## 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 2.2μF output capacitor for stability with any load and consumes less than 1μA 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 2.2μF Ceramic Capacitor for Any Load
- Typical Output Current : 600mA
- Low Quiescent Current : ~100μA
- 440mV Dropout at 600mA Load (4.5V)
- Only Need Input and Output Capacitors
- Power Saving Shutdown Mode (<1μA)
- 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 Circuit

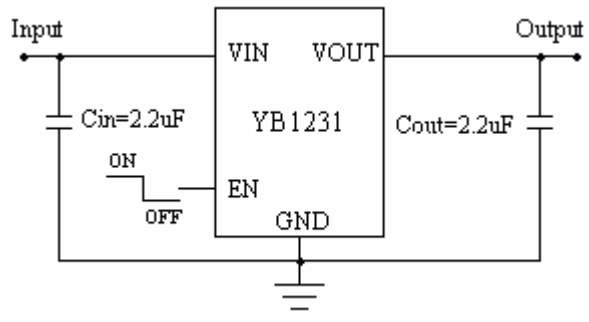



Figure 1-1: SOT-25 Application Circuit

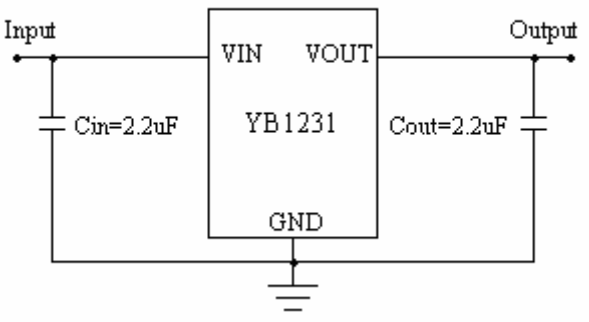



Figure 1-2: SOT-23/SOT-89 Application Circuit

## Pin Configuration

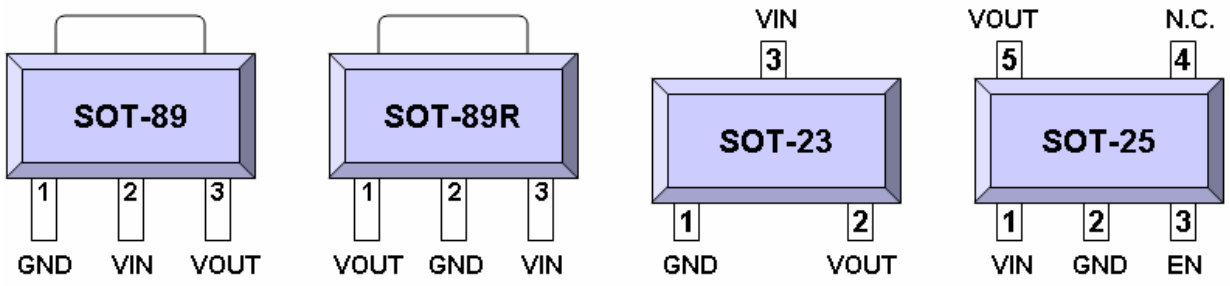


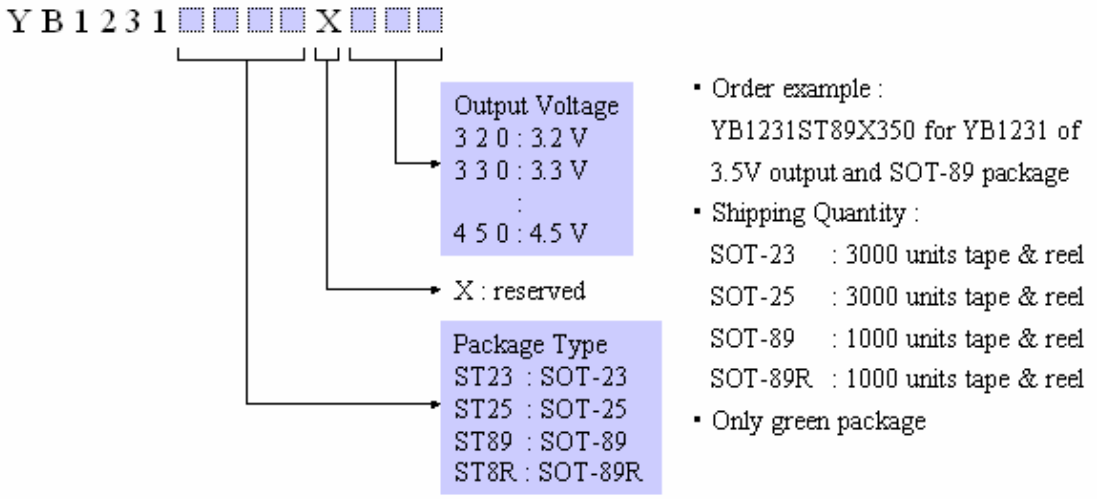

**Figure 2: Pin Configuration**

## Pin Description

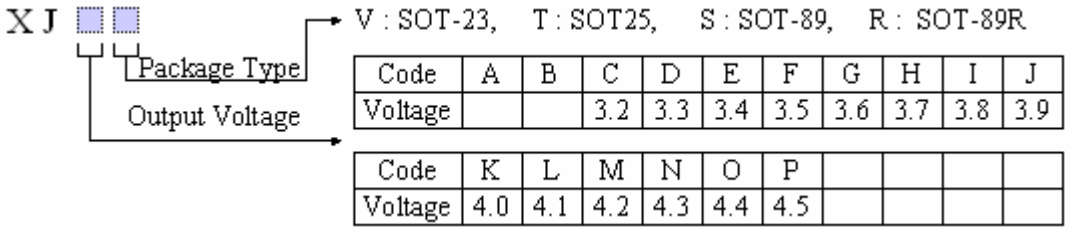
**Table 1**

| Name | Description |
|---|---|
| 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




## Marking Information




| Code | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | | | 3.2 | 3.3 | 3.4 | 3.5 | 3.6 | 3.7 | 3.8 | 3.9 |

