36V,300mA,1.9uA,Low-Dropout Voltage Regulator

Features

- Low Quiescent Current : 1.9uA
- Wide Input Voltage Range : 3V to 36V
- High Output Current : 250mA
- Low Dropout Voltage : 300mV@100mA
- Fixed Output Voltages : 1.8V, 3.0V, 3.3V, and 5.0V.
- Output Voltage Tolerance : ±2%
- Current Limit Protection
- Short Circuit Protection
- Thermal Shutdown Protection
- Available Packages : SOT23-3, SOT89-3, SOT23-5

Applications

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

Description

The MST53XXB series is an ultra-small, low dropout (LDO) linear regulator that can source 300mA of output current. The MST53XXB series is designed to provide high input voltage, and excellent load and line transient performance.

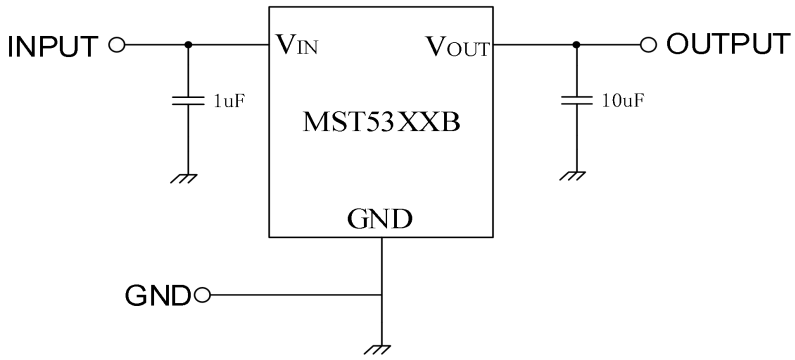
The MST53XXB series has thermal shutdown, current limit, and short Circuit protections for added safety.

The MST53XXB series contains four fixed output voltages of 1.8V, 3.0V, 3.3V and 5.0V.

PART NUMBER	PACKAGE	BODY SISE(NOM)
MST53XXBTE	SOT23-3	2.9mm*2.8mm
MST53XXBTS	SOT89-3	4.5mm*4.2mm
MST53XXBTG	SOT23-5	2.9mm*2.8mm

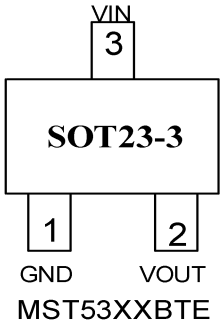
(1) For all available packages, see the orderable addendum at the end of the data sheet.

Typical Application

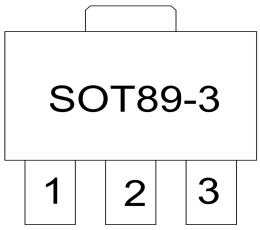


35V, Low-Dropout Voltage Regulator

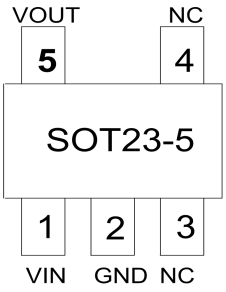
Pin Configuration and Functions



MST53XXBTE



MST53XXBTS



MST53XXBTG

Pin Functions

Pin Number			Pin Name	Description
SOT23-3	SOT89-3	SOT23-5		
1	1	2	GND	Ground Pin
2	3	5	VOUT	Output Pin
3	2	1	VIN	Input Pin

Absolute Maximum Ratings

Parameter	Description	Min	Max	Unit
Input Voltage	VIN to GND	-0.3	36	V
	VOUT to GND	-0.3	7	V
	VIN to VOUT	-0.3	30	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
	SOT23-3	200		℃/W
	SOT23-5	200		℃/W
Power Dissipation	SOT89	900		mW
	SOT23-3	600		mW
	SOT23-3	600		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.

