

## Description

The YB1210 family consists of a series of 300mA ultra-low-noise, low dropout (LDO) linear regulators especially designed for battery-powered RF and wireless applications. The YB1210 regulator achieves a low 450mV dropout at 250mA load current of 3.3V output, ultra-low output voltage noise of 15 $\mu$ Vrms and PSRR of 57dB at 1KHz.

The YB1210 regulators are also optimized to work with low-ESR and low cost ceramic capacitors reducing the amount of board space critical in hand-held devices. The YB1210 requires only 0.47  $\mu$ F output capacitor for stability with any load. The YB1210 consumes less than 1 $\mu$ A in shutdown mode.

Other features include high output voltage accuracy and current limiting protection. The YB1210 regulators are available in SOT-23 / SOT-25 / SOT-89 packages.

## Features

- High Accuracy  $\pm$ 2% Output Voltage
- Ultra-Low-Noise Low-Drop-Out Regulator with 1.8/2.5/2.6/2.8/3.0V/3.3V Preset Outputs
- Stable with 0.47 $\mu$ F Ceramic Capacitor for Any Load
- Allowable Output Current: 300mA
- Low Quiescent Current:  $\sim$ 90 $\mu$ A
- 450mV Dropout at 250mA Load (3.3V)
- 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

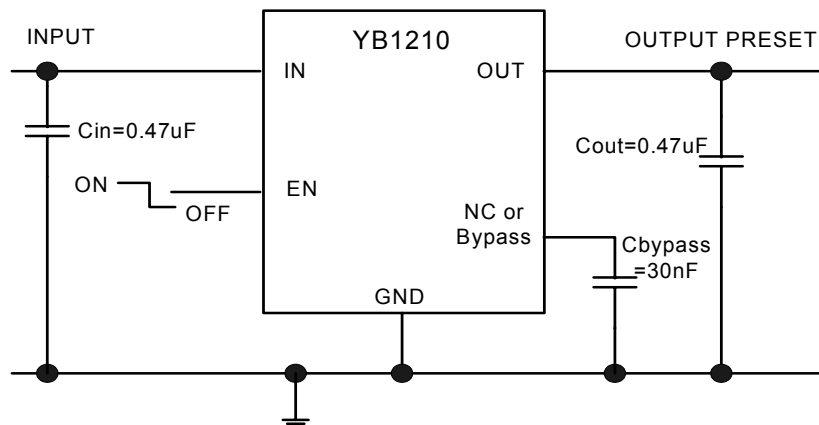


Figure 1-1. SOT-25 application circuit

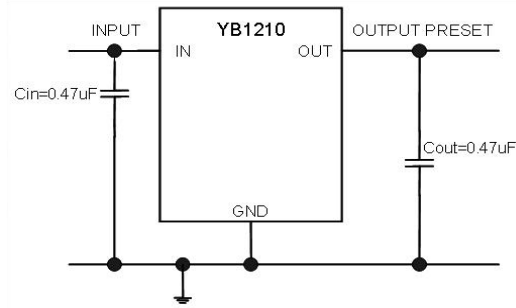


Figure 1-2. SOT-23 / SOT-89 application circuit

### Pin Configuration

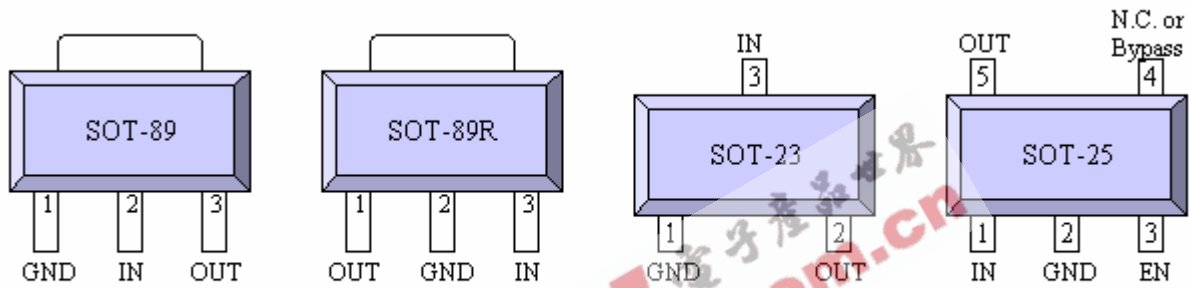


Figure 2 : pin configuration

### Pin Description

Table 1

| Pin        | Name           | SOT-25 Description   | Pin        | Name        | SOT-89 Description         |
|------------|----------------|--|------------|-------------|----------------------------|
| 1          | IN             | Unregulated Input Supply   | 1          | GND         | Ground Pin                 |
| 2          | GND            | Ground Pin   | 2          | IN          | Unregulated Input Supply   |
| 3          | EN             | Pull High To Enable The Regulator  | 3          | OUT         | Regulated Voltage Output   |
| 4          | N.C. or Bypass | No Connection For Normal Operation Or Noise Bypass For Ultra-Low-Noise Operation By A 30nF Cap. To GND | <b>Pin</b> | <b>Name</b> | <b>SOT-89R Description</b> |