| Code | K | L | M | N | O | P | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Voltage | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | | | | |

## Absolute Maximum Ratings (Note 1)

Supply Voltage ..... -0.3V to 6V
Output Voltage ..... -0.3V to ($V_{IN}$+0.3V)
Output Short-Circuit Duration..... Infinite
Junction Temperature Range ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature ..... +250℃

## Recommended Operating Conditions

(Note 2)

Input Supply Voltage ..... 2.0V to 5.5V
Operating Temperature ..... -40℃ to +85℃

## Thermal In formation (Note 3)

Thermal Resistance (SOT-23/25, $\theta_{JA}$) ... 280℃/W
Thermal Resistance (SOT-89, $\theta_{JA}$) ..... 180℃/W
Internal Power Dissipation (SOT-23/25, $P_D$) . 0.4W
Internal Power Dissipation (SOT-89, $P_D$) ..... 0.55W

**Note:**

1. Exceeding these ratings may damage the device.
2. The device is not guaranteed to function outside of its operating conditions.
3. $\theta_{JA}$ is measured in free air at $T_A$ = 25℃ on a low effective thermal conductivity board.

## Electrical Characteristics

**Table 2 $V_{IN}$ = ( $V_{OUT}$ + 1V ), $C_{IN}$ = $C_{OUT}$ = 2.2µF, $V_{EN}$ = $V_{IN}$, $T_A$=25°C, unless otherwise noted.**

