CE5HL5XXFQ - High Input Very-Low I_Q 300mA LDO

General Description

CE5HL5XXFQ is the high input very low I_Q 300mA LDO , The very-low consumption of type 2.8μA ensures long battery life and dynamic transient boost feature improves device transient response for automotive device applications.

CE5HL5XXFQ offered SOT89-3 package and operates over an ambient temperature range of -40°C to 125°C.

Features

- Wide input voltage range from 3.0V to 40V
- Up to 300mA Load Current
- Very low I_Q is 2.8μA typical
- Fixed Output Voltage are 3.0V,3.3V,3.6V,5.0V,6.0V,7.0V,8.0V,9.0V,12V, etc
- Low dropout is 900mV at 300mA Load @V_{OUT}=5.0V
- Excellent load/line transient response
- High Ripple Rejection: 52dB at 1KHz
- Automotive AEC-Q100 Grade 1 Qualified
- Ambient temperature range of -40°C to 125°C.
- Part No. and package

Part No.	Package	Packing Option	MSL
CE5HL5XXFQ	SOT89-3	Tape and Reel, 1K/Reel	1

Application

- Automotive device power supply
- Automotive infotainment and cluster

Device Information

CE 5HL5 XX F Q

XX Output Voltage		F Package		Q AEC-Q100 Qualified	
XX	X.XV Output Voltage For example, 33 is 3.3V output	F	SOT89-3	Q	With AEC-Q100 Qualified

Pin Configuration

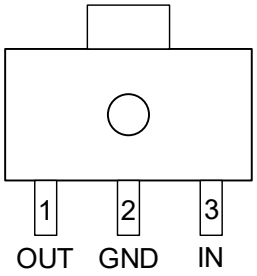


Figure1. Pin Configuration

Pin Function

Pin No.	Pin Name	Pin Function
1	OUT	Output Pin
2	GND	Ground Pin
3	IN	Supply Input Pin

Block Diagram

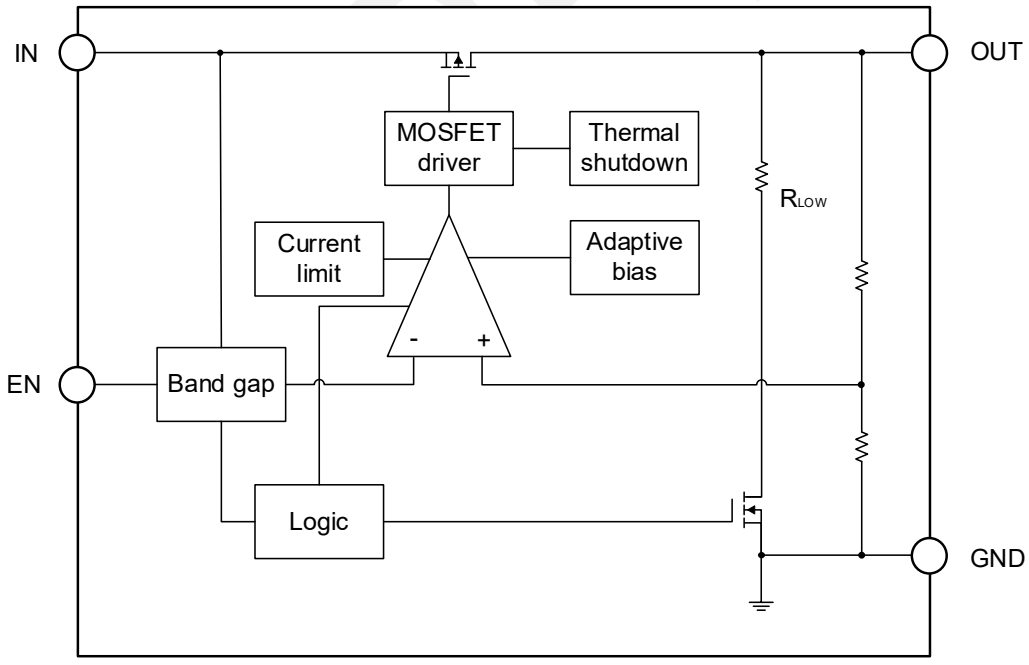


Figure2. Block Diagram

Functional Description

Input Capacitor

A 1μF~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 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.

