

# AP1084

## Adjustable 5A Positive Low Dropout Regulator

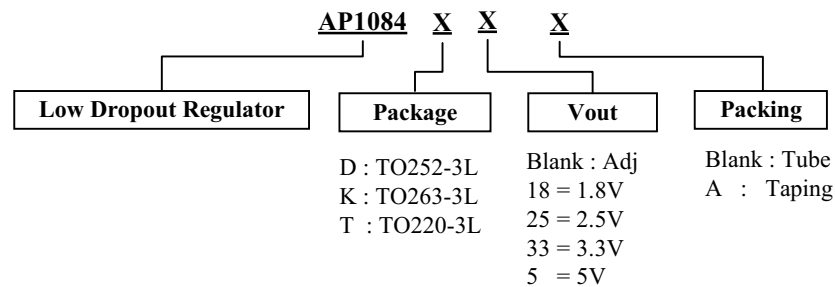
### ■ Features

- 1.4V maximum dropout at full load current
- Built-in thermal shutdown
- Output current limiting
- Adjustable output voltage or fixed 1.8V, 2.5V, 3.3V, 5V
- Fast transient response
- Good noise rejection
- Package: TO252, TO263, TO220

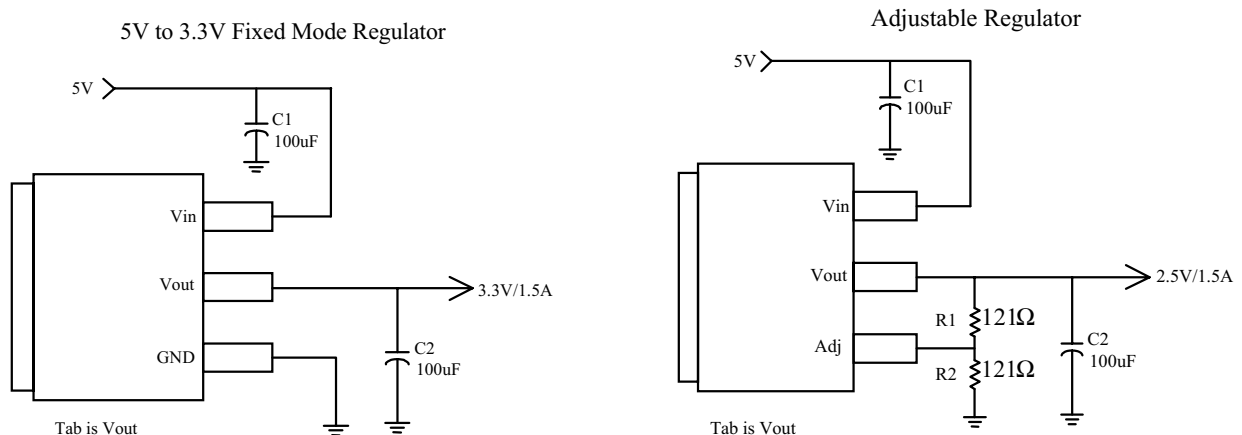
### ■ General Description

AP1084 is an adjustable positive low dropout regulator with minimum of 5.0A output current capability. The product is specifically designed to provide well-regulated supply for low voltage IC applications such as high-speed bus termination and low current 3.3V logic supply. AP1084 is also well suited for other applications such as VGA cards. AP1084 is guaranteed to have lower than 1.4V dropout at full load current making it ideal to provide well-regulated outputs of 1.25 to 3.3V with 4.7 to 7V input supply.

