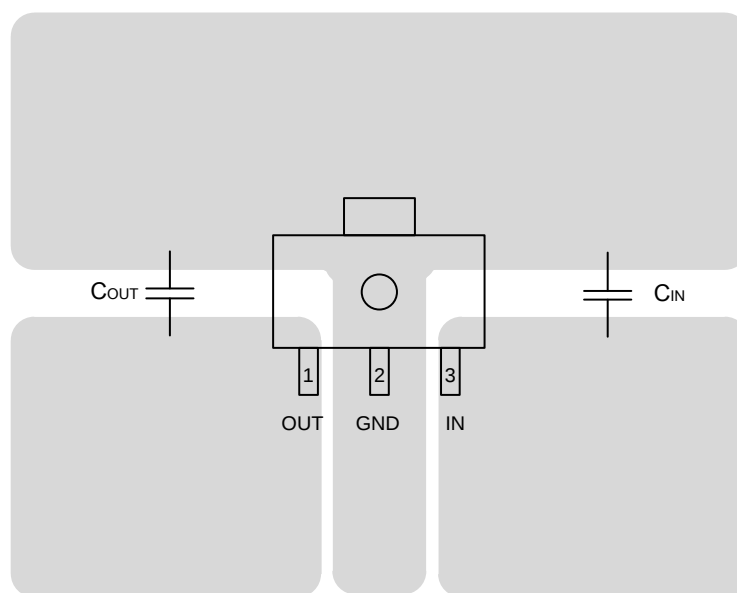
No EN Control Pin



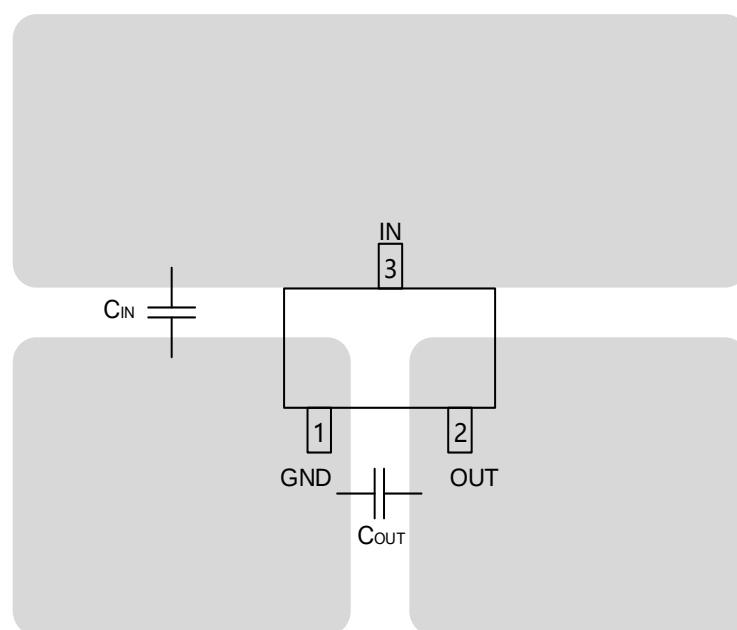
With EN Control Pin

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PCB Layout Guide

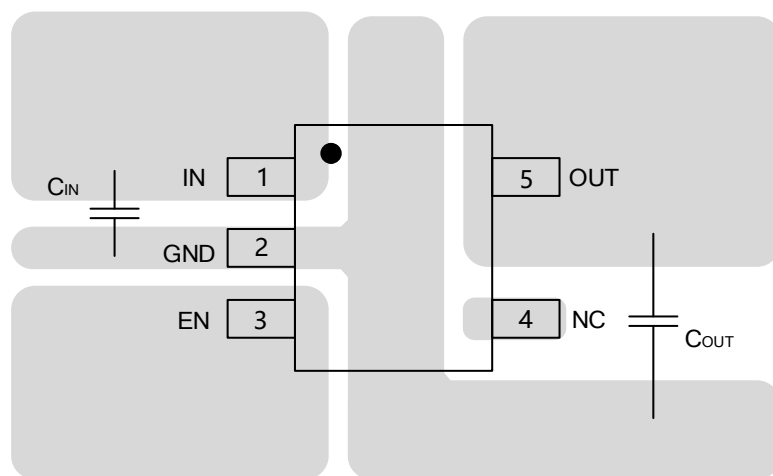


SOT89-3

