

## Description

The YB1231 is a series of ultra-low-noise, low dropout (LDO) linear regulators with 2.0% output voltage accuracy. The YB1231 regulators achieve a low 440mV dropout at 600mA load current of 4.5V output and are available in voltages ranging from 3.2V to 4.5V with 0.1 V per step (custom voltage is considerable at request).

The YB1231 regulators are optimized to work with low-ESR and low cost ceramic capacitors, reducing the amount of board space critical in hand-held devices. The YB1231 requires only 2.2  $\mu$ F output capacitor for stability with any load and consumes less than 1 $\mu$ A in shutdown mode.

Built-in thermal shutdown and short-circuit protect offer secure protection against fault operation. The YB1231 regulators are available in SOT-23 / SOT-25 / SOT-89 packages.

## Features

- 2.0% Accuracy Output Voltage
- Output Voltage range 3.2V~4.5V
- Low-Noise Low-Drop-Out
- Stable with 2.2 $\mu$ F Ceramic Capacitor for Any Load
- Typical Output Current : 600 mA
- Low Quiescent Current : ~100 $\mu$ A
- 440mV Dropout at 600mA Load (4.5V)
- Only Need Input and Output Capacitors
- Power Saving Shutdown Mode (<1 $\mu$ A)
- Thermal Protection Shutdown
- Built-In Internal Soft-Start
- Output Short-circuit Current Limit Protection
- Green package (RoHS) available

## Applications

- PDA, Palmtops and Notebook Computers
- DSC, Handset Camera Modules
- PCMCIA Cards, PC Cameras
- USB Based Portable Devices (MP3, PMP)
- GSM/GPRS/3G RF Transceiver Modules
- Wireless LANs
- Bluetooth Portable Radios

## Typical Application Circuitry

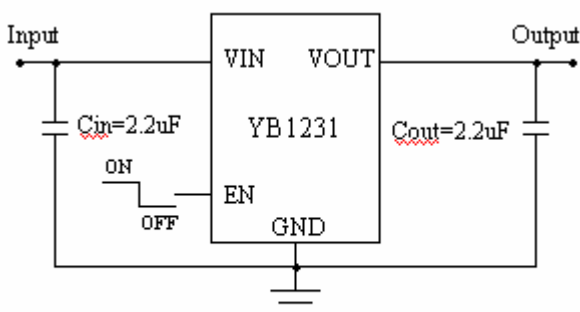


Figure 1-1 : SOT-25 application circuit

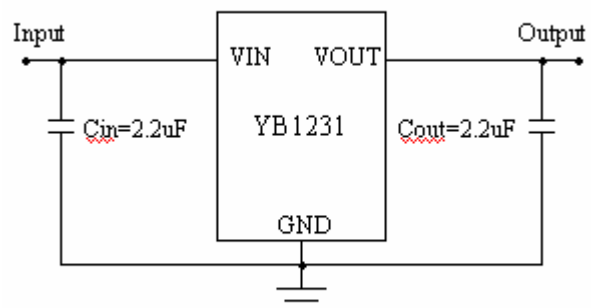


Figure 1-2 : SOT-23, SOT-89 application circuit

### Pin Configuration

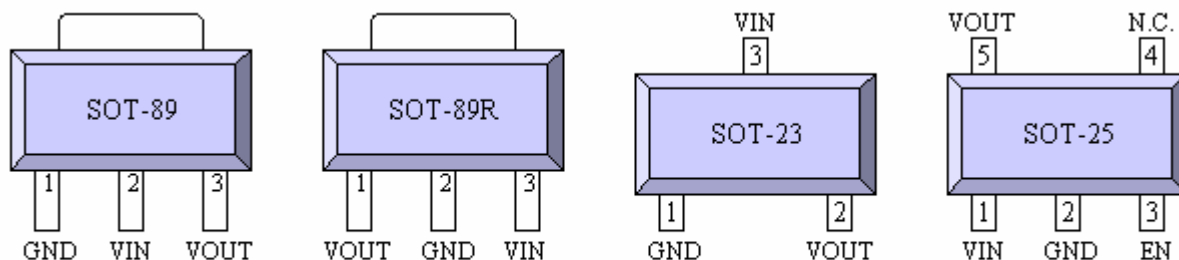


Figure 2 : pin configuration

### Pin Description

Table 1

Pin Name	Pin Function
VIN	Unregulated Input Supply. Bypass with a capacitor to GND.
GND	Ground pin.
EN	Pull high to enable the regulator.
VOUT	Regulated Output Voltage. Bypass with a capacitor to GND.

