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 3.0V~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: 3.0V to 60V
- Up to 300mA Load Current
- Very low I_Q: 3.0μA
- Fixed Output Voltage are 3.0V,3.3V,3.6V,5.0V,8.0V,12V,etc
- Low dropout: 1350mV @ 300mA /V_{OUT}=3.0V
- Excellent Load/Line Transient Response
- High Ripple Rejection: 50dB at 1KHz
- Packages are SOT89-3, SOT23-5, SOT23-3, ESOP8

Device information

ET 5H7 XX X

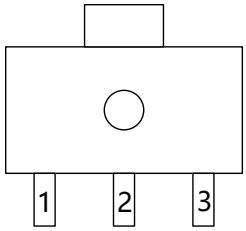
XX Output Voltage		**X Package**	
XX	Output X.X-V For example, 33 is 3.3V output	F	SOT89-3
		S	SOT23-3
		L	SOT23-5
		/	SOT23-5 (Default)
		M	ESOP8
		M1	ESOP8
		M2	ESOP8

Mark Specification Label

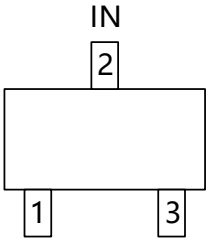
Part No.	Marking				V_{OUT}
	SOT89-3	SOT23-3	SOT23-5		
	ET5H7XXF	ET5H7XXS	ET5H7XX	ET5H7XXL	
ET5H730	30F	30S	30	30T	3.0V
ET5H733	33F	33S	33	33T	3.3V
ET5H736	36F	36S	36	36T	3.6V
ET5H750	50F	50S	50	50T	5.0V
ET5H780	80F	80S	80	80T	8.0V
ET5H7120	120F	120S	120	120T	12V

Part No.	Marking			V_{OUT}
	ESOP8			
	ET5H7XXM	ET5H7XXM1	ET5H7XXM2	
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

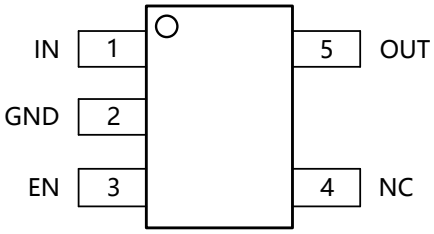
Pin Configuration



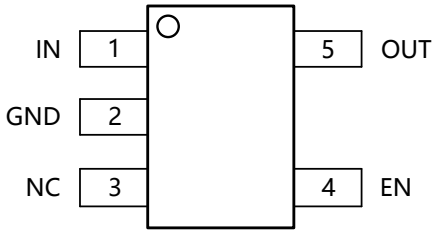
ET5H7XXF(SOT89-3)



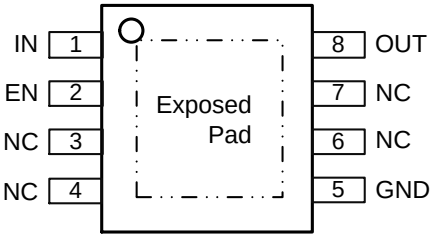
ET5H7XXS(SOT23-3)



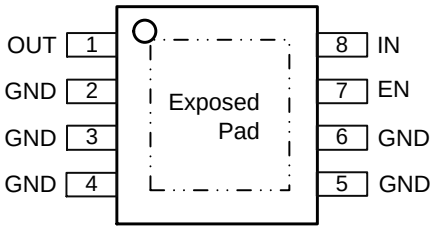
ET5H7XX(SOT23-5)



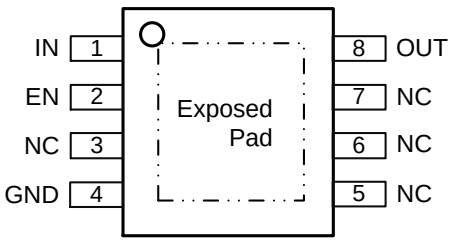
ET5H7XXL(SOT23-5)



ET5H7XXM(ESOP8)



ET5H7XXM1(ESOP8)

