



### ■ Description

The MST56XXB series is a high voltage, ultralow-power regulator. The device can allow an input voltage as high as 60V. The typical quiescent current is only 2μA. The device is available in fixed output voltages of 3.3V and 5.0V.

The device features integrated short-circuit and thermal shutdown protection.

Although designed primarily as fixed voltage regulators, the device can be used with external components to obtain variable voltages.

### ■ Application

- Battery-powered equipment
- Smoke detector and sensor
- Microcontroller Applications
- Home Appliance

### ■ Features

- Low Quiescent Current: 2μA
- High Input Voltage: Up to 60V
- High Output Current: ≥100mA
- Dropout Voltage:
  - 70mV@10mA
  - 700mV@100mA
- Fixed Output Voltages: 3.3V and 5.0V
- High-accuracy Output Voltage
- MST 56XXB ±2%
- Good Transient Response
- Integrated Short-Circuit Protection
- Integrated Thermal Protection
- Available Packages:

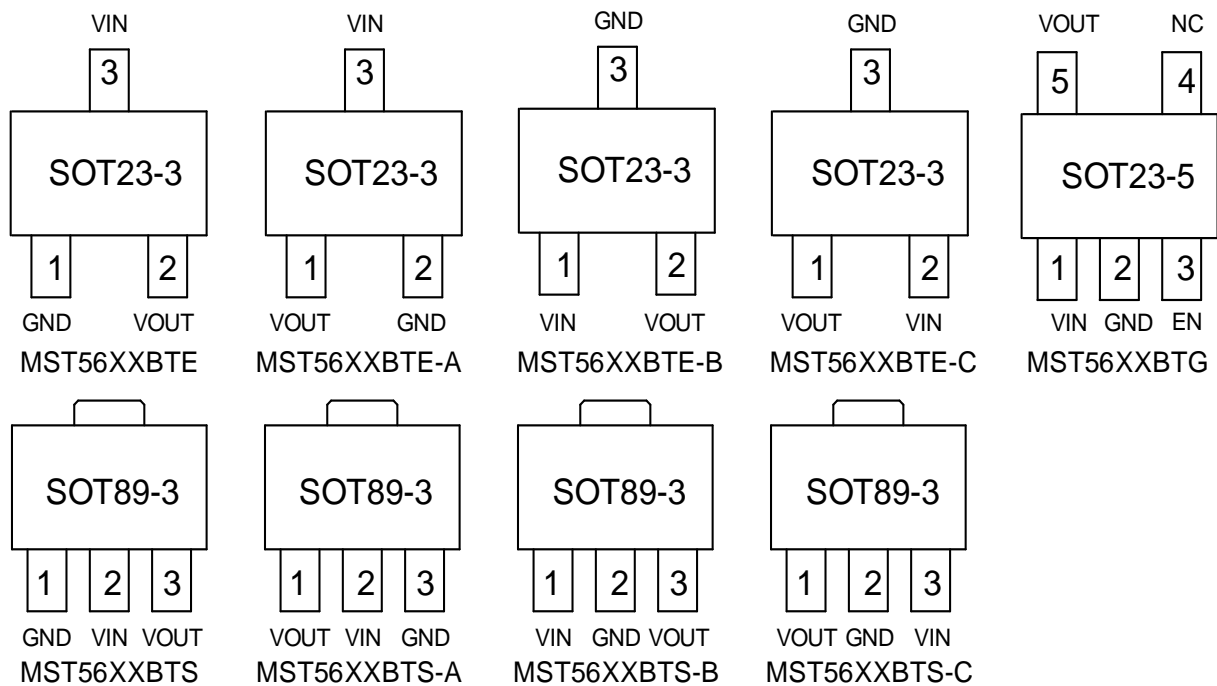
|              |         |
|--------------|---------|
| MST56XXBTE   | SOT23-3 |
| MST56XXBTE-A |         |
| MST56XXBTE-B |         |
| MST56XXBTE-C |         |
| MST56XXBTS   | SOT89-3 |
| MST56XXBTS-A |         |
| MST56XXBTS-B |         |
| MST56XXBTS-C |         |
| MST56XXBTG   | SOT23-5 |

