

Description

The YB1210R is a series of ultra-low-noise, low dropout (LDO) linear regulators with 2.0% output voltage accuracy. The YB1210R regulators achieve a low 320mV dropout at 300mA load current of 3.3V output and are available in voltages ranging from 1.2V to 3.6V with 0.1 V per step (custom voltage is considerable at request).

The YB1210R regulators are optimized to work with low-ESR and low cost ceramic capacitors, reducing the amount of board space critical in portable devices. The YB1210R requires only 1.0 μ F output capacitor for stability with any load and consumes less than 1 μ A in shutdown mode.

Built-in thermal shutdown and short-circuit protect offer secure protection against fault operation. The YB1210R regulators are available in SOT-23 / SOT-25 / SOT-89 packages.

Features

- High Accuracy Output Voltage : $\pm 2\%$
- Wide Output Voltage Range : 1.2~3.6V
- Ultra-Low-Noise Low-Drop-Out
- Typical Output Current : 300 mA
- Low Quiescent Current: $\sim 60\mu$ A
- 320mV Dropout at 300mA 3.3V Output
- Stable with 1.0 μ F Ceramic Capacitor
- Only Need Input and Output Capacitors
- Thermal Protection Shutdown
- Output Short-Circuit Current Limit
- Built-In Internal Soft-Start
- Green Package (RoHS) Available

Applications

- PDA, Notebook, PC Computers
- DSC, Handset Camera Modules
- PCMCIA Cards, PC Cameras
- USB Based Portable Devices
- GSM/GPRS/3G RF Transceiver
- Wireless LANs
- Bluetooth Portable Radios
- Battery-Powered Devices

Typical Application Circuitry

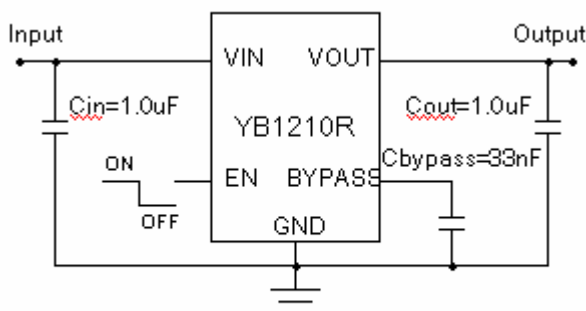


Figure 1-1 : SOT-25 application circuit

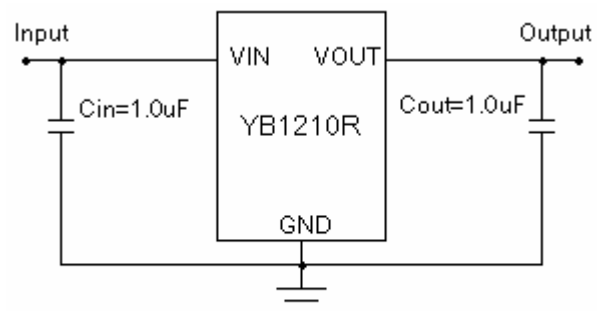


Figure 1-2 : SOT-23, SOT-89 application circuit

Pin Configuration

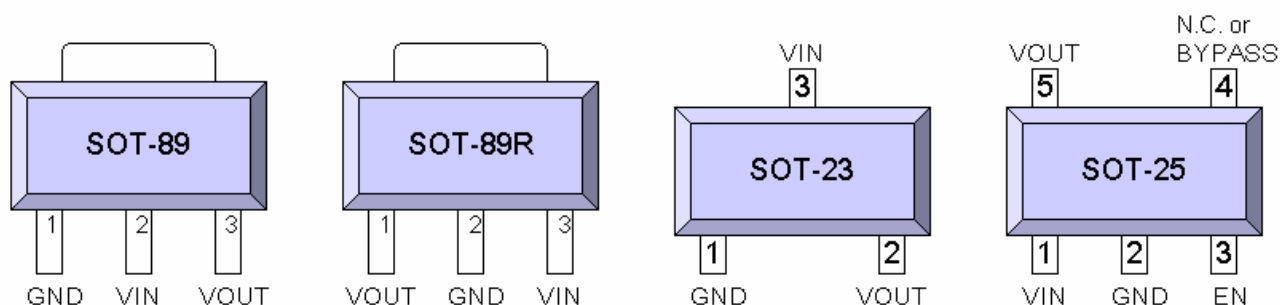


Figure 2 : pin configuration

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.
N.C. or BYPASS	Connect a 33nF capacitor to GND for low noise operation or N.C.
VOUT	Regulated Output Voltage. Bypass with a capacitor to GND.