Dropout Voltage

The CE5HL5XXFQ uses a PMOS pass transistor to achieve low dropout. When (V_{IN} - V_{OUT}) is less than the dropout voltage (V_{DO}), 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_{DO} 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. The maximum power dissipation depends on the operating ambient temperature for fixed $T_{J(MAX)}$ and thermal resistance, θ_{JA}.

Current-Limit Protection

The CE5HL5XXFQ 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} (1)	Input Voltage	-0.3~50	V
V_{OUT}	Output Voltage	0.8~15	V
T_{JMAX}	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:

HBM tested per AEC-Q100-002(JEDEC JS-001);
CDM tested per AEC-Q100-011(JEDEC JS-002);
Latch up Current Maximum Rating tested per AEC-Q100-004(JEDEC JESD78F).

Thermal Characteristics

Symbol	Package	Ratings	Value	Unit
$R_{\theta JA}$	SOT89-3	Thermal Characteristics, Thermal Resistance, Junction-to-Air	135	°C/W
P_D	SOT89-3	Power Dissipation@25°C, PCB board dimension: 40mm x 40mm (2layer) Copper :1OZ	920	mW

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 125	°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	5 to 100	mΩ

Electrical Characteristics

(V_{IN} = V_{OUT} + 2V; I_{OUT} = 10mA, C_{IN} = C_{OUT} = 1μF, 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	-1.5		1.5	%
		-40°C ≤ T_A ≤ 125°C	-2		2	
I_Q	Quiescent Current	I_{OUT} = 0mA		2.8	6.5	μA
$Line_{REG}$	Line Regulation	V_{IN} = V_{OUT} + 1V to 40V, I_{OUT} = 10mA （ΔV_{OUT} / ΔV_{IN} / V_{OUT}）		40	90	mV
V_{DROP}[4]	Dropout Voltage I_{OUT}=300mA	V_{OUT}=1.8V, T_A = 25°C		950	1450	mV
		V_{OUT} = 3.0~13V, T_A = 25°C		1000	1500	
$Load_{REG}$	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
PSRR[5]	Power Supply Rejection Ratio	f = 1kHz, 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, 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}		25		°C

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

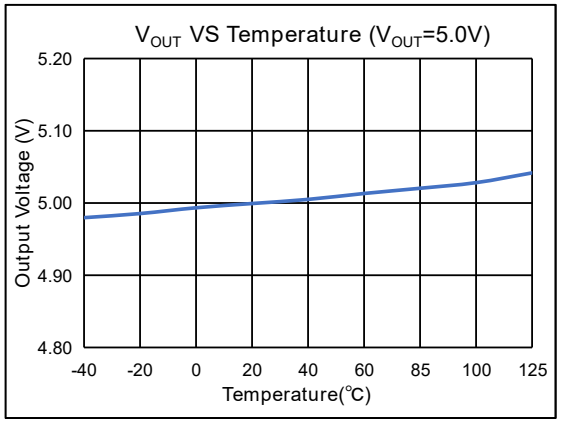
Note4. V_{DROP} FT test method: test the V_{OUT} voltage at V_{OUT} + $V_{DROPMAX}$ with 300mA output current.