### ■ Pin Descriptions

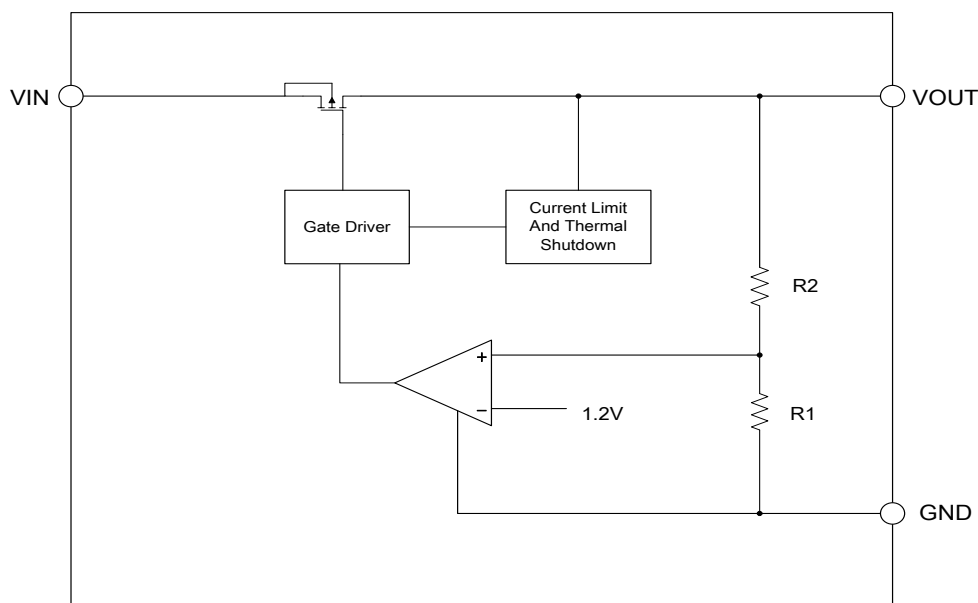
| SOT23-3     |               |               |               | SOT23-5     | PIN NAME | DESCRIPTION   |
|-------------|---------------|---------------|---------------|-------------|----------|---------------|
| MST56XX BTE | MST56XX BTE-A | MST56XX BTE-B | MST56XX BTE-C | MST56XX BTG |          |               |
| 1           | 2             | 3             | 3             | 2           | GND      | Ground Pin    |
| 2           | 1             | 2             | 1             | 5           | VOUT     | Output Pin    |
| 3           | 3             | 1             | 2             | 1           | VIN      | Input Pin     |
|             |               |               |               | 3           | EN       | Enable pin    |
|             |               |               |               | 4           | NC       | No connection |

| SOT89-3    |              |              |              | PIN NAME | DESCRIPTION |
|------------|--------------|--------------|--------------|----------|-------------|
| MST56XXBTS | MST56XXBTS-A | MST56XXBTS-B | MST56XXBTS-C |          |             |
| 1          | 3            | 2            | 2            | GND      | Ground Pin  |
| 3          | 1            | 3            | 1            | VOUT     | Output Pin  |
| 2          | 2            | 1            | 3            | VIN      | Input Pin   |

## ■ Packages and Pin Assignment



## ■ Functional Block Diagram



## ■ Absolute Maximum Ratings

| Item  | Description                            | Min                | Max | Unit |
|---|--|--------------------|-----|------|
| Voltage                                     | VIN Pin to GND Pin                     | -0.3               | 60  | V    |
|   | VOOUT Pin to GND pin                   | -0.3               | 6   | V    |
|   | VOOUT Pin to VIN Pin                   | -35                | 0.3 | V    |
| Current                                     | Peak output                            | Internally limited |     |      |
| Temperature                                 | Operating Ambient Temperature          | -40                | 85  | °C   |
|   | Storage Temperature                    | -40                | 150 | °C   |
|   | Operating virtual junction Temperature | -                  | 150 | °C   |
| Thermal Resistance<br>(Junction to Ambient) | SOT89                                  | 180                |     | °C/W |
|   | SOT23-3                                | 380                |     | °C/W |
|   | SOT23-5                                | 300                |     | °C/W |
| Power Dissipation                           | SOT89                                  | 600                |     | mW   |
|   | SOT23-3                                | 300                |     | mW   |
|   | SOT23-5                                | 400                |     | mW   |
| Electrostatic discharge<br>rating           | Human Body Model ( HBM )               | 4                  |     | kV   |
|   | Charged Device Model ( MM )            | 100                |     | V    |

Note : Stresses exceeding the range specified under “Absolute Maximum Ratings” may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

