45V,350mA,2.8uA,HighPSRR,Low-Dropout Voltage Regulator With Enable

Features

- Low Quiescent Current : 2.8uA
- Shutdown Current : 130nA
- Wide Input Voltage Range : 3V to 45V
- High Output Current : 350mA
- High PSRR : 83dB at 1kHZ
- Low Dropout Voltage : 320mV@100mA
- Fixed Output Voltages : 1.8V, 3.0V, 3.3V and 5.0V
- Output Voltage Accuracy : ±2%
- Fast Transient Response
- Current Limit Protection
- Short Circuit Protection
- Thermal Shutdown Protection
- Available Packages : SOT23-3, SOT89-3, SOT23-5,SOT223-3 and SOT252-3

Applications

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

Description

The MST54XXB series is an ultra-small, low dropout (LDO) linear regulator that can source 350mA of output current. The MST54XXB series is designed to provide high PSRR, high input voltage, and excellent load and line transient performance.

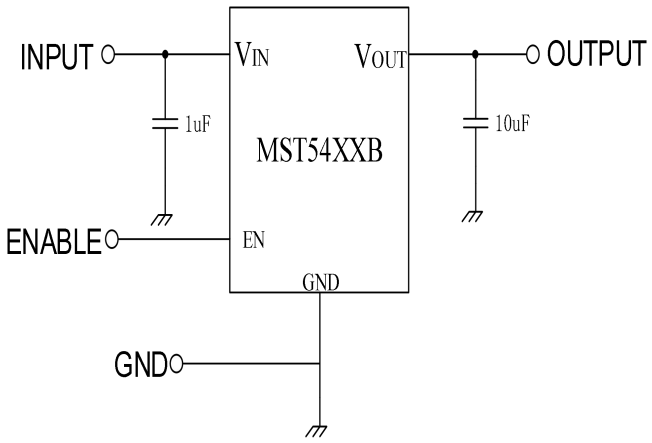
The MST54XXB series has thermal shutdown, current limit, and short circuit protections for added safety. Shutdown mode is enabled by pulling the EN pin low.

The MST54XXB series contains four fixed output voltages of 1.8V, 3.0V, 3.3V and 5.0V.

PART NUMBER	PACKAGE	BODY SISE(NOM)
MST54XXBTE	SOT23-3	2.9mm*2.8mm
MST54XXBTS	SOT89-3	4.5mm*4.2mm
MST54XXBTG	SOT23-5	2.9mm*2.8mm
MST54XXBTM	SOT223-3	3.5mm*6.5mm
MST54XXBTQ	TO252-3	6.5mm*10.0mm

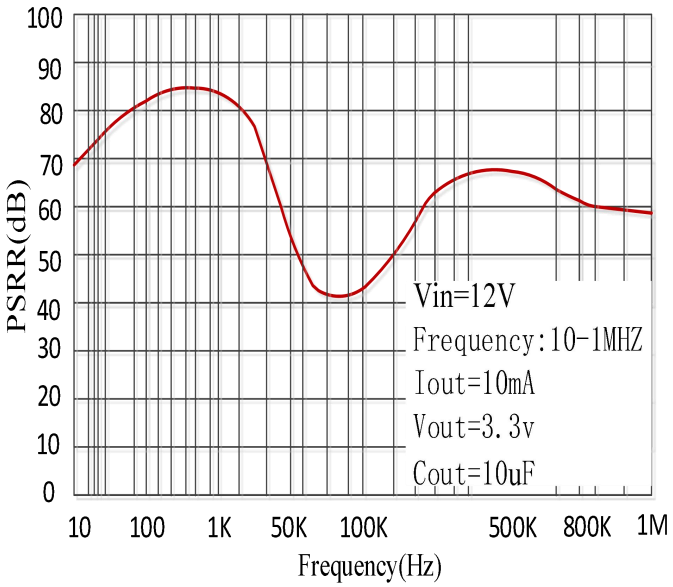
(1) For all available packages, see the orderable addendum at the end of the data sheet.