| 5          | OUT            | Regulated Voltage Output   | 1          | OUT         | Regulated Voltage Output   |
| <b>Pin</b> | <b>Name</b>    | <b>SOT-23 Description</b>  | 2          | GND         | Ground Pin                 |
| 1          | GND            | Ground Pin   | 3          | IN          | Unregulated Input Supply   |
| 2          | OUT            | Regulated Voltage Output   |            |             |                            |
| 3          | IN             | Unregulated Input Supply   |            |             |                            |

### Ordering Information

Y B 1 2 1 0         S -        

Material  
G : Green package

Output Voltage  
1 . 8 : 1.8 V  
2 . 5 : 2.5 V  
2 . 6 : 2.6 V  
2 . 8 : 2.8 V  
3 . 0 : 3.0 V  
3 . 3 : 3.3 V

Package Type  
ST23 : SOT-23  
ST25 : SOT-25  
ST89 : SOT-89  
ST8R : SOT-89R

- Order example :  
YB1210ST89S-2.5G for YB1210 of 2.5V output and green 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

### Marking Information



|                |         |     |     |     |     |     |     |
|----------------|---------|-----|-----|-----|-----|-----|-----|
| Output Voltage | Voltage | 1.8 | 2.5 | 2.6 | 2.8 | 3.0 | 3.3 |
|                | Code    | D   | K   | L   | N   | P   | S   |

Package

| Package | Marking |
|---------|---------|
| SOT25   | BD      |
| SOT23   | DH      |
| SOT89   | EI      |
| SOT89R  | FF      |

### Absolute Maximum Ratings

Supply Voltage ..... -0.3V to 7.0V  
 Output Voltage ..... -0.3V to (V<sub>IN</sub>+0.3V)  
 Output Short-Circuit Duration ..... Infinite  
 Junction Temperature Range..... +150°C  
 Storage Temperature Range ..... -65°C to +150°C  
 Lead Temperature..... +250°C  
 Thermal Resistance (SOT-23/25, θJA)..... 280°C/W  
 Thermal Resistance (SOT-89, θJA)..... 180°C/W  
 Internal Power Dissipation (SOT-23/25, PD).....0.4W  
 Internal Power Dissipation (SOT-89, PD).....0.55W

### Recommended Operating Conditions

Input Supply Voltage..... 2V to 6.0V  
 Operating Temperature..... -40°C to +85°C  
 ESD Susceptibility (HBM)..... 2KV  
 ESD Susceptibility (MM).....200V