### ■ Ordering Information



### ■ Typical Circuit



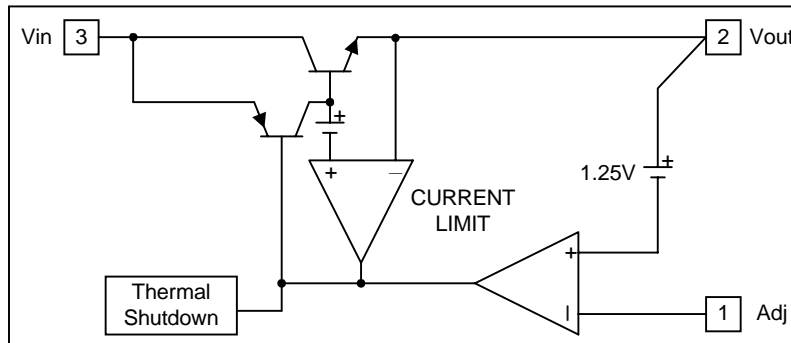
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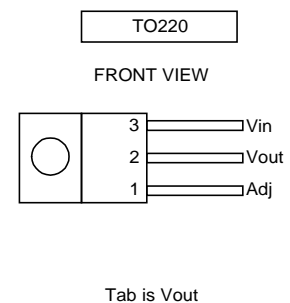
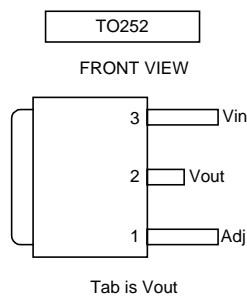
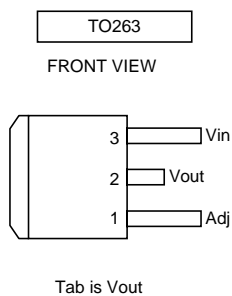


## Adjustable 5A Positive Low Dropout Regulator

### ■ Block Diagram



### ■ Connection Diagram



### ■ Pin Descriptions

| Name | I/O | Pin# | Function   |
|------|-----|------|--|
| Adj  |     | 1    | A resistor divider from this pin to the Vout pin and ground sets the output voltage.   |
| Vout | O   | 2    | The output of the regulator. A minimum of 10uF capacitor must be connected from this pin to ground to insure stability.  |
| Vin  | I   | 3    | The input pin of regulator. Typically a large storage capacitor is connected from this pin to ground to insure that the input voltage does not sag below the minimum dropout voltage during the load transient response. This pin must always be 1.4V higher than Vout in order for the device to regulate properly. |

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### ■ Absolute Maximum Ratings

|  |                    |
|--|--------------------|
| DC Supply Voltage (Vin) .....              | -0.3 to 12 V       |
| Power Dissipation .....                    | Internally Limited |
| Storage Temperature .....                  | -65 to +150 °C     |
| Operating Junction Temperature Range ..... | 0 to +150 °C       |

### ■ Electrical Characteristics (Under Operating Conditions)

| Sym.             | Parameter  | Conditions (Notes)  | Min.  | Typ.     | Max.  | Unit |
|------------------|--|---|---|----------|-------|------|
| V <sub>REF</sub> | Reference Voltage  | I <sub>o</sub> =10mA, T <sub>j</sub> =25°C, (V <sub>in</sub> -V <sub>out</sub> )=1.5V | 1.243   | 1.250    | 1.257 | V    |
|                  |  | I <sub>o</sub> =10mA, (V <sub>in</sub> -V <sub>out</sub> )=1.5V                       | 1.237   | 1.250    | 1.263 |      |
|                  | Line Regulation  | I <sub>o</sub> =10mA, 1.4V < (V <sub>in</sub> -V <sub>out</sub> ) < 12V               |   |          | 0.2   | %    |
|                  | Load Regulation  | V <sub>in</sub> =3.3V, V <sub>adj</sub> =0, 10mA < I <sub>o</sub> < 5.0A              |   |          | 1     | %    |
| ΔV <sub>o</sub>  | Dropout Voltage  | I <sub>o</sub> =5.0A (ΔV <sub>out</sub> = 1% V <sub>out</sub> )                       |   | 1.3      | 1.4   | V    |
|                  |  | Current Limit   | V <sub>in</sub> =3.3V, dV <sub>o</sub> =100mV | 5.1      |       |      |
|                  | Minimum Load Current   | V <sub>in</sub> =3.3V, V <sub>adj</sub> =0V   |   | 5        | 10    | mA   |
| I <sub>ADJ</sub> | Adjust Pin Current   | I <sub>o</sub> =10mA, V <sub>in</sub> -V <sub>out</sub> =1.5V, T <sub>j</sub> =25°C   |   | 55       | 100   | μA   |
|                  |  | I <sub>o</sub> =10mA, V <sub>in</sub> -V <sub>out</sub> =1.5V                         |   |          |       |      |
|                  | Adjust Pin Current Change  | I <sub>o</sub> =10mA, V <sub>in</sub> -V <sub>out</sub> =1.5V, T <sub>j</sub> =25°C   |   | 0.2      | 5     | μA   |
|                  | Temperature Stability  | V <sub>in</sub> =3.3V, V <sub>adj</sub> =0V, I <sub>o</sub> =10mA                     |   | 0.5      |       | %    |
| θ <sub>JA</sub>  | Thermal Resistance<br>Junction-to-Ambient<br>(No heat sink ;No air flow) | TO-252  |   | 98       |       | °C/W |
|                  |  | TO-263  |   | 91       |       | °C/W |
|                  |  | TO-220  |   | 83       |       | °C/W |
| θ <sub>JC</sub>  | Thermal Resistance<br>Junction-to-Case                                   | TO-252: Control Circuitry/Power Transistor  |   | 15       |       | °C/W |
|                  |  | TO-263: Control Circuitry/Power Transistor  |   | 10       |       | °C/W |
|                  |  | TO-220: Control Circuitry/Power Transistor  |   | 0.65/2.7 |       | °C/W |

