100V,100mA,4.5uA,High Voltage,Low-Dropout Voltage Regulator

Features

- Low Quiescent Current : 4.5uA
- Wide Input Voltage Range : 4V to 100V
- High Output Current : 100mA
- Fixed Output Voltages : 3.3V and 5.0V.
- Output Voltage Tolerance : ±2%
- Current Limit Protection
- Short Circuit Protection
- Thermal Shutdown Protection
- Available Packages：SOT89-3

Applications

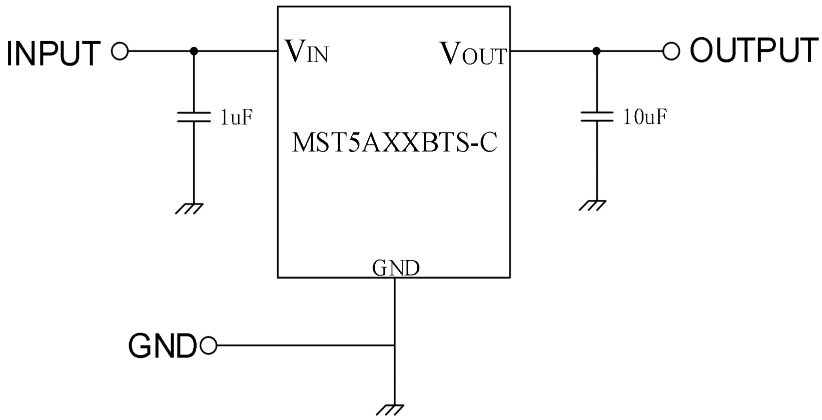
- Battery-powered Equipment
- Smoke Detector and Sensor
- Micro Controller Applications
- Home Appliance

Description

MST5AXXBTS-C is a high-voltage low-power LDO with an input voltage up to 100V, a static current of 4.5uA (VIN=12V), ±2% high output voltage accuracy, and a maximum output current of 100mA. MST5AXXBTS-C has a fast response to input voltage transients and load current transients, ensuring no overshoot voltage during startup and short-circuit recovery.

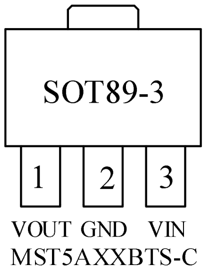
MST5AXXBTS-C has short-circuit protection, current limiting protection, and over-temperature protection functions. MST5AXXBTS-C includes two fixed output voltages: 3.3V and 5.0V.

Typical Application



100V, Low-Dropout Voltage Regulator

Pin Configuration and Functions



Pin Functions

名称	SOT89-3	描述
	MST5AXXBTS-C	
VOUT	1	Output Pin
GND	2	Ground Pin
VIN	3	Input Pin

Absolute Maximum Ratings

Parameter	Description	Min	Max	Unit
Input Voltage	VIN to GND	-0.3	115	V
	VOUT to GND	-0.3	7	V
	VIN to VOUT	-0.3	110	V
Current	Peak output current	Internally limited		
Temperature	Operating Temperature Range	-40	125	℃
	Storage Temperature	-40	150	℃
Thermal Resistance (Junction to Ambient)	SOT89	130		℃/W
Power Dissipation	SOT89	900		mW

Note:

exceeding the range specified by the rated parameters will cause damage to the chip, and the working state of the chip beyond the range of rated parameters cannot be guaranteed. Exposure outside the rated parameter range will affect the reliability of the chip.

ESD Ratings

Parameter	Description	Range	Unit
V_{ESD}	Human Body Model(HBM)	4	KV
	Charged Device Model(CDM)	200	V

Note:

JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

JEDEC document JEP157 states that 200-V CDM allows safe manufacturing with a standard ESD control process.