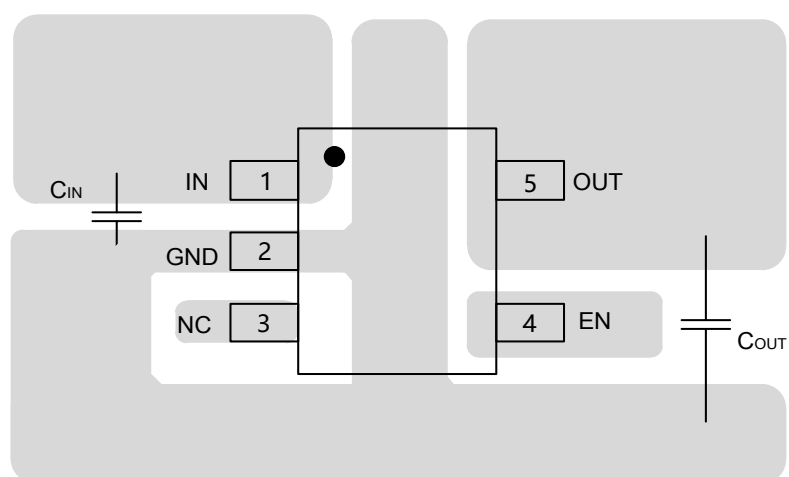


SOT23-3

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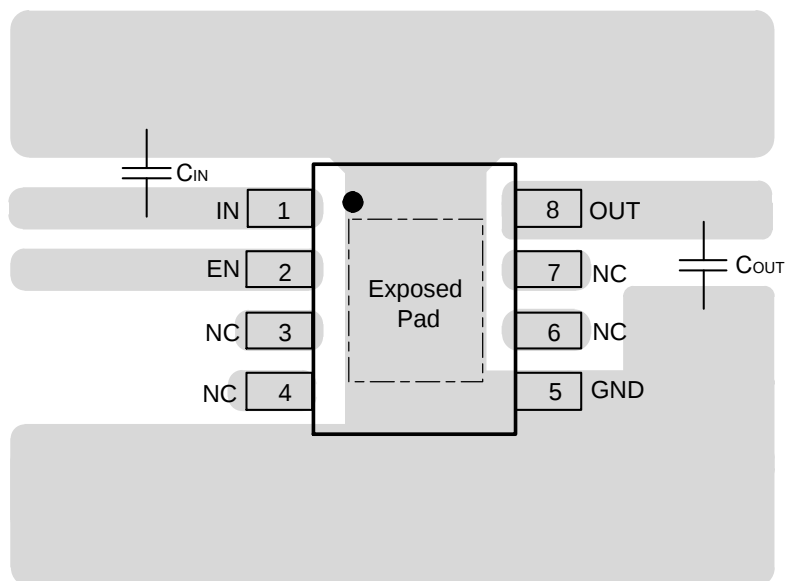


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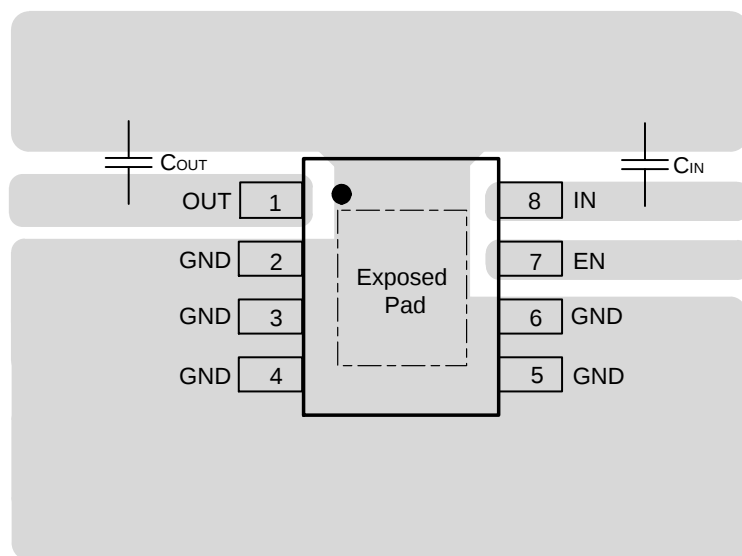