### ■ Functional Description

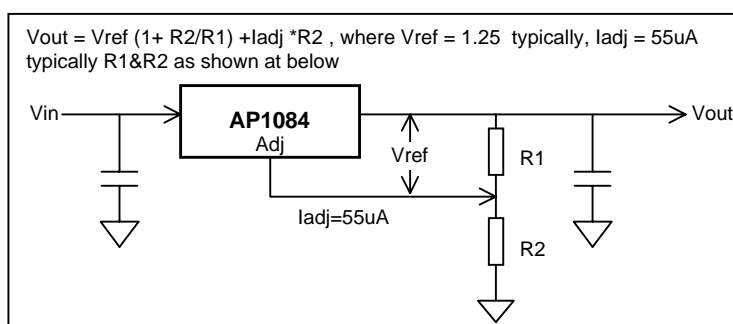
#### Introduction

The AP1084 adjustable Low Dropout (LDO) regulator is a 3 terminal device which can easily be programmed with the addition of two external resistors to any voltages within the range of 1.25 to 5V. The AP1084 only needs 1.4V differential between  $V_{in}$  and  $V_{out}$  to maintain output regulation. In addition, the output voltage tolerances are also extremely tight and they include the transient response as part of the specification. For example Intel VRE specification calls for a total of +/- 100mV including initial tolerance, load regulation and 0 to 5.0A load step.

The AP1084 is specifically designed to meet the fast current transient needs as well as providing an accurate initial voltage, reducing the overall system cost with the need for fewer output capacitors.

#### Output Voltage Setting

The AP1084 can be programmed to any voltages in the range of 1.25V to 5V with the addition of R1 and R2 external resistors according to the following formula:



The AP1084 keeps a constant 1.25V between the output pin and the adjust pin. By placing a resistor R1 across these two pins a constant current flows through R1, adding to the  $I_{adj}$  current and into the R2 resistor producing a voltage equal to the  $(1.25/R1)*R2 + I_{adj}*R2$  which will be added to the 1.25V to set the output voltage. This is summarized in the above equation. Since the minimum load current requirement of the AP1084 is 10mA, R1 is typically selected to be 121Ω resistor so that it automatically satisfies the minimum current requirement. Notice that since  $I_{adj}$  is typically in the range of 55uA it only adds a small error to the output voltage and should only be considered when a very precise output voltage setting is required. For example, in a typical 3.3V application where R1=121Ω and R2=200Ω the error due to  $I_{adj}$  is only 0.3% of the nominal set point.

#### Load Regulation

Since the AP1084 is only a 3 terminal device, it is not possible to provide true remote sensing of the output voltage at the load. The best load regulation is achieved when the bottom side of R2 is connected to the load and the top-side of R1 resistor is connected directly to the case or the Vout pin of the regulator and not to the load. It is important to note that for high current applications, this can re-present a significant percentage of the overall load regulation and one must keep the path from the regulator to the load as short as possible to minimize this effect.

#### Stability

The AP1084 requires the use of an output capacitor as part of the frequency compensation in order to make the regulator stable. For most applications a minimum of 10uF aluminum electrolytic capacitor insures both stability and good transient response.

#### Thermal Design

The AP1084 incorporates an internal thermal shutdown that protects the device when the junction temperature exceeds the maximum allowable junction temperature. Although this device can operate with junction temperatures in the range of 150°C, it is recommended that the selected heat sink be chosen such that during maximum continuous load operation the junction temperature is kept below the temperature.

