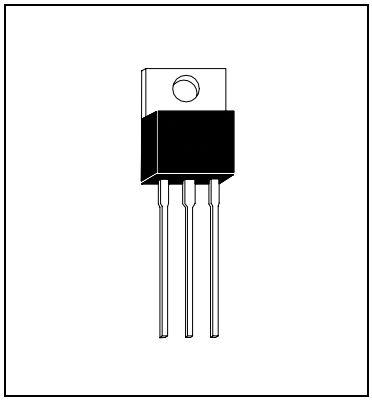
# H1084E Series

5A LOW DROPOUT POSITIVE VOLTAGE REGULATOR



## Features

- Low Dropout Voltage 1.2V at 5A
- Adjustable or Fixed Voltage.
- Line Regulation Typically 0.015%.
- Load Regulation Typically 0.05%.
- Adjust Pin Current Less Than 90 uA.
- Over Current Protection.
- Thermal Protection.

## Applications

- High Efficiency Linear Regulators
- Post Regulators For Switching Supplies
- 5V to 3.3V Voltage Converter
- Battery Charger

## General Description

The H1084E is a 5A low-dropout positive voltage regulator. It is available in fixed and adjustable output voltage versions. Over Current and thermal protection are integrated onto the chip. Output current will decrease while it reaches the pre-set current or temperature limit. The dropout voltage is specified at 1.2V Maximum at full rated output current. H1084E Series provides excellent regulation over variations due to changes in line, load and temperature. H1084E is three terminal regulator and available in popular packages.

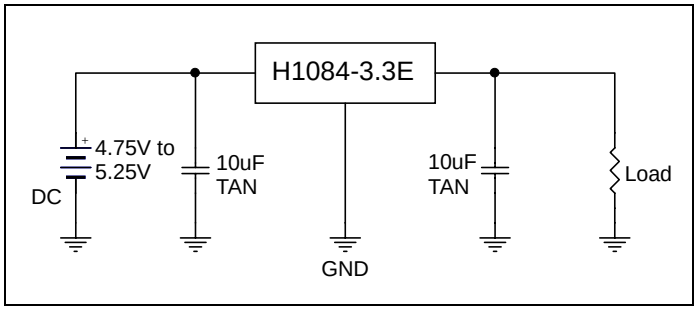
## Device Selection Guide

| Device | Output Voltage | Package |
|---|---|---|
| H1084E | 1.3V to 4V | TO-220AB |
| H1084-3.3E | 3.3 | |

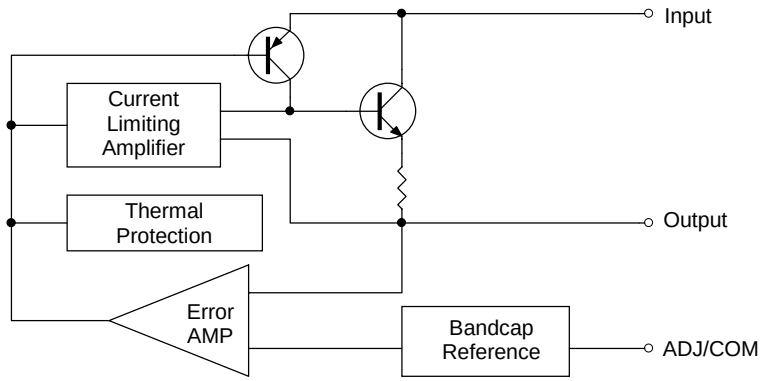
## Absolute Maximum Ratings

| Parameter | Symbol | Maximum | Units |
|---|---|---|---|
| Input Voltage | $V_{IN}$ | 7 | V |
| Power Dissipation | $P_D$ | Internally Limited | W |
| Thermal Resistance Junction To Case TO-220 | $\theta_{JC}$ | 3 | °C/W |
| Thermal Resistance Junction To Ambient TO-220 | $\theta_{JA}$ | 50 | °C/W |
| Operating Junction Temperature Range | $T_j$ | 0 To 125 | °C |
| Storage Temperature Range | $T_{STG}$ | -65 To 150 | °C |
| Lead Temperature (Soldering) 10 Sec | $T_{LEAD}$ | 260 | °C |

## Typical Application



## Block Diagram




## Electrical Characteristics

H1084E (adj version)