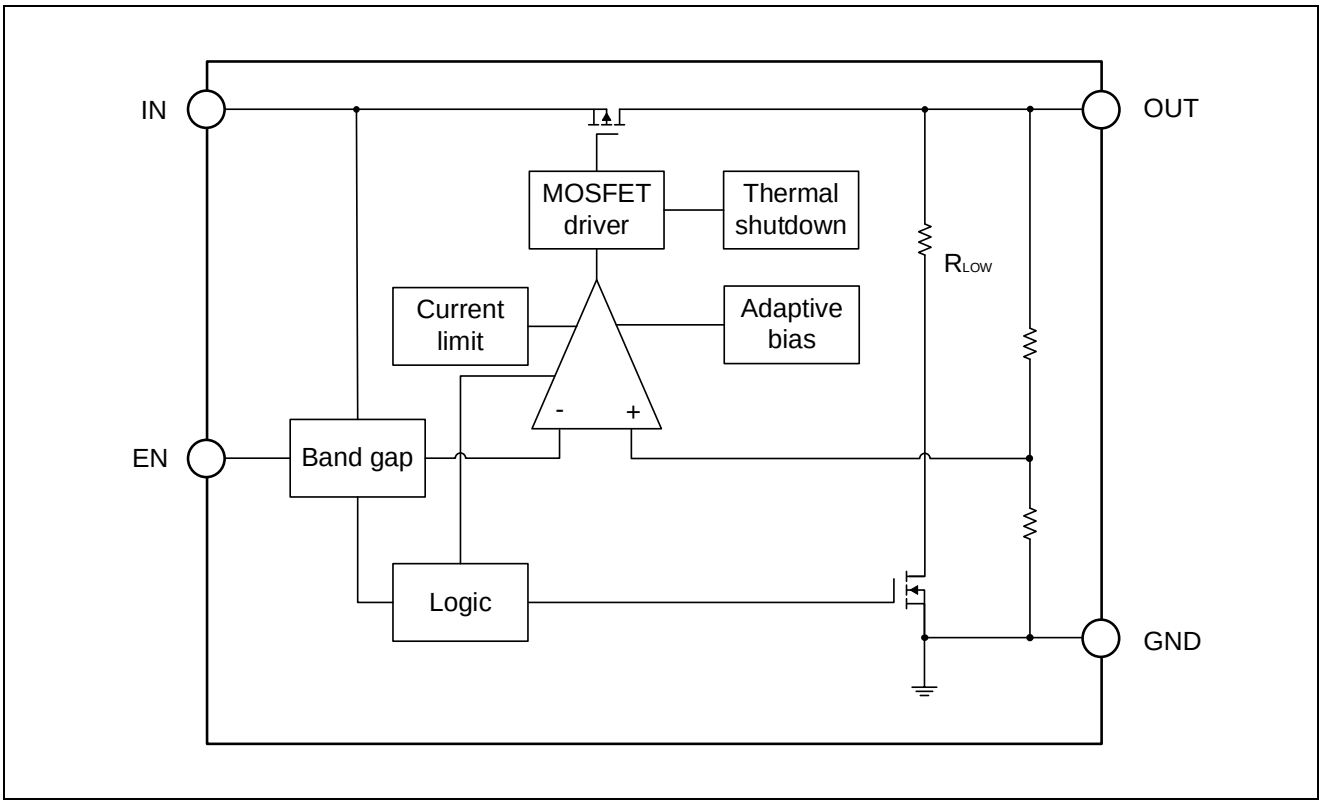


ET5H7XXM2(ESOP8)

Pin Function

Pin No.							Pin Name	Pin Function
SOT89-3	SOT23-3	SOT23-5		ESOP8				
XXF	XXS	XX	XXL	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 1μF~10μF 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 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 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.

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	3.0 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

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		60	V
V_{OUT}	Output Voltage	T_A = +25°C	-2%		+2%	V
		-40°C ≤ T_A ≤ 85°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°C		0.1	1	μA
Reg_{LINE}	Line Regulation	V_{IN} = V_{OUT} +2V to 60V, I_{OUT} = 10mA, T_A = +25°C (ΔV_{OUT} / ΔV_{IN} / V_{OUT})		0.01	0.05	%/V
V_{DROP} (4)	Dropout Voltage I_{OUT}=300mA	V_{OUT} = 3.0V		1350	1750	mV
		V_{OUT} = 5.0V		1280	1650	
		V_{OUT} = 12V		1170	1550	
Reg_{LOAD}	Load Regulation	1mA ≤ I_{OUT} ≤ 300mA, T_A = 25°C (ΔV_{OUT} / V_{OUT})		0.4	1	%
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}=0~60V		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} = 1μF		30*V_{OUT}		μVrms
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}		30		°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.

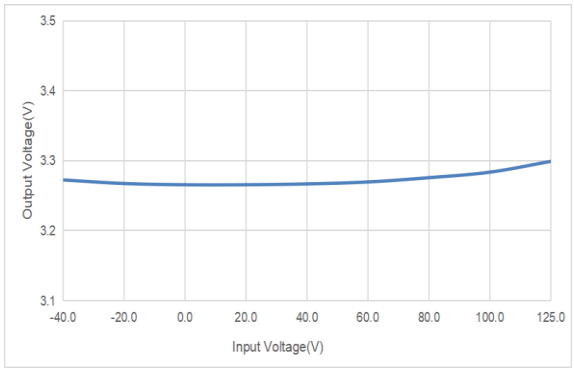
Note4. V_{DROP} FT test method: test the V_{OUT} voltage at V_{SET}+$V_{DROPMAX}$ with 300mA output current.