Typical Application

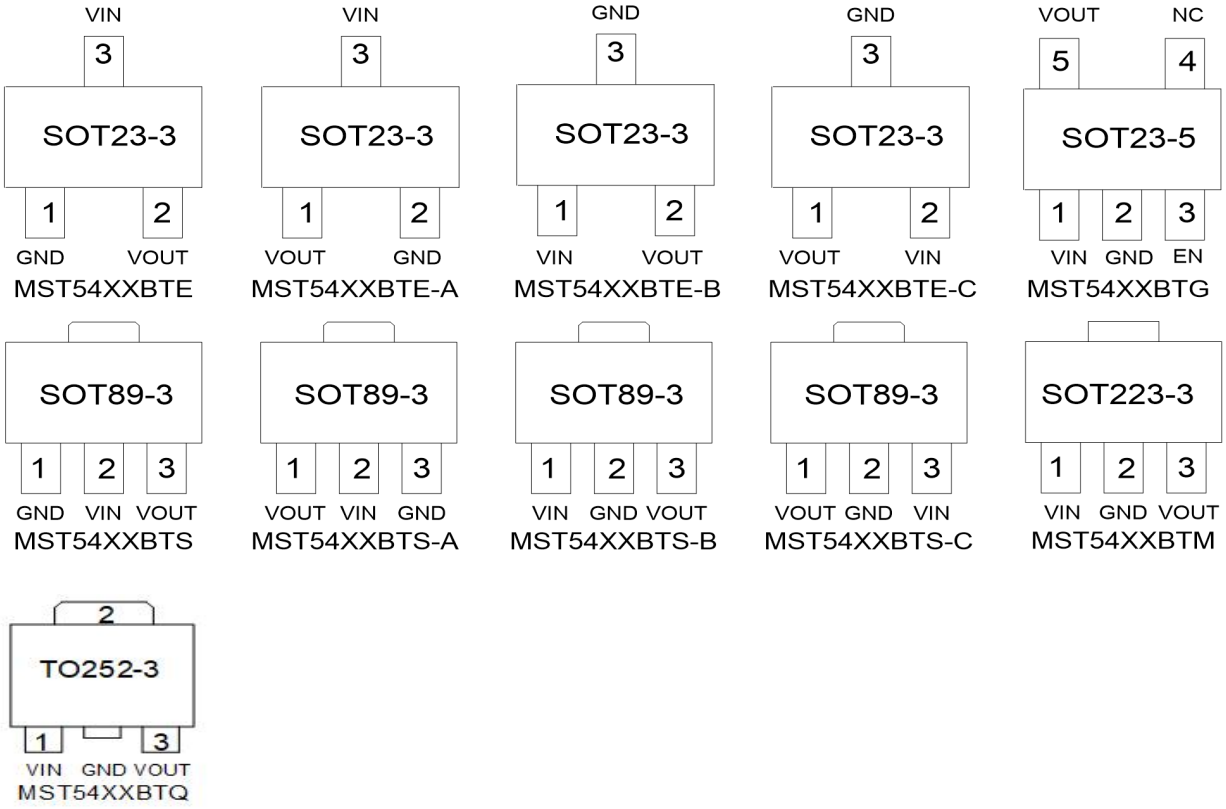


45V, Low-Dropout Voltage Regulator

PSRR



Pin Configuration and Functions



Name	SOT23-3				Description
	MST54XX BTE	MST54XXBTE-A	MST54XXBTE-B	MST54XXBTE-C	
GND	1	2	3	3	Ground Pin
VOUT	2	1	2	1	Output Pin
VIN	3	3	1	2	Input Pin
Name	**SOT89-3**				**Description**
	MST54XX BTS	**MST54XXBTS-A**	**MST54XXBTS-B**	**MST54XXBTS-C**	
GND	1	3	2	2	Ground Pin
VOUT	3	1	3	1	Output Pin
VIN	2	2	1	3	Input Pin

Name	SOT23-5	SOT223-3	SOT252-3	Description
	MST54XXBTG	MST54XXBTM	MST54XXBTQ	
VIN	1	1	1	Input Pin
GND	2	2	2	Ground Pin
EN	3			Enable pin
NC	4			No Connection
VOUT	5	3	3	Output Pin

Absolute Maximum Ratings

Parameter	Description	Min	Max	Unit
Input Voltage	VIN to GND	-0.3	55	V
	VOUT to GND	-0.3	7	V
	VIN to VOUT	-0.3	50	V
	EN to GND	-0.3	55	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
	SOT23	200		℃/W
	SOT223	120		℃/W
	SOT252	80		℃/W
Power Dissipation	SOT89	900		mW
	SOT23	600		mW
	SOT223	1000		mW
	SOT252	1700		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.