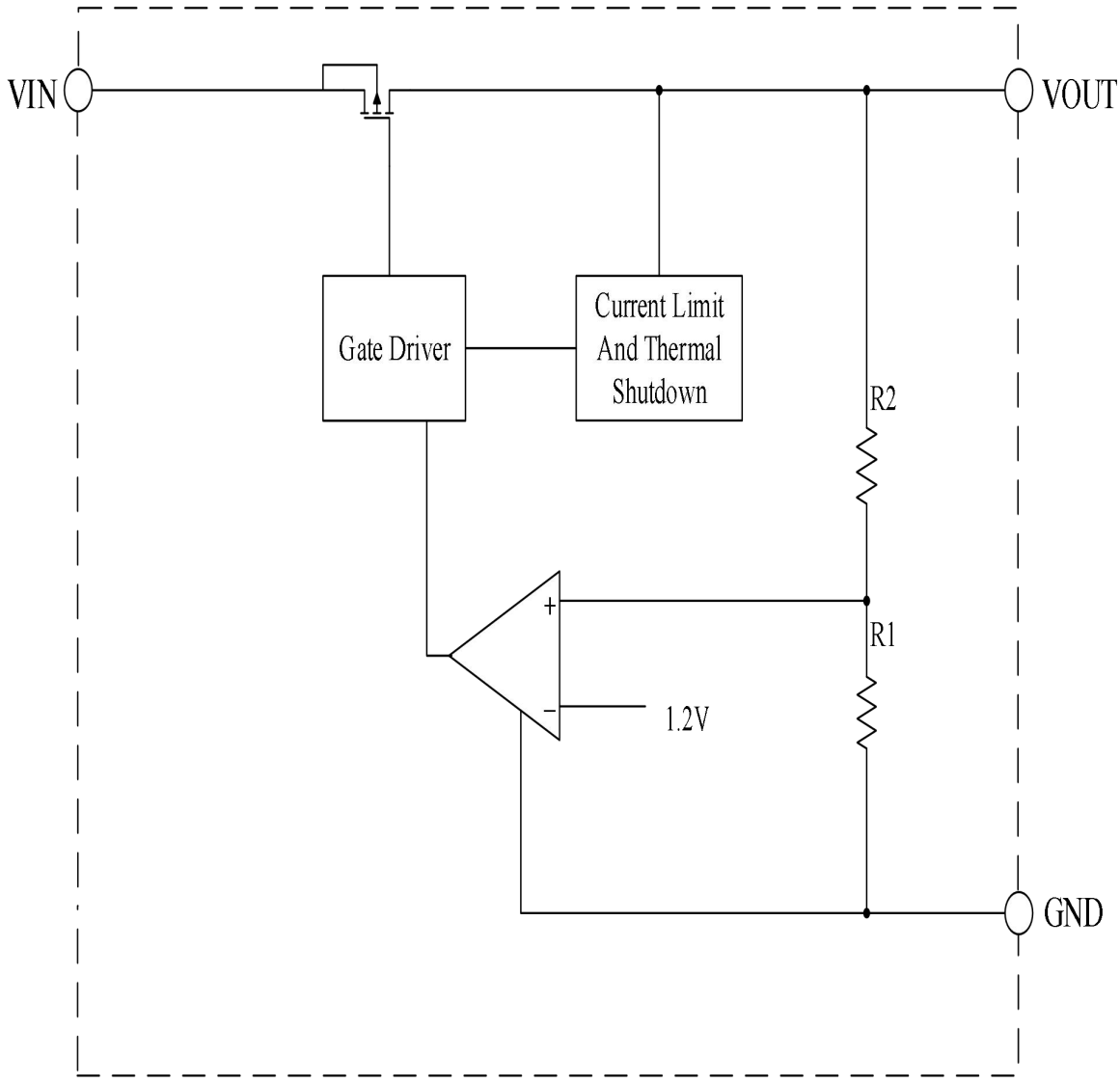
Electrical Characteristics

（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 voltage		3	—	36	V
I_{GND}	Quiescent Current	V_{IN}=12V, No load	1.7	1.9	2.1	uA
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		200	250	—	mA
V_{DROP}	Dropout Voltage (MST5350)	I_{OUT}=100mA , V_{IN}=V_{OUTNOM}-0.1V	—	350	—	mV
		I_{OUT}=200mA , V_{IN}=V_{OUTNOM}-0.1V	—	700	—	
	Dropout Voltage(1) (MST5333)	I_{OUT}=100mA , V_{IN}=V_{OUTNOM}-0.1V	—	300	—	mV
		I_{OUT}=200mA , V_{IN}=V_{OUTNOM}-0.1V	—	600	—	
$\Delta V_{OUT}/\Delta I_{OUT}$	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}+1V≤V_{IN}≤36V	—	0.4	—	mV/V
I_{LIMIT}	Current Limit		—	400	—	mA
ISHORT	Short Current	V_{IN}=12V	—	300	—	mA
TSHDN	Thermal Shutdown Temperature	Shutdown, temperature increasing	—	154	—	℃
		Reset, temperature decreasing	—	125	—	

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.