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

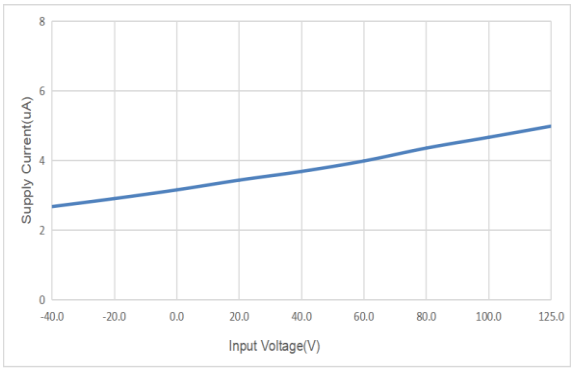
Typical Characteristics

VOLTAGE VERSION 3.3V

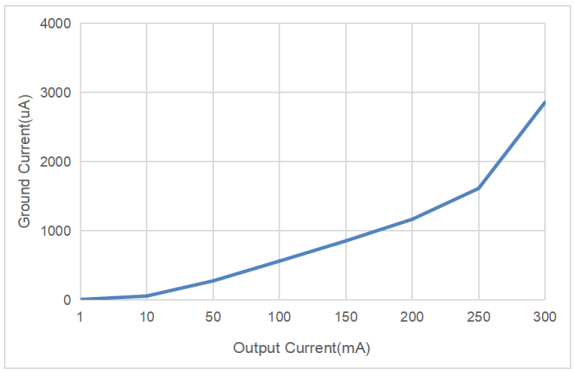
(V_{IN} =V_{OUT}+2V; I_{OUT} = 10mA, C_{IN} = C_{OUT} = 1.0μF, unless otherwise noted. Typical values are at T_A = +25°C.)



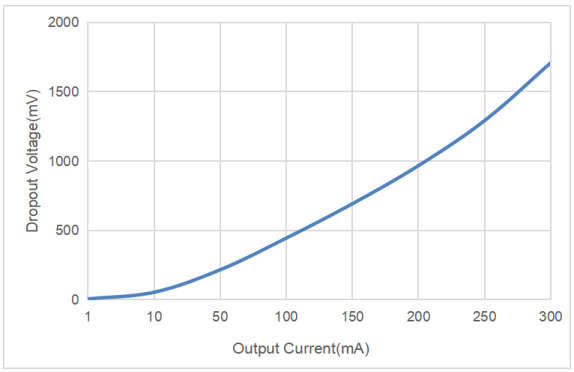
Output Voltage VS Temperature



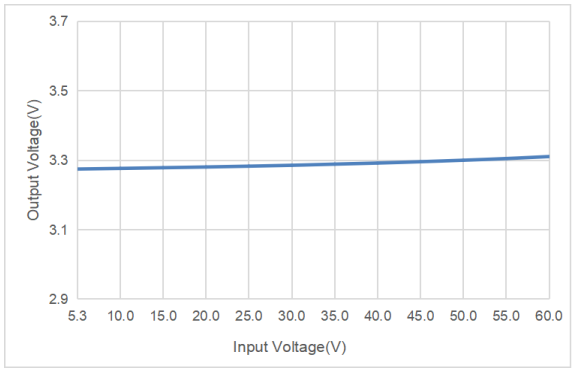
Quiescent Current VS Temperature



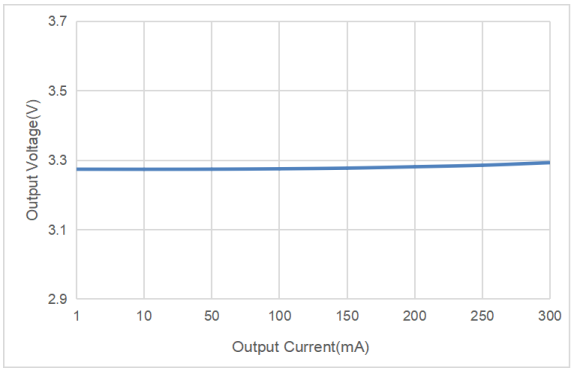
Ground Current VS Output Current



Dropout Voltage VS Output Current



Output Voltage VS Input Voltage

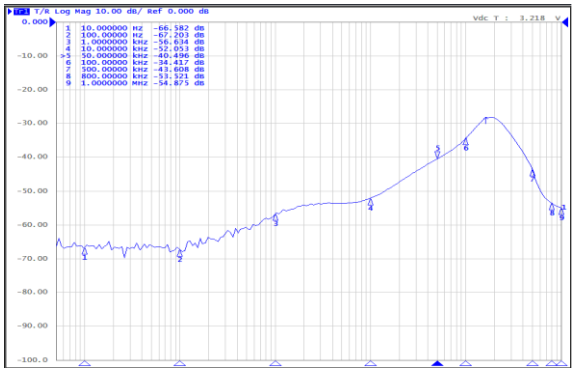


Output Voltage VS Output Current

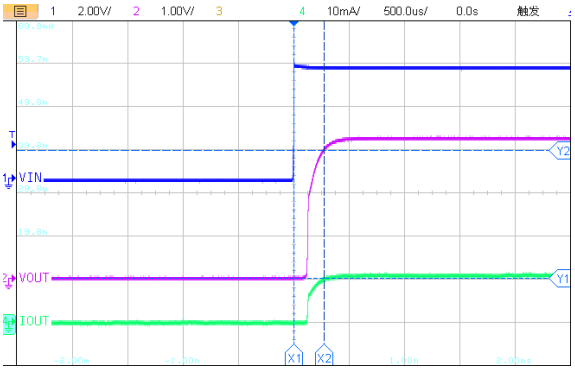
Typical Characteristics (Continued)