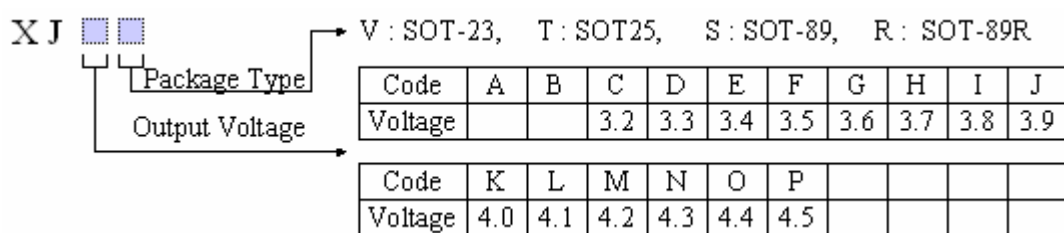
### Ordering Information

Y B 1 2 3 1 [ ] [ ] [ ] [ ] X [ ] [ ] [ ] [ ]

- Output Voltage
  - 3 2 0 : 3.2 V
  - 3 3 0 : 3.3 V
  - ...
  - 4 5 0 : 4.5 V
- X : reserved
- Package Type
  - ST23 : SOT-23
  - ST25 : SOT-25
  - ST89 : SOT-89
  - ST8R : SOT-89R

- Order example :  
YB1231ST89X350 for YB1231 of 3.5V output and SOT-89 package
- Shipping Quantity :
  - SOT-23 : 3000 units tape & reel
  - SOT-25 : 3000 units tape & reel
  - SOT-89 : 1000 units tape & reel
  - SOT-89R : 1000 units tape & reel
- Only green package

### Marking Information



### Absolute Maximum Ratings

Supply Voltage ..... -0.3V to 7.0V  
 Output Voltage ..... -0.3V to ( $V_{IN}+0.3V$ )  
 Output Short-Circuit Duration ..... Infinite  
 Junction Temperature Range..... +150°C  
 Storage Temperature Range ..... -65°C to +150°C  
 Lead Temperature..... +250°C

### Recommended Operating Conditions

Input Supply Voltage..... 2V to 6.0V  
 Operating Temperature..... -40°C to +85°C  
 Thermal Resistance (SOT-23/25,  $\theta_{JC}$ ) ..... 140°C/W  
 Thermal Resistance (SOT-23/25,  $\theta_{JA}$ )..... 280°C/W  
 Thermal Resistance (SOT-89,  $\theta_{JC}$ ) ..... 46°C/W  
 Thermal Resistance (SOT-89,  $\theta_{JA}$ )..... 180°C/W  
 Thermal Power Dissipation (SOT-23/25,  $P_D$ )....0.4W  
 Thermal Power Dissipation (SOT-89,  $P_D$ ).....0.55W

### Electrical Characteristics

**Table 2**  $T_A = 25^\circ\text{C}$ ,  $V_{IN} = (V_{OUT} + 1\text{V})$ ,  $C_{IN} = C_{OUT} = 2.2\mu\text{F}$ ,  $V_{EN} = V_{IN}$