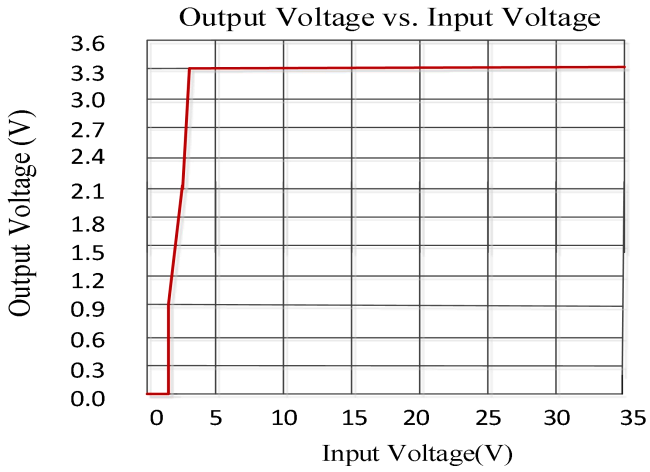
Functional Block Diagram

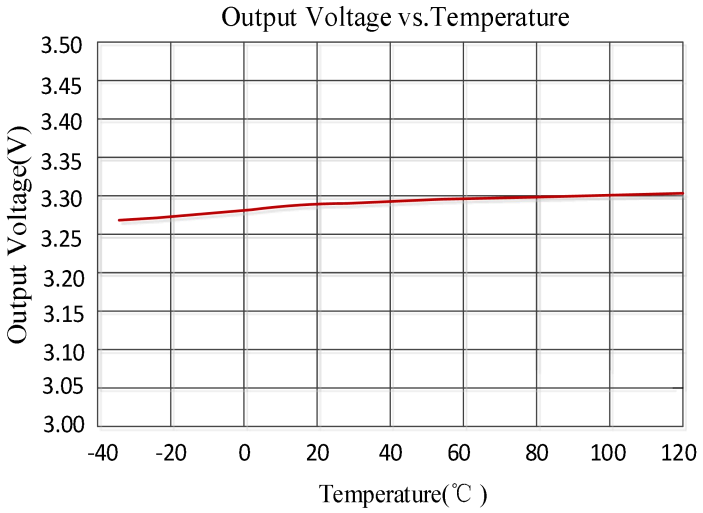


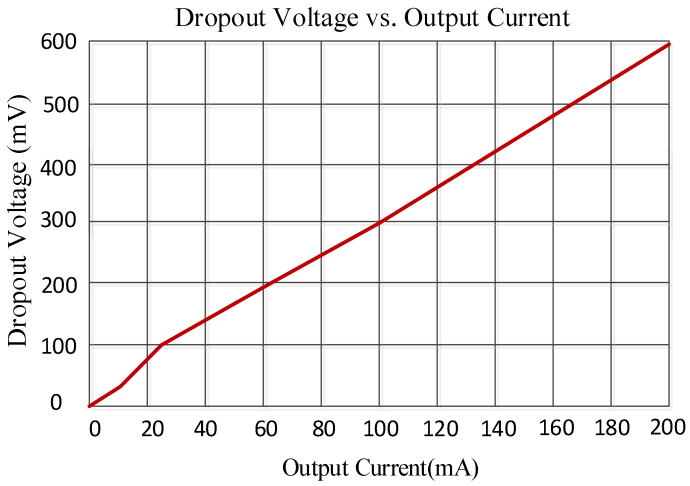
Functional Block Diagram

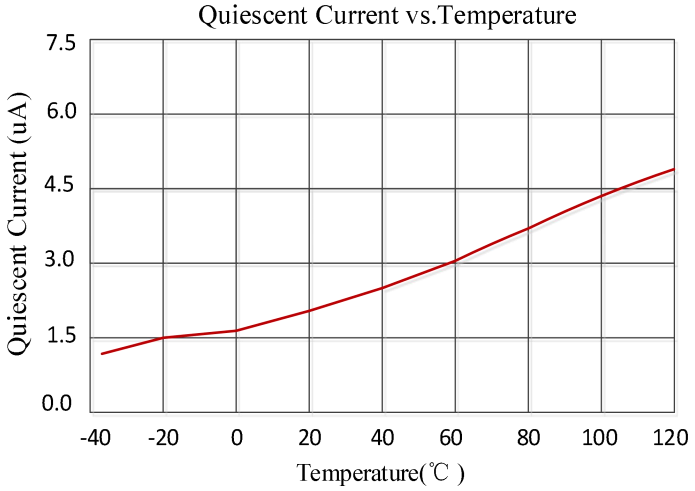
Typical Characteristics

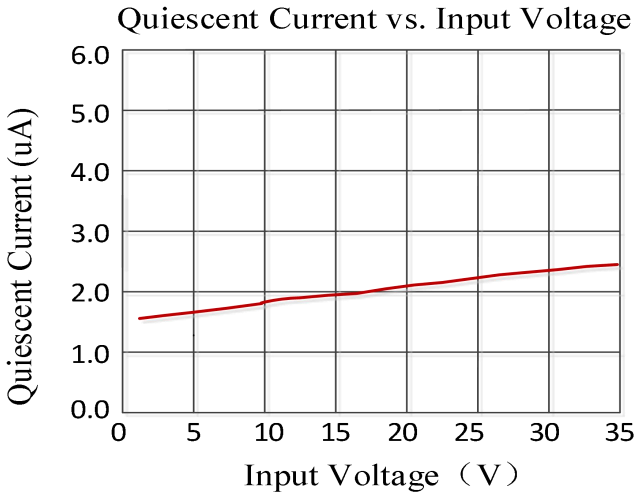