Ordering Information

Y B 1 2 1 0 R

Output Voltage
 1 2 0 : 1.2 V
 1 3 0 : 1.3 V
 :
 3 6 0 : 3.6 V

R : fixed

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

- Order example :
YB1210ST89R250 for YB1210R of 2.5V 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

X C

Package Type V : SOT-23, T : SOT-25, S : SOT-89, R : SOT-89R

Code	A	B	C	D	E	F	G	H	I	J	K	L	M
Voltage	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4

Output Voltage

Code	N	O	P	Q	R	S	T	U	V	W	X	Y	
Voltage	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6	

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
 ESD Susceptibility (HBM) 2KV
 ESD Susceptibility (MM) 200V
 Thermal Resistance (SOT-23/25, θ_{JC}) 140°C/W
 Thermal Resistance (SOT-89, θ_{JC}) 46°C/W
 Thermal Resistance (SOT-23/25, θ_{JA}) 280°C/W
 Thermal Resistance (SOT-89, θ_{JA}) 180°C/W
 Internal Power Dissipation (SOT-23/25, P_D) 0.4W
 Internal Power Dissipation (SOT-89, P_D) 0.55W

Electrical Characteristics

Table 2

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

Function Parameter	Conditions	Min	Typ	Max	Units
Input Voltage Range		2.0		6.0	V
Output Voltage	Predefined	1.2		3.6	V
Output Voltage Accuracy	$I_{OUT} = 10\text{mA}$, $V_{OUT} \geq 1.3\text{V}$	-2.0		+2.0	%
	$I_{OUT} = 10\text{mA}$, $V_{OUT} = 1.2\text{V}$	0		+4.0	%
Output Current Limit	Short-circuit output		50		mA
Dropout Voltage (Note 1)	$V_{out} = 3.6\text{V}$, $I_{out} = 300\text{mA}$		300		mV
	$V_{out} = 3.0\text{V}$, $I_{out} = 300\text{mA}$		350		
	$V_{out} = 2.5\text{V}$, $I_{out} = 300\text{mA}$		450		
	$V_{out} = 1.5\text{V}$, $I_{out} = 300\text{mA}$		700		
	$V_{out} = 1.2\text{V}$, $I_{out} = 300\text{mA}$		870		
Ground Current	$I_{ground} = I_{in} - I_{out}$		60		μA
Line Regulation	$V_{in} = (V_{out} + 1\text{V})$ to 6V, $I_{out} = 10\text{mA}$		0.30	0.40	%/V
Load Regulation	$I_{out} = 1\text{mA}$ to 300 mA		1.0	1.5	%
Shutdown Supply Current	$EN = 0.4\text{V}$		0.01		μA
Ripple Rejection (PSRR)	$f = 1\text{KHz}$, $I_{out} = 1\text{mA}$		50		dB
	$f = 10\text{KHz}$, $I_{out} = 1\text{mA}$		60		
	$f = 100\text{KHz}$, $I_{out} = 1\text{mA}$		40		
Start Up Delay (Note 2)	$R_{load} = 100\text{ohm}$, $C_{bypass} = 0\text{nF}$		20	50	μS
	$R_{load} = 100\text{ohm}$, $C_{bypass} = 33\text{nF}$		2	3.5	mS
Shutdown Delay (Note 3)	$R_{load} = 10\text{K ohm}$, $V_{OUT} = 1.5\text{V}$		1		mS
	$R_{load} = 10\text{K ohm}$, $V_{OUT} = 1.2\text{V}$		1		mS
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	1.2		V_{in}	V
EN Input Bias Current	$V_{in} = EN = V_{out} + 1\text{V}$		0.01		μA
Thermal Shutdown	Shutdown Temperature		160		$^\circ\text{C}$
Thermal Hysteresis			20		$^\circ\text{C}$

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 V_{OUT} where $V_{in} = V_{out} + 1\text{V}$ for nominal V_{OUT} .