VOLTAGE VERSION 3.3V

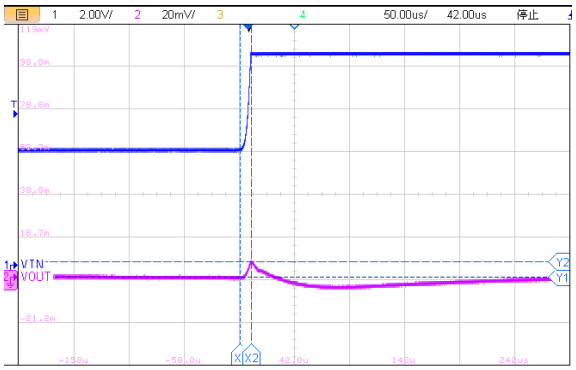
(V_{IN} =V_{OUT}+2V; I_{OUT} = 10mA, C_{IN} = C_{OUT} = 1.0μF, unless otherwise noted. Typical values are at T_A = +25°C.)



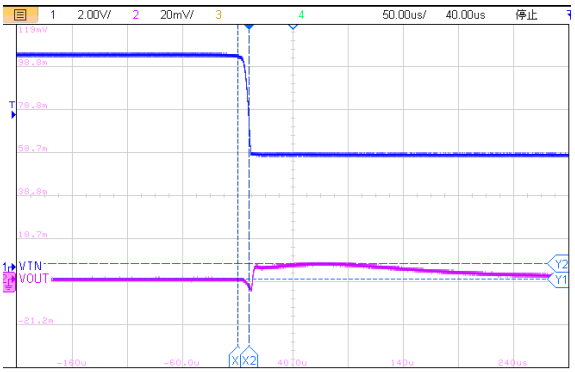
PSRR



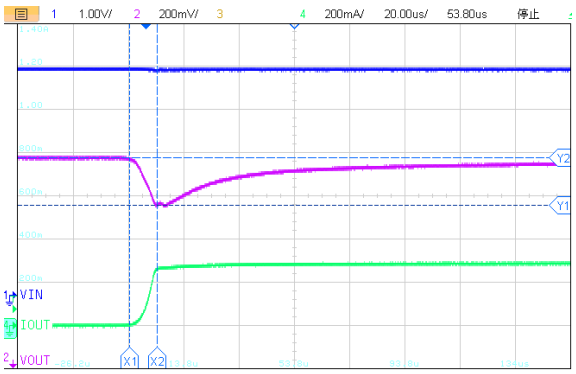
T_{ON}(I_{OUT} = 10mA)



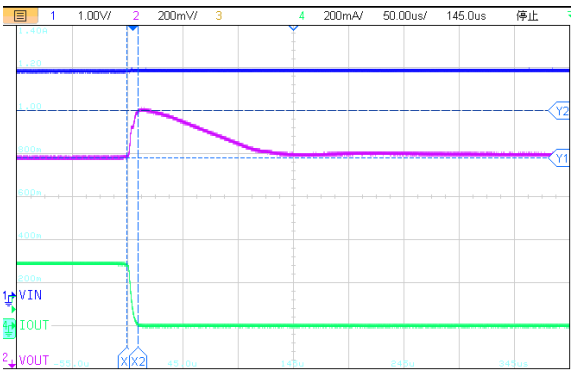
Input Transient(7~15V t=10μs 10mA)



Input Transient(15~7V t=10μs 10mA)

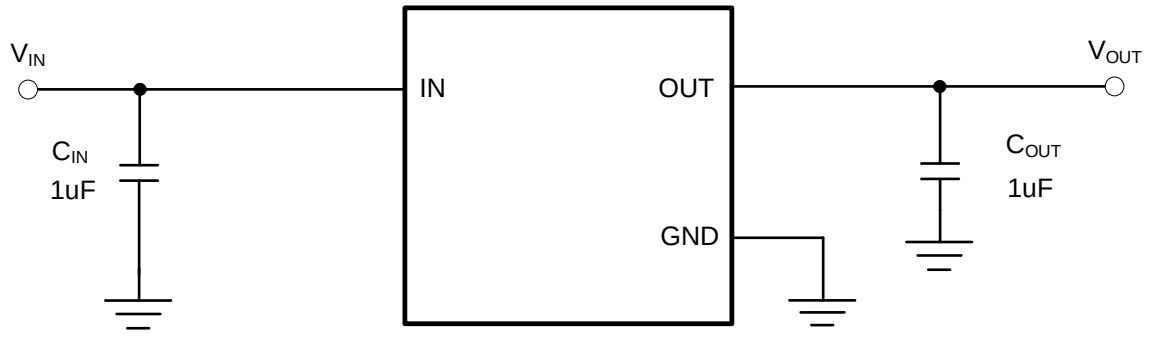


Load Transient(1mA~300mA t=10μs)