#### Layout Consideration

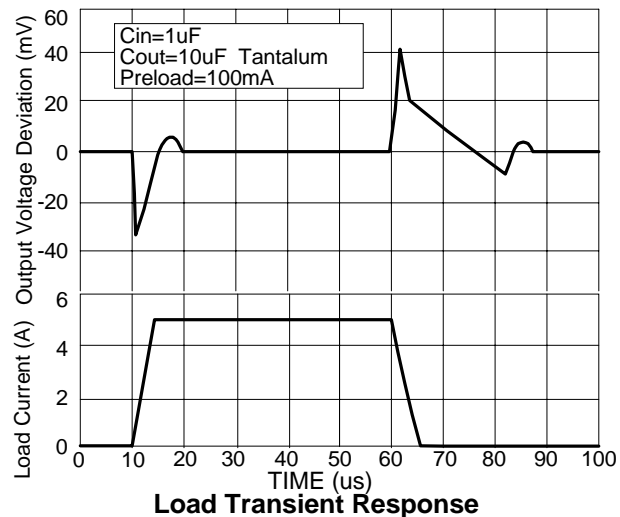
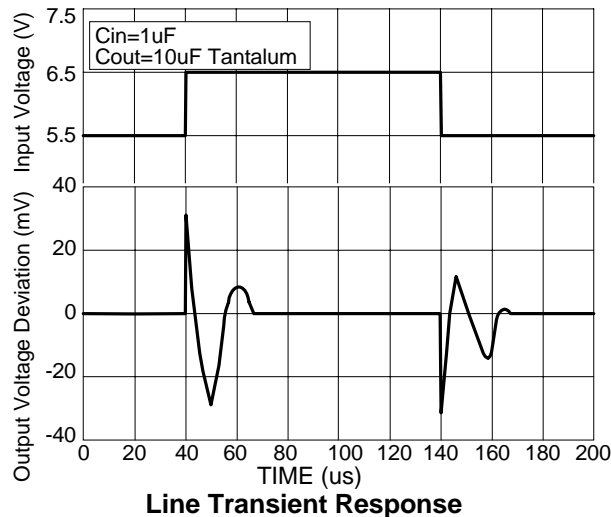
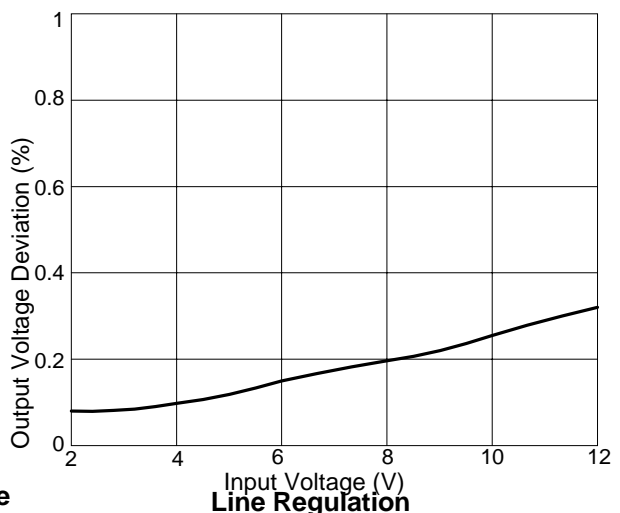
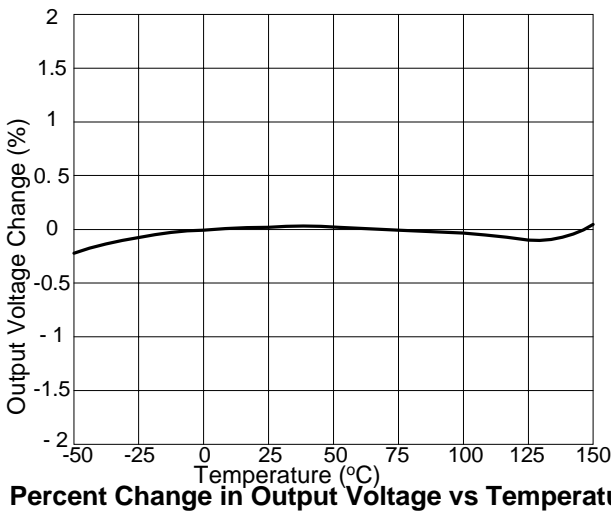
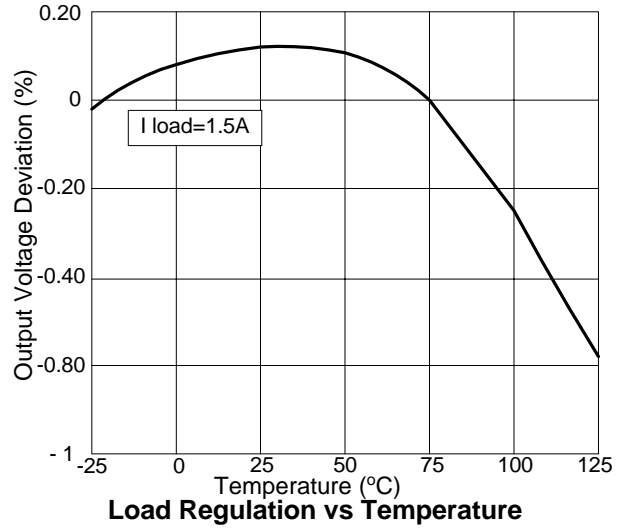
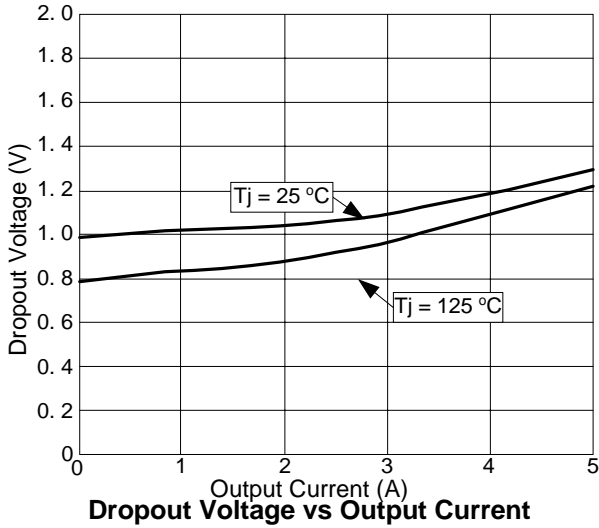
The output capacitors must be located as close to the Vout terminal of the device as possible. It is recommended to use a section of a layer of the PC board as a plane to connect the Vout pin to the output capacitors to prevent any high frequency oscillation that may result due to excessive trace inductance.