Function Parameter	Conditions	Min	Typ	Max	Units
Input Voltage Range		3.5		6.0	V
Output Voltage	Predefined	3.2		4.5	V
Output Voltage Accuracy	$I_{OUT} = 10\text{mA}$	-2.0		+2.0	%
Output Current Limit	Short-circuit output		420		mA
Dropout Voltage (Note 1)	$V_{out} = 4.5\text{V}$ , $I_{out} = 600\text{mA}$		440		mV
	$V_{out} = 4.0\text{V}$ , $I_{out} = 600\text{mA}$		470		
	$V_{out} = 3.6\text{V}$ , $I_{out} = 600\text{mA}$		500		
	$V_{out} = 3.3\text{V}$ , $I_{out} = 600\text{mA}$		530		
	$V_{out} = 3.2\text{V}$ , $I_{out} = 600\text{mA}$		550		
Ground Current	$I_{ground} = I_{in} - I_{out}$		100	160	$\mu\text{A}$
Line Regulation	$V_{in} = (V_{out} + 1\text{V})$ to 6V, $I_{out} = 10\text{mA}$		0.4		%/V
Load Regulation	$I_{out} = 1\text{mA}$ to 600 mA		1.7		%
Shutdown Supply Current	$EN = 0.4\text{V}$		0.01		$\mu\text{A}$
Ripple Rejection (PSRR)	$f = 100\text{Hz}$ , $I_{out} = 10\text{mA}$		51		dB
	$f = 1\text{KHz}$ , $I_{out} = 10\text{mA}$		51		
	$f = 10\text{KHz}$ , $I_{out} = 10\text{mA}$		45		
Shutdown Exit Delay (Note 2)	$V_{out} = 3.3\text{V}$ , $R_{load} = 11\text{ohm}$		36	100	$\mu\text{S}$
EN Logic Low Level	$V_{in} = 2.0\text{V}$ to 6.0V			0.4	V
EN Logic High Level	$V_{in} = 2.0\text{V}$ to 6.0 V	1.5		$V_{in}$	V
EN Input Bias Current	$V_{in} = EN = V_{out} + 1\text{V}$		0.01		$\mu\text{A}$
Thermal Shutdown	Shutdown Temperature		160		°C
Thermal Shutdown Hysteresis	$V_{OUT} = 3.3\text{V}$ , $I_{OUT} = 100\text{mA}$		20		°C

**Note1** : The drop out voltage varies depending on output voltage selection

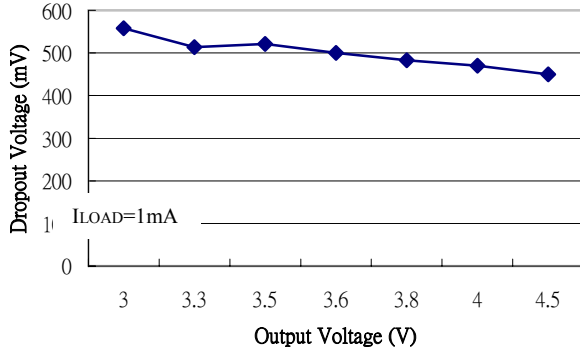
Dropout is defined as  $V_{IN} - V_{OUT}$  when  $V_{OUT}$  is 100mV below  $V_{OUT}$  where  $V_{in} = V_{out} + 1\text{V}$  for nominal  $V_{OUT}$ .

**Note 2:** Time needed for  $V_{OUT}$  to reach 90% of final value.

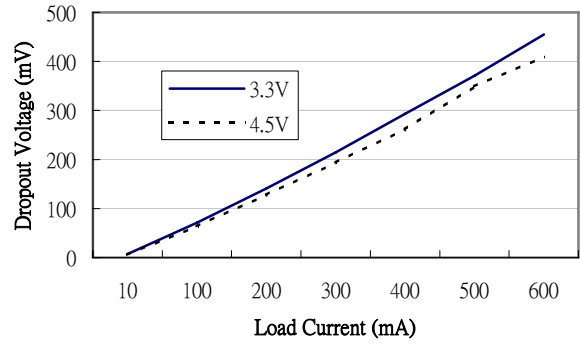
### Typical Characteristics

At  $T_A=25^{\circ}\text{C}$ ,  $V_{IN}=(V_{OUT}+1\text{V})$ ,  $C_{IN}=C_{OUT}=2.2\mu\text{F}$ ,  $V_{EN}=V_{IN}$ , unless otherwise noted.