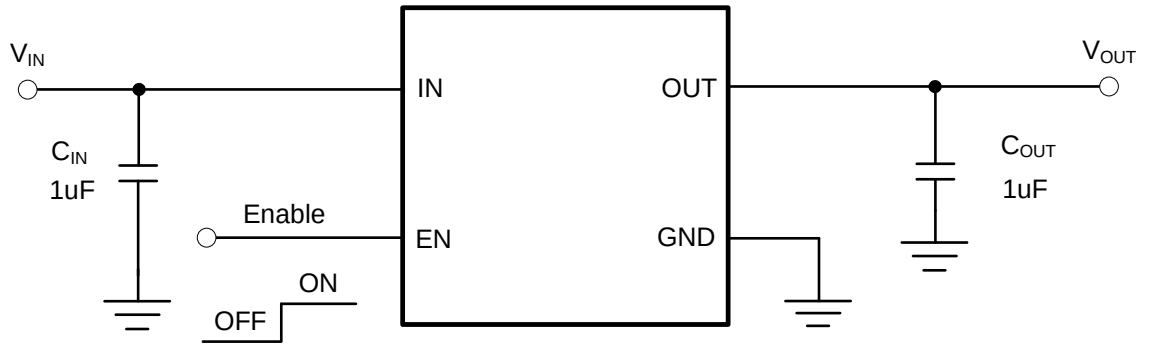


Load Transient(300mA~1mA t=10μs)