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

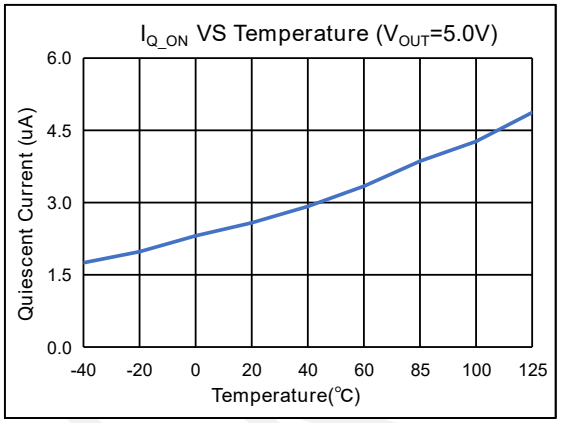
Typical Characteristics

VOLTAGE VERSION 5.0V

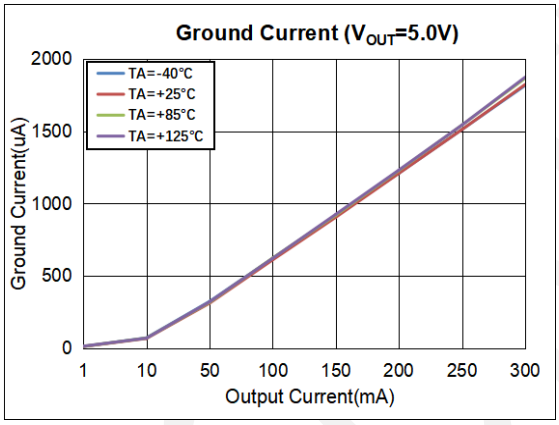
(V_{IN} = V_{OUT} + 2V, I_{OUT} = 10mA, C_{IN} = C_{OUT} = 1μF, unless otherwise noted. Typical values are at T_A = 25°C.)