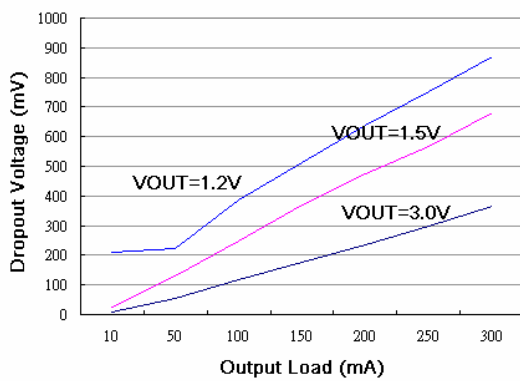
Note 2: Time needed for V_{OUT} to reach 90% of final value.

Note 3: Time needed for V_{OUT} to discharge below 0.5V.

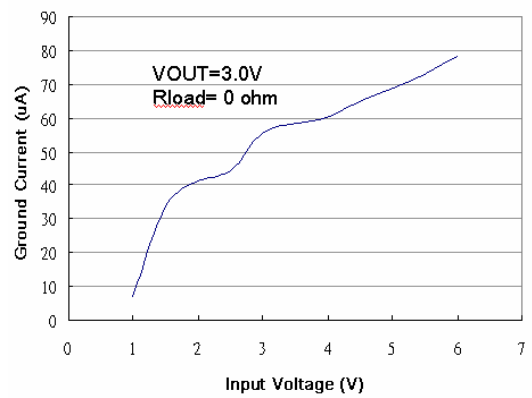
Typical Characteristics

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

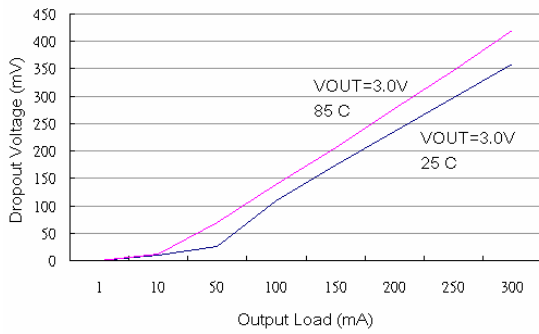
Dropout Voltage vs Output Load



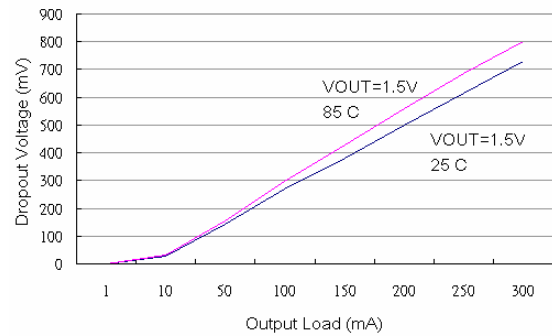
Ground Current vs Input Voltage



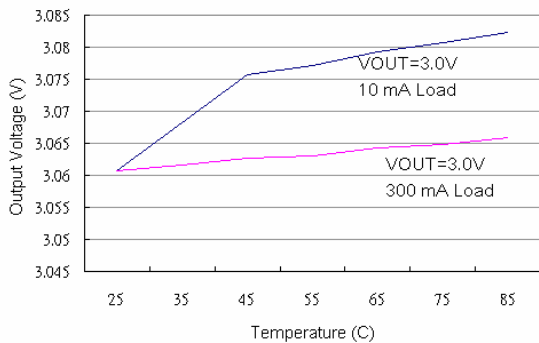
Dropout Voltage vs Temperature