| Description | Symbol | Test Conditions | MIN | TYP | MAX | Units |
|---|---|---|---|---|---|---|
| Input Voltage Range | $V_{IN}$ | | 2.0 | | 5.5 | V |
| Output Voltage | $V_{OUT}$ | Predefined | 3.2 | | 4.5 | V |
| Output Voltage Accuracy | $\Delta V_{OUT}$ | $I_{OUT}$ = 10mA | -2.0 | | +2.0 | % |
| Output Current Limit | $I_{SC}$ | Short-Circuit Output | | 420 | | mA |
| Dropout Voltage (Note 1) | $V_{DROP}$ | $V_{OUT}$ = 4.5V, $I_{OUT}$ = 600mA | | 440 | | mV |
| | | $V_{OUT}$ = 4.0V, $I_{OUT}$ = 600mA | | 470 | | |
| | | $V_{OUT}$ = 3.6V, $I_{OUT}$ = 600mA | | 500 | | |
| | | $V_{OUT}$ = 3.3V, $I_{OUT}$ = 600mA | | 530 | | |
| | | $V_{OUT}$ = 3.2V, $I_{OUT}$ = 600mA | | 550 | | |
| Ground Current | $I_G$ | Iground = $I_{IN}$ - $I_{OUT}$ | | 100 | 160 | µA |
| Line Regulation | $\Delta V_{LINE}$ | $V_{IN}$=($V_{OUT}$+1V) to 5.5V, $I_{OUT}$=10mA | | 0.4 | | %/V |
| Load Regulation | $\Delta V_{LOAD}$ | $I_{OUT}$ = 1mA to 600mA | | 1.7 | | % |
| Shutdown Supply Current | $I_{SD}$ | EN = 0V | | | 1 | µA |
| Ripple Rejection (PSRR) | PSRR | f = 100Hz, $I_{OUT}$ = 10mA | | 51 | | dB |
| | | f = 1KHz, $I_{OUT}$ = 10mA | | 51 | | |
| | | f = 10KHz, $I_{OUT}$ = 10mA | | 45 | | |
| Shutdown Exit Delay (Note 2) | | $V_{OUT}$ = 3.3V, Rload = 11 ohm | | 36 | 100 | µs |
| EN Logic Low Level | $V_{IL}$ | $V_{IN}$ = 2.0V to 5.5V | | | 0.4 | V |
| EN Logic High Level | $V_{IH}$ | $V_{IN}$ = 2.0V to 5.5V | 1.5 | | $V_{IN}$ | V |
| EN Input Bias Current | $I_{BEN}$ | $V_{IN}$ = EN = $V_{OUT}$ +1V | | 0.01 | | µA |
| Thermal Shutdown | $T_{SD}$ | Shutdown Temperature | | 160 | | °C |
| Thermal Hysteresis | $T_{HYS}$ | $V_{OUT}$ = 3.3V, $I_{OUT}$ = 100mA | | 20 | | °C |

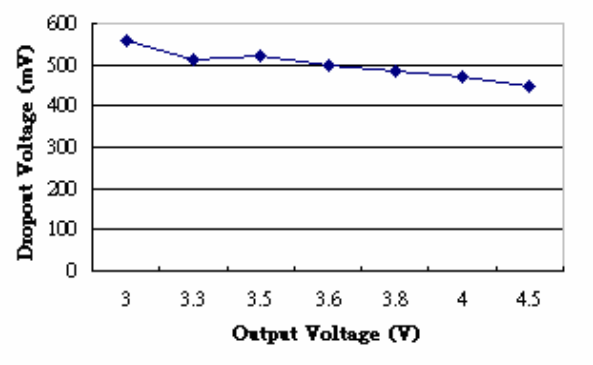
**Note :**

1. The drop out voltage varies depending on output voltage selection. Dropout is defined as $V_{IN}$ – $V_{OUT}$ when $V_{OUT}$ is 100mV below nominal $V_{OUT}$ where $V_{IN}$ = $V_{OUT}$ + 1V for nominal $V_{OUT}$.
2. Time needed for $V_{OUT}$ to reach 90% of final value.

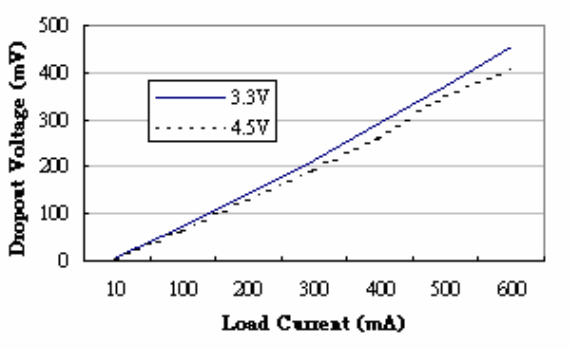
## Typical Performance Characteristics

**$V_{IN}$ = ( $V_{OUT}$ + 1V ), $C_{IN}$ = $C_{OUT}$ = 2.2μF, $V_{EN}$ = $V_{IN}$, $T_A$=25°C, unless otherwise noted.**