(Test Condition: $T_{A=}$25°C,Vin=12V, Iout=1mA,C_{OUT}=10uF,Vout=3.3V unless otherwise note)

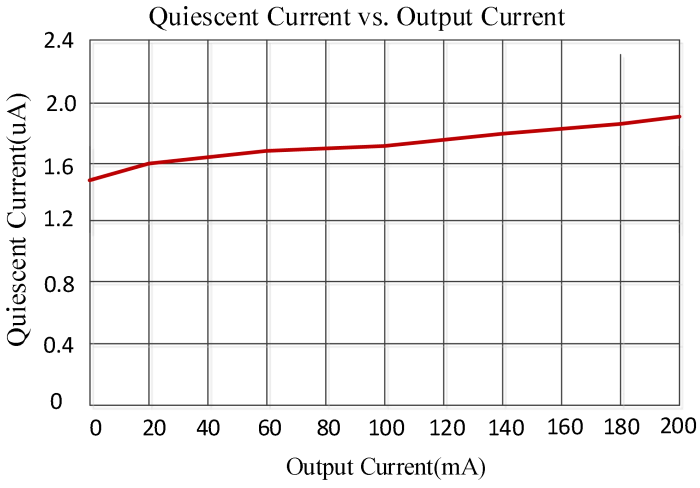




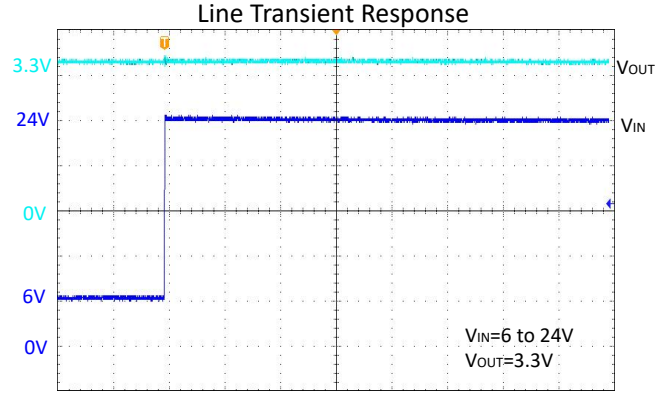






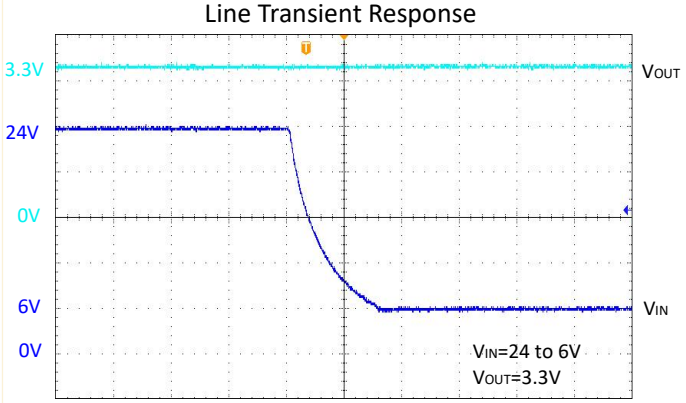


Line Transient Response



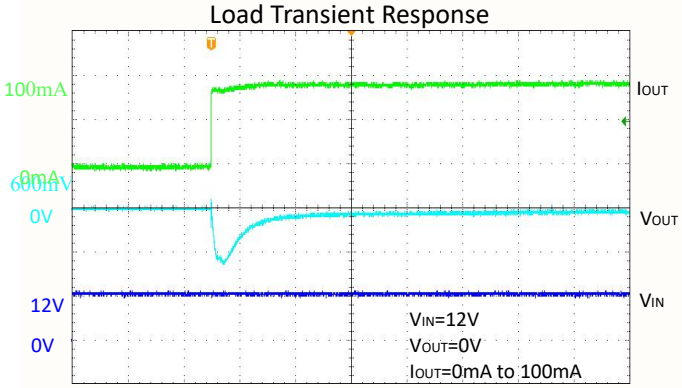
Time(4us/div)