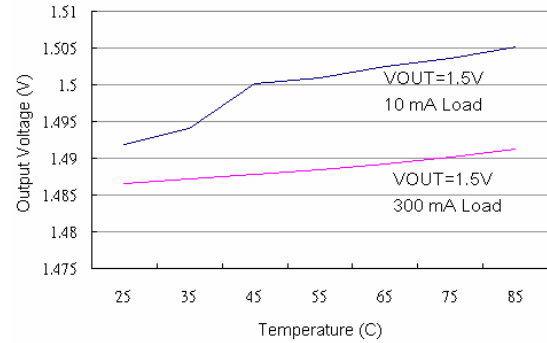
Dropout Voltage vs Temperature



Output Voltage vs Temperature

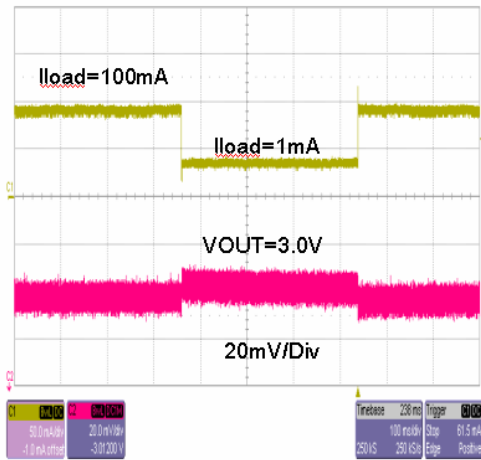


Output Voltage vs Temperature

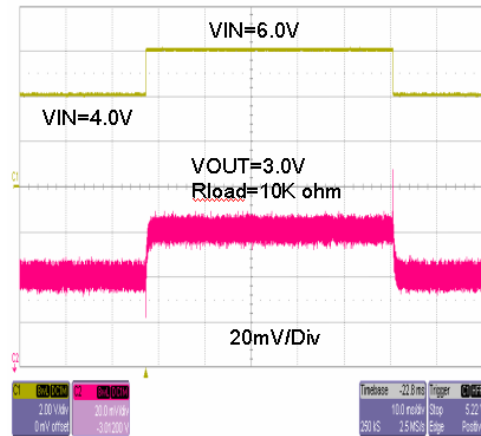


300mA, Ultra-Low-Noise, High PSRR LDO Regulator

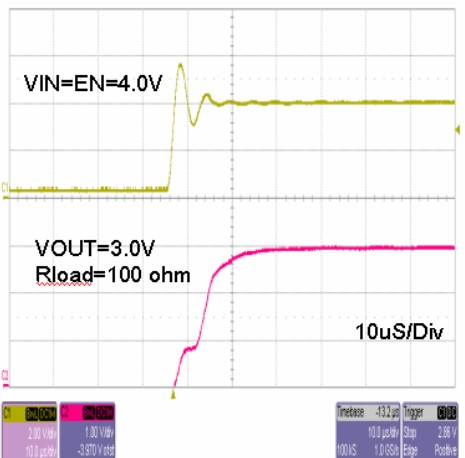
Load Transient Response



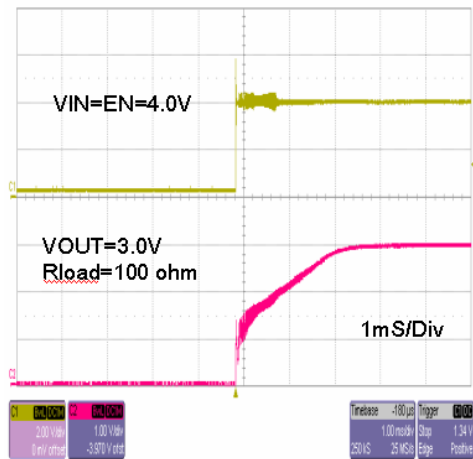
Line Transient Response



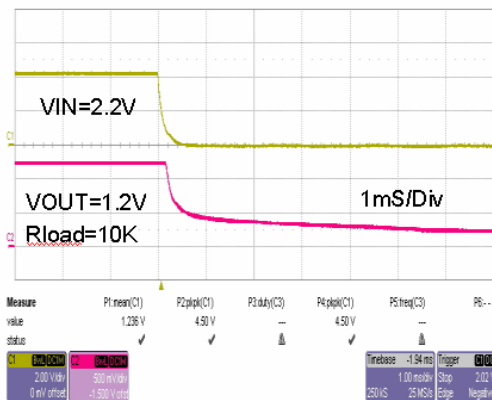
Start Up Delay ($C_{bypass} = 0nF$)