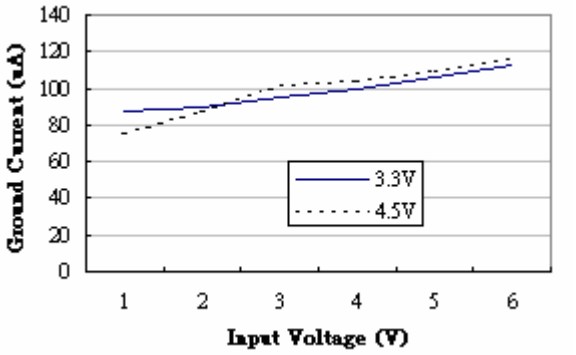
### Dropout Voltage vs. Output Voltage



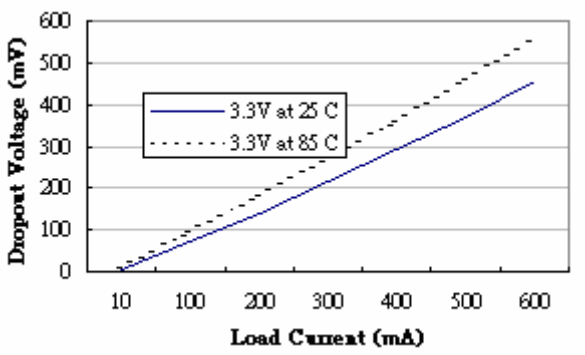

### Dropout Voltage vs. Load Current



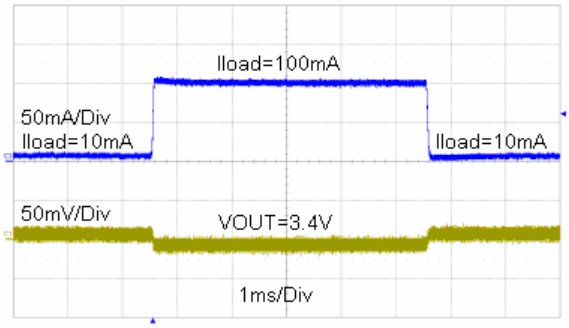

### Ground Current vs. Input Voltage



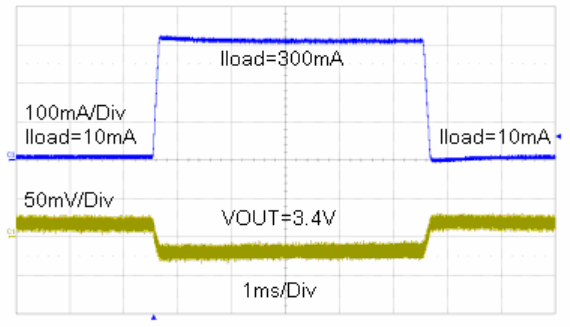

### Dropout Voltage vs. Temperature



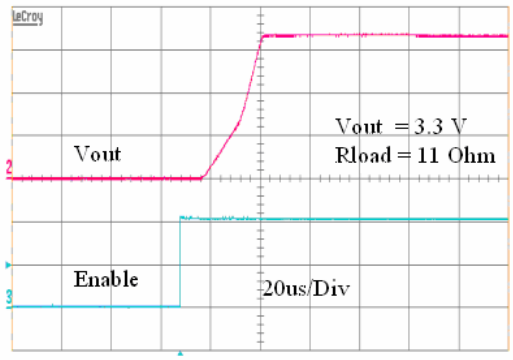

