# 75V, 50mA, Low Power Adjustable Output Linear Regulator

## FEATURES

- Wide 4.5V to 75V Input Range
- 10μA Quiescent Supply Current
- 2μA Shutdown Current
- 1.2V to 40V Adjustable Output
- 50mA Output Current with 100mA Peak Current Limit
- ±2% Accuracy
- Thermal Shutdown
- Available in SOP-8 Exposed Pad Package

## APPLICATIONS

- Notebook Computers
- Smart-Battery Packs
- PDAs
- Handheld Devices
- Battery-Powered Systems

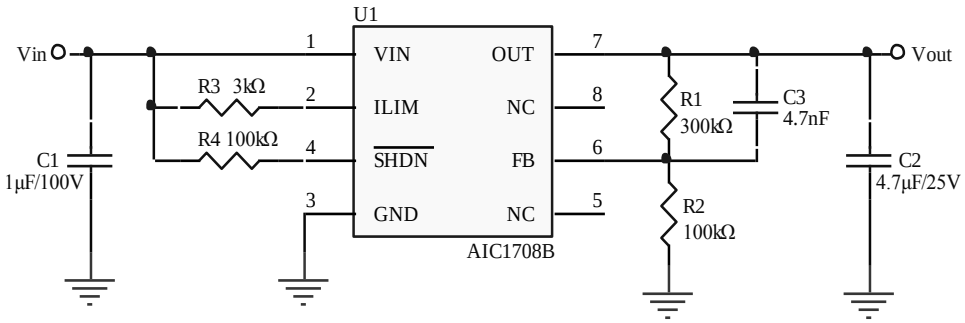
## DESCRIPTION

The AIC1708B is a low power linear regulator that supplies power to systems with high voltage batteries. It includes a wide 4V to 75V input range, low dropout voltage and low quiescent supply current.

The AIC1708B provides excellent line transient response time and 50dB power supply rejection ratio (PSRR). The AIC1708B can be set externally from 1.2V to 40V through a simple resistor divider network.

The AIC1708B also includes thermal shutdown and current limiting fault protection. It is in SOP-8 Exposed Pad packages.

## TYPICAL APPLICATION CIRCUIT




AIC1708B Typical Application Circuit

## ORDERING INFORMATION

AIC1708BXXXXXX

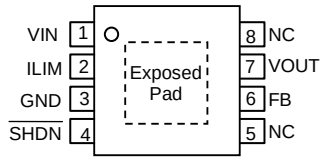
- PACKING TYPE
  TR: TAPE & REEL
  TB: TUBE
- PACKAGE TYPE
  S8E: SOP-8 Exposed Pad
- G: Green Package

Example: AIC1708BGS8ETR

→ Green SOP-8 Exposed Pad Package and Tape & Reel Packing Type

PIN CONFIGURATION

SOP-8 Exposed Pad
TOP VIEW




Note:
The exposed pad should be connected with GND pin

## ABSOLUTE MAXIMUM RATINGS

VIN Pin and $\overline{SHDN}$ Pin Voltage ..... 80V

GND Pin Voltage ..... -0.3V to $V_{IN}$+0.3V

FB Pin Voltage ..... -0.3V to +1.5V

Junction Temperature ..... 150ºC

Storage Temperature Range ..... -65ºC~150ºC

Lead Temperature (Soldering, 10 sec) ..... 260ºC

Operating Temperature Range ..... -40ºC~85ºC

Thermal Resistance Junction to Case, $\theta_{JC}$ SOP-8 Exposed Pad* ..... 15°C/W

Thermal Resistance Junction to Ambient, $\theta_{JA}$ SOP-8 Exposed Pad* ..... 45°C/W

Continuous Power Dissipation ($T_A$ = +25°C), $P_D$ SOP-8 Exposed Pad** ..... 2.5W
(Assume no Ambient Airflow)

**Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.**

* Measured on JESD51-7, 4-layer PCB.

** The maximum allowable power dissipation is a function of the maximum junction temperature $T_{J(MAX)}$, the junction-to-ambient thermal resistance $\theta_{JA}$, and the ambient temperature $T_A$. The maximum allowable continuous power dissipation at any ambient temperature is calculated by $P_{D(MAX)} = (T_{J(MAX)}-T_A)/\theta_{JA}$. Exceeding the maximum allowable power dissipation will cause excessive die temperature, and the regulator will go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.