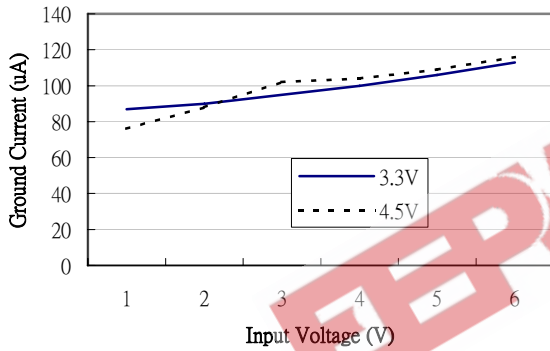
Dropout Voltage vs Output Voltage



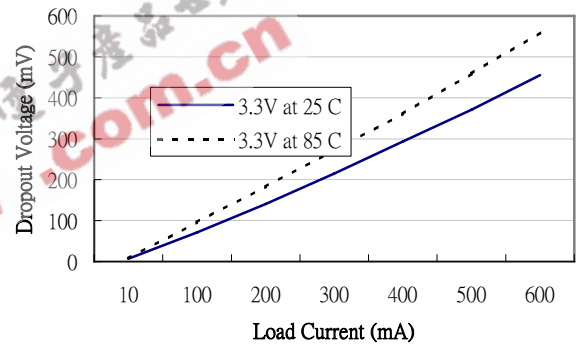
Dropout Voltage vs. Load Current



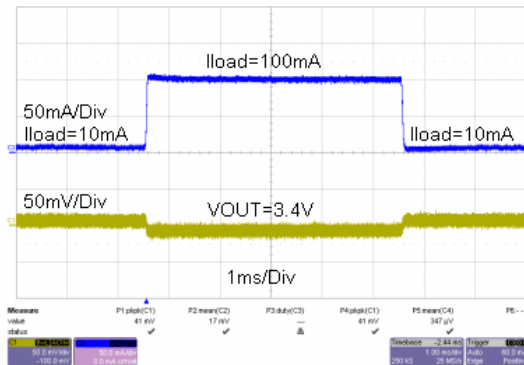
Ground Current vs. Input Voltage



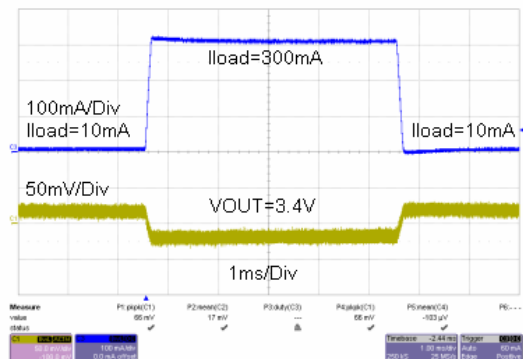
Dropout Voltage vs. Temperature



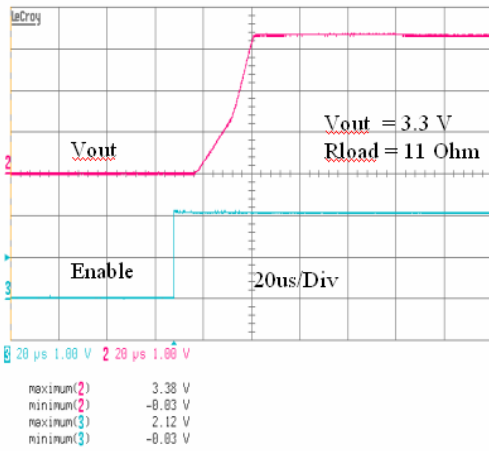
Load Transient Response (1)



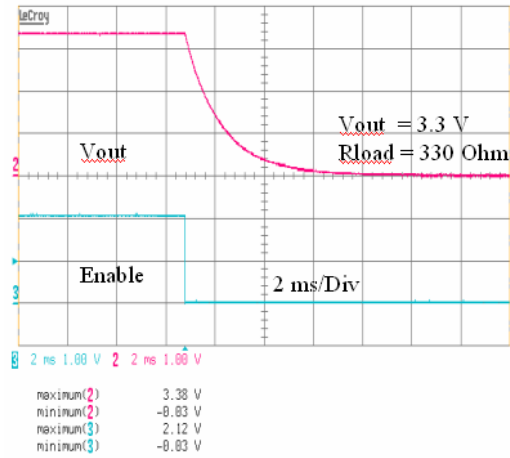
Load Transient Response (2)