### Load Transient Response (1)



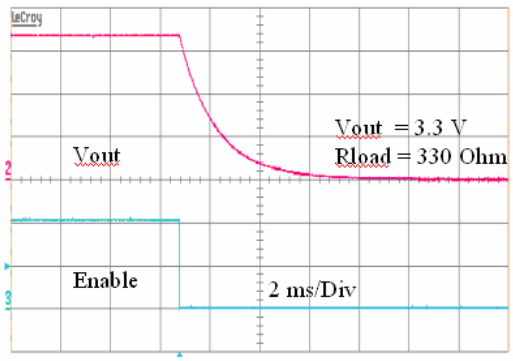

### Load Transient Response (2)



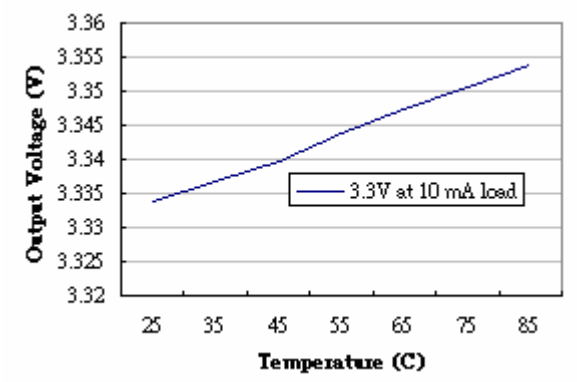
### Shutdown Exit Delay



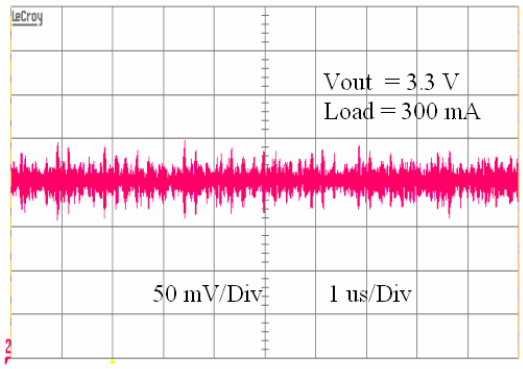

### Shutdown Delay



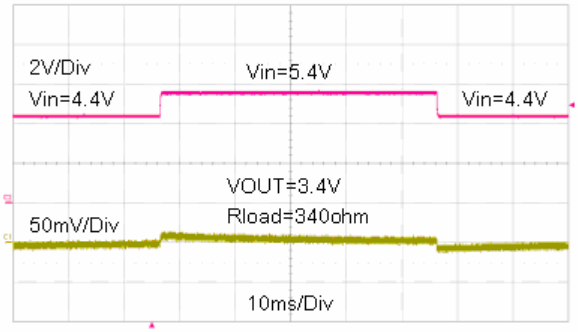

### Output Voltage vs. Temperature



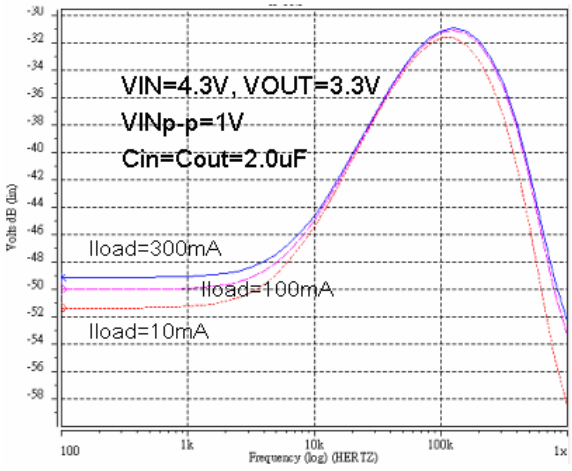