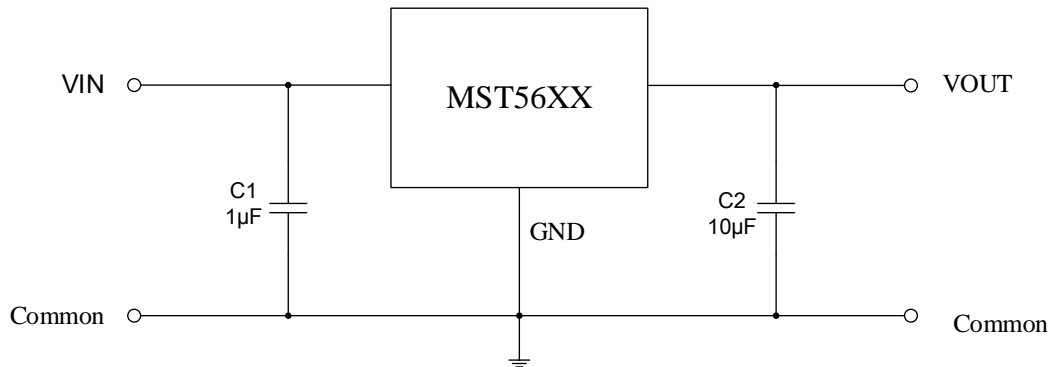
## ■ Electrical characteristics

( At  $T_A=25^\circ\text{C}$ ,  $C_{IN}=1\mu\text{F}$ ,  $V_{IN}=V_{OUTNOM}+1.0\text{V}$ ,  $C_{OUT}=10\mu\text{F}$ , unless otherwise noted )

| Symbol   | Parameter                      | Test Conditions  | MIN | TYP | MAX | UNIT             |
|--|--------------------------------|--|-----|-----|-----|------------------|
| $V_{IN}$   | Input Voltage                  |  | —   | —   | 60  | V                |
| $I_{GND}$  | Quiescent Current              | $V_{IN}=12\text{V}$ , No load  | —   | 1.8 | —   | $\mu\text{A}$    |
| $V_{OUT(MST56XXB)}$  | Output Voltage                 | $V_{IN}=12\text{V}$ , $I_{OUT}=10\text{mA}$  | -2% |     | 2%  | $V_{OUT}$        |
| $I_{OUT\_MAX}$   | Output Current                 |  | —   | 200 | —   | mA               |
| $V_{DROP}$   | Dropout Voltage*1<br>(MST5650) | $I_{OUT}=10\text{mA}$ ,<br>$\Delta V_{OUT} = -V_{OUTNOM} * 2\%$                    | —   | 70  | —   | mV               |
|  |                                | $I_{OUT}=100\text{mA}$ ,<br>$\Delta V_{OUT} = -V_{OUTNOM} * 2\%$                   | —   | 700 | —   | mV               |
|  | Dropout Voltage*1<br>(MST5633) | $I_{OUT}=10\text{mA}$ ,<br>$\Delta V_{OUT} = -V_{OUTNOM} * 2\%$                    | —   | 70  | —   | mV               |
|  |                                | $I_{OUT}=100\text{mA}$ ,<br>$\Delta V_{OUT} = -V_{OUTNOM} * 2\%$                   | —   | 700 | —   | mV               |
| $\Delta V_{OUT}$   | Load Regulation                | $1\text{mA} \leq I_{OUT} \leq 100\text{mA}$  | —   | 20  | —   | mV               |
| $\frac{\Delta V_{OUT} \times 100}{\Delta V_{IN} \times V_{OUT}}$ | Line Regulation                | $I_{OUT}=1\text{mA}$ ,<br>$V_{IN}=(V_{OUTNOM}+1\text{V})$ to $V_{60}$              | —   | 0.2 | —   | %/V              |
| $I_{LIMIT}$  | Current Limit                  | $V_{IN}=(V_{OUTNOM}+1\text{V})$ to $60\text{V}$<br>$R_{LOAD}=V_{OUTNOM}/1\text{A}$ | —   | 400 | —   | mA               |
| $T_{SHDN}$   | Thermal Shutdown<br>Threshold  |  | —   | 125 | —   | $^\circ\text{C}$ |

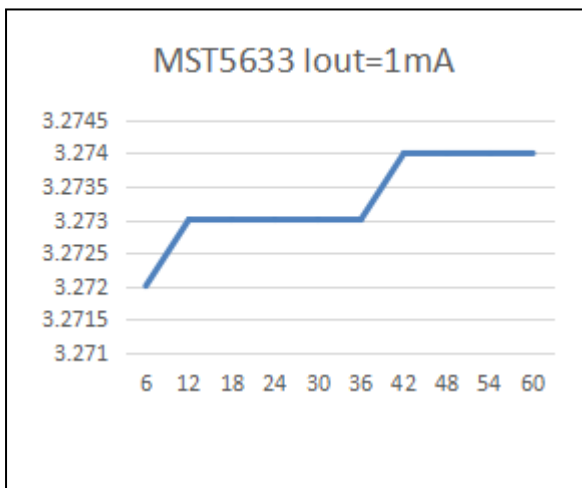
Note : \*1 Dropout Voltage is the voltage difference between the input and the output at which the output voltage drops 2% below its nominal value.