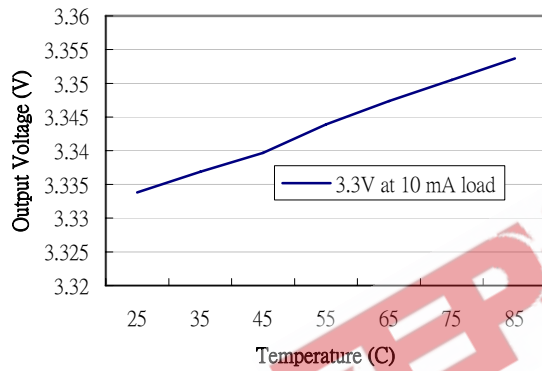
**Shutdown Exit Delay**



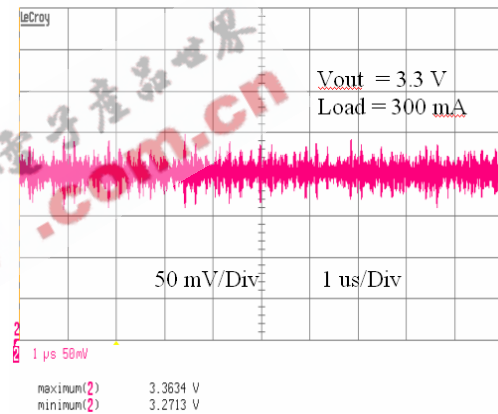
**Shutdown Delay**



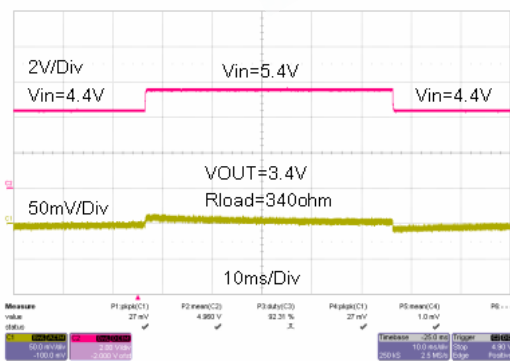
**Output Voltage vs. Temperature**



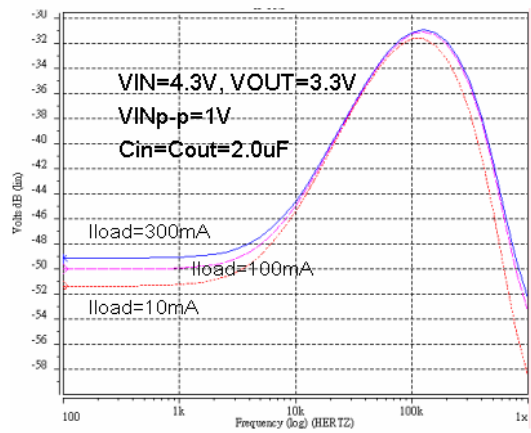
**Output Noise Measurement**



**Line Transient Response (10mA)**



**PSRR vs Frequency**



## Functional Block Diagram

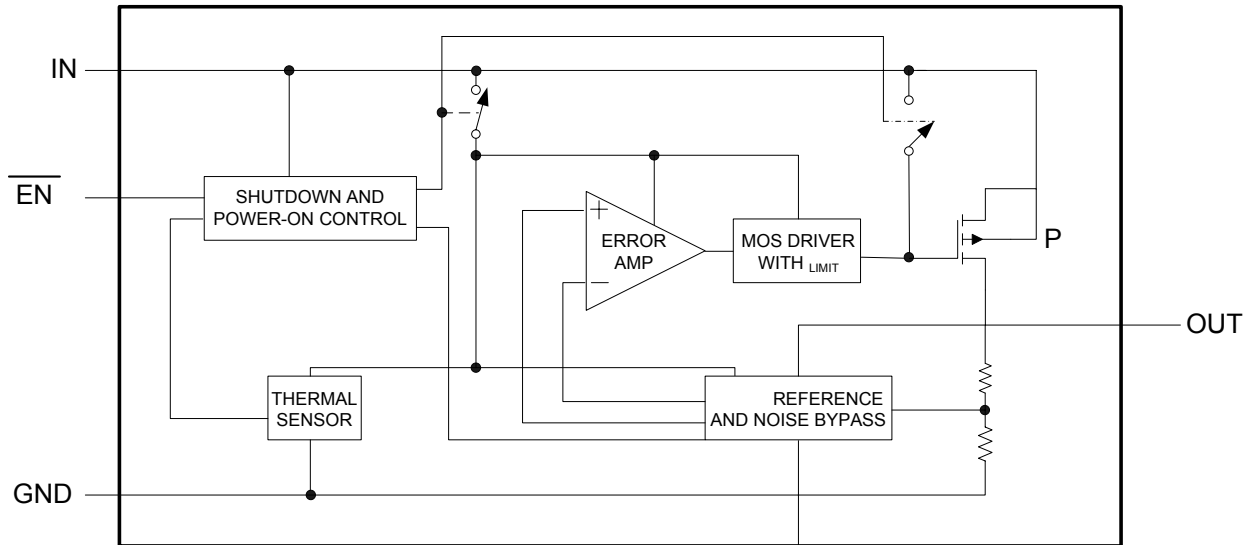


Figure 3. Block Diagram

## Functional Description

The YB1231 is an ultra-low-noise, low-quiescent current, low-dropout linear regulator. It is supplied in a SOT-23 / SOT-25 / SOT-89 package for different applications. These devices can supply loads up to 600mA. As shown in the *Functional Block Diagram*, the YB1231 consists of a reference and noise bypass circuit, error amplifier, output drive transistor, internal feedback voltage divider, thermal sensor, and short circuit current limiter. The internal reference is connected to the error amplifier's inverting input. The error amplifier compares this reference with the feedback voltage and amplifies the difference. If the feedback voltage is lower than the reference voltage, the pass-transistor gate is pulled low. This allows more current to pass to the output and increases the output voltage. If the

feedback voltage is too high, the pass transistor gate is pulled high, allowing less current to pass to the output. The parts are available with preset output voltages ranging from 3.2V to 4.5V.

### Stability

The YB1231 is a high performance LDO emphasizing stability with low output capacitance. It is able to maintain stability with an output capacitor as low as 2.2  $\mu$ F. The output capacitor can also be increased to optimize performance. The YB1231 will remain stable and in regulation with no load, unlike many other voltage regulators.

### Internal P-Channel Pass Transistor

The YB1231 features a low impedance P-channel MOSFET pass transistor. This provides several advantages over similar

designs using a PNP pass transistor, including low operating power and longer battery life. The YB1231 consumes only 100 $\mu$ A of quiescent current under most conditions.