### Output Noise Measurement




### Line Transient Response (10mA)




### PSRR vs. Frequency



## Function Block

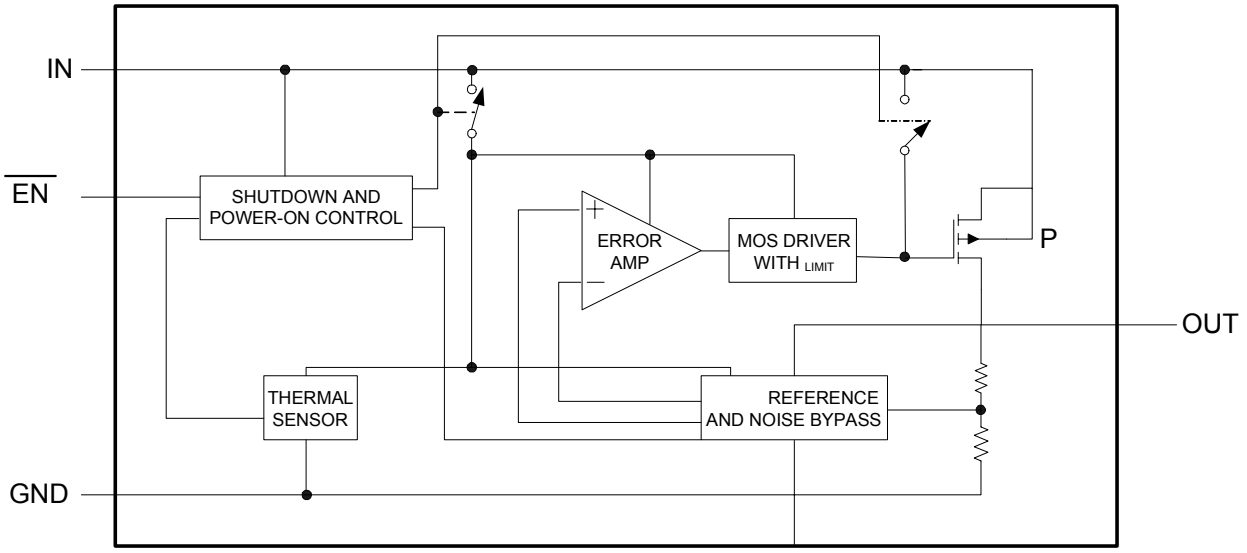



**Figure 3: Function Block**

## 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 2.2μF. 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 100μA 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 1μA.