## Application Circuits

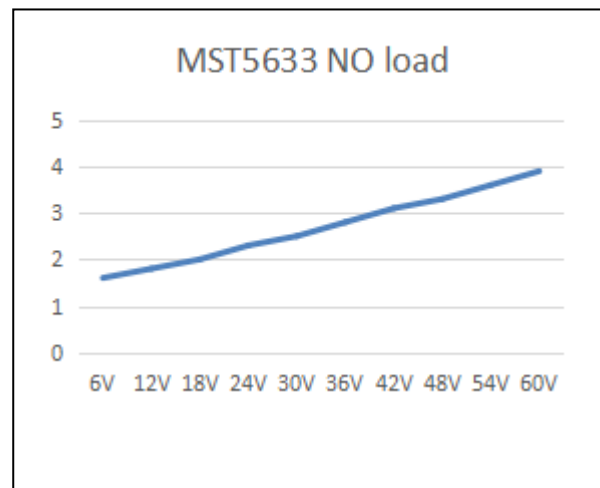


## Typical Performance Characteristics

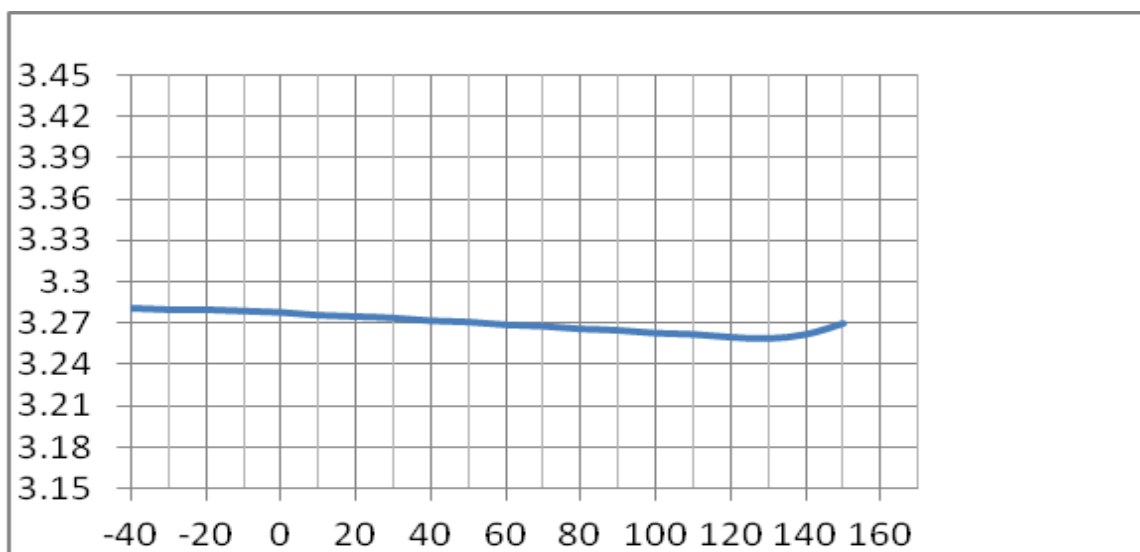
Test Condition:  $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=V_{OUTNOM}+1.0\text{ V}$ ,  $I_{OUT}=1\text{ mA}$ ,  $C_{OUT}=10\mu\text{F}$ , unless otherwise noted.