### **Output Short-Circuit Current Limit**

The YB1231 includes a current limiter, which monitors and controls the pass transistor's gate voltage, limiting the output current to about 420mA, for example, in a short-circuit output situation.

### **Shutdown**

The YB1231 also features a low-power active shutdown mode. It has a switch that turns off the device when disabled. This allows the output capacitor and load to discharge and de-energize the load. In the shutdown mode, the internal functional blocks, such as voltage reference and the error amplifier, are turned off completely, and the quiescent current is less than 1 $\mu$ A.

### **Thermal Protection Shutdown**

The thermal protection shutdown function protects the device from operating in over temperature condition. When the junction temperature exceeds +160°C, the thermal sensor signals the shutdown logic, turning off the pass transistor and allowing the IC to cool down. The thermal sensor turns the pass transistor on again after the IC's junction temperature drops to +140°C.

### **Soft-Start Circuitry**

The YB1231 includes a soft-start circuitry to limit inrush current at turn-on. During power

up, the output capacitor and output load are charged with a reduced output current. Shortly after the initial power up, the soft-start feature is terminated and normal operation is resumed.

## **Application Information**

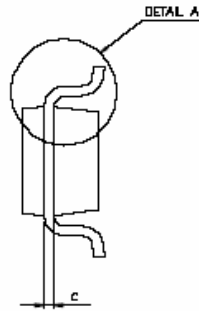
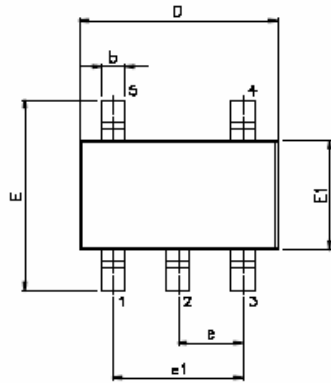
### **Enable/Shutdown**

The YB1231 comes with an active-high enable pin that allows the regulator to be enabled. Forcing the enable pin low disables the regulator and puts it into the shutdown mode. This pin cannot be left floating as it may cause an undetermined state.

### **Input/Output Capacitor**

It is recommended to use a 2.2 $\mu$ F capacitor on the YB1231 input and a 2.2 $\mu$ F capacitor on the output. For high regulation performance, larger input capacitor values and lower ESRs provide better noise rejection and line-transient response. The output noise, load-transient response, stability, and power-supply rejection can be improved by using large output capacitors. Low ESR ceramic capacitors provide optimal performance and save space.