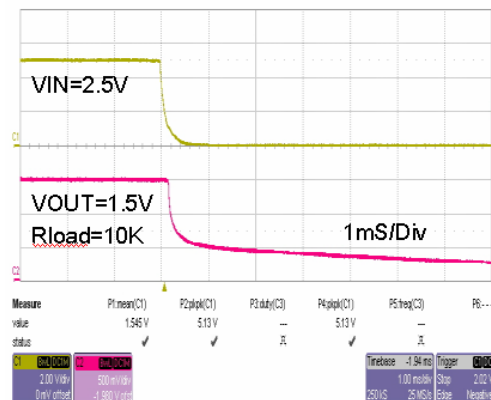
Start Up Delay ($C_{bypass} = 33nF$)

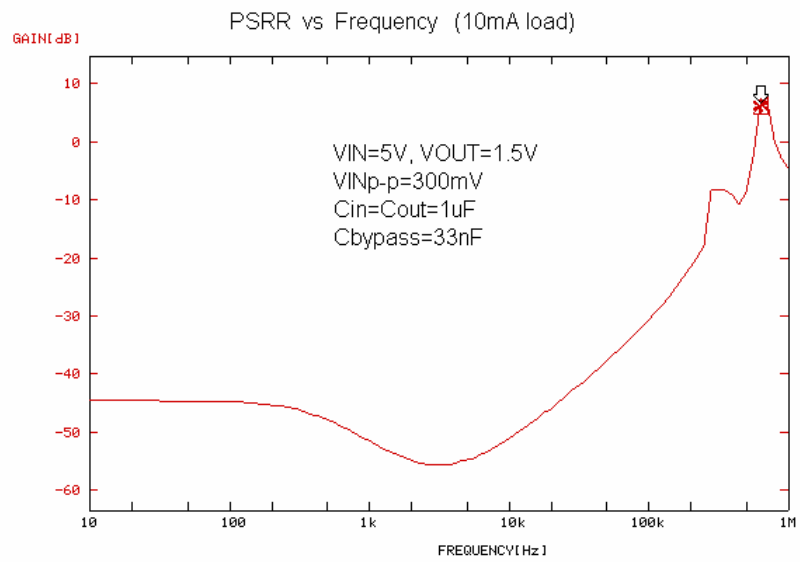
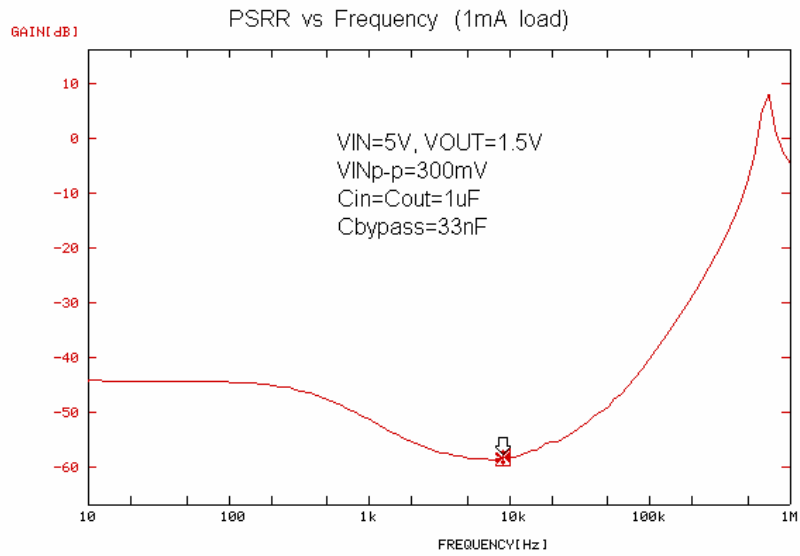


Shutdown Delay ($V_{OUT} = 1.2V$)



Shutdown Delay ($V_{OUT} = 1.5V$)