### Electrical Characteristics

**Table 3** T<sub>A</sub> = 25°C, V<sub>IN</sub> = (V<sub>OUT</sub> + 1 V), C<sub>IN</sub> = C<sub>OUT</sub> = 0.47μF, V<sub>EN</sub> = V<sub>IN</sub>

| Function Parameter           | Conditions   | Min  | Typ   | Max  | Units |
|------------------------------|--|------|-------|------|-------|
| Input Voltage Range          |  | 2.0  |       | 6.0  | V     |
| Output Voltage               | Predefined (metal masks)   | 1.8  |       | 3.3  | V     |
| Output Voltage Accuracy      | I <sub>OUT</sub> = 10mA  | -2.0 |       | +2.0 | %     |
| Output Current Limit         | Short-circuit output   |      | 200   | 250  | mA    |
| Dropout Voltage (See Note 1) | V <sub>OUT</sub> = 3.3V, I <sub>OUT</sub> = 250mA                          |      | 450   | 550  | mV    |
|                              | V <sub>OUT</sub> = 3.0V, I <sub>OUT</sub> = 250mA                          |      | 470   | 590  |       |
|                              | V <sub>OUT</sub> = 2.8V, I <sub>OUT</sub> = 250mA                          |      | 500   | 600  |       |
|                              | V <sub>OUT</sub> = 2.6V, I <sub>OUT</sub> = 250mA                          |      | 520   | 620  |       |
|                              | V <sub>OUT</sub> = 2.5V, I <sub>OUT</sub> = 250mA                          |      | 540   | 640  |       |
|                              | V <sub>OUT</sub> = 1.8V, I <sub>OUT</sub> = 250mA                          |      | 800   | 900  |       |
| Ground Current               | I <sub>OUT</sub> = 0 mA  |      | 90    | 150  | μA    |
| Line Regulation              | V <sub>IN</sub> = (V <sub>OUT</sub> +1V) to 6.0V, I <sub>OUT</sub> = 10 mA |      | 0.3   | 0.5  | %/V   |
| Load Regulation              | I <sub>OUT</sub> = 1mA to 250mA  |      | 1.2   | 3    | %     |
| Shutdown Supply Current      | EN=0V  |      | ~0.01 |      | μA    |

|   |  |     |      |                 |       |
|---|--|-----|------|-----------------|-------|
| Ripple Rejection (PSRR)                     | f = 100Hz, I <sub>OUT</sub> =1mA                             |     | 55   |                 | dB    |
|   | f = 1KHz, I <sub>OUT</sub> =1mA                              |     | 57   |                 |       |
|   | f = 10KHz, I <sub>OUT</sub> =1mA                             |     | 55   |                 |       |
| Output Noise Voltage                        | f = 100Hz to 100KHz,<br>I <sub>load</sub> =10mA, Bypass=0nF  |     | 45   |                 | μVrms |
|   | f = 100Hz to 100KHz,<br>I <sub>load</sub> =10mA, Bypass=30nF |     | 15   |                 | μVrms |
| Shutdown Exit Delay <sup>(See Note 2)</sup> | R <sub>load</sub> =50ohm                                     |     | 45   | 300             | μs    |
| EN Logic Low Level                          | V <sub>IN</sub> =2.0V to 5.5V                                |     |      | 0.4             | V     |
| EN Logic High Level                         | V <sub>IN</sub> =2.0V to 5.5V                                | 1.2 |      | V <sub>IN</sub> | V     |
| EN Input Bias Current                       | V <sub>IN</sub> =5.5V, SHDN=0V or 6V                         |     | 0.01 |                 | μA    |
| Thermal Shutdown                            | Shutdown Temperature   |     | 160  |                 | °C    |
| Thermal-Shutdown Hysteresis                 |  |     | 20   |                 | °C    |

**Note 1 :** The drop out voltage varies depending on output voltage selection

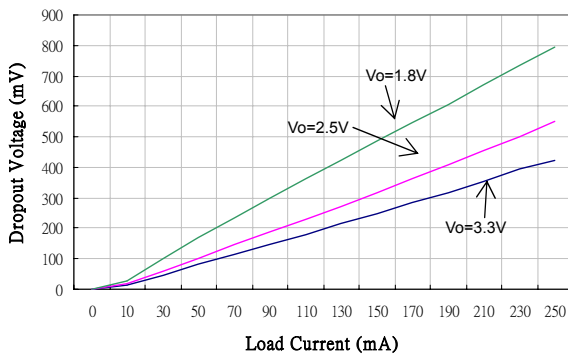
Dropout is defined as V<sub>IN</sub> – V<sub>OUT</sub> when V<sub>OUT</sub> is 100mV below V<sub>OUT</sub> where V<sub>in</sub>=V<sub>out</sub> + 1V for nominal V<sub>OUT</sub>.