Application Circuits

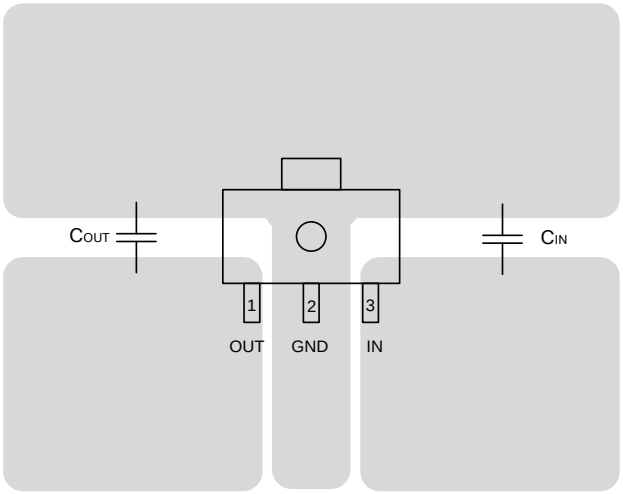


No EN Control Pin

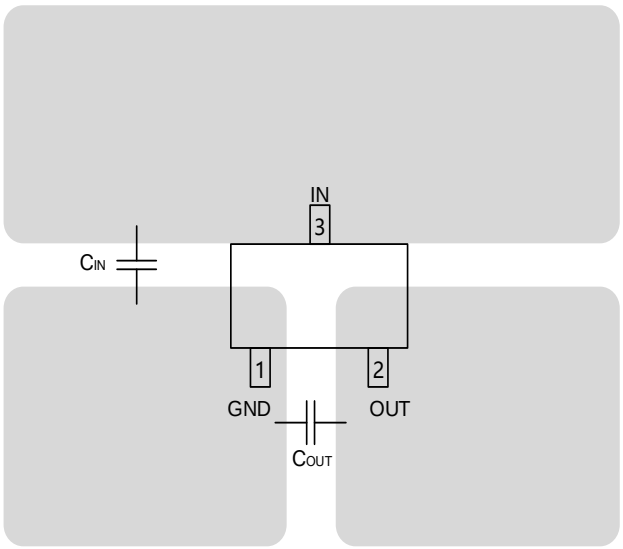


With EN Control Pin

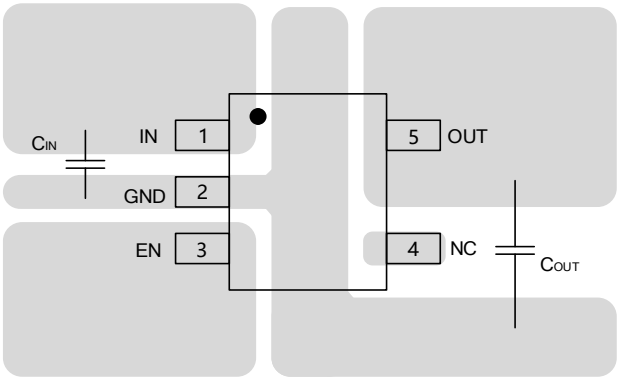
PCB Layout Guide



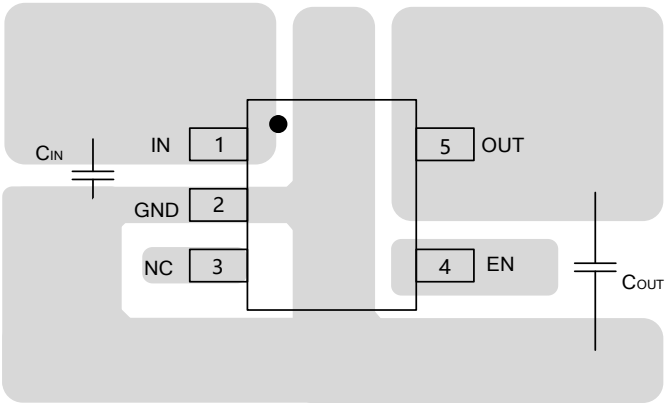
ET5H7XXF (SOT89-3)



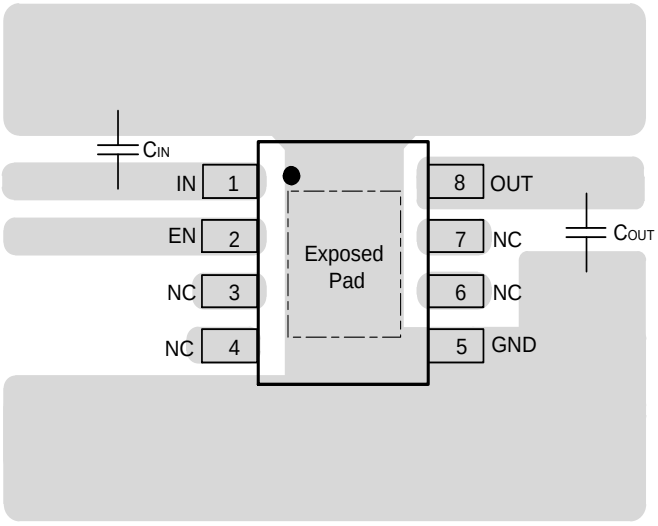
ET5H7XXS (SOT23-3)



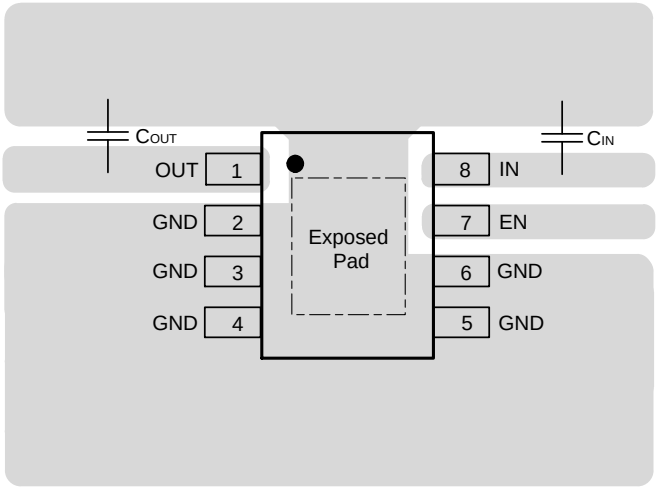
ET5H7XX (SOT23-5)



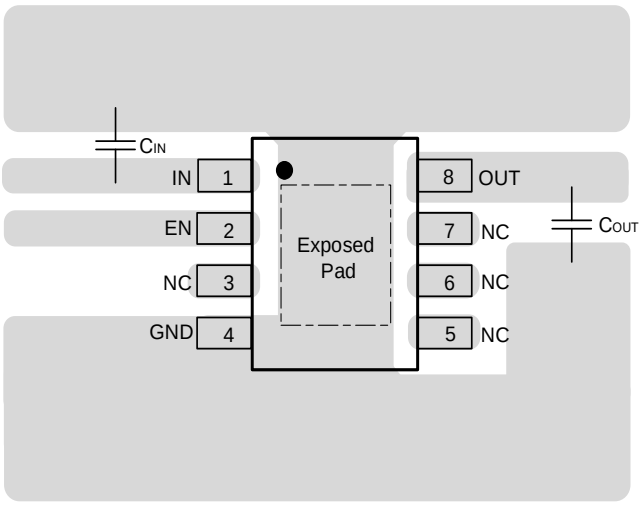
ET5H7XXL(SOT23-5)



ET5H7XXM (ESOP8)



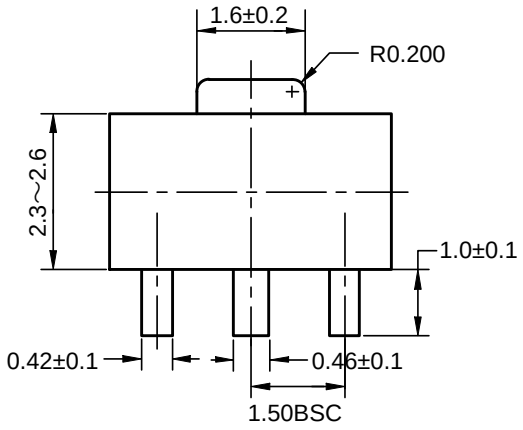
ET5H7XXM1 (ESOP8)