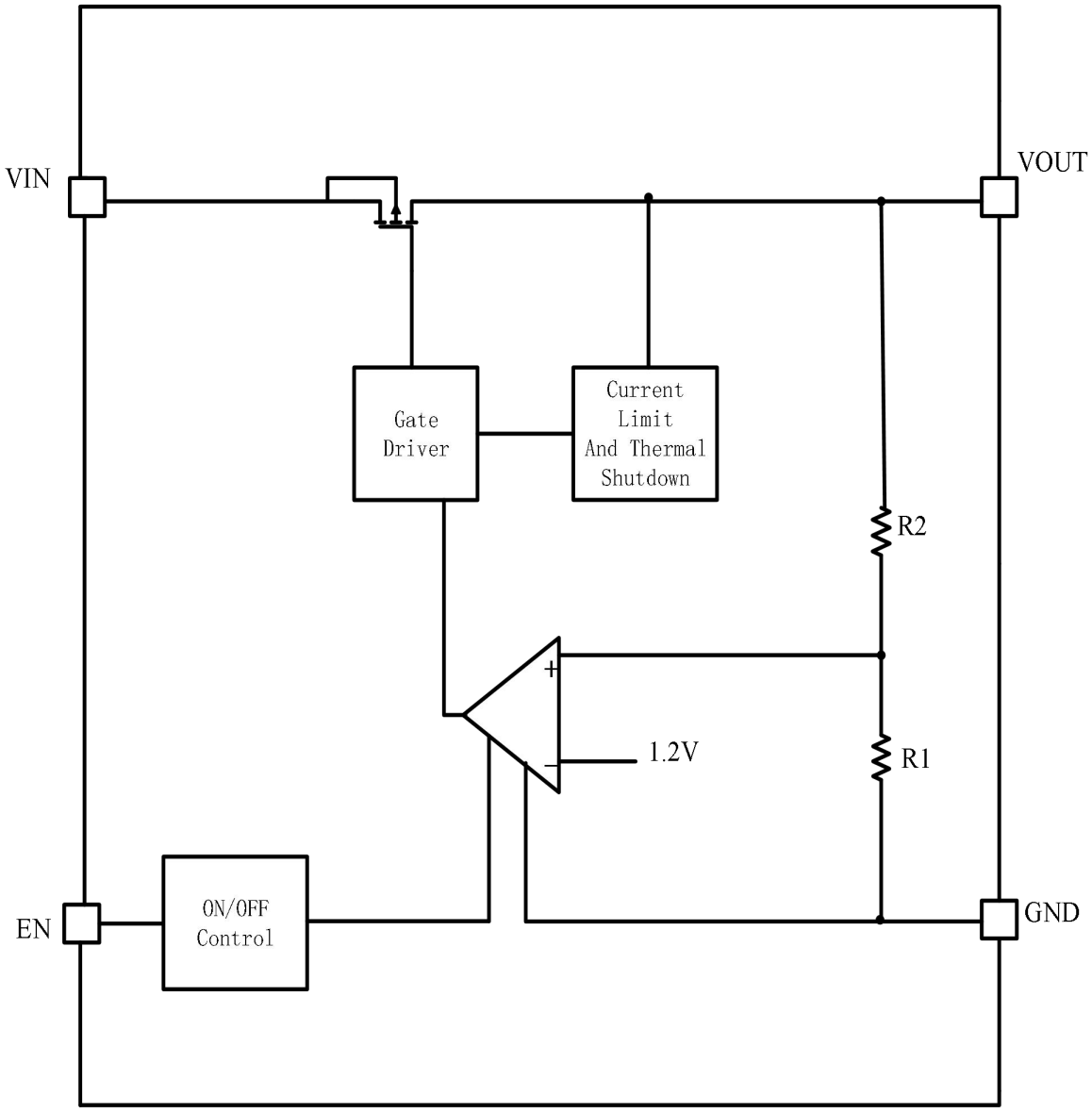
Electrical Characteristics

(At T_A=25°C, C_{IN}=1uF, V_{IN}=V_{OUTNOM}+1.0V, C_{OUT}=10uF, unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Operating input vol tage		3	—	45	V
I_{GND}	Quiescent Current	V_{IN}=12V, No load	2.5	2.8	3.2	uA
I_{SHUT}	Shutdown Current	V_{IN}=12V, EN=0V	—	130	—	nA
V_{OUT}	Output Voltage	V_{IN}=12V, I_{OUT}=10mA	V_{OUTNOM} * 0.98	V_{OUTNOM}	V_{OUTNOM} * 1.02	V
I_{OUT_MAX}	Output Current		300	350	—	mA
V_{DROP}	Dropout Voltage(1)	I_{OUT}=10mA , V_{IN}=V_{OUTNOM}-0.1V	—	35	—	mV
		I_{OUT}=100mA , V_{IN}=V_{OUTNOM}-0.1V	—	320	—	mV
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN}=7V, 1mA≤I_{OUT}≤100mA	—	0.1	—	mV/ mA
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	I_{OUT}=1mA, V_{OUTNOM}+0.5V≤V_{IN}≤45V	—	0.1	—	mV/V
I_{LIMIT}	Current Limit		—	700	—	mA
T_{SHDN}	Thermal Shutdown Temperature	Shutdown, temperature increasing	—	150	—	℃
		Reset, temperature decreasing	—	130	—	
PSRR		V_{IN}=10V , I_{OUT}=10mA F=1Khz,V_{OUT}=5V	—	83	—	dB
V_{ENH}	EN High level	Enabled	1	—	45	V
V_{ENL}	EN Low level	Shutdown	—	—	0.4	V

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.

Functional Block Diagram

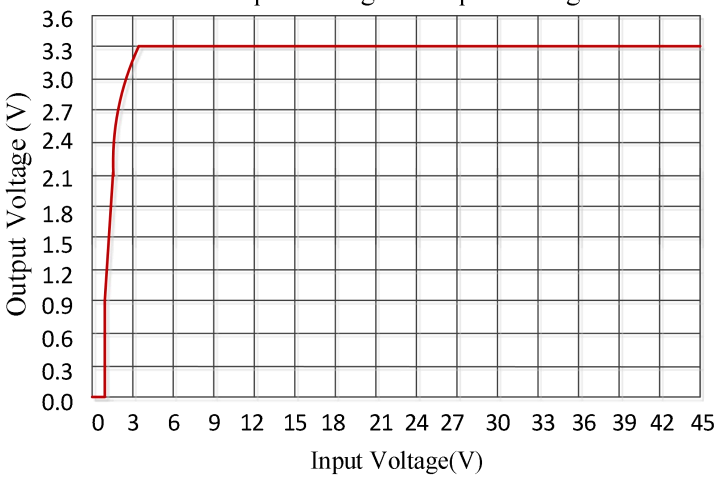


Functional Block Diagram

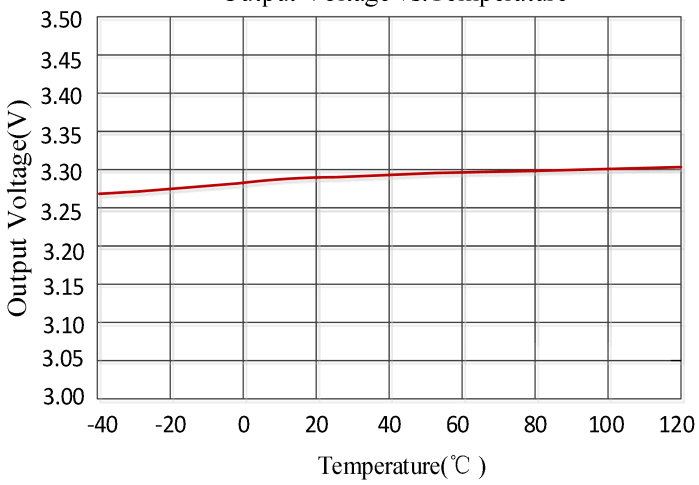
Typical Characteristics

(Test Condition: $T_{A=}$25°C,Vin=12V, Iout=1mA,C_{OUT}=10uF,Vout=3.3V unless otherwise note)