Output Voltage vs. Input Voltage



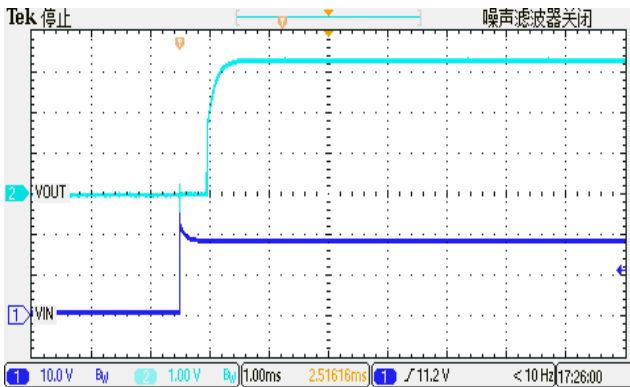
Quiescent Current vs. Input Voltage



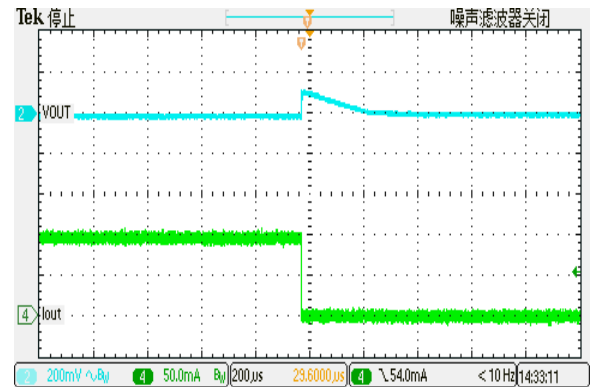
Output Voltage vs. Temperature

## Startup

$V_{IN}=24V$  , No Load ,  $C_{OUT}=10\mu F$



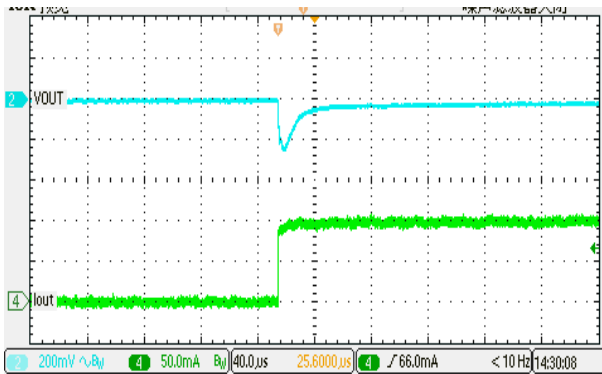
$V_{IN}=12.0V$ ,  $C_{OUT}=10\mu F$ ,  $I_{OUT}=100mA$  to  $10mA$



## Transient Response

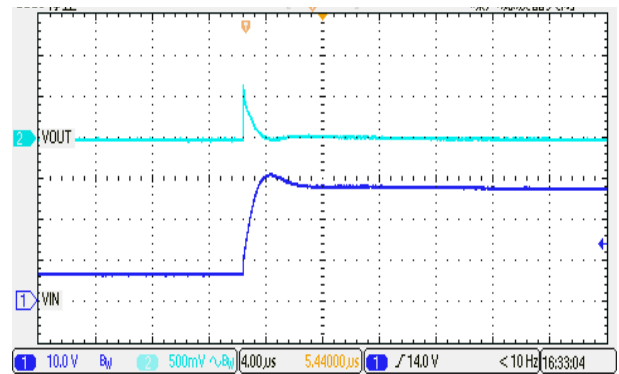
Load Transient

$V_{IN}=12.0V$ ,  $C_{OUT}=10\mu F$ ,  $I_{OUT}=10mA$  to  $100mA$

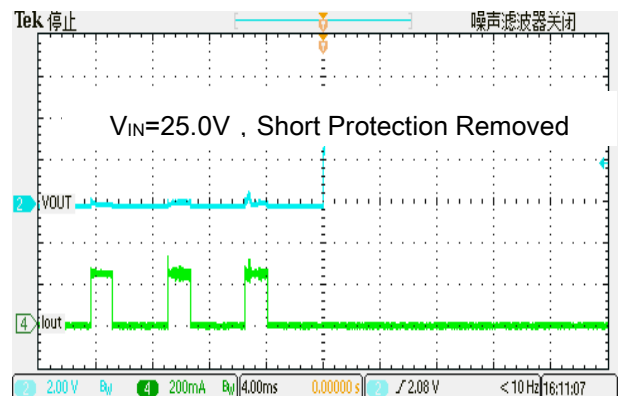
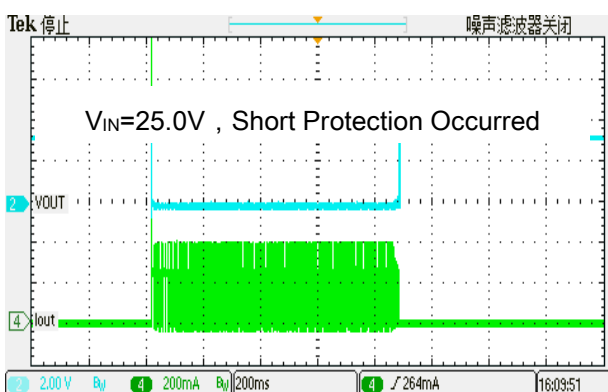