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### ■ Performance Characteristics



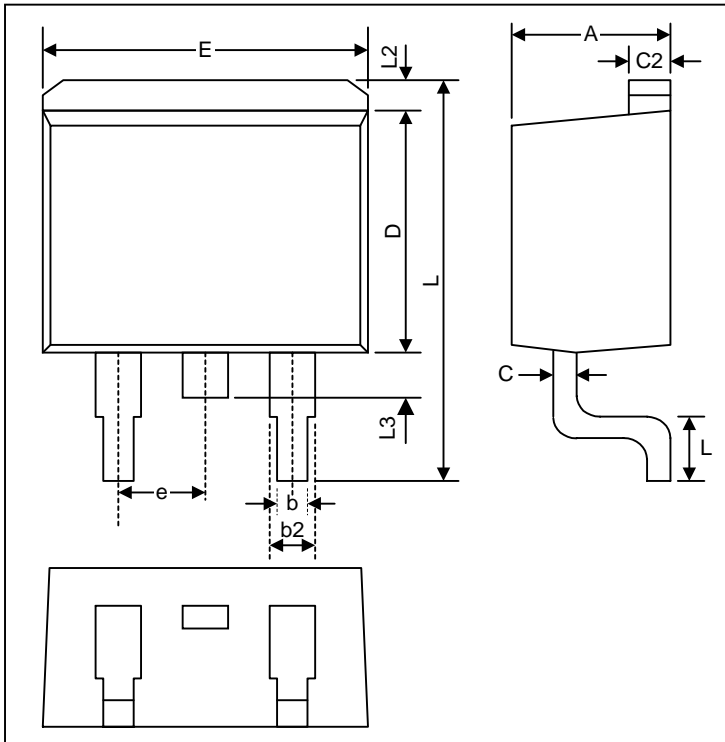
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## Adjustable 5A Positive Low Dropout Regulator