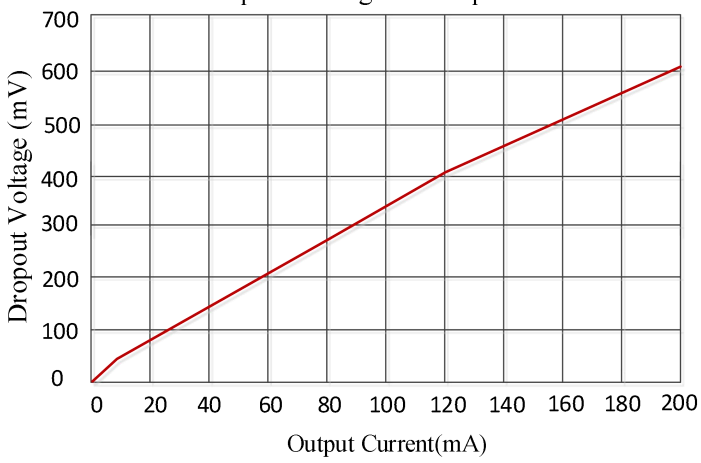
Output Voltage vs. Input Voltage



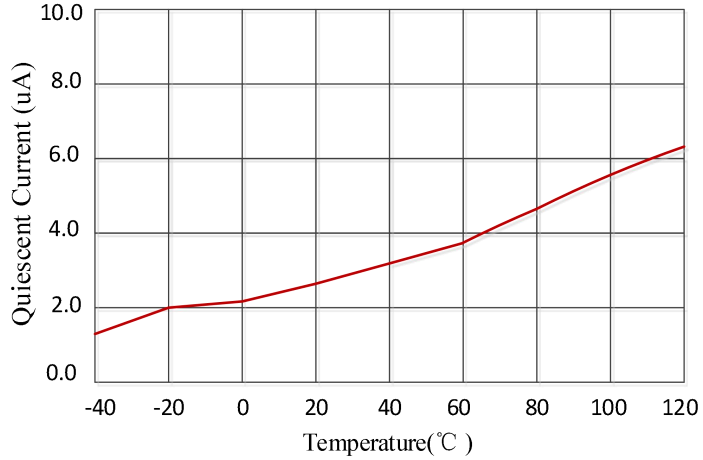
Output Voltage vs.Temperature



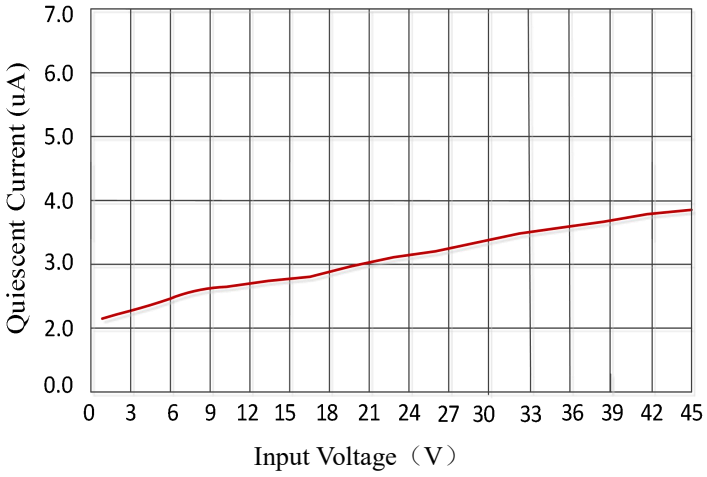
Dropout Voltage vs. Output Current



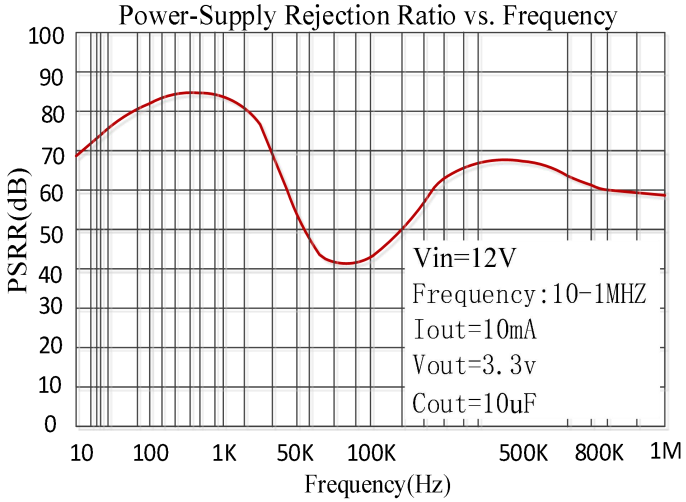
Quiescent Current vs.Temperature



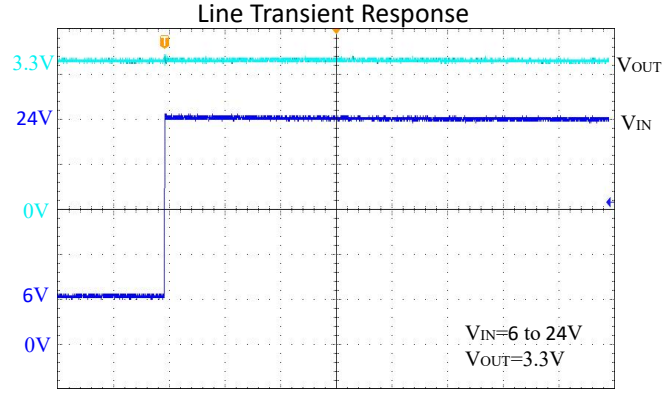
Quiescent Current vs. Input Voltage



Power-Supply Rejection Ratio vs. Frequency

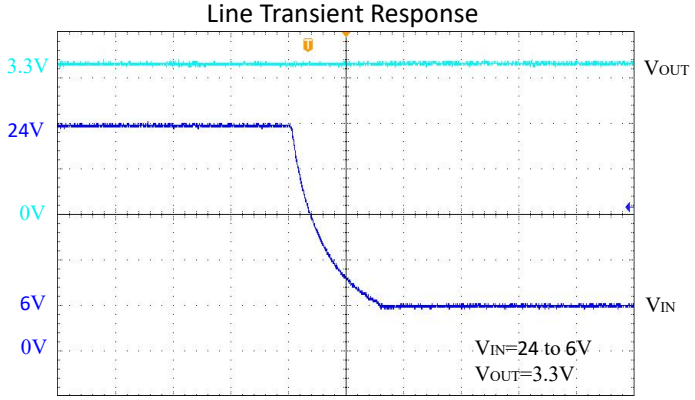


Line Transient Response



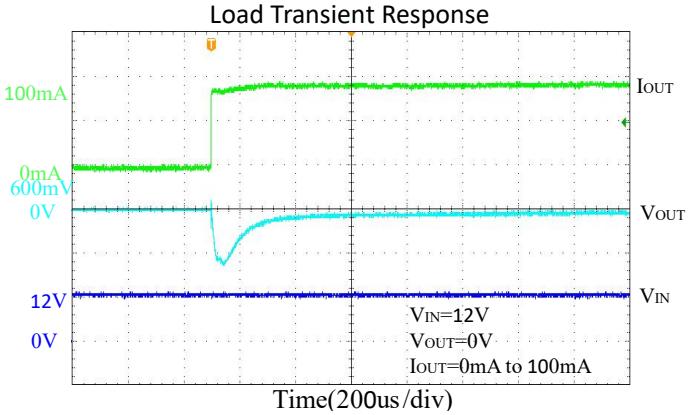
Time(4us/div)