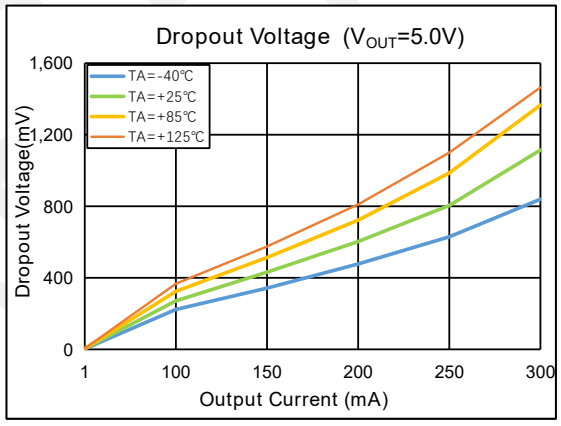
Output Voltage VS Temperature



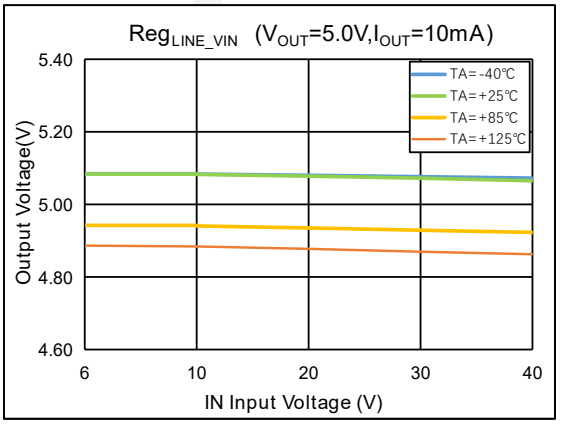
Quiescent Current VS Temperature



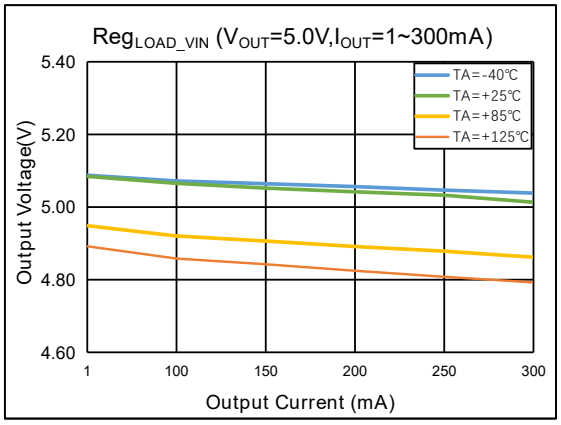
Ground Current VS Output Current



Dropout Voltage VS Output Current



Output Voltage VS Input Voltage

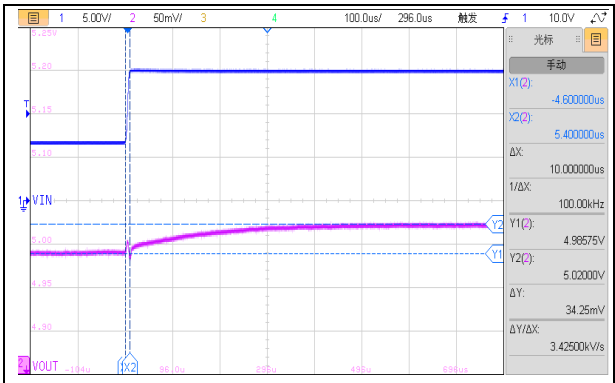


Output Voltage VS Output Current

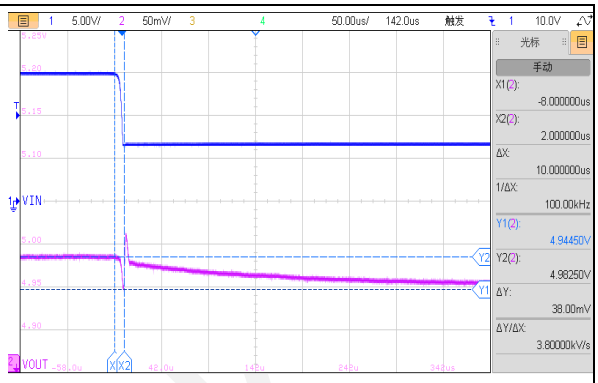
Typical Characteristics (Continued)

VOLTAGE VERSION 5.0V

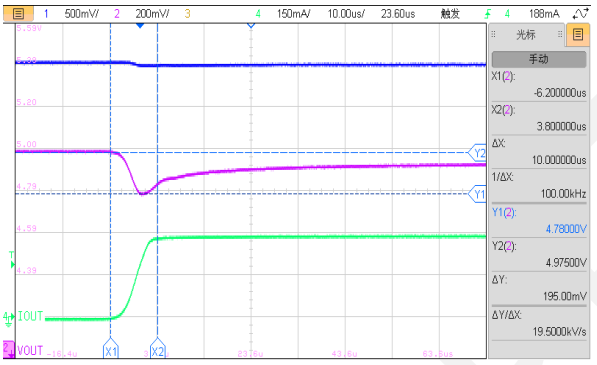
(V_{IN} =V_{OUT} + 2V, I_{OUT} = 10mA, C_{IN} = C_{OUT} = 1μF, unless otherwise noted. Typical values are at T_A = 25°C.)



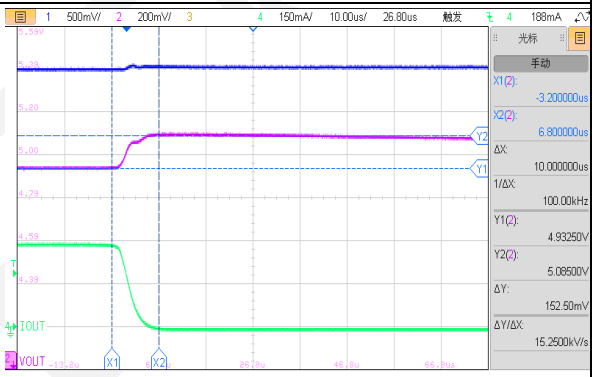
Input-Transient (7~15V, t_r = 10μs, I_{OUT} = 1mA)