Electrical Characteristics

(At T_{A}=25°C, C_{IN}=1uF, V_{IN}=V_{OUTNOM}+1V, C_{OUT}=10uF, unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Operating input voltage		4	—	100	V
I_{GND}	Quiescent Current	V_{IN}=12V, No load	—	4.5	—	uA
V_{OUT}	Output Voltage	V_{IN}=12V, I_{OUT}=10mA	—	3.3	—	V
I_{OUT_MAX}	Output Current	V_{IN}=V_{OUTNOM}+1V	—	100	—	mA
V_{DROP}	Dropout Voltage(1)	I_{OUT}=10mA , V_{IN}=V_{OUTNOM}-0.1V	—	120	—	mV
		I_{OUT}=100mA , V_{IN}=V_{OUTNOM}-0.1V	—	830	—	
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN}=7V, 1mA≤I_{OUT}≤100mA	—	0.1	—	mV/mA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	I_{OUT}=1mA, 6V≤V_{IN}≤1000V	—	0.1	—	mV/V
I_{LIMIT}	Current Limit		—	240	—	mA
I_{SHORT}	Short Current	V_{IN}=12V	—	80	—	mA
T_{SHDN}	Thermal Shutdown Temperature	Shutdown, temperature increasing	—	145	—	°C
		Reset, temperature decreasing	—	120	—	

Note：(1) Dropout Voltage is the voltage difference between the input and the output at which the output voltage drops 2% below its nominal value.

Detailed Description

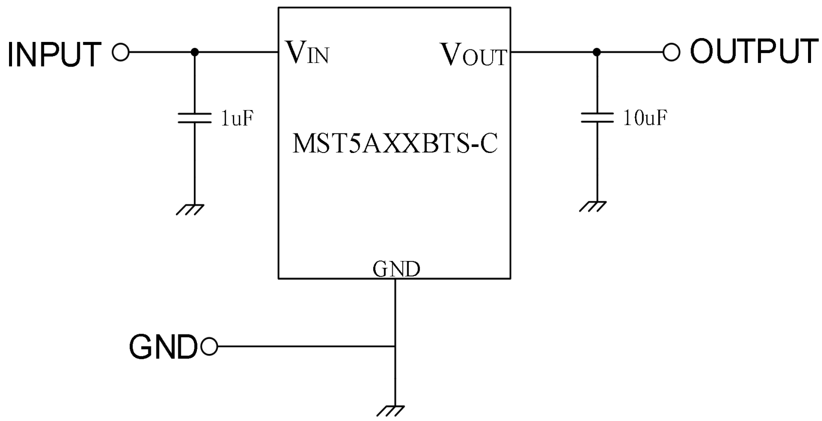
Overview

MST5AXXBTS-C is a high-voltage low-power LDO with an input voltage up to 100V, a static current of 4.5uA (VIN=12V), ±2% high output voltage accuracy, and a maximum output current of 100mA. MST5AXXBTS-C has a fast response to input voltage transients and load current transients, ensuring no overshoot voltage during startup and short-circuit recovery.

MST5AXXBTS-C has short-circuit protection, current limiting protection, and over-temperature protection functions. MST5AXXBTS-C includes two fixed output voltages: 3.3V and 5.0V.

Input Capacitor and Output Capacitor

A 1μF 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.When VIN≥48V,it is recommended to add R1(R1>1Ω,The resistance shall be adjusted according to the actual application) at the input end.



An output capacitor is required for the stability of the LDO. The recommended minimum output capacitance is 1μF, ceramic capacitor is recommended, and temperature characteristics are X5R or X7R. 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 VOUT and GND pins.

Current Limit and Short Circuit Protection

When output current at VOUT pin is higher than current limit threshold or the VOUT pin is direct short to GND, the current limit protection will be triggered and clamp the output current at a pre-designed level to prevent over-current and thermal damage.

Power Dissipation and Thermal Protection

The MST5AXXBTS-C has internal thermal sense and protection circuits. When excessive power dissipation happens on the device, such as short circuit at the output pin or very heavy load current with a large voltage drop across the device, the internal thermal protection circuit will be triggered, and it will shut down the power MOSFET to prevent the LDO from damage. As soon as excessive thermal condition is removed and the temperature of the device drops down, the thermal protection circuit will lease the control of the power MOSFET, and the LDO device goes to normal operation.