Line Transient Response



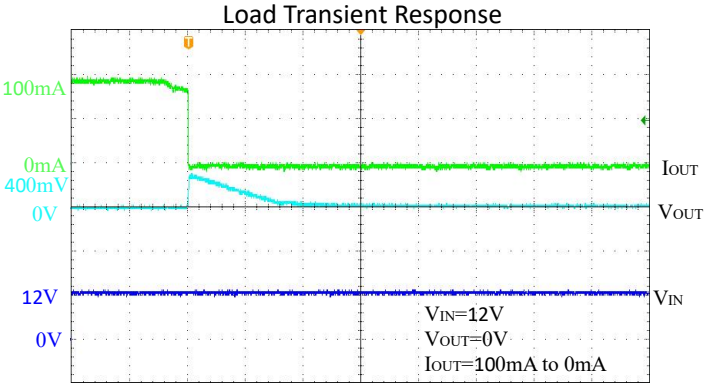
Time(4us/div)

Load Transient Response



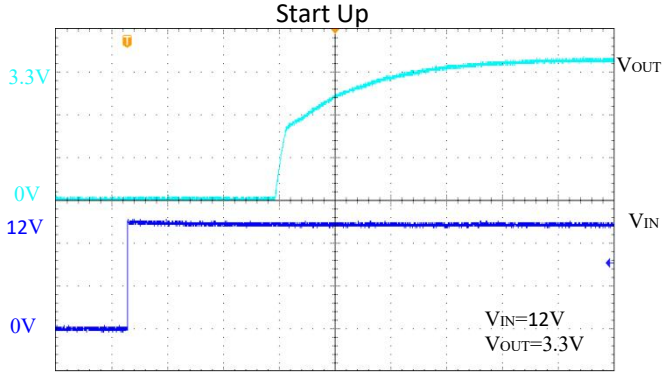
Time(200us/div)

Load Transient Response



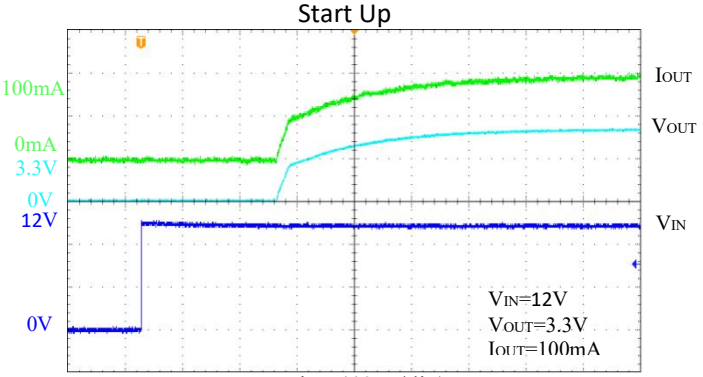
Time(200us/div)

Start Up



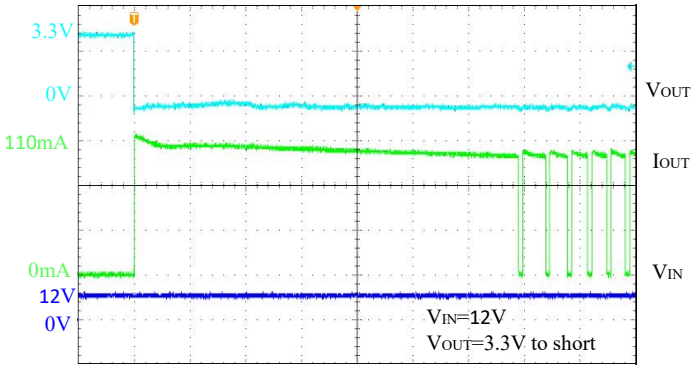
Time(40us/div)

Start Up



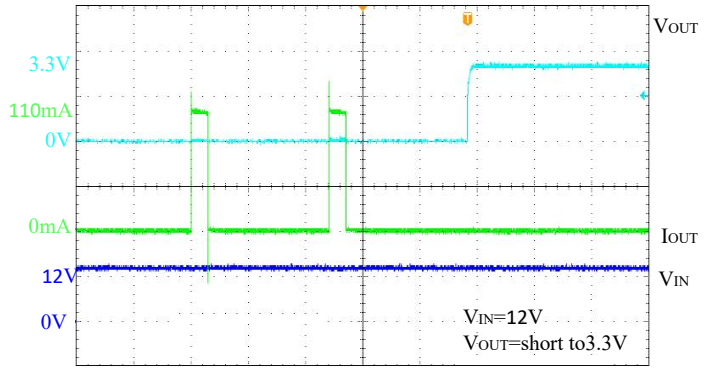
Time(40us/div)

Short Circuit Protection



Time(2ms/div)

Short Circuit Protection



Time(2ms/div)

Detailed Description

Overview

The MST54XXB series products are 350mA wide input voltage range linear regulators with very low quiescent current. These voltage regulators operate from 3V to 45V DC input voltage with supporting 45V transient input voltage and consume 2.8μA quiescent current at no load.

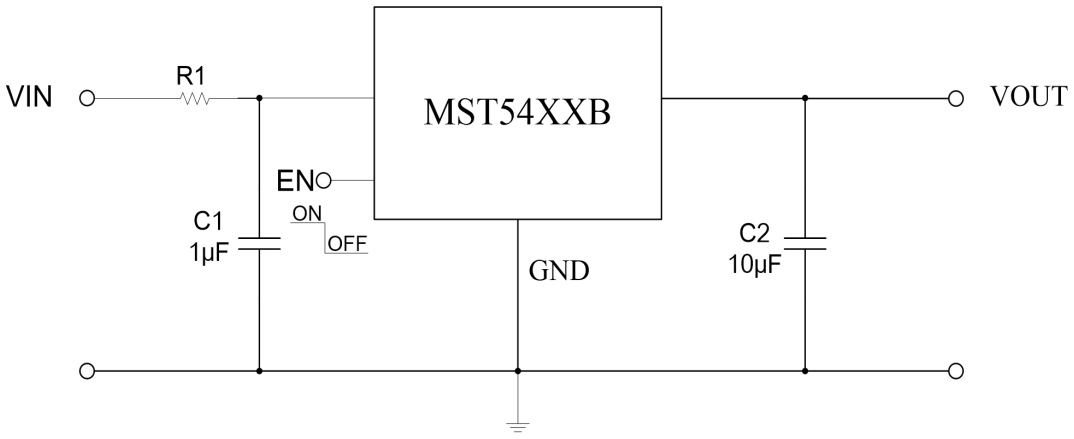
The MST54XXB series products are available in fixed voltage versions of 1.8V, 3.0V, 3.3V and 5.0V with 1% output voltage accuracy at room temp and 2% output voltage accuracy over operating conditions. The series products are available in SOT23-3,SOT89-3, SOT23-5,SOT223-3and SOT252-3 packages.