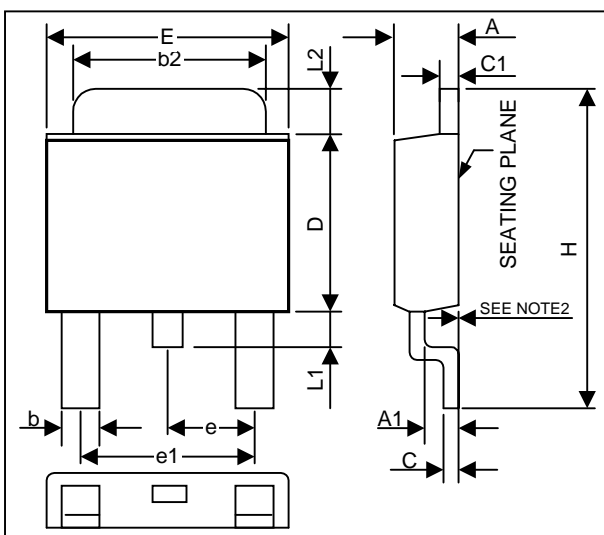
### ■ Package Dimension Unit: inch ; Variations (All Dimensions Show in inch)

#### (1) TO263-3L



| SYMBOLS | MIN.       | MAX.  |
|---------|------------|-------|
| A       | 0.16       | 0.19  |
| B       | 0.02       | 0.039 |
| B2      | 0.045      | 0.055 |
| C       | 0.015 TYP. |       |
| C2      | 0.045      | 0.055 |
| D       | 0.34       | 0.38  |
| E       | 0.38       | 0.405 |
| e       | 0.100 BSC. |       |
| L       | 0.575      | 0.625 |
| L1      | 0.09       | 0.11  |
| L2      | —          | 0.115 |
| L3      | 0.050      | 0.070 |

#### (2) TO252-3L



| SYMBOLS | MIN.       | MAX.  |
|---------|------------|-------|
| A       | 0.086      | 0.094 |
| A1      | 0.040      | 0.050 |
| b       | 0.024 TYP. |       |
| b2      | 0.205      | 0.215 |
| C       | 0.018      | 0.023 |
| C1      | 0.018      | 0.023 |
| D       | 0.210      | 0.220 |
| E       | 0.250      | 0.265 |
| e       | 0.090 BSC. |       |
| e1      | 0.180 BSC. |       |
| H       | 0.370      | 0.410 |
| L       | 0.020      | —     |
| L1      | 0.025      | 0.040 |
| L2      | 0.06       | 0.08  |

#### NOTES:

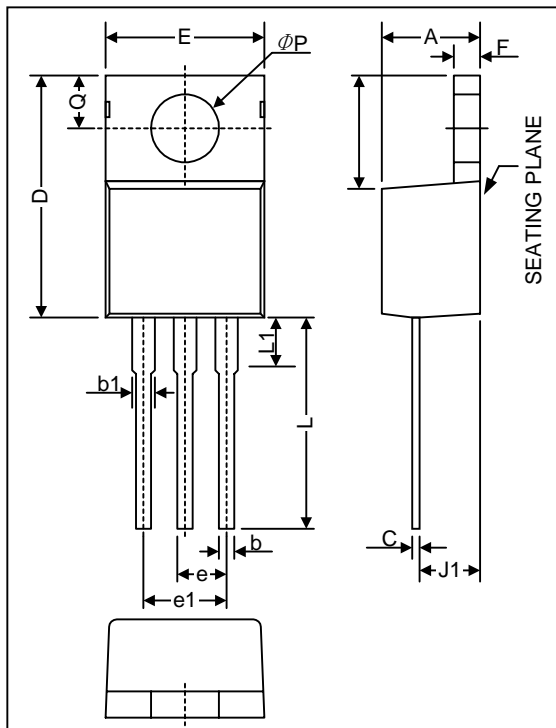
1. JEDEC OUTLINE: TO-252 AB
2. 2 MILS SUGGESTED FOR POSITIVE CONTACT AT MOUNTING.

# AP1084

## Adjustable 5A Positive Low Dropout Regulator



(3) TO220-3L



| SYMBOLS  | MIN.  | MAX.  |
|----------|-------|-------|
| A        | 0.14  | 0.19  |
| b1       | 0.045 | 0.07  |
| b        | 0.02  | 0.045 |
| C        | 0.012 | 0.045 |
| D        | 0.56  | 0.65  |
| E        | 0.38  | 0.42  |
| e        | 0.09  | 0.11  |
| e1       | 0.19  | 0.21  |
| F        | 0.02  | 0.055 |
| H1       | 0.23  | 0.27  |
| J1       | 0.08  | 0.115 |
| L        | 0.5   | 0.58  |
| $\phi P$ | 0.139 | 0.161 |
| Q        | 0.1   | 0.135 |