**Note 2:** Time needed for V<sub>OUT</sub> to reach 90% of final value.

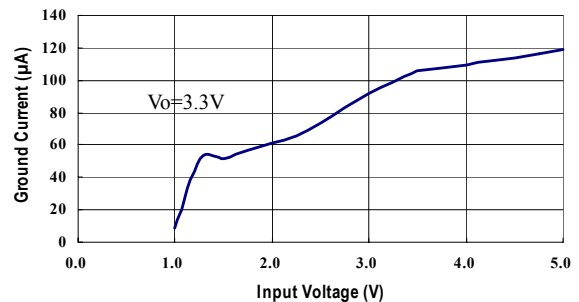
## Typical Characteristics

At T<sub>A</sub>=25°C, V<sub>IN</sub>=(V<sub>OUT</sub>+0.5V), C<sub>IN</sub>=C<sub>OUT</sub>=0.47μF, V<sub>EN</sub>=V<sub>IN</sub>, unless otherwise noted.

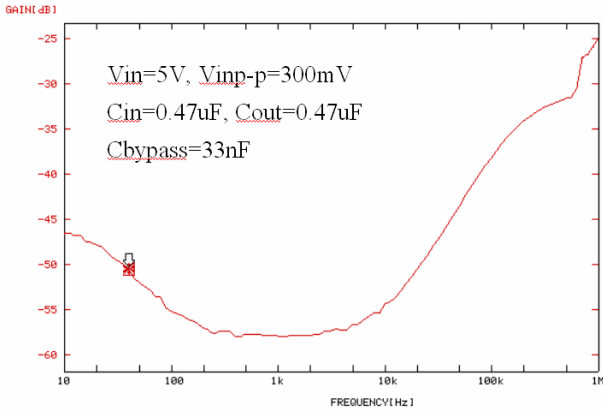
Dropout Voltage vs Load Current



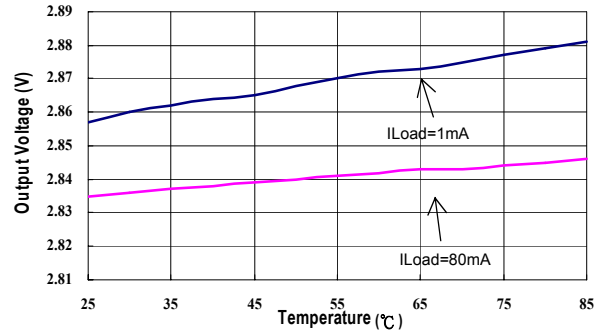
Ground Current vs. Input Voltage



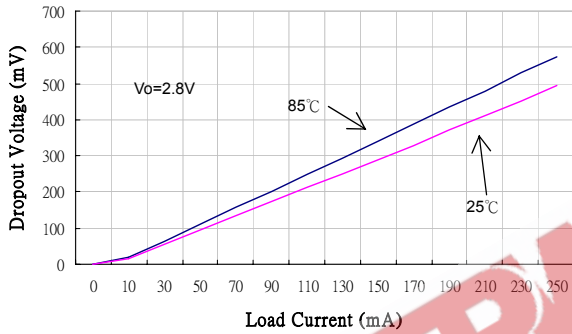
**PSRR vs Frequency (Load=1mA)**



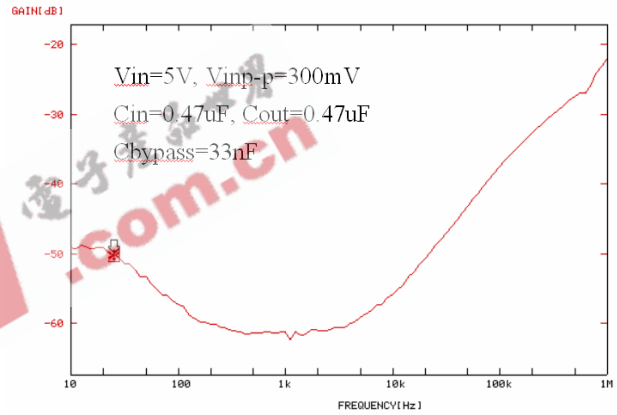