Power dissipation caused by voltage drop across the LDO and by the output current flowing through the device needs to be dissipated out from the chip. The maximum junction temperature is dependent on power dissipation,package, the PCB layout, number of used Cu layers, Cu layers thickness and the ambient temperature.

During normal operation, LDO junction temperature should not exceed 150°C, or else it may result in deterioration of the properties of the chip. Using below equations to calculate the power dissipation and estimate the junction temperature.

The power dissipation can be calculated using Equation1 .

$$PD = (VIN - VOUT) \times IOUT \quad (1)$$

The junction temperature can be estimated using Equation . RθJA_EVM is the junction-to-ambient thermal resistance based on customer's PCB. Verify the application and allow sufficient margins in the thermal design by the Equation 2.

$$TJ = TA + PD \times R\theta JA\_EVM \quad (2)$$

RθJA_EVM is a critical parameter and depends on many factors such as the following:

· Power dissipation

· Air temperature/flow

· PCB area

· Copper heat-sink area

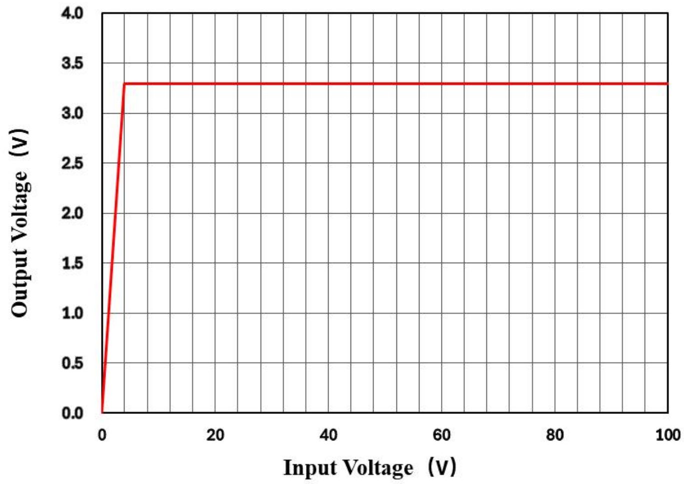
· Number of thermal vias under the package

· Adjacent component placement

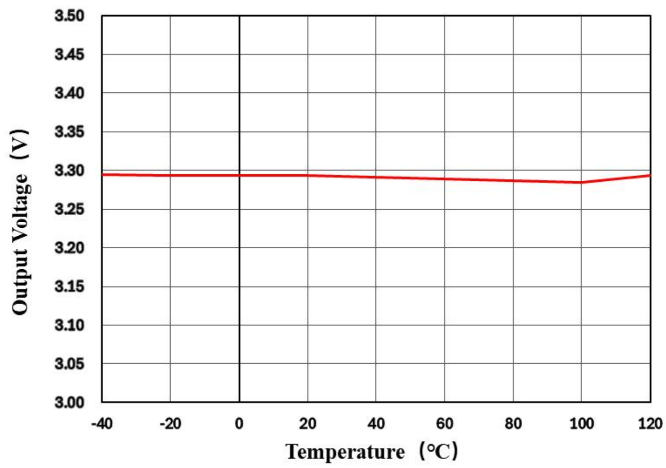
典型性能特征

（除特殊说明外，以下参数均在 T_A=25°C，C_{IN}=1uF，V_{IN}=V_{OUTNOM}+1V，C_{OUT}=10μF,V_{out}=3.3V条件下测试）