Line Transient Response



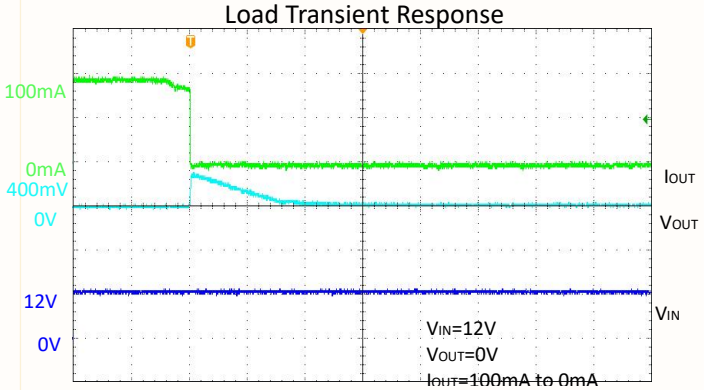
Time(4us/div)

Load Transient Response



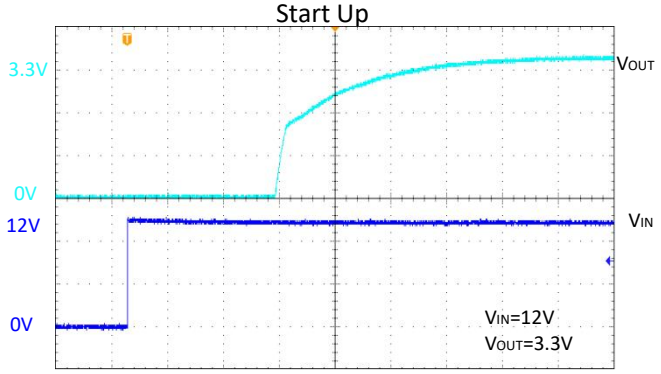
Time(200us/div)

Load Transient Response



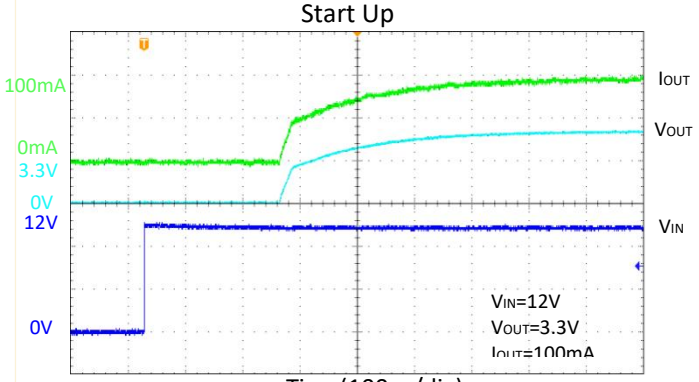
Time(200us/div)

Start Up



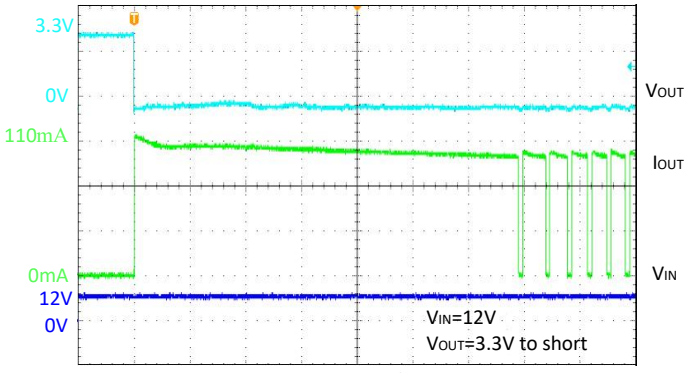
Time(100us/div)