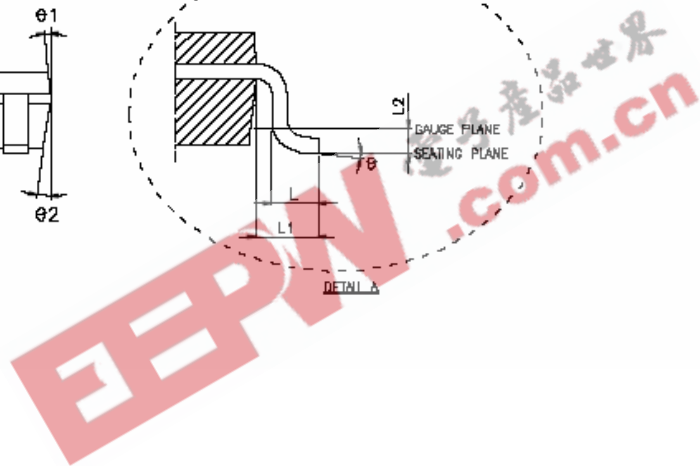
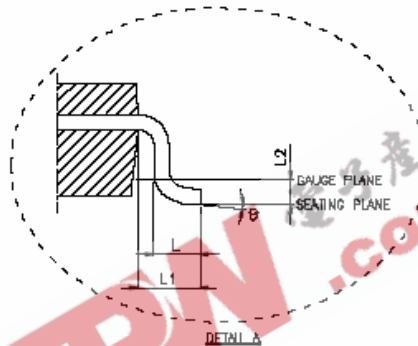
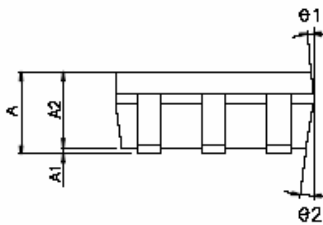
**SOT-25 Package Information**



VARIATION (ALL DIMENSIONS SHOWN IN MM)

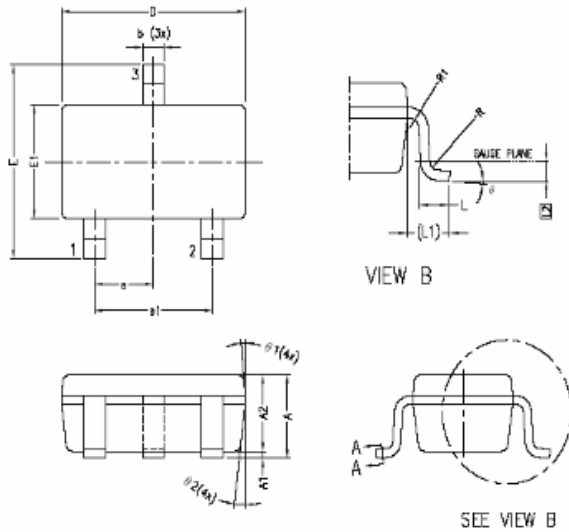
SYMBOL	MIN.	NGM.	MAX.
A	1.05	1.20	1.35
A1	0.05	0.10	0.15
A2	1.00	1.10	1.20
b	0.25	-	0.50
c	0.08	-	0.20
D	2.70	2.90	3.00
E	2.60	2.90	3.00
E1	1.50	1.80	1.70
e	0.95 BSC.		
e1	1.80 BSC.		
L	0.30	0.45	0.55
L1	0.60 REF.		
L2	0.25 BSC.		
Ø	0'	5'	10'
Ø1	3'	5'	7'
Ø2	8'	8'	10'