**Output Voltage vs. Temperature**



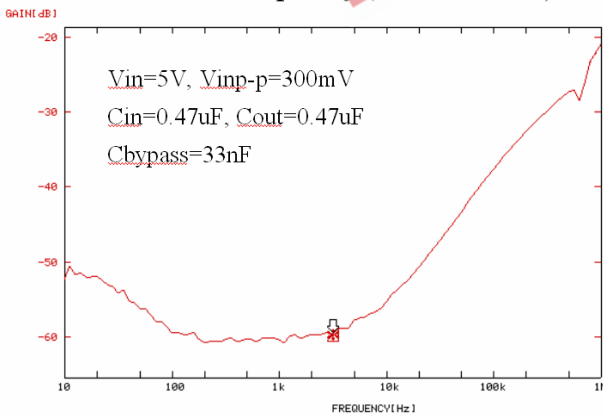
**Dropout Voltage vs Temperature**



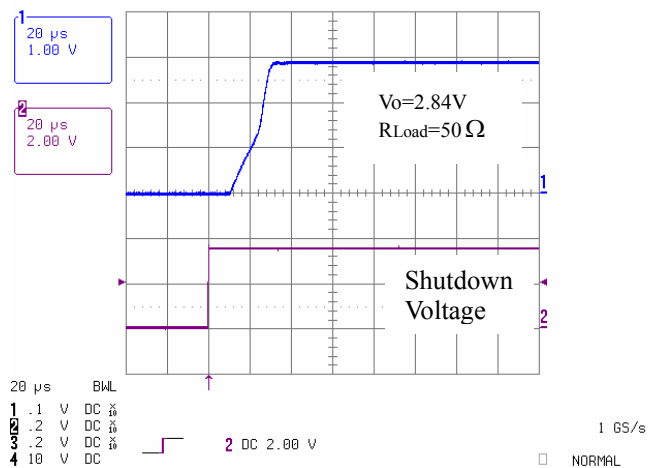
**PSRR vs Frequency (Load=10mA)**



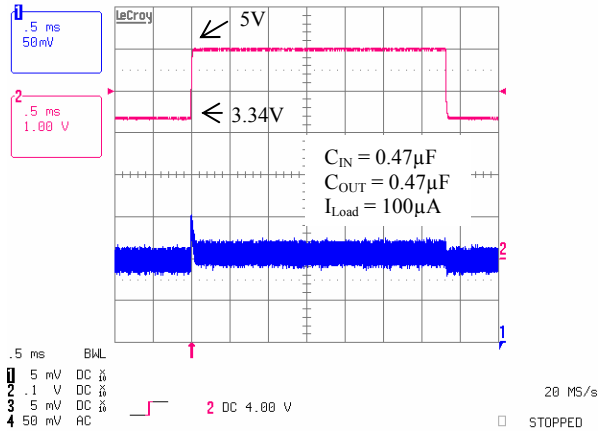
**PSRR vs Frequency (Load=100mA)**



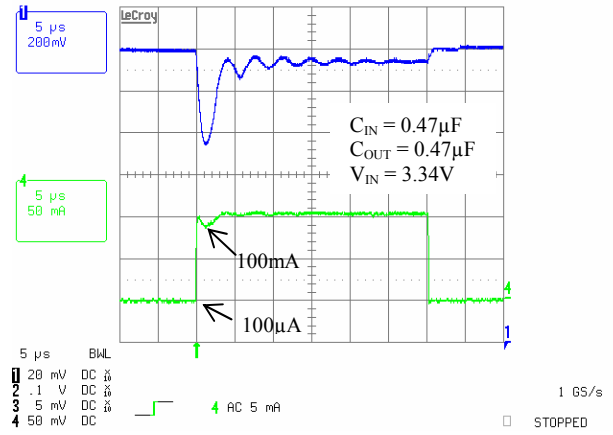
**Shutdown Exit Delay**



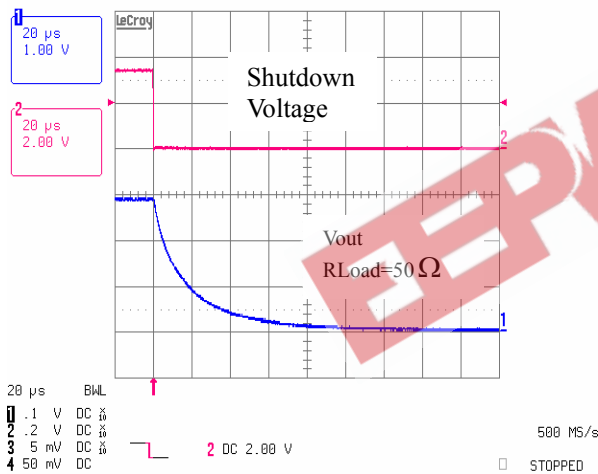
**Line Transient Response**



**Load Transient Response**



**Shutdown Delay**



## Functional Block Diagram

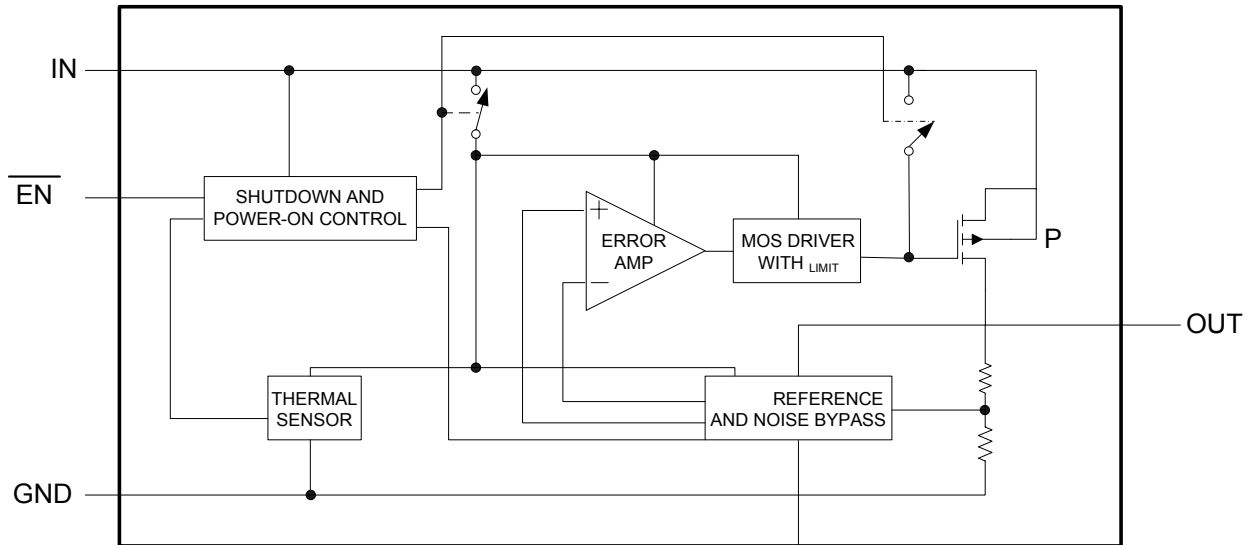


Figure 3. Block Diagram

## Functional Description

The YB1210 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 250mA. As shown in the *Functional Block Diagram*, the YB1210 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 1.8V to 3.3V.

### Stability

The YB1210 is a high performance LDO emphasizing stability with low output capacitance. It is able to maintain stability with an output capacitor as low as 0.47uF. The output capacitor can also be increased to optimize performance. The YB1210 will remain stable and in regulation with no load, unlike many other voltage regulators.