Start Up



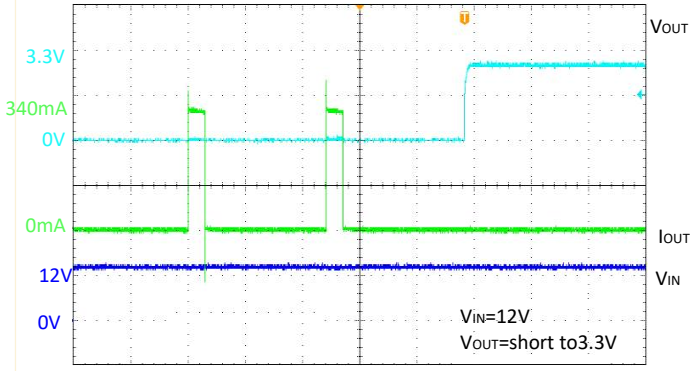
Time(100us/div)

Short Circuit Protection



Time(2ms/div)

Short Circuit Protection



Time(2ms/div)

Detailed Description

Overview

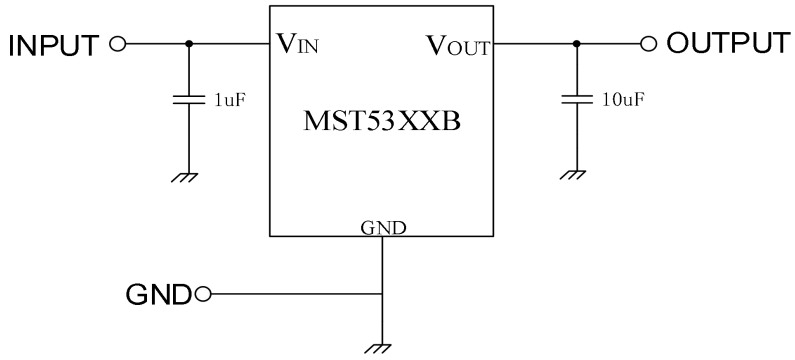
The MST53XXB series is an ultra-small, low dropout (LDO) linear regulator that can source 300mA of output current. The MST53XXB series is designed to provide high input voltage, and excellent load and line transient performance.

The MST53XXB series has thermal shutdown, current limit, and short Circuit protections for added safety.

The MST53XXB series contains four fixed output voltages of 1.8V, 3.0V, 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≥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 MST53XXB 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.

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 MST53XXB 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