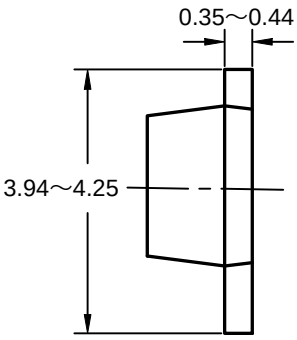
ET5H7XXM2 (ESOP8)

Package Dimension

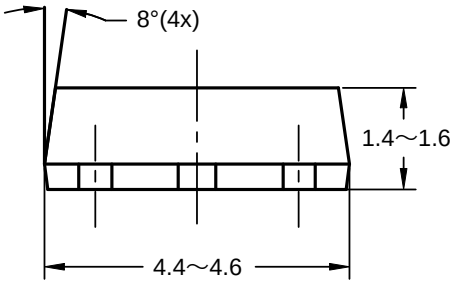
SOT89-3



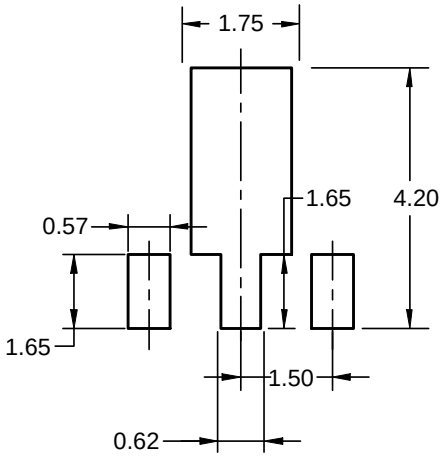
Top View



Side View



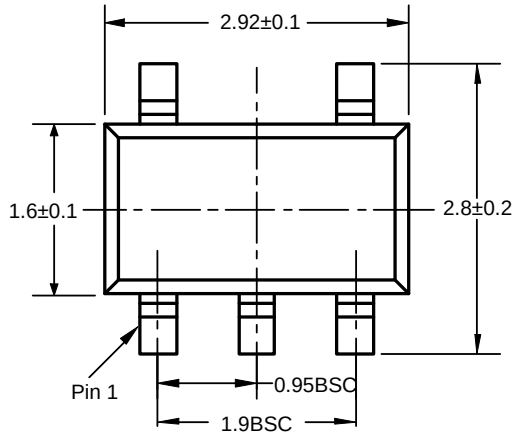
Side View

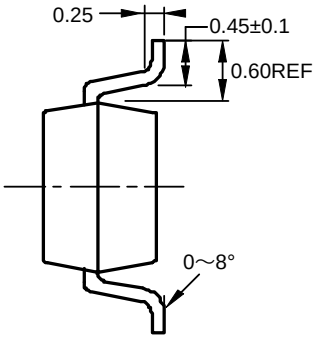


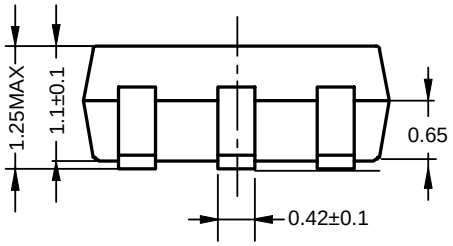
Recommended Land Pattern

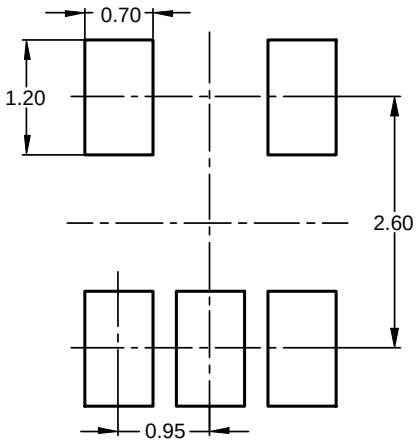
Unit: mm

SOT23-5





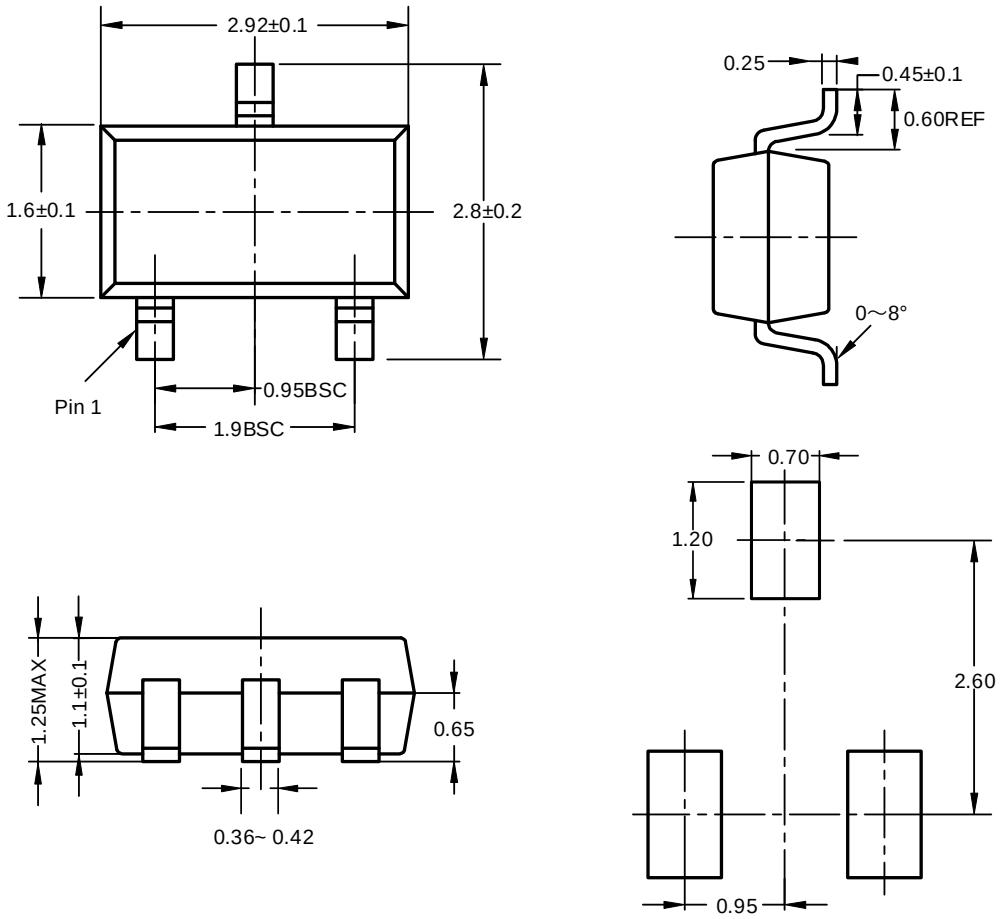