### Internal P-Channel Pass Transistor

The YB1210 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 YB1210 consumes only 90 $\mu$ A of quiescent current under most conditions.

### Output Short-Circuit Current Limit

The YB1210 includes a current limiter, which monitors and controls the pass transistor's gate voltage, limiting the output current to about 200mA, for example, in a short-circuit output situation.

### Shutdown

The YB1210 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 $^{\circ}$ 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 $^{\circ}$ C.

### Soft-Start Circuitry

The YB1210 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 YB1210 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.

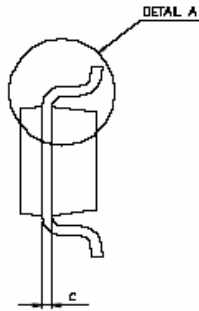
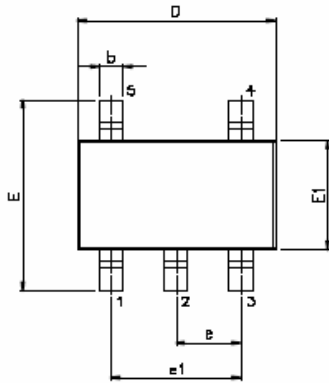
### Input/Output Capacitor

It is recommended to use a 0.47 $\mu$ F capacitor on the YB1210 input and a 0.47 $\mu$ 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.

### Power Supply Rejection and Transient Response

The PSRR and transient response can be improved by increasing the values of the input and output bypass capacitors, and through passive filtering techniques.

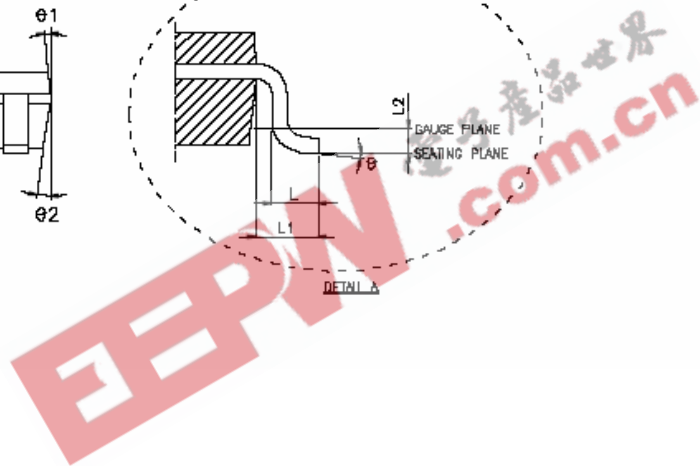
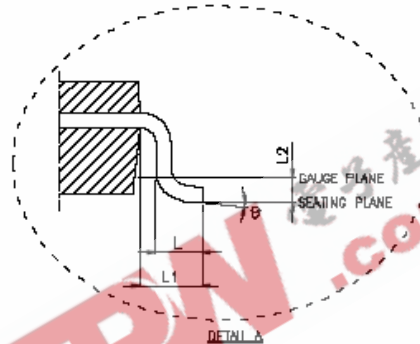
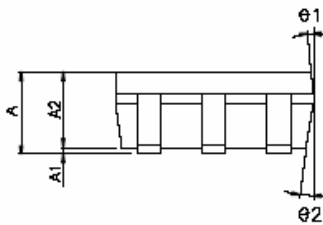
**SOT-25 Package Information**



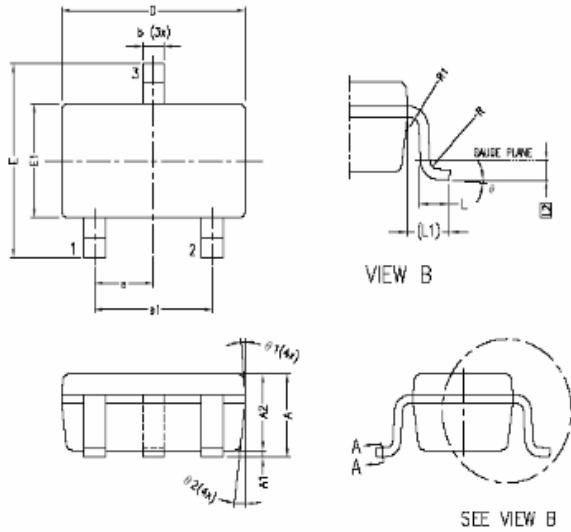
VARIATION (ALL DIMENSIONS SHOWN IN MM)

| 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     | 6'        | 8'   | 10'  |