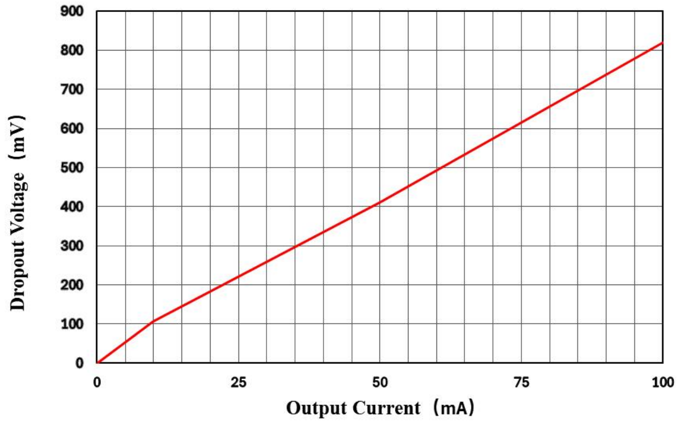
Output Voltage vs. Input Voltage



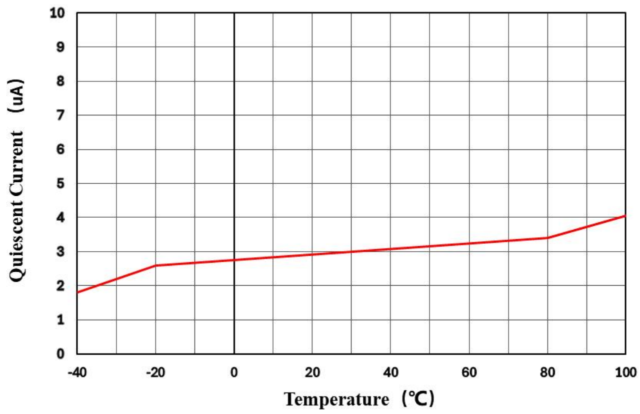
Output Voltage vs. Temperature



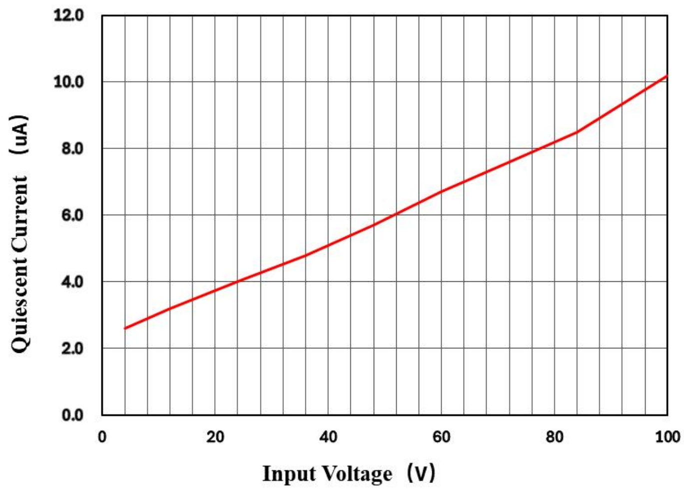
Dropout Voltage vs. Output Current



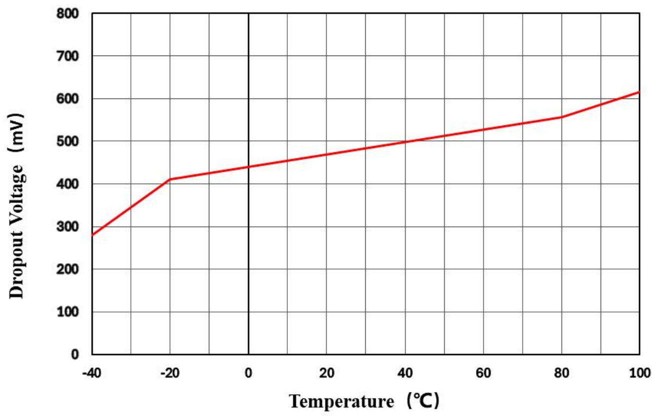
Quiescent Current vs. Temperature



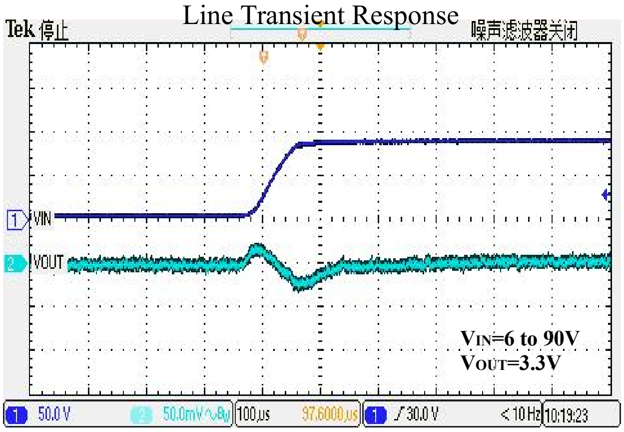
Quiescent Current vs. Input Voltage