## ■ ELECTRICAL CHARACTERISTICS

**($V_{IN}$=12V, $T_A$=25°C, unless otherwise specified) (Note 1)**

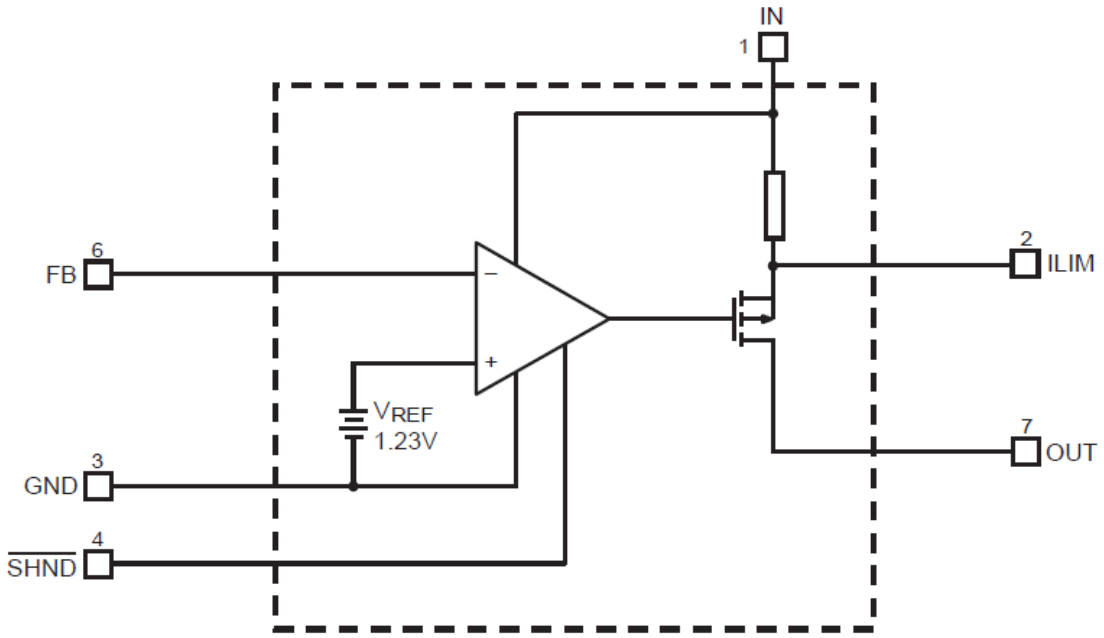
| PARAMETER | TEST CONDITIONS | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| Input Voltage | | $V_{IN}$ | 4 | | 75 | V |
| Output Voltage | | | 1.2 | | 40 | V |
| Input Supply Current | $T_A$ = +25°C | $I_Q$ | | 10 | | µA |
| | $T_A$ = -40°C to +85°C | | | | 30 | |
| Minimum Load Current | | | | | 0 | µA |
| Shutdown Supply Current | Shutdown Mode, $T_A$ = +25°C | $I_{OFF}$ | 1.2 | 1.35 | 1.5 | µA |
| | Shutdown Mode, $T_A$ = -40°C to +85°C | | | | | |
| FB Threshold | FB = OUT, $I_{LOAD}$ = 1mA | $V_{FB}$ | 1.205 | 1.23 | 1.254 | V |
| | FB = OUT, $I_{LOAD}$ = 5µA to 30mA, $T_A$ = -40°C to +85°C | | 1.181 | 1.23 | 1.279 | V |
| FB Input Current | $V_{FB}$ = 1.3V | $I_{FB}$ | -30 | 4 | 30 | nA |
| Dropout Voltage (Note 2) | $I_{LOAD}$ = 30mA | $V_{DROPOUT}$ | | 700 | 900 | mV |
| PSRR | DC, $I_{OUT}$ = 10mA | | | 65 | | dB |
| Current Limit (Note 3) | $V_{IN}$ = 6V | | | 50 | | mA |
| Ground Current | $I_{OUT}$ = 35mA | | | 35 | | µA |
| Capacitive Load Requirements | | | 0.23 | | | µF/mA |
| Startup Response Time | $R_L$ = 500Ω, C2 = 6.8µF, $V_{OUT}$ = 5V | | | | 1 | ms |
| Startup Overshoot | RL = 500Ω, C2 = 10µF, within 90% of the nominal output voltage | $V_{OSH}$ | | 0.58 | | % $V_{OUT}$ |
| $\overline{SHDN}$ Input Threshold Voltage | | $V_{IL}$ | | | 0.22 | V |
| | | $V_{IH}$ | 1.8 | | | V |
| $\overline{SHDN}$ Input Current | $\overline{SHDN}$ = 0V or 15V | $I_{SHDN}$ | | 0.6 | 1.5 | µA |
| Line Regulation | | | | 0.023 | | %/V |
| Load Regulation | | | | 0.003 | | %/mA |
| Thermal Shutdown | SHDN = 0V or 15V, Hysteresis =+20°C | | | 150 | | °C |

**Note 1.** Specifications are production tested at $T_A$=25°C. Specifications over the -40°C to 85°C operating temperature range are assured by design, characterization and correlation with Statistical Quality Controls (SQC).