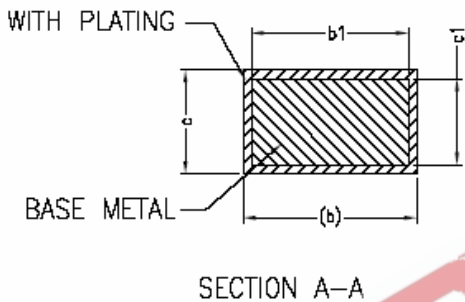
NOTE : 1. JEDEC OUTLINE : MO-17B AA



### SOT-23 Package Information



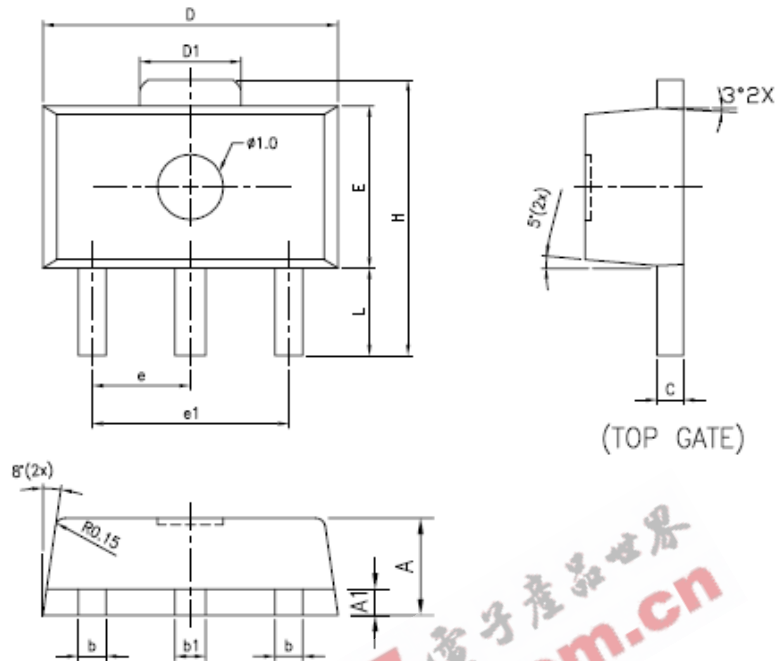
| SYMBOLS | DIMENSIONS IN MILLIMETERS |      |      |
|---------|---------------------------|------|------|
|         | MIN                       | NOM  | MAX  |
| A       | 1.05                      | 1.20 | 1.35 |
| A1      | 0.05                      | 0.10 | 0.15 |
| A2      | 1.00                      | 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                      | 1.60 | 1.70 |
| e       | 0.95 BSC                  |      |      |
| a1      | 1.90 BSC                  |      |      |
| L       | 0.35                      | 0.43 | 0.60 |
| L1      | 0.60 REF                  |      |      |
| L2      | 0.25 BSC                  |      |      |
| R       | 0.10                      | —    | —    |
| R1      | 0.10                      | —    | 0.25 |
| B       | 0°                        | 4°   | 8°   |
| θ1      | 5°                        | 6°   | 15°  |
| θ2      | 5°                        | 8°   | 15°  |



**NOTE:**

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. 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.
3. 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..
4. DIMENSION "b"
5. 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 . MINIMUM SPACE BETWEEN  
PROTRUSION AND AN ADJACENT LEAD SHALL NOT BE LESS  
THAN 0.07mm
5. 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 |
| C       | 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