Recommended Land Pattern

Unit: mm

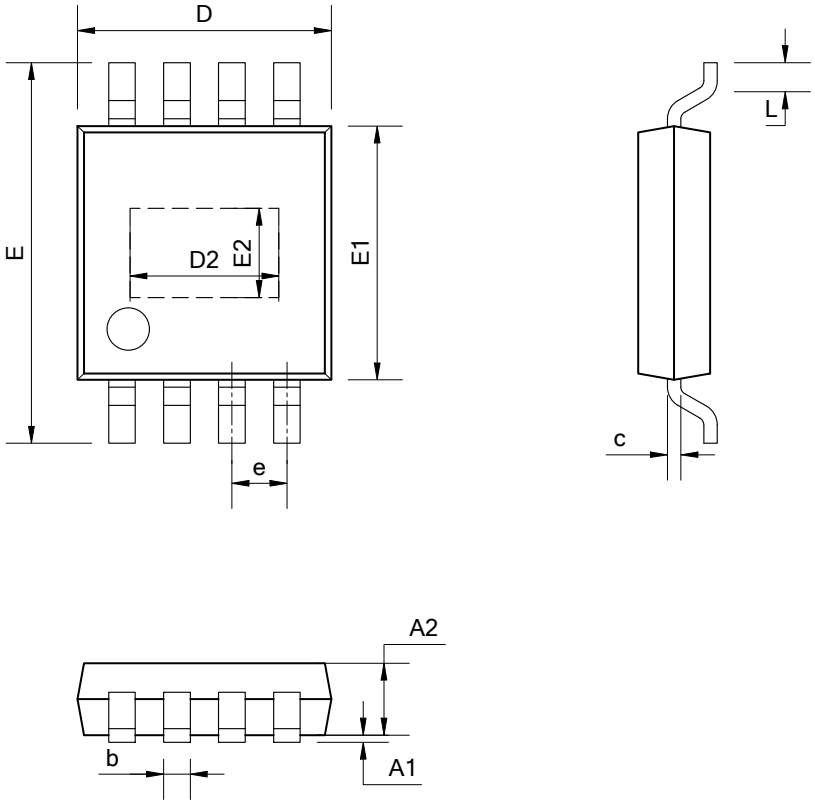
SOT23-3



Recommended Land Pattern

Unit: mm

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

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	Liujy
0.1	2023-02-21	Add 8V Version	Shibo	Liuxm	Liujy
0.2	2023-08-08	Removed XXB	Shibo	Shibo	Shibo
1.0	2023-10-7	Official Version	Pengjj	Liuxm	Liujy
1.1	2024-01-16	Add ESOP8	Shibo	Liuxm	Liujy
1.2	2025-04-08	Update Electrical Characteristics	Pengjj	Liuxm	Liujy