SOT23-5

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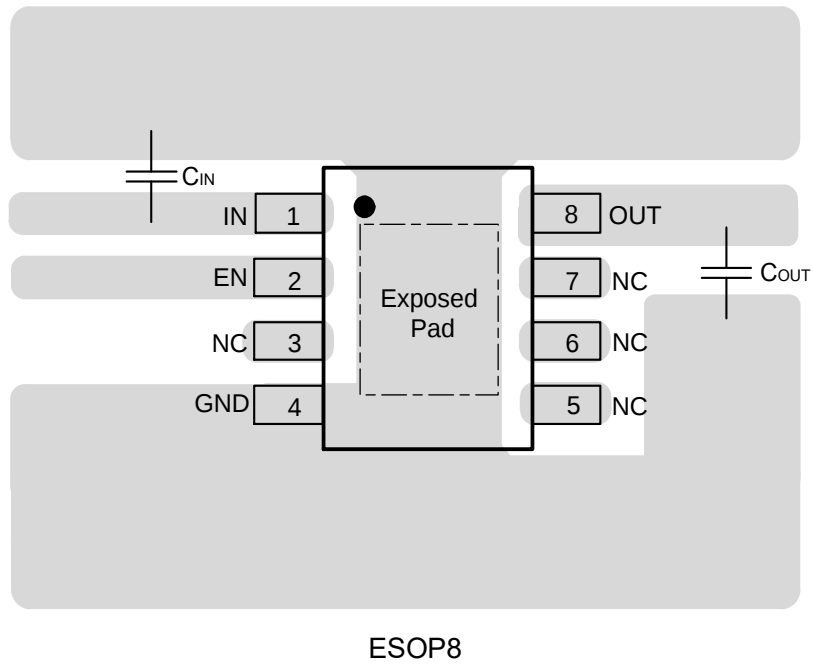