Regulated Output Voltage

The MST54XXB series are available in fixed voltage versions of 1.8V,3V,3.3V and 5V. When the input voltage is higher VOUT(NOM)+VDROP, output pin is the regulated output based on the selected voltage version. When the input voltage falls below VOUT(NOM)+VDROP, output pin tracks the input voltage minus the dropout voltage based on the load curre nt. When the input voltage drops below UVLO threshold, the output keeps shut off.

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≥18V,it is recommended to add R1(R1>1Ω,The resistance shall be adjusted according to the actual application) at the input end.



To ensure loop stability, the MST54XXB series products requires an output capacitor with a minimum effective capacitance value of 3.3μF. And the series products could support output capacitor range from 3.3uF to 220uF and

with an ESR range between 0.001Ω and 5Ω. MST recommends selecting a X5R- or X7R-type 4.7uF~10uF ceramic capacitor with low ESR over temperature range to improve the load transient response.

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.

EN Pin Operation

The MST54XXB is turned on by setting the EN pin to "H". Since the EN pin is neither pulled down nor pulled up internally, do not set it in floating status. When the EN pin is not used, connect the EN pin with VIN to keep the LDO in operating mode.

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 andThermal Protection

The MST54XXB 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 Equation 1.

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

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

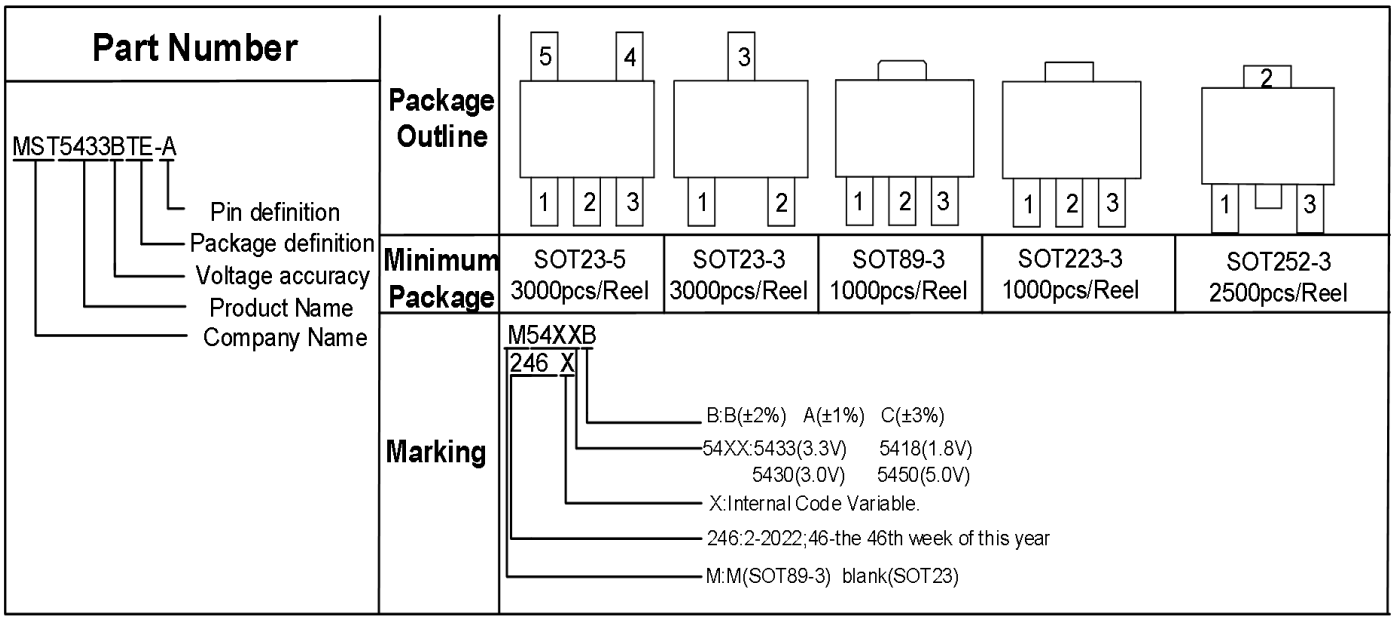
· PCB area

· Copper heat-sink area

· Number of thermal vias under the package

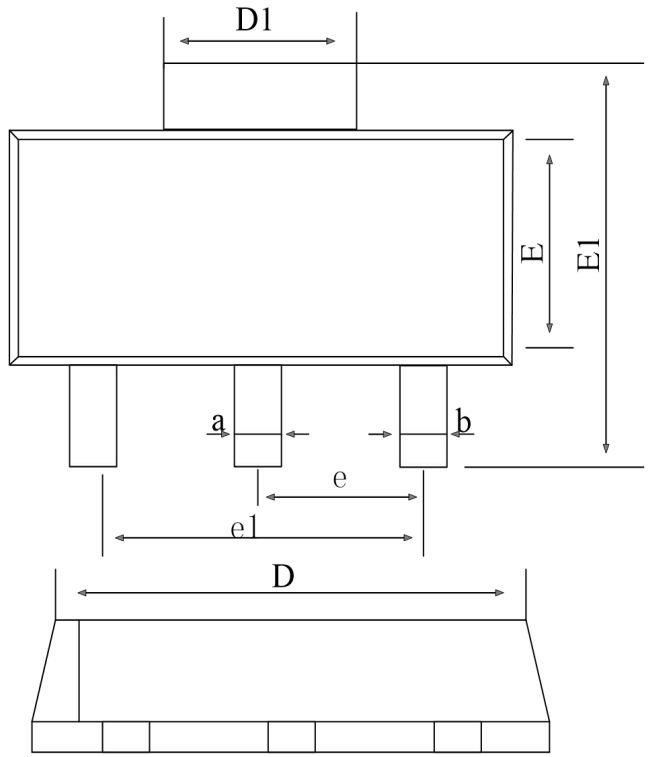
· Adjacent component placement

Ordering And Marking Information



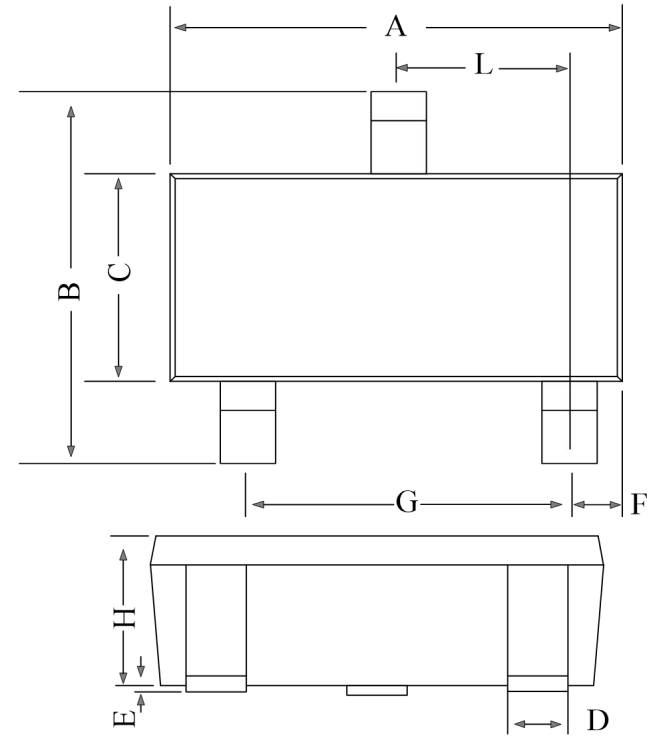
Package Outline

SOT223-3



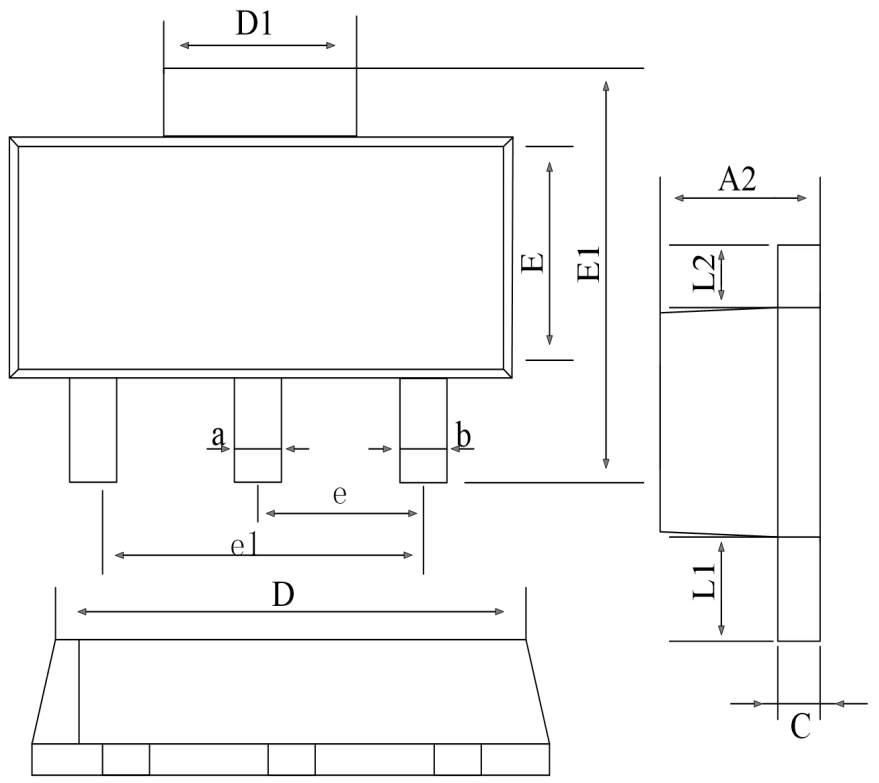
REF.	Millimeter	
	Min.	Max.
A2	1.5	1.7
a	0.45	0.55
b	0.66	0.84
c	0.23	0.35
D	6.30	6.70
D1	2.90	3.10
E	2.40	2.60
E1	3.30	3.70
e	2.20	2.30
e1	4.40	4.60
L1	0.80	1.00
L2	0.65	0.75

SOT23-3



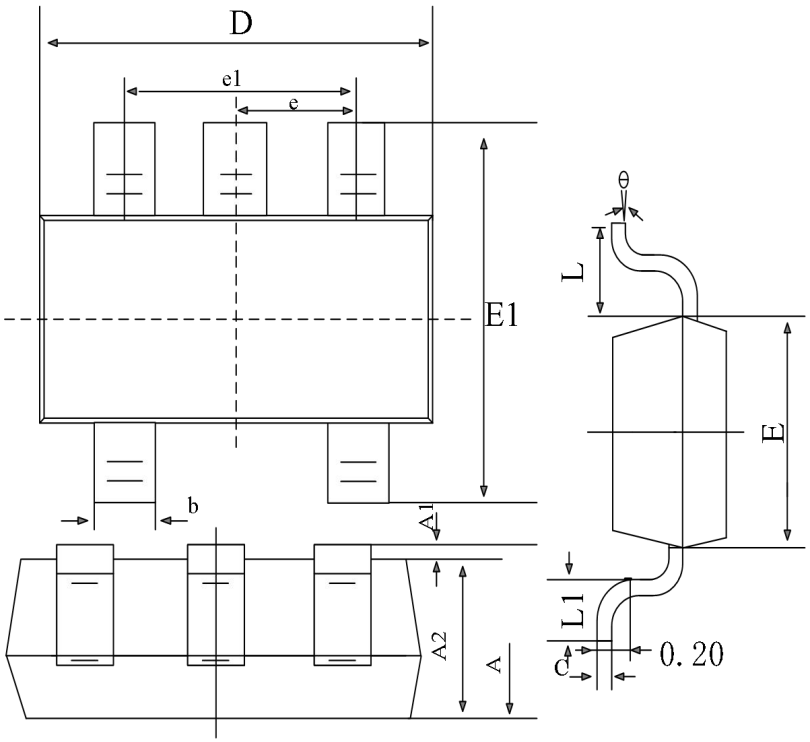
REF.	Millimeter	
	Min.	Max.
A	2.82	2.92
B	2.65	2.95
C	1.56	1.60
D	0.35	0.55
E	0	0.1
F	0.45	0.55
G	1.90 REF.	
H	1.0	1.3
K	0.10	0.20
J	0.40	_
L	0.85	1.15
M	0°	10°