**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

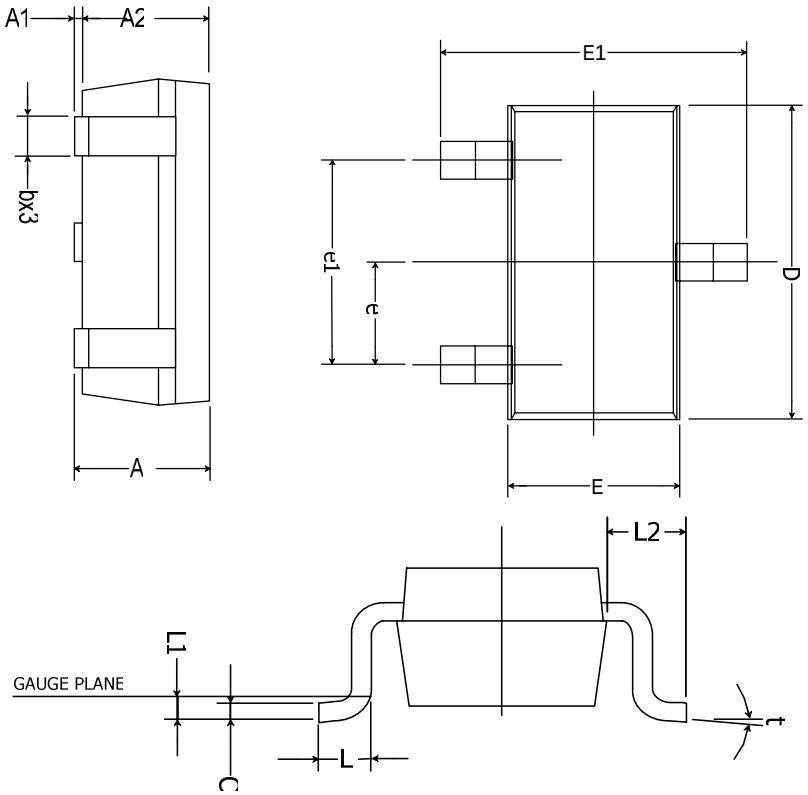
**Enable/Shutdown**

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**

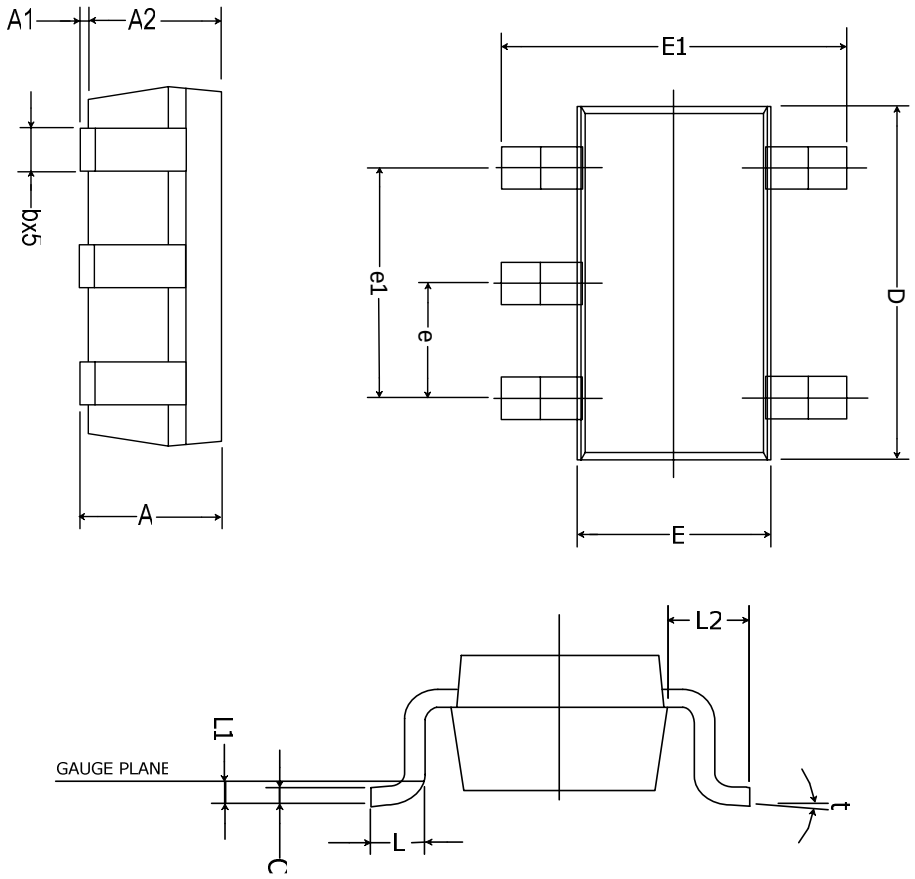
It is recommended to use a 2.2μF capacitor on the YB1231 input and a 2.2μF capacitor on the output. For high regulation performance, larger input capacitor values and lower ESRs provide better noise rejection and line-transient response. The output noise, load-transient response, stability, and power-supply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