Functional Block Diagram

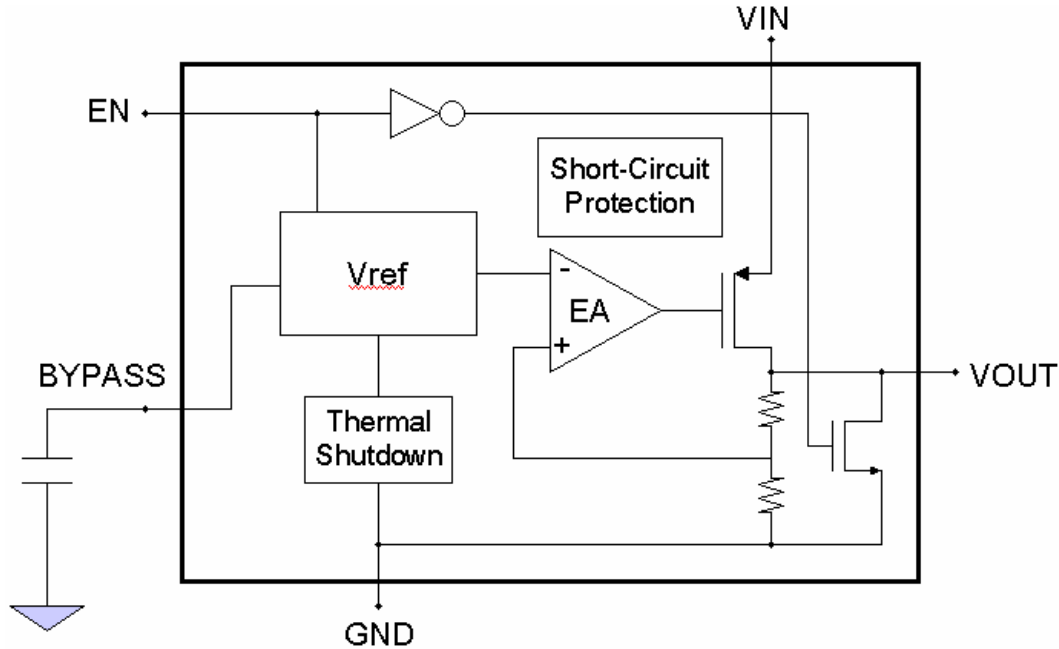


Figure 3 : Function Diagram

Functional Description

The YB1210R 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. YB1210R can supply loads up to 300mA (typical operation, not maximum) and output voltages are preset and ranging from 1.2V to 3.6V.

As shown in the *Functional Block Diagram*, the YB1210R 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 gate of the pass-transistor 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 gate of the pass transistor is pulled high, allowing less current to pass to the output.

Stability

The YB1210R is a high performance LDO emphasizing stability with low output capacitance. It is able to maintain stability with an output capacitor as low as 1.0 uF. The output capacitor can also be increased to optimize performance. The YB1210R will remain stable and in regulation with no load, unlike many other voltage regulators.

Internal P-Channel Pass Transistor

The YB1210R 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 YB1210R consumes only 60 μ A of quiescent current under most conditions.

Output Short-Circuit Current Limit

The YB1210R 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 YB1210R 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 μ 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.

Auto-Discharge Circuitry

The YB1210R deploys a NMOS connecting between VOUT and ground. When EN pin is pulled low, the NMOS is activated by an inverted signal from EN. The charge kept on output capacitor is discharged quickly through the NMOS. It prevents the system

from abnormal operation at the beginning of shutdown mode.

Soft-Start Circuitry

The YB1210R 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

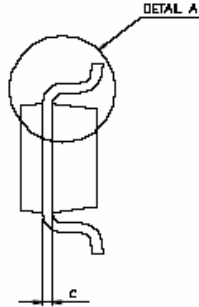
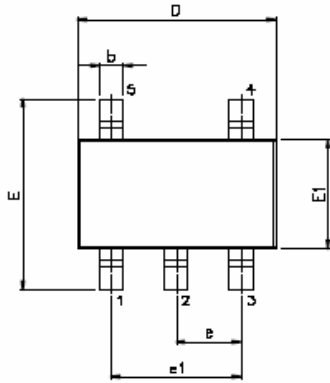
Enable/Shutdown