**Note 2.** Dropout Voltage is defined as the input to output differential when the output voltage drops 1% below its nominal value.

**Note 3.** Sense resistor defined.

## BLOCK DIAGRAM




Functional Block Diagram of AIC1708B

## PIN DESCRIPTION

| Pin No. | Pin Name | Pin Function |
|---|---|---|
| 1 | VIN | Input Voltage. Connect a 4V to 75V supply to this pin. |
| 2 | ILIM | Programmable maximum peak current pin by sensing current through an accurate sense resistor between this pin and VIN. |
| 3 | GND | Ground. Connect the exposed pad and GND to the same ground plane. |
| 4 | $\overline{\text{SHDN}}$ | Shutdown. A logic Low on this pin will shut down the IC; a logic High will start it up. Connect this pin to VIN for automatic startup. |
| 5 | NC | No Connect. |
| 6 | FB | Feedback. This is the feedback input pin, regulated to 1.23V nominally. |
| 7 | OUT | Regulator Output. |
| 8 | NC | No Connect. |

## APPLICATION INFORMATION

The AIC1708B is a linear regulator designed primarily for high input voltage applications. The AIC1708B has an output that is adjustable from 1.2V to 40V with a simple resistor divider. The maximum power output current is a function of the package's maximum power dissipation for a given temperature.

The AIC1708B uses external feedback, allowing the user to set the output voltage with an external resistor divider. The typical FB pin threshold is 1.23V.

The IC enters shutdown mode when $\overline{SHDN}$ is low. In shutdown mode, the pass transistor, control circuitry, reference and all biases turn off, reducing the supply current to <2μA. Connect $\overline{SHDN}$ to VIN for automatic startup.

The peak output current is limited to 100mA, which exceeds the 50mA recommended continuous output current. The output can be shorted to ground for 30 seconds without damaging the part.

When the junction temperature is too high, the thermal sensor sends a signal to the control logic that will shutdown the IC. The IC will restart when the temperature has sufficiently cooled.

The maximum power dissipation is dependent on the thermal resistance of the case and the circuit board, the temperature difference between the die junction and the ambient air, and the rate of air flow. The GND pin and Exposed Pad must be connected to the ground plane for proper dissipation.

### COMPONENT SELECTION

#### Setting the Output Voltage

Set the output voltage of the AIC1708B by using a resistor divider as shown in figure 2.

Choose R2=250kΩ to maintain a 5μA minimum load. Calculate the value for R1 using the following equation:

$$R_1 = R_2 \times \left( \frac{V_{OUT}}{1.23V} - 1 \right)$$

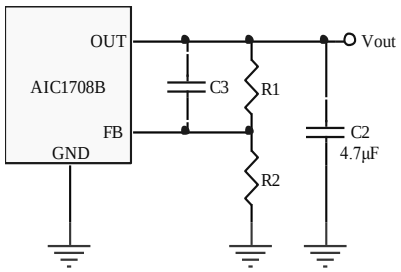



Fig. 2 AIC1708B with External Resistor Divider

#### Input Capacitor

For proper operation, place a ceramic capacitor (C1) between 1μF and 10μF of dielectric type X5R or X7R between the input pin and ground. Larger values in this range will help improve line transient response.

#### Output Capacitor

For stable operation, use a ceramic capacitor (C2) of type X5R or X7R between 1μF and 10μF. Larger values in this range will help improve load transient response and reduce noise. Output capacitors of other dielectric types may be used, but are not recommended as their capacitance can deviate greatly from their rated value over temperature.