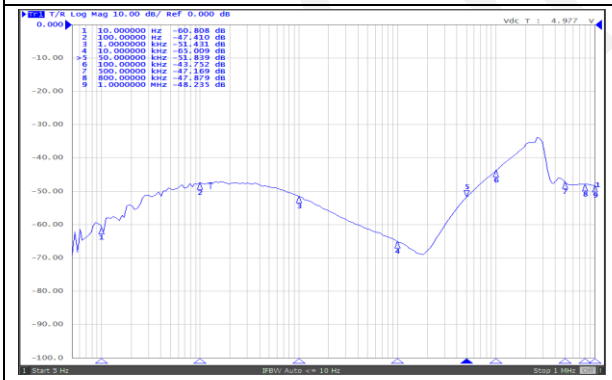
Input-Transient (15~7V, t_f = 10μs, I_{OUT} = 1mA)



Load-Transient
(V_{IN} = 7V, I_{OUT} = 1~300mA, t_r = 10μs)



Load-Transient
(V_{IN} = 7V, I_{OUT} = 300~1mA, t_f = 10μs)



PSRR (I_{OUT} = 20mA)

Application Circuits

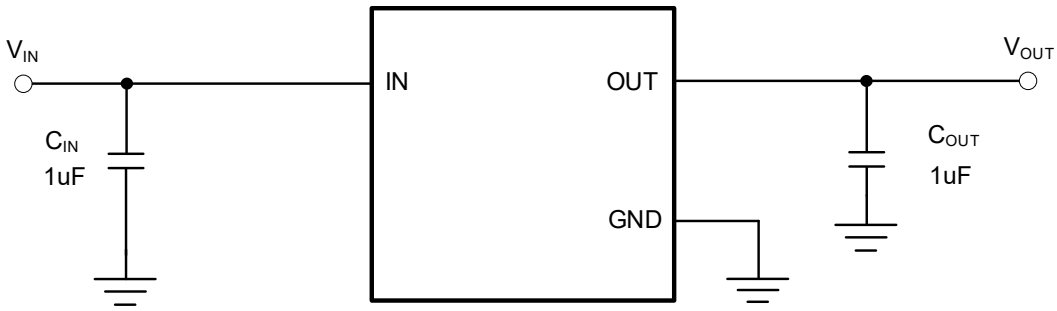
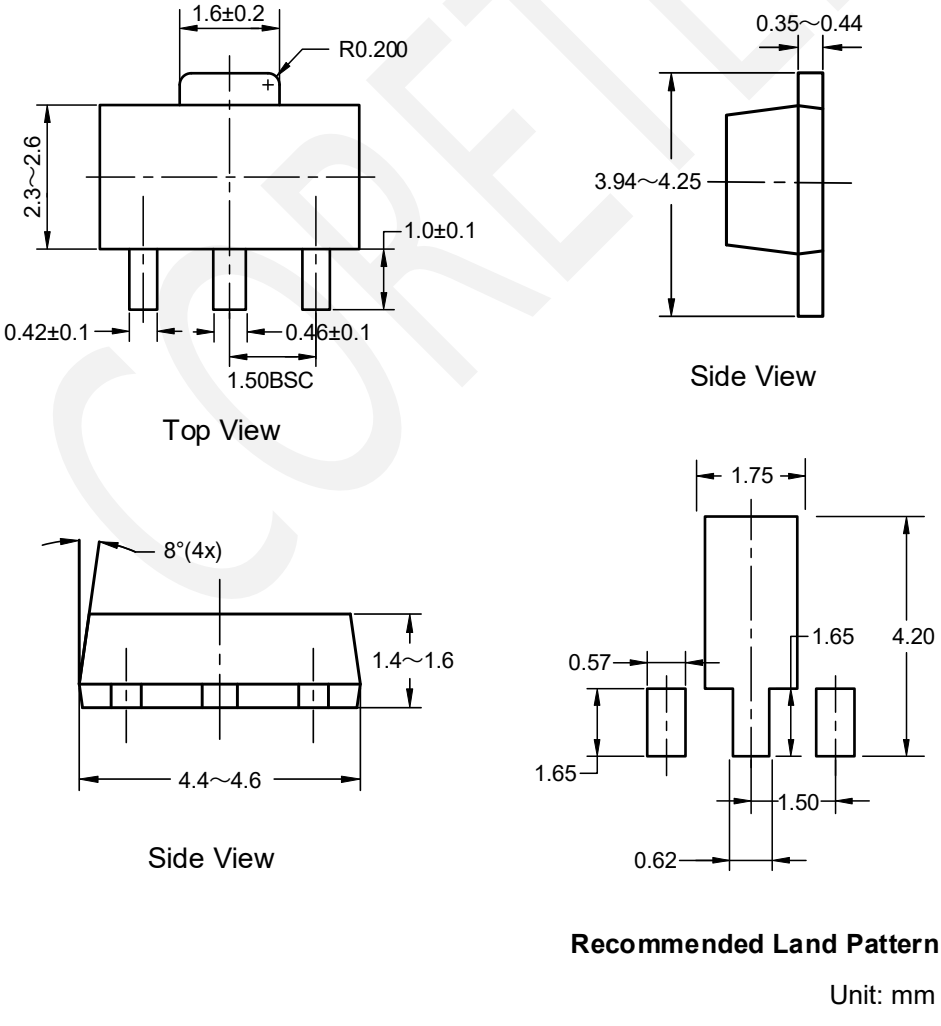