## Package Information (SOT-23)



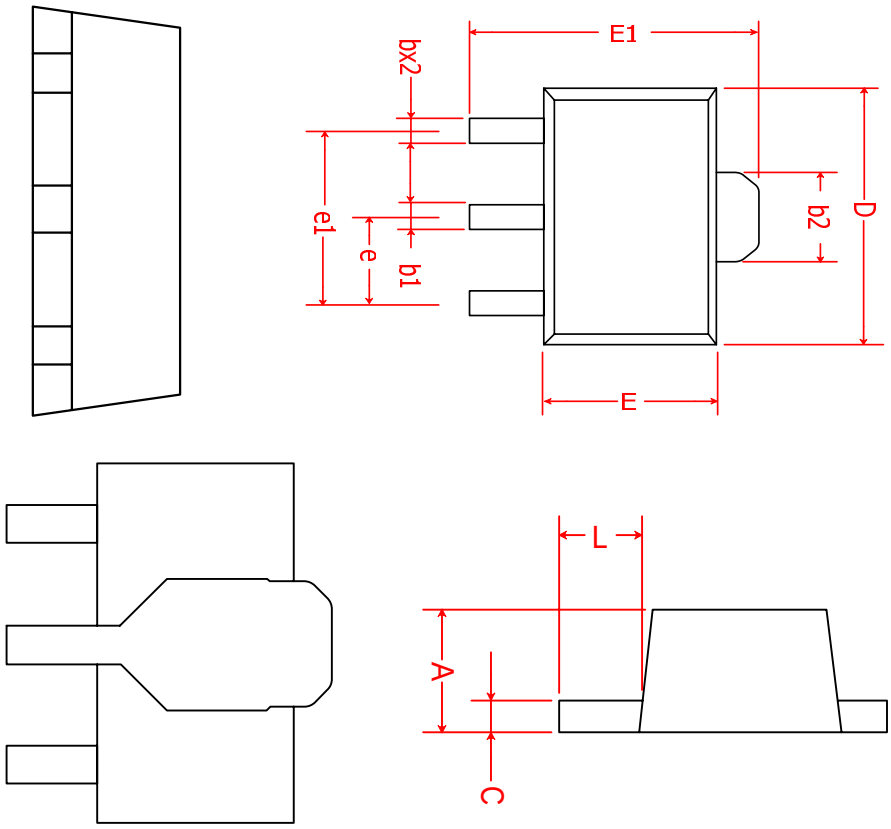

| Symbol | milimeters | | Inches | |
|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. |
| A | 0.95 | 1.45 | .037 | .057 |
| A1 | 0.05 | 0.15 | .002 | .006 |
| A2 | 0.90 | 1.30 | .035 | .051 |
| b | 0.30 | 0.50 | .0118 | .019 |
| C | 0.08 | 0.20 | .0031 | .0078 |
| D | 2.84 | 3.00 | .1118 | .118 |
| E | 1.50 | 1.70 | .059 | .0669 |
| E1 | 2.60 | 3.00 | .102 | .118 |
| e | 0.95 BSC. | | .0374 BSC. | |
| e1 | 1.90 BSC. | | .0748 BSC. | |
| L | 0.35 | 0.55 | .0137 | .0216 |
| L1 | 0.10 BSC. | | .0039 BSC. | |
| L2 | 0.60 REF. | | .0236 REF. | |
| t | 0° | 8° | 0° | 8° |

## Package Information (SOT-25)




| Symbol | milimeters | | Inches | |
|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. |
| A | 0.95 | 1.45 | .037 | .057 |
| A1 | 0.05 | 0.15 | .002 | .006 |
| A2 | 0.90 | 1.30 | .035 | .051 |
| b | 0.30 | 0.50 | .0118 | .019 |
| C | 0.08 | 0.20 | .0031 | .0078 |
| D | 2.84 | 3.00 | .1118 | .118 |
| E | 1.50 | 1.70 | .059 | .0669 |
| E1 | 2.60 | 3.00 | .102 | .118 |
| e | 0.95 BSC. | | .0374 BSC. | |
| e1 | 1.90 BSC. | | .0748 BSC. | |
| L | 0.35 | 0.55 | .0137 | .0216 |
| L1 | 0.10 BSC. | | .0039 BSC. | |
| L2 | 0.60 REF. | | .0236 REF. | |
| t | 0° | 8° | 0° | 8° |

## Package Information (SOT-89)




| Symbol | milimeters | | Inches | |
|---|---|---|---|---|
| | MIN. | MAX. | MIN. | MAX. |
| A | 1.40 | 1.60 | .055 | .063 |
| b | 0.36 | 0.48 | .014 | .019 |
| b1 | 0.44 | 0.56 | .017 | .022 |
| b2 | 1.50 | 1.83 | .059 | .072 |
| C | 0.35 | 0.44 | .014 | .017 |
| D | 4.40 | 4.60 | .173 | .181 |
| E | 2.29 | 2.60 | .090 | .102 |
| E1 | 3.94 | 4.25 | .155 | .167 |
| e | 1.50 BSC. | | .059 BSC. | |
| e1 | 3.00 BSC. | | .118 BSC. | |
| L | 0.89 | 1.20 | .035 | .047 |

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- The information described herein is subject to change without notice.
- Yobon does not assume any responsibility for use of any circuitry or applications described herein, nor does it convey any patent license.