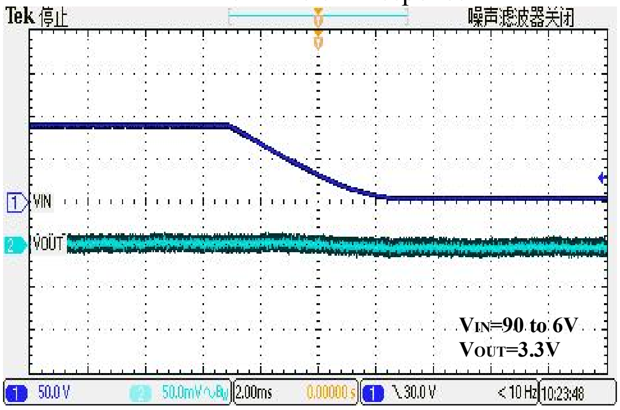
Dropout Voltage vs. Temperature



Line Transient Response



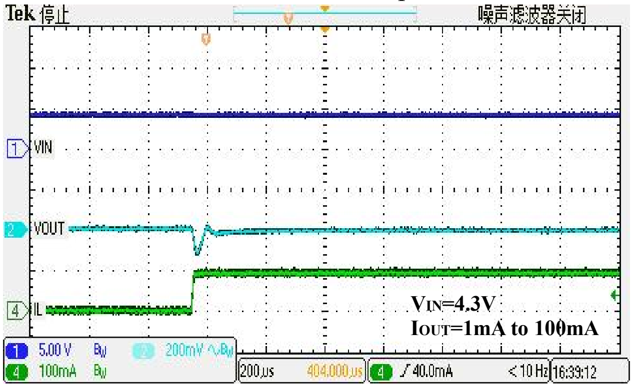
Line Transient Response



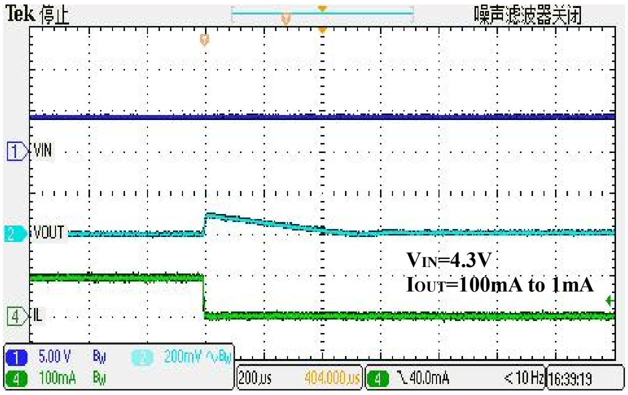
V_{OUT}

V_{IN}

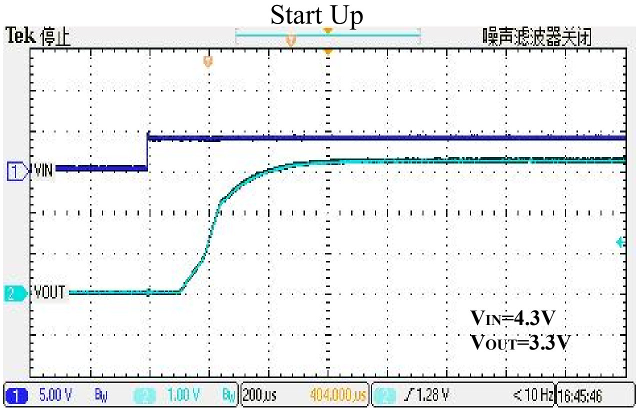
Load Transient Response



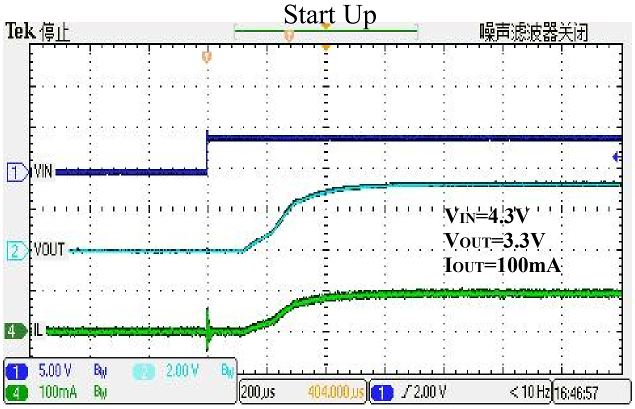
Load Transient Response