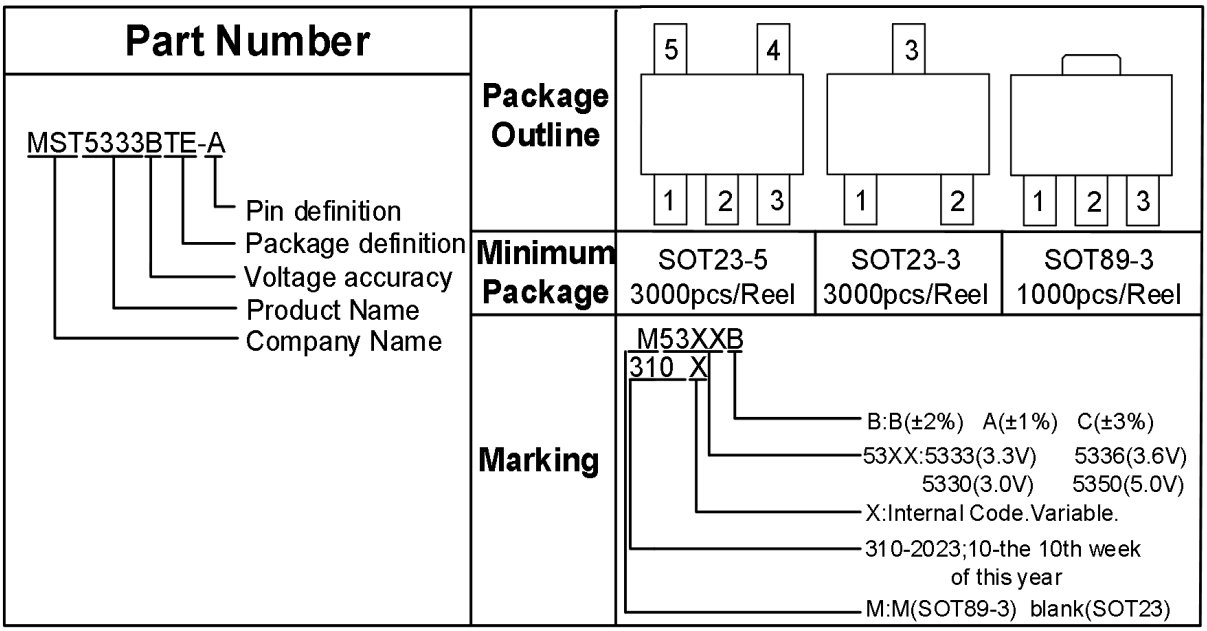
· PCB area

· Copper heat-sink area

· Number of thermal vias under the package

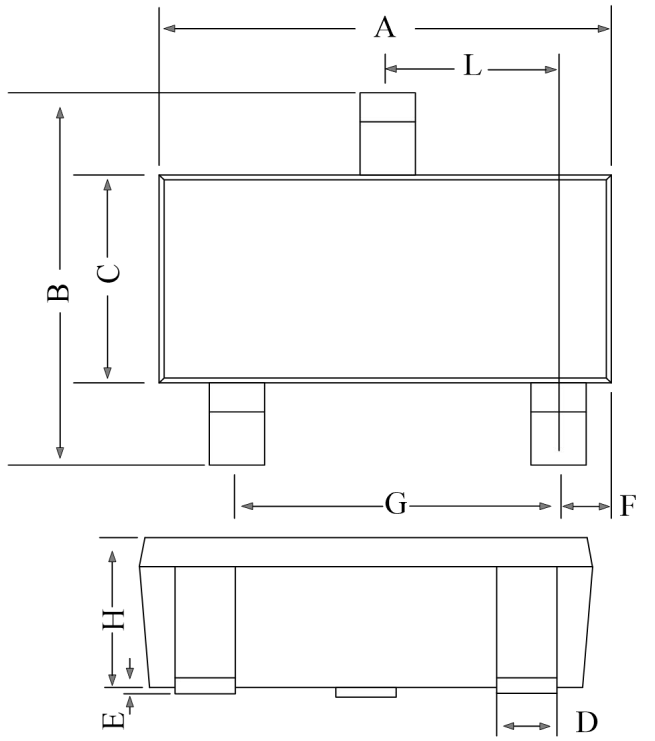
· Adjacent component placement

Ordering And Marking Information



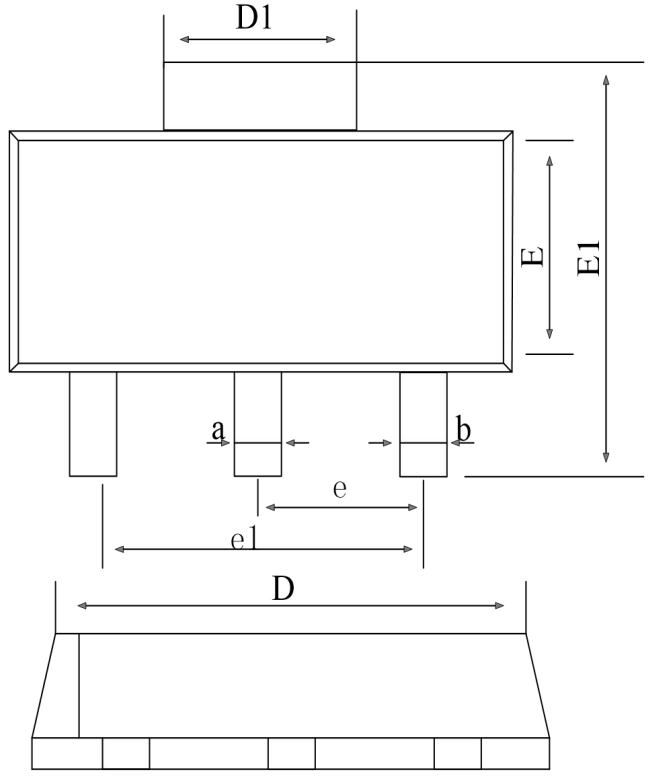
Package Outline

SOT23-3



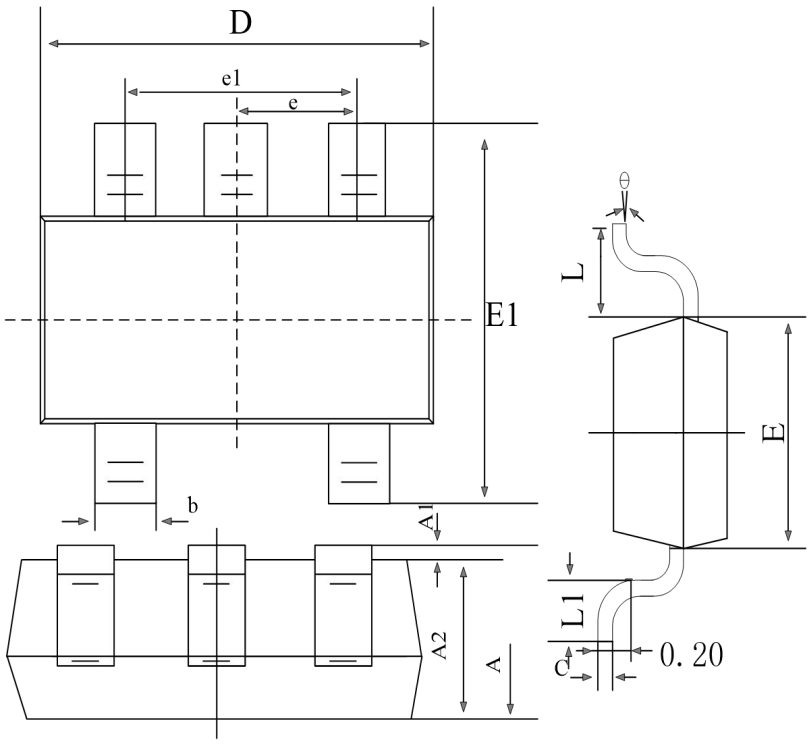
REF.	Millimeter	
	Min.	Max.
A	2.82	2.92
B	2.65	2.95
C	1.56	1.60
D	0.35	0.55
E	0	0.1
F	0.45	0.55
G	1.90	REF.
H	1.0	1.3
K	0.10	0.20
J	0.40	_
L	0.85	1.15
M	0°	10°

SOT89-3



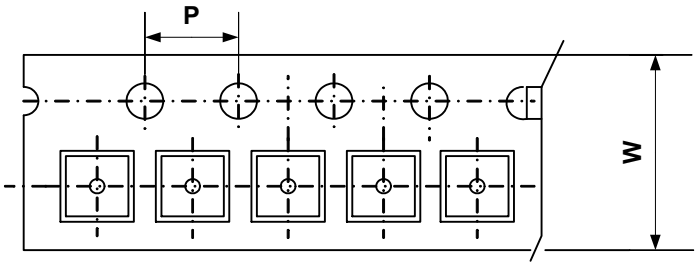
REF.	Millimeter	
	Min.	Max.
A2	1.4	1.6
a	0.45	0.55
b	0.38	0.48
c	0.36	0.46
D	4.40	4.60
D1	1.60	1.80
E	2.40	2.60
E1	4.00	4.30
e	1.00	2.00
e1	2.95	3.05
L1	0.80	1.00
L2	0.65	0.75

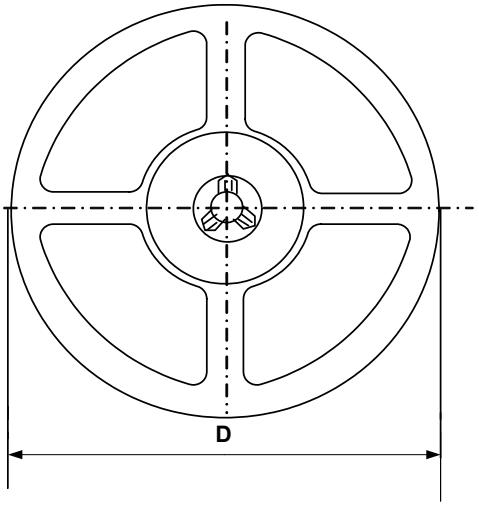
SOT23-5



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	0^0	8^0

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

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1-0	2023-5-9		Xingxiaolin	Xingxiaolin	Xingxiaolin

IMPORTANT NOTICE

MST INCORPORATED MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARDS TO THIS DOCUMENT, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION).

MST Incorporated reserves the right to make modifications, enhancements, improvements, corrections or other changes without further notice to this document and any product described herein. MST Incorporated does not assume any liability arising out of the application or use of this document or any product described herein; neither does MST Incorporated convey any license under its patent or trademark rights, nor the rights of others. Any Customer or user of this document or products described herein in such applications shall assume all risks of such use and will agree to hold MST Incorporated and all the companies whose products are represented on MST Incorporated website, harmless against all damages.

MST Incorporated does not warrant or accept any liability whatsoever in respect of any products purchased through unauthorized sales channel. Should Customers purchase or use MST Incorporated products for any unintended or unauthorized application, Customers shall indemnify and hold MST Incorporated and its representatives harmless against all claims, damages, expenses, and attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized application.

Products described herein may be covered by one or more United States, international or foreign patents pending. Product names and markings noted herein may also be covered by one or more United States, international or foreign trademarks.