SOT89-3



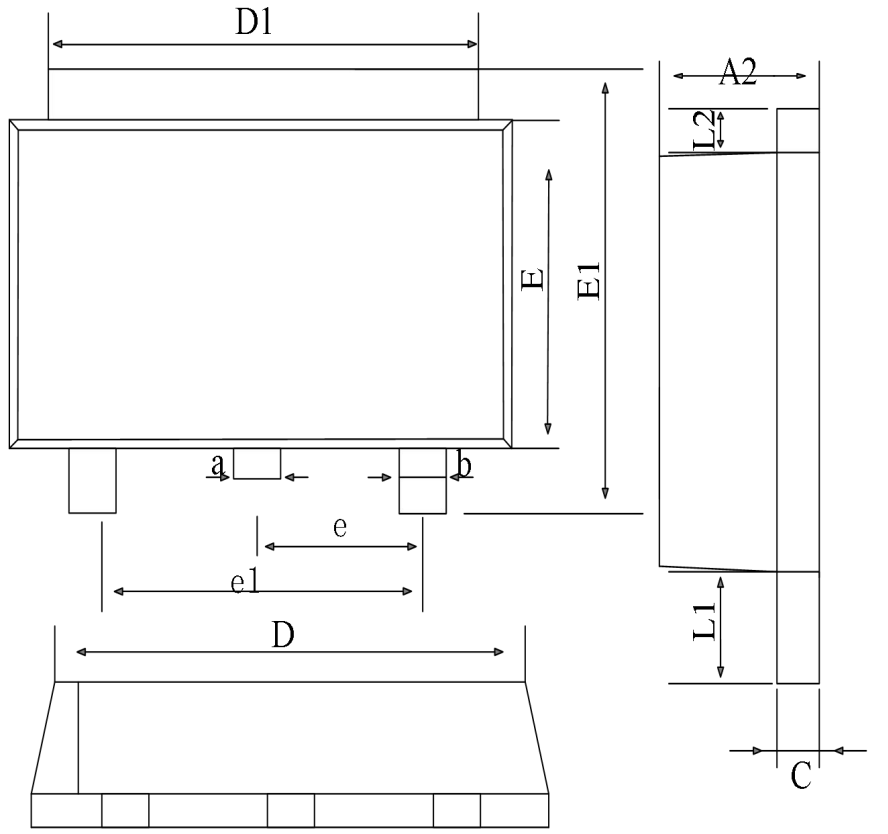
REF.	Millimeter	
	Min.	Max.
A2	1.4	1.6
a	0.45	0.55
b	0.38	0.48
c	0.36	0.46
D	4.40	4.60
D1	1.60	1.80
E	2.40	2.60
E1	4.00	4.30
e	1.00	2.00
e1	2.95	3.05
L1	0.80	1.00
L2	0.65	0.75

SOT23-5



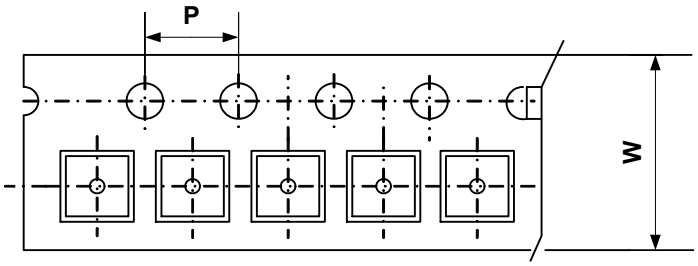
REF.	Millimeter	
	Min.	Max.
A	1.05	1.25
A1	0	0.1
A2	1.05	1.15
b	0.3	0.5
c	0.1	0.2
D	2.85	3.05
E	1.5	1.7
E1	2.65	2.95
e	0.95(BSC)	
e1	1.8	2.0
L	0.3	0.6
θ	0°	8°

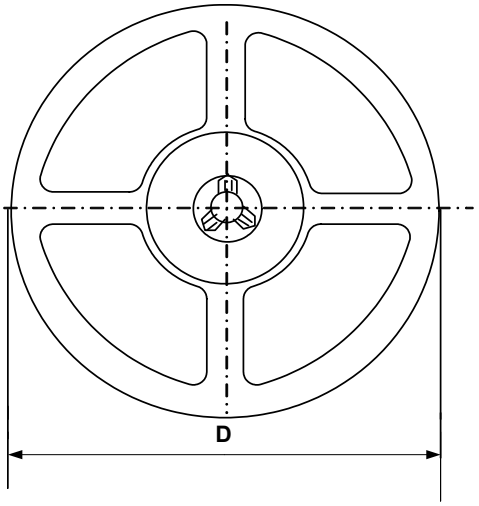
TO252-3



REF.	Millimeter	
	最小值	最大值
A2	2.2	2.4
a	0.64	0.88
b	0.64	0.88
c	0.45	0.58
D	6.45	6.70
D1	5.21	5.46
E	6.00	6.20
E1	9.40	10.40
e	2.28	2.30
e1	4.56	4.60
L1	2.70	2.75
L2	0.90	1.27

Packing Information





Type	W(mm)	P(mm)	D(mm)	Qty (pcs)
SOT23-3	8.0±0.1 mm	4.0±0.1 mm	180±1 mm	3000pcs
SOT23-5	8.0±0.1 mm	4.0±0.1 mm	180±1 mm	3000pcs
SOT89-3	12.0±0.1 mm	4.0±0.1 mm	180±1 mm	1000pcs
SOT223-3	12.0±0.1 mm	4.0±0.1 mm	180±1 mm	1000pcs
TO252-3	16.0±0.1 mm	4.0±0.1 mm	327±1 mm	2500pcs

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1-0	2023-12-21		Xingxiaolin	Xingxiaolin	Xingxiaolin

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