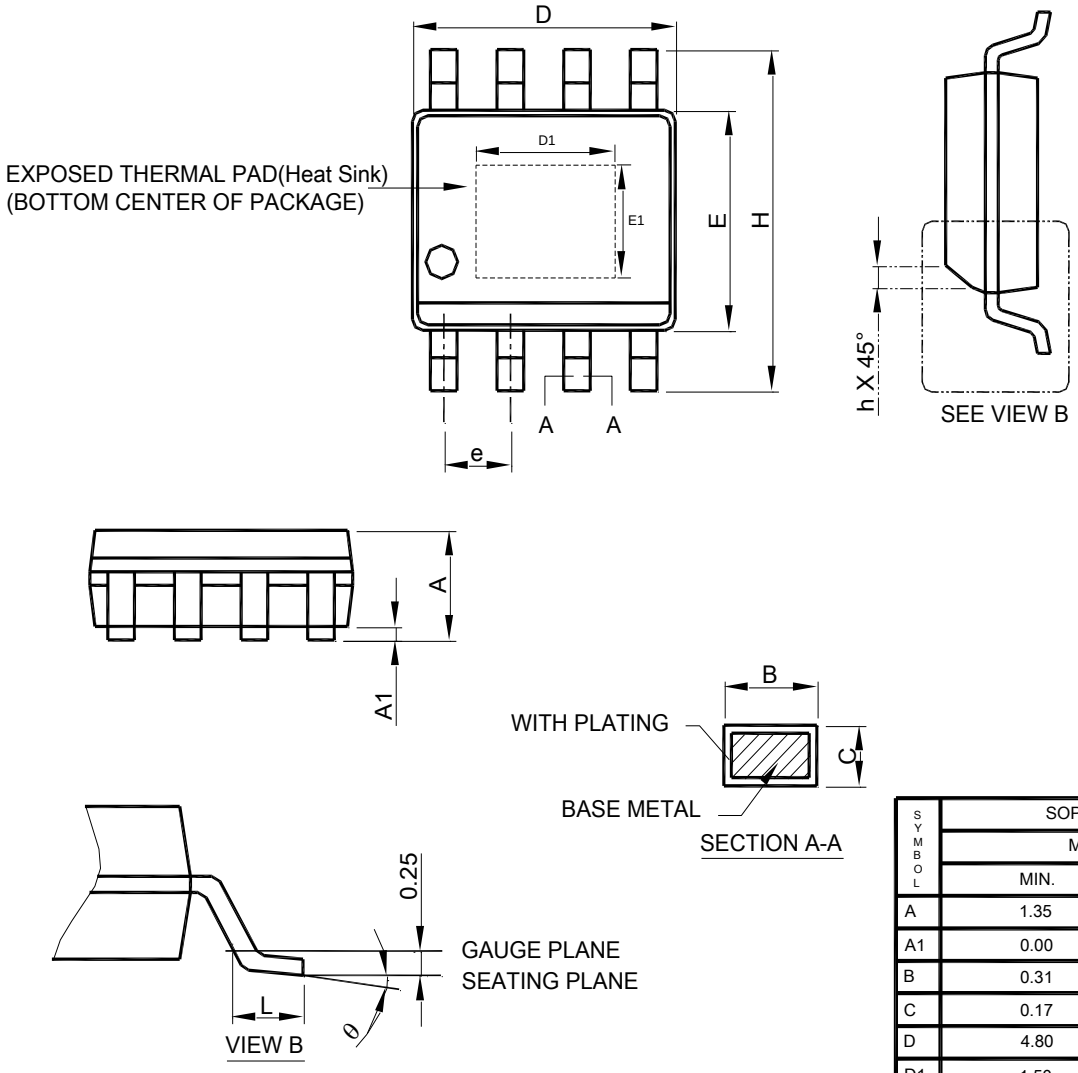
To improve load transient response, add a small ceramic (X5R, X7R or Y5V dielectric) 22nF feed forward capacitor in parallel with R1. The feed forward capacitor is not required for stable operation.

#### Output Noise

The AIC1708B will exhibit noise on the output during normal operation. This noise is negligible for most applications. However, in applications that include analog-to-digital converters (ADCs) of more than 12 bits, one needs to consider the ADC's power supply rejection specifications. The feed forward capacitor C3 across R1 will significantly reduce the output noise.

## PHYSICAL DIMENSIONS

- **SOP-8 Exposed Pad**




| SYMBOL | SOP-8 Exposed Pad | |
|---|---|---|
| | MILLIMETERS | |
| | MIN. | MAX. |
| A | 1.35 | 1.75 |
| A1 | 0.00 | 0.15 |
| B | 0.31 | 0.51 |
| C | 0.17 | 0.25 |
| D | 4.80 | 5.00 |
| D1 | 1.50 | 3.50 |
| E | 3.80 | 4.00 |
| E1 | 1.0 | 2.55 |
| e | 1.27 BSC | |
| H | 5.80 | 6.20 |
| h | 0.25 | 0.50 |
| L | 0.40 | 1.27 |
| θ | 0° | 8° |

Note : 1. Refer to JEDEC MS-012E.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side .
3. Dimension "E" does not include inter-lead flash or protrusions.
4. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.