The YB1210R 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

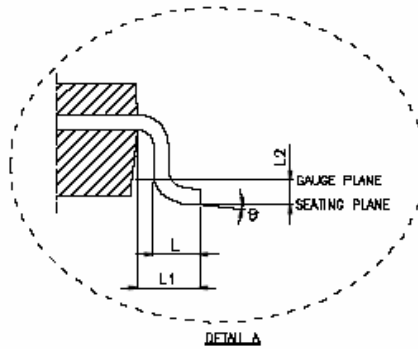
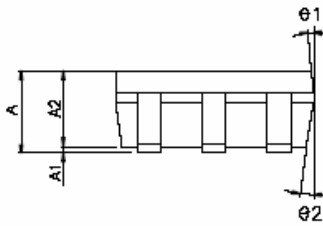
It is recommended to use a 1.0 μ F capacitor on the YB1210R input and a 1.0 μ F capacitor on the output. For high regulation performance, larger input capacitor values and lower ESRs provide better noise rejection and line-transient response. The output noise, load-transient response, stability, and 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



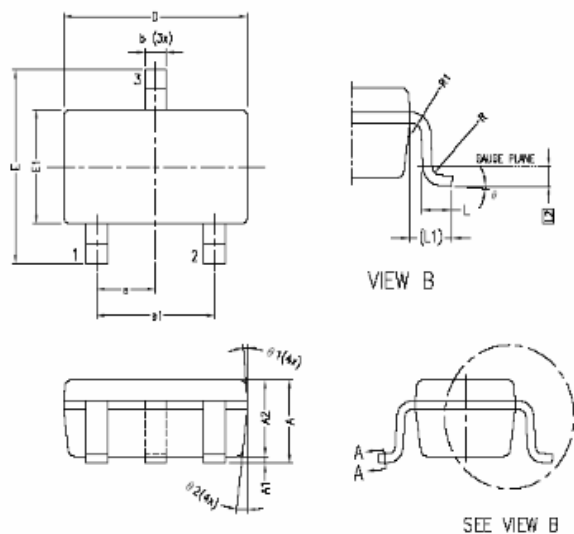
VARIATION (ALL DIMENSIONS SHOWN IN MM)

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	2.80	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.		
θ	0°	5°	10°
θ1	3°	5°	7°
θ2	8°	8°	10°

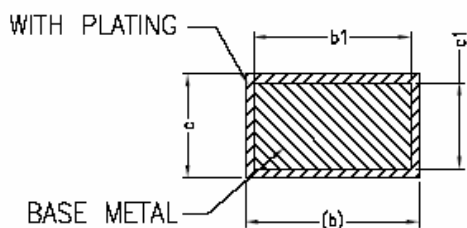


NOTE : 1. JEDEC OUTLINE : MO-178 AA

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	2.60	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	0°	4°	8°
θ1	5°	6°	15°
θ2	5°	8°	15°

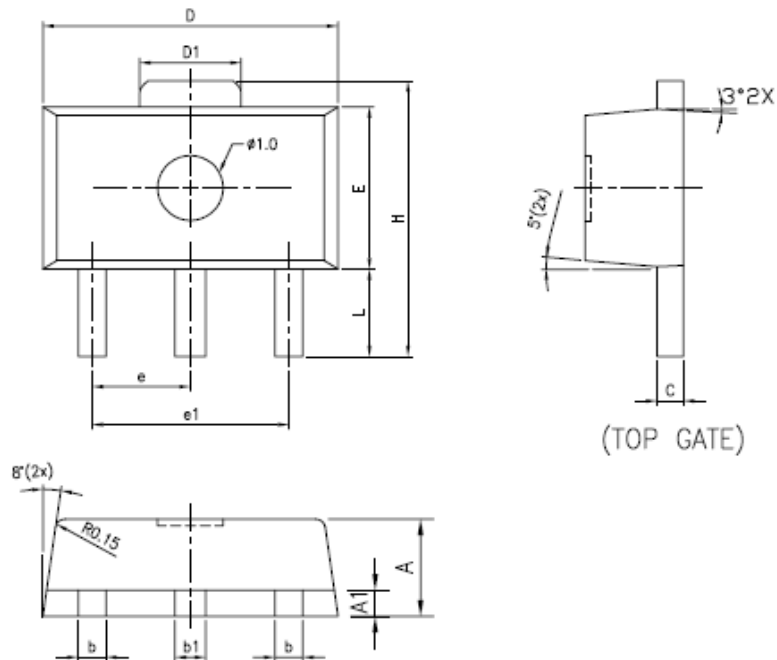


SECTION A-A

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” 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
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
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