NOTE : 1. JEDEC OUTLINE : MO-17B AA

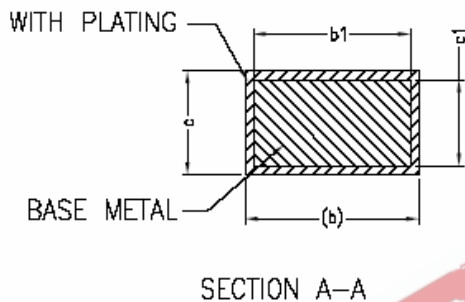




### SOT-23 Package Information



SYMBOLS	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	1.05	1.20	1.35
A1	0.05	0.10	0.15
A2	1.00	1.10	1.20
b	0.30	—	0.50
b1	0.30	0.35	0.45
c	0.08	—	0.22
c1	0.08	0.13	0.20
D	2.80	2.90	3.00
E	2.80	2.80	3.00
E1	1.50	1.80	1.70
e	0.95 BSC		
e1	1.90 BSC		
L	0.35	0.43	0.80
L1	0.60 REF		
L2	0.25 BSC.		
R	0.10	—	—
R1	0.10	—	0.25
B	5°	4°	8°
B1	5°	6°	15°
B2	5°	8°	15°

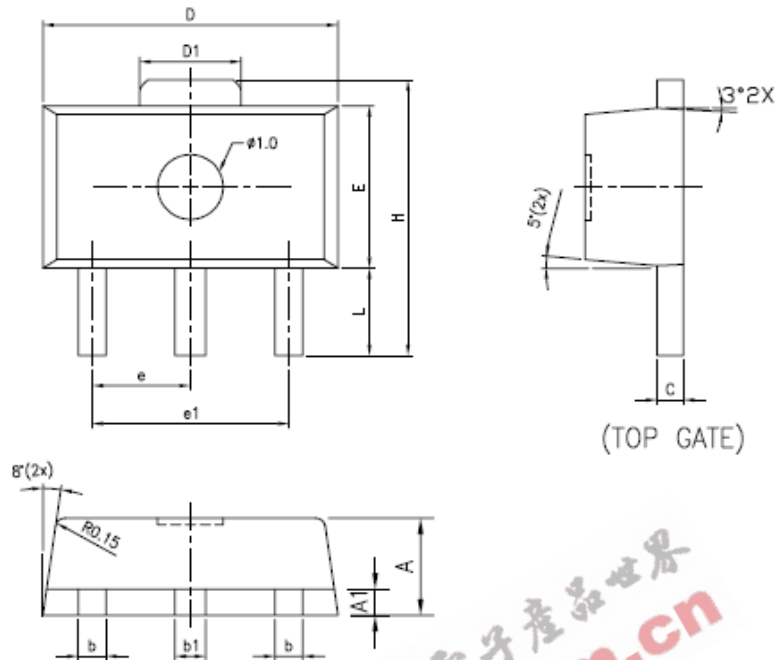


SECTION A-A

**NOTE:**

- ALL DIMENSIONS ARE IN MILLIMETERS.
- DIMENSION DOES NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURRS SHALL NOT EXCEED 0.25mm PER END.  
DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 PER SIDE.
- THE PACKAGE TOP MAY BE SMALLER THAN THE PACKAGE BOTTOM.  
DIMENSIONS D AND E1 ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, THE BAR BURRS. GATE BURRS AND INTERLEAD FLASH, BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE PLASTIC BODY..
- DIMENSION "b" DOES NOT INCLUDE DAMBAR PROTRUSION.  
ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08mm TOTAL IN EXCESS OF THE "b" DIMENSION AT MAXIMUM MATERIAL CONDITION. THE DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OF THE FOOT . MINMUM SPACE BETWEEN PROTRUSION AND AN ADJACENT LEAD SHALL NOT BE LESS THAN 0.07mm
- LEAD FRAME MATERIAL:EFTEC 64T

SOT-89 Package Information



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.40	1.50	1.60	0.055	0.059	0.063
A1	0.30	0.40	0.50	0.011	0.015	0.019
L	0.80	—	1.20	0.031	—	0.047
b	0.36	0.42	0.48	0.014	0.016	0.018
b1	0.41	0.47	0.53	0.016	0.018	0.020
C	0.38	0.40	0.43	0.014	0.015	0.017
D	4.40	4.50	4.60	0.173	0.177	0.181
D1	1.40	1.60	1.75	0.055	0.062	0.069
H	3.94	—	4.25	0.155	—	0.167
E	2.40	2.50	2.60	0.094	0.098	0.102
e1	2.90	3.00	3.10	0.114	0.118	0.122
e	1.45	1.50	1.55	0.057	0.059	0.061

NOTES:

1. CONTROLLING DIMENSION : mm
2. LEAD FRAME MATERIAL : COPPER