ESOP8



ESOP8

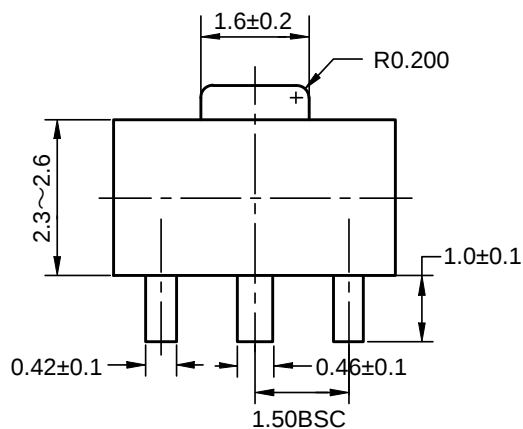
ET5H7XX



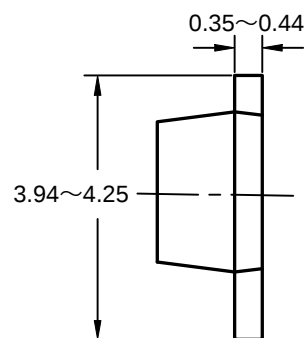
ET5H7XX

Package Dimension

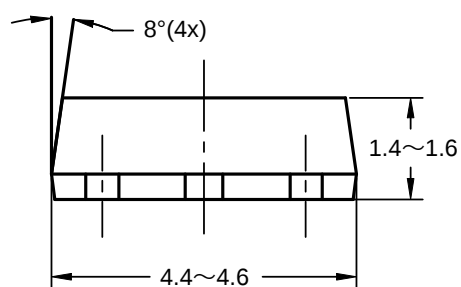
SOT89-3



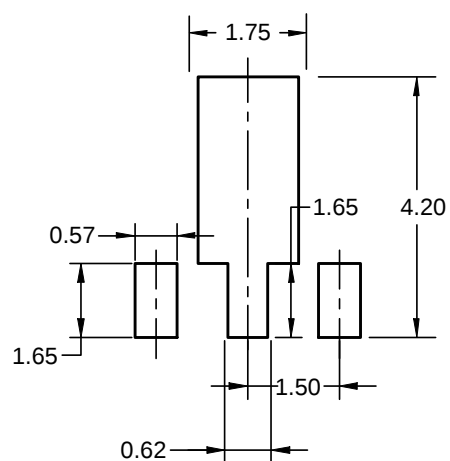
Top View



Side View



Side View

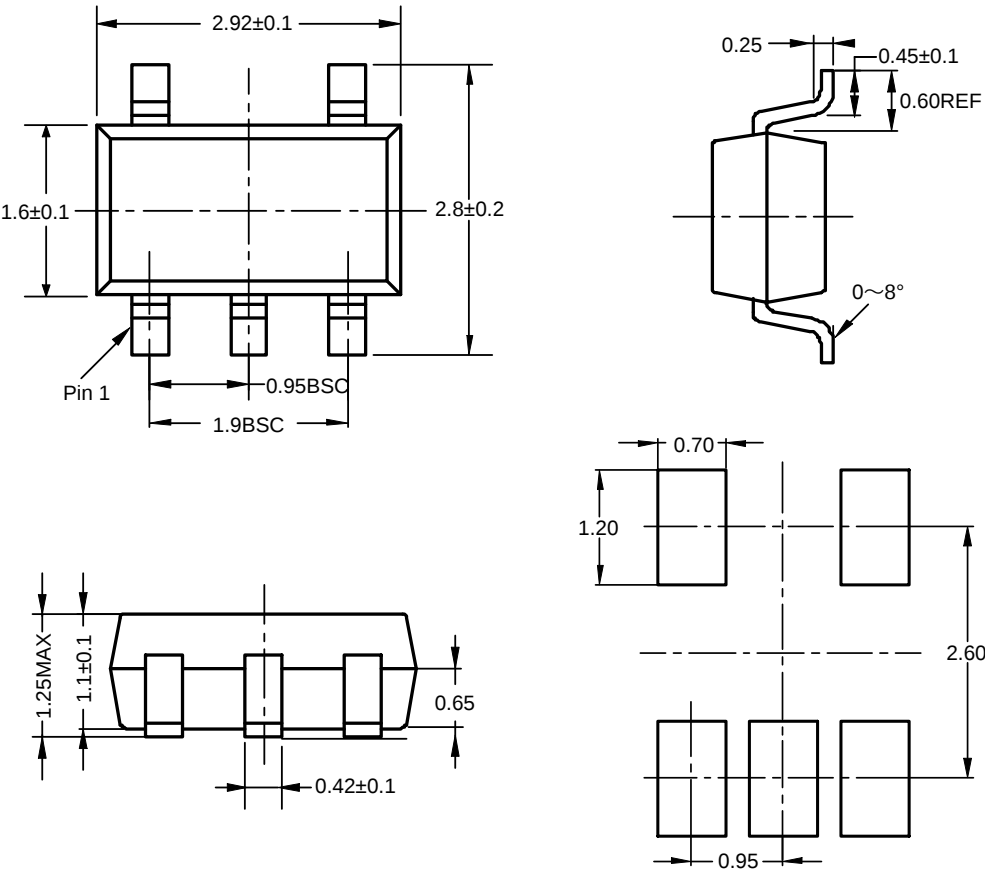


Recommended Land Pattern

Unit: mm

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SOT23-5

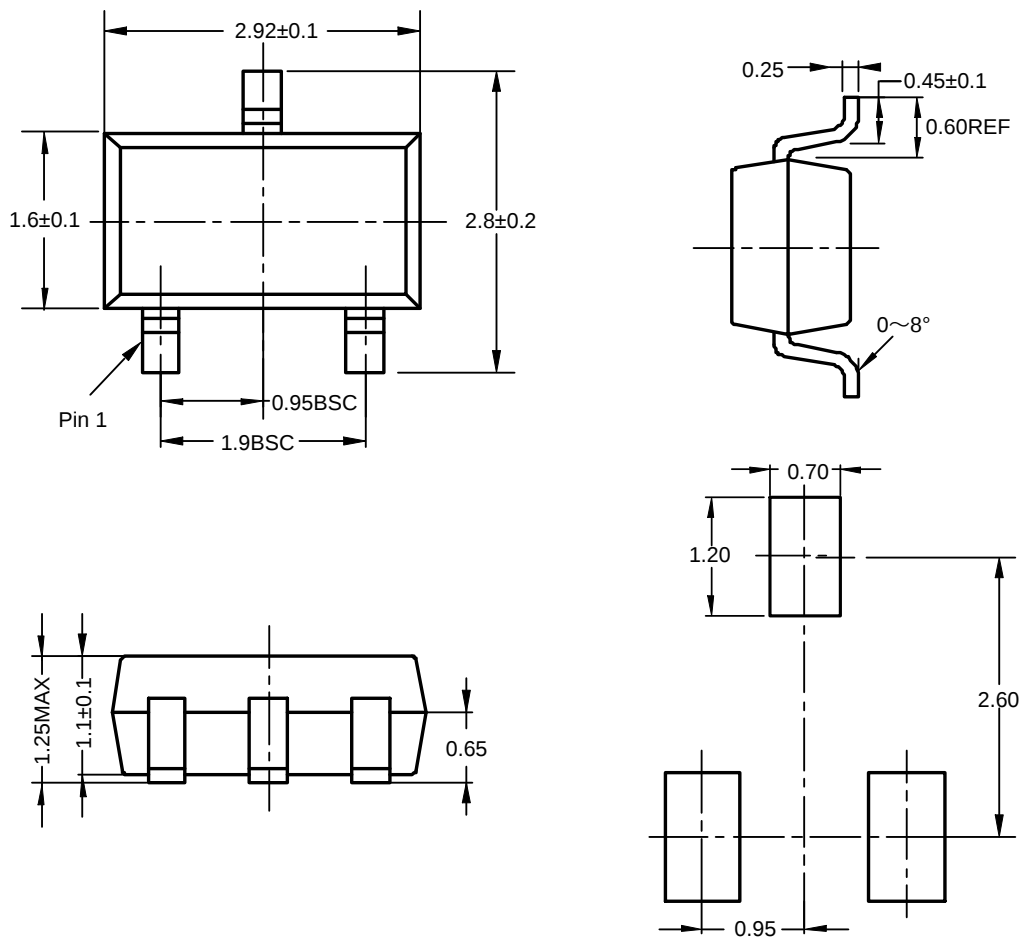


Recommended Land Pattern

Unit: mm

ET5H7XX

SOT23-3

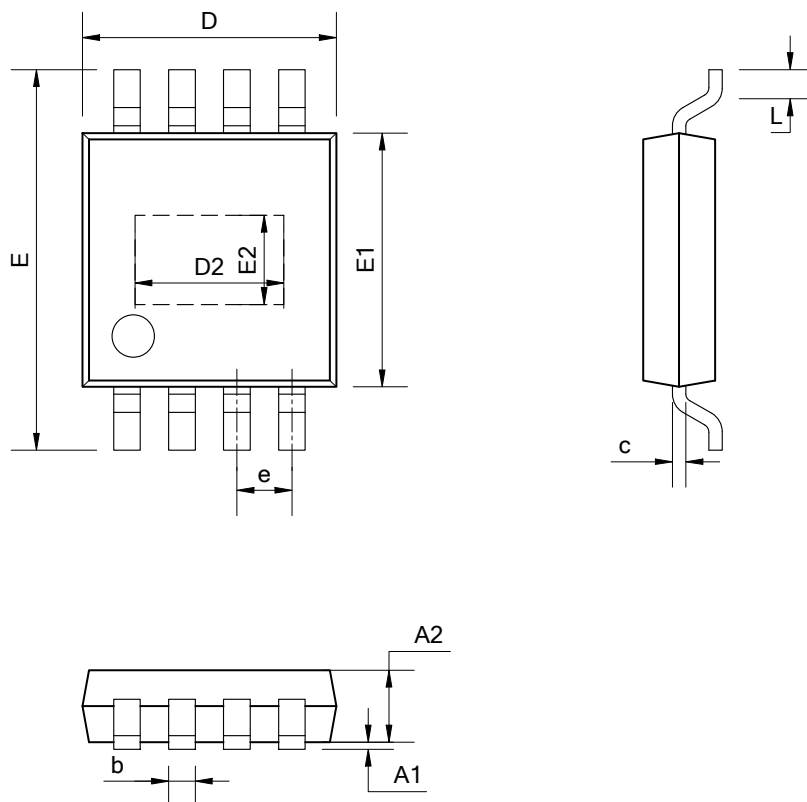


Recommended Land Pattern

Unit: mm

ET5H7XX

ESOP8



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A1	0.00	-	0.15
A2	1.35	1.40	1.50
b	0.38	-	0.47
c	0.17	-	0.25
D	4.80	4.90	5.00
E	5.80	6.00	6.20
D2	3.02	3.17	3.32
E1	3.80	3.90	4.00
E2	2.13	2.28	2.43
e	1.17	1.27	1.37
L	0.45	0.60	0.80

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Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2023-01-17	Preliminary Version	Liuxm,Wuh	Liuxm	Liujoy
0.1	2023-02-21	Add 8V Version	Shibo	Liuxm	Liujoy
0.2	2023-8-8	Removed XXB	Shibo	Shibo	Shibo
1.0	2023-10-7	Official Version	Pengjj	Liuxm	Liujoy
1.1	2024-1-16	Add ESOP8	Shibo	Liuxm	Liujoy