Figure3. Application Circuits

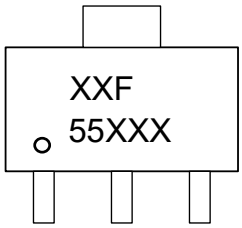
* Typical application circuit for reference only.

Package Dimension

SOT89-3



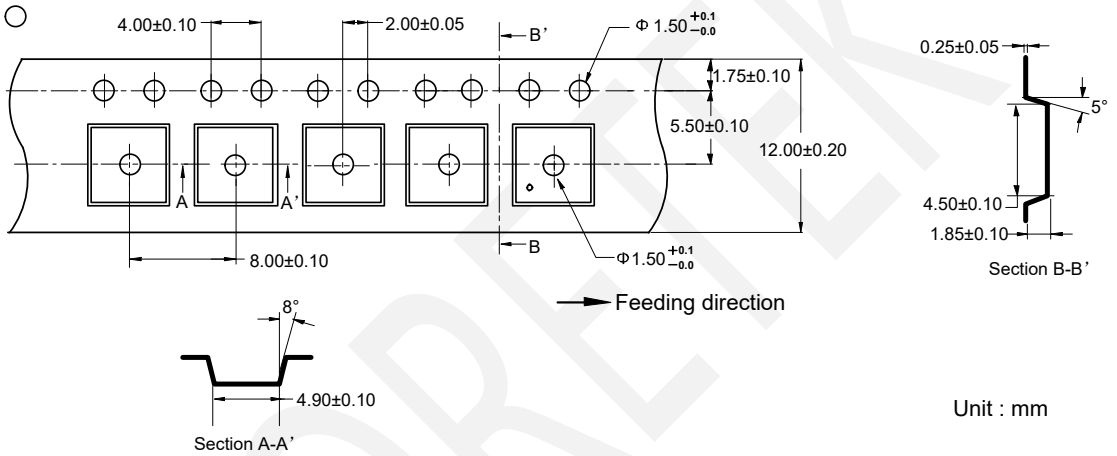
Marking



XXF = Output Version, e.g. 50F: 5.0V

55XXX = Tracking Number

Tape Information



Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2022-11-13	Preliminary Version	Liu xiaomin	Liu xiaomin	Zhu junli
1.0	2025-02-10	Official Version	Peng junjie	Liu xiaomin	Zhu junli