Line Transient

$V_{IN}=6.3V$  to  $30V$ ,  $C_{OUT}=10\mu F$ ,  $I_{OUT}=1mA$

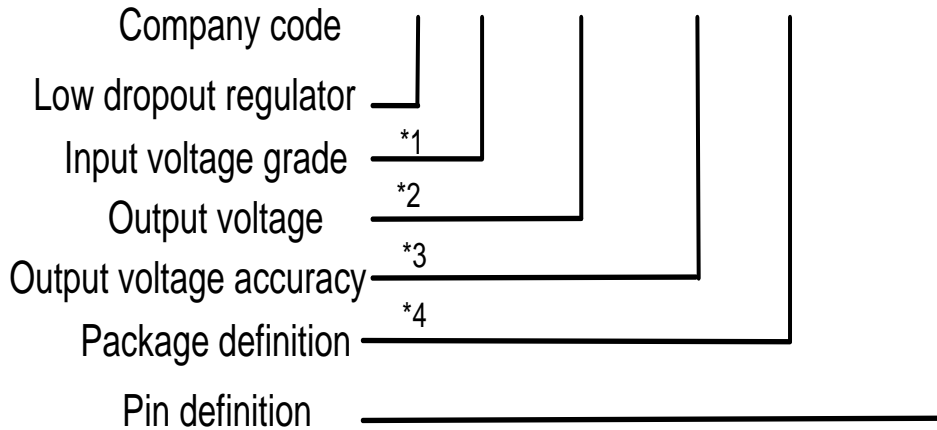


## Short Protection



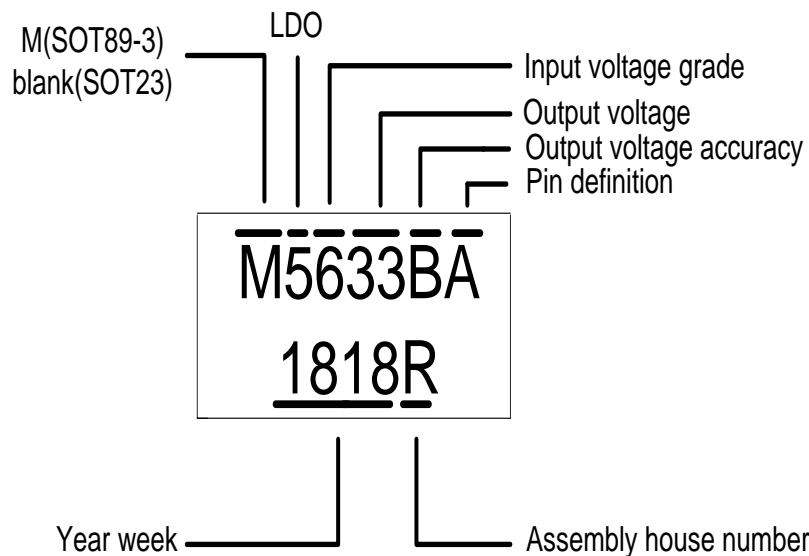
## ■ Marking Information

# MST56XXBTE-A



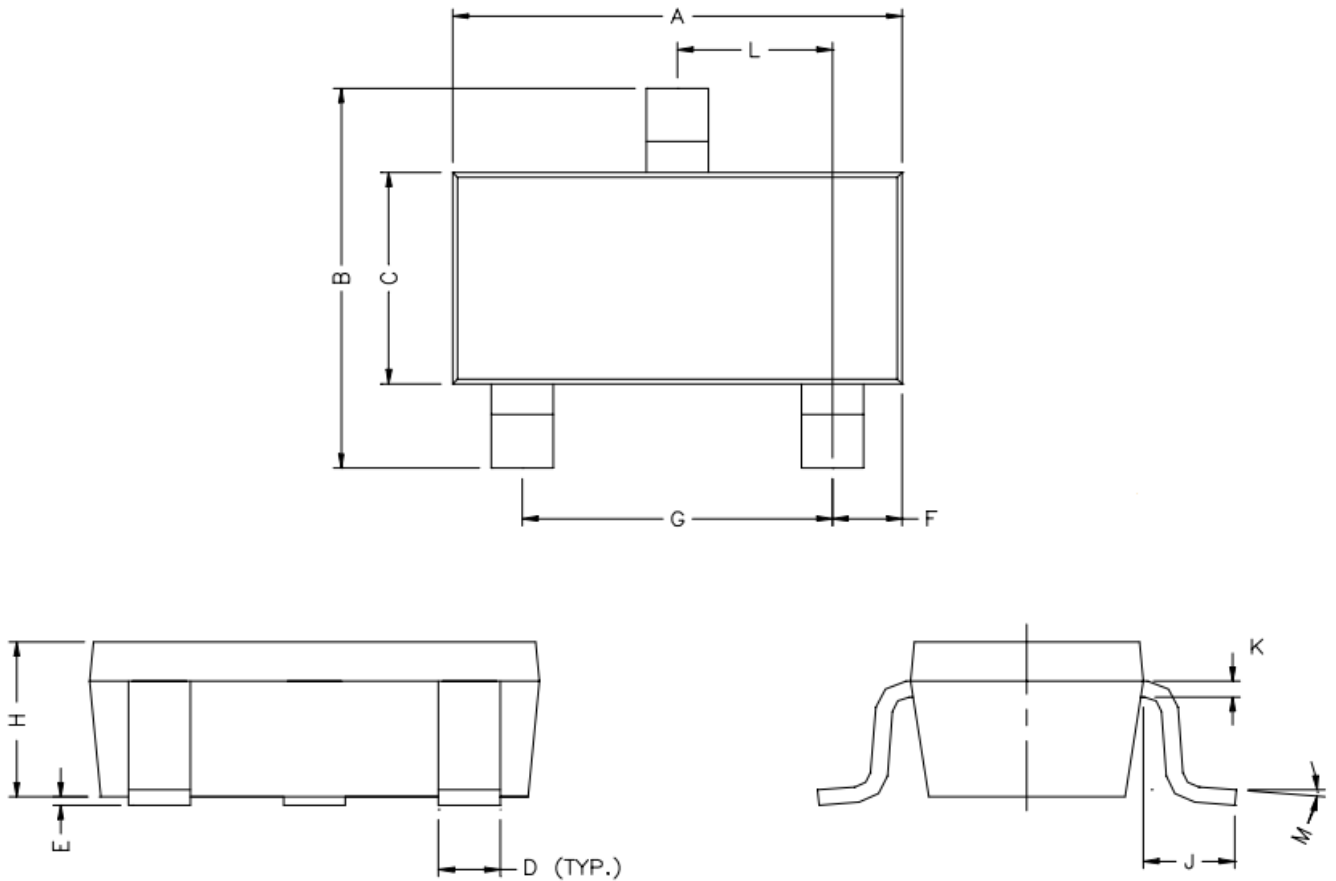
### Note:

- (\*1) 4-60V
- (\*2) 33(3.3V) 50(5.0V)
- (\*3) A(±1%) B (±2%) C (±3%)
- (\*4) TE(SOT23-3) TS(SOT89-3) TG(SOT23-5)



## ■ Package Information

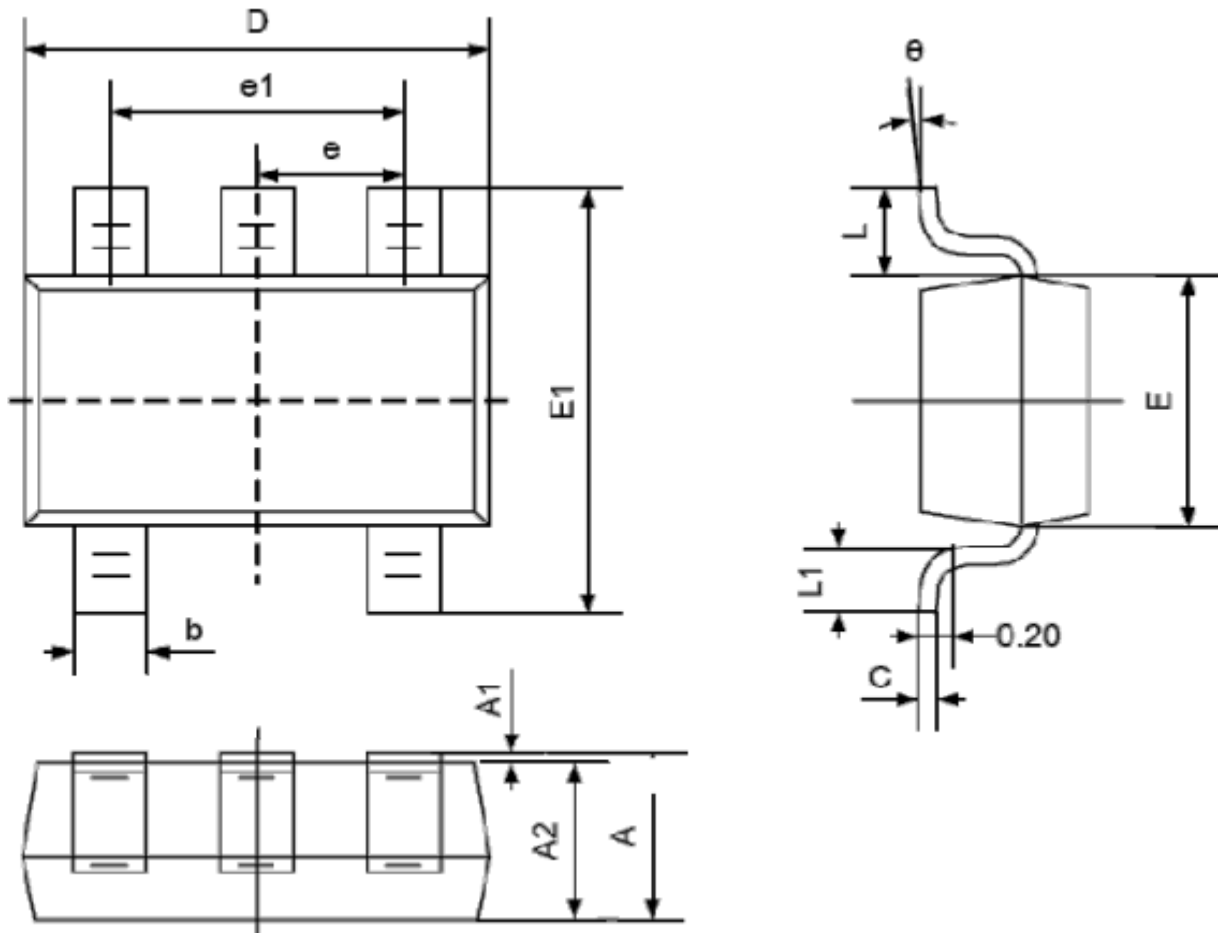
### SOT23-3



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

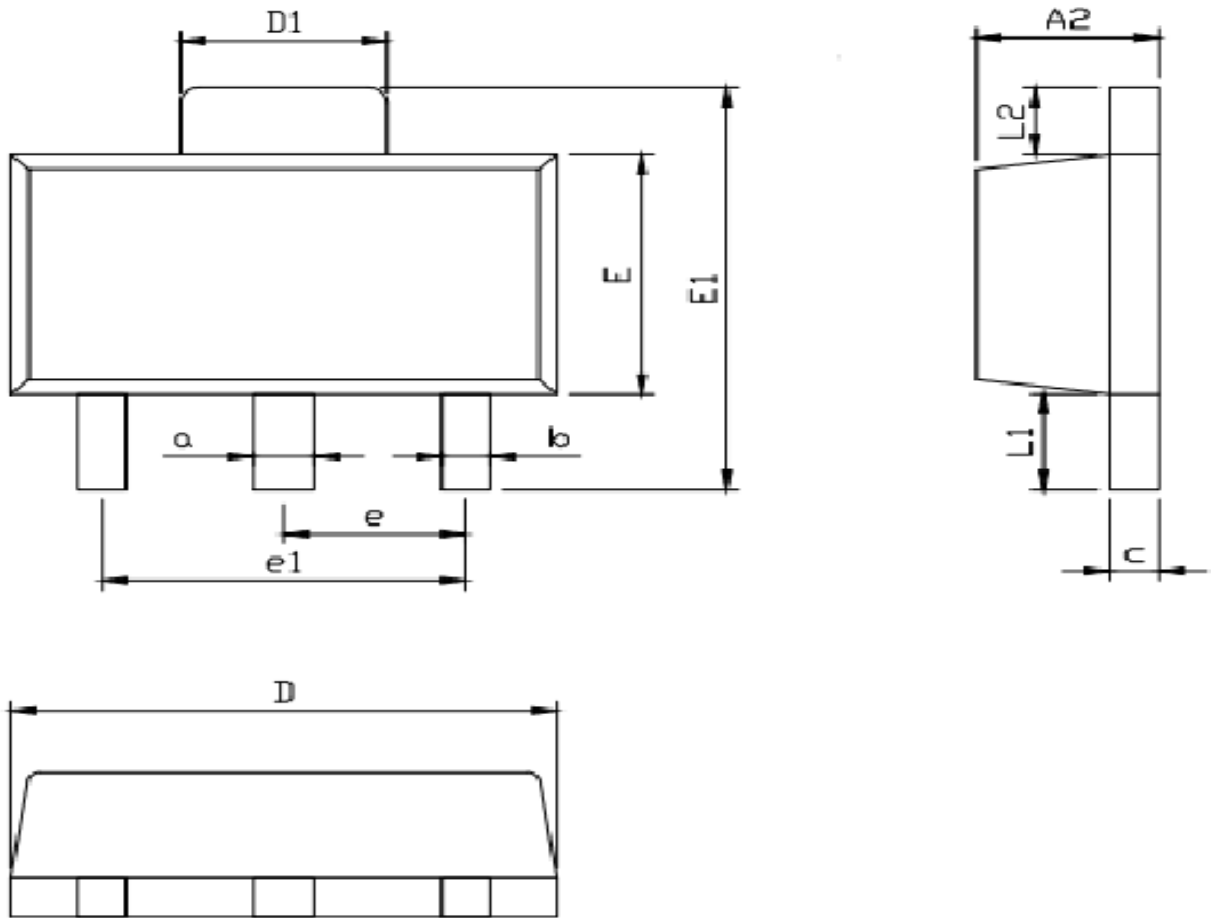


## SOT23-5



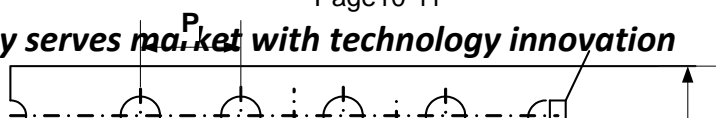
| REF. | Millimeter |      | REF.     | Millimeter |      |
|------|------------|------|----------|------------|------|
|      | Min.       | Max. |          | Min.       | Max. |
| A    | 1.05       | 1.25 | E        | 1.5        | 1.7  |
| A1   | 0          | 0.1  | E1       | 2.65       | 2.95 |
|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

## SOT89-3



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

## ■ Packing information





| Type               | W(mm)             | P(mm)            | D(mm)          | Qty (pcs) |
|--------------------|-------------------|------------------|----------------|-----------|
| SOT23-3<br>SOT23-5 | 12.0 $\pm$ 0.1 mm | 8.0 $\pm$ 0.1 mm | 330 $\pm$ 1 mm | 3000pcs   |
| SOT89-3            | /                 | /                | /              | 1000pcs   |