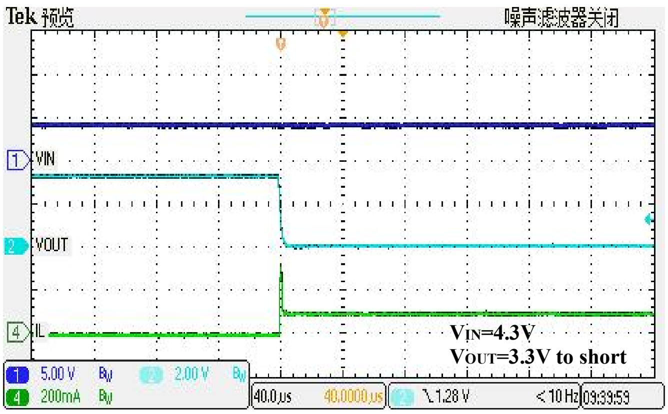
Start Up



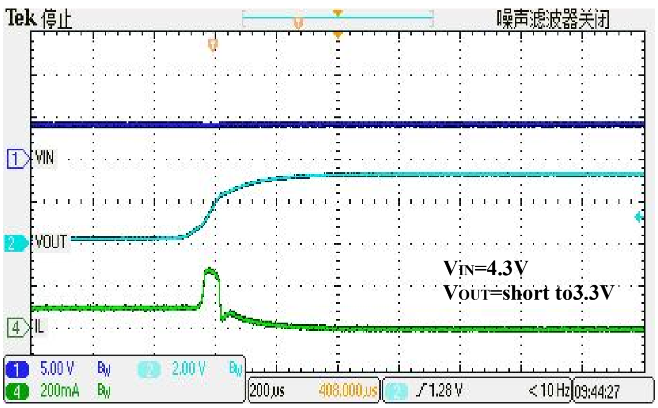
Start Up



Short Circuit

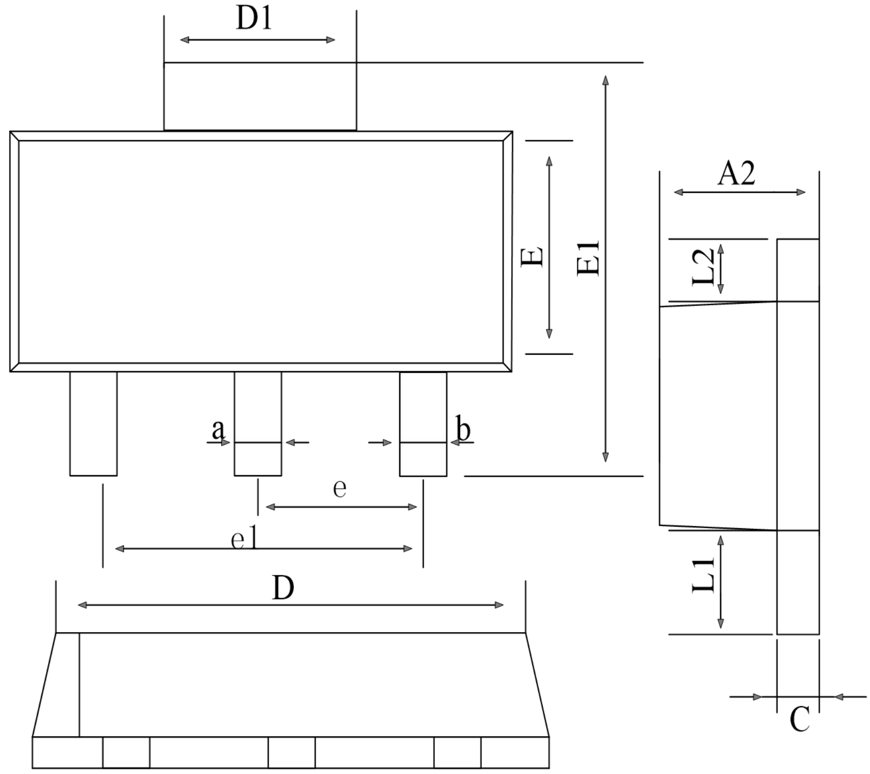


Short Circuit Protection



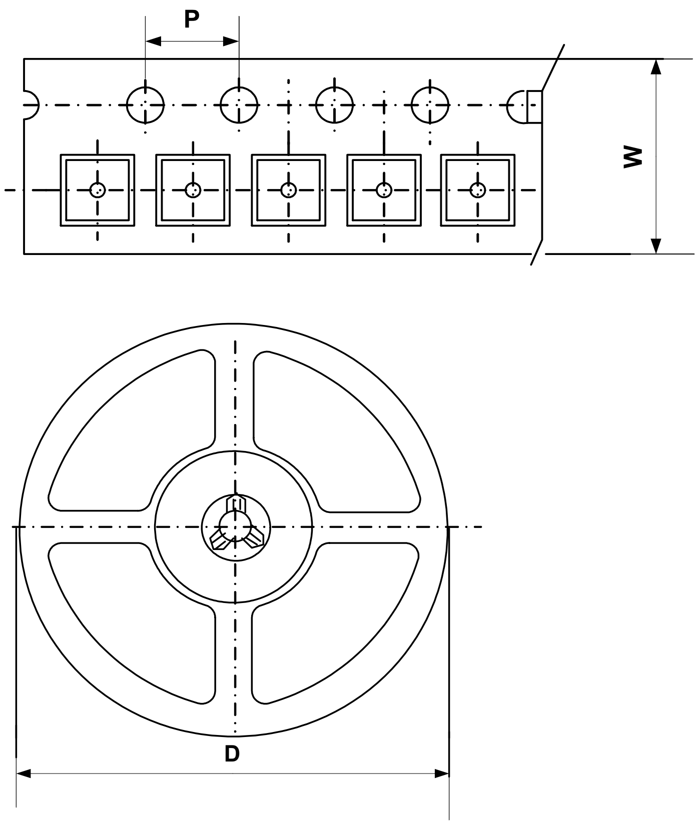
Package Outline

SOT89-3



REF.	Millimeter	
	Min.	Max.
A2	1.4	1.6
a	0.45	0.55
b	0.38	0.48
c	0.36	0.46
D	4.40	4.60
D1	1.60	1.80
E	2.40	2.60
E1	4.00	4.30
e	1.00	2.00
e1	2.95	3.05
L1	0.80	1.00
L2	0.65	0.75

Packing Information



Type	W(mm)	P(mm)	D(mm)	Qty (pcs)
SOT89-3	12.0±0.1 mm	4.0±0.1 mm	180±1 mm	1000pcs

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1-0	2024-4-25		Xingxiaolin	Xingxiaolin	Xingxiaolin
1-1	2024-5-9		Lvhan	Lvhan	Lvhan
1-2	2024-6-7		Lvhan	Lvhan	Lvhan

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