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Reference Voltage<br>Adj Voltage | $V_{REF}$ | $V_{IN}$=5V, $I_O$=10mA, $T_j$=25°C | 1.238 | 1.250 | 1.262 | V |
| | | $V_{IN}$=5V, $I_O$=10mA, Over Temp. | 1.225 | 1.250 | 1.275 | |
| Line Regulation | $Reg_{LINE}$ | $V_{IN}$=2.75~7V, $I_O$=10mA, $T_j$=25°C | - | 0.015 | 0.2 | % |
| | | $V_{IN}$=2.75~7V, $I_O$=10mA, Over Temp. | - | 0.035 | 0.2 | |
| Load Regulation | $Reg_{LOAD}$ | $V_{IN}$=5V, $I_O$=10mA~5A,$T_j$=25°C | - | 0.05 | 0.3 | % |
| | | $V_{IN}$=5V, $I_O$=10mA~5A, Over Temp. | - | 0.2 | 0.4 | |
| Dropout Voltage<br>$\Delta V_{OUT}$, $\Delta V_{REF}$=1% | $V_D$ | $V_{IN}$=2.75~7V, $I_O$=10mA~5A | - | 1 | - | V |
| | | | - | 1 | 1.2 | |
| Current Limit | $I_S$ | $V_{IN}$=2.75~7V, Over Temp. | 5 | - | - | A |
| Temperature Coeff. | $T_C$ | $V_{IN}$=2.75~7V, $I_O$=10mA~5A | - | 0.005 | - | %/°C |
| Adjust Pin Current | $I_{adj}$ | $V_{IN}$=2.75~7V, $I_O$=10mA~5A,Tj=25°C | - | 55 | - | uA |
| | | $V_{IN}$=2.75~7V, $I_O$=10mA~5A, Over Temp. | - | - | 90 | |
| Adjust Pin Current Change | $\Delta I_{adj}$ | $V_{IN}$=2.75~7V, $I_O$=10mA~5A, Over Temp. | - | 0.2 | 5 | |
| Temperature Stability | $T_S$ | $V_{IN}$=5V, $I_O$=500mA, Over Temp. | - | 0.5 | - | % |
| Minimum Load Current | $I_O$ | $V_{IN}$=5V | - | 5 | 10 | mA |
| RMS Output Noise | $V_N$ | $T_j$=25°C | - | 0.003 | - | %$V_O$ |
| Ripple Rejection Ratio | $R_A$ | $V_{IN}$=5V, $I_O$=5A, Over Temp. | 60 | 72 | - | dB |

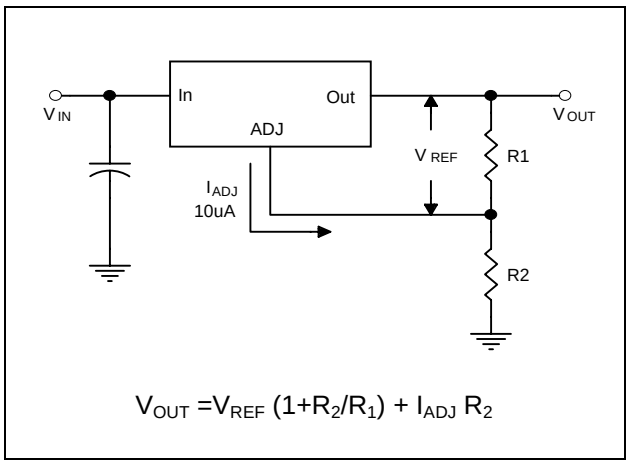
H1084-3.3E

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Output Voltage<br>Fixed Voltage | $V_O$ | $V_{IN}$=5V, $I_O$=0A,$T_j$=25°C | 3.267 | 3.3 | 3.333 | V |
| | | $V_{IN}$=5V, $I_O$=0A, Over Temp. | 3.234 | 3.3 | 3.366 | |
| Line Regulation | $Reg_{LINE}$ | $V_{IN}$=4.5~7V, $I_O$=0A, $T_j$=25°C | - | 0.015 | 0.2 | % |
| | | $V_{IN}$=4.5~7V, $I_O$=0A, Over Temp. | - | 0.035 | 0.2 | |
| Load Regulation | $Reg_{LOAD}$ | $V_{IN}$=5V, $I_O$=0A~5A,$T_j$=25°C | - | 0.05 | 0.3 | % |
| | | $V_{IN}$=5V, $I_O$=0A~5A, Over Temp. | - | 0.2 | 0.4 | |
| Dropout Voltage<br>$\Delta V_{OUT}$, $\Delta V_{REF}$=1% | $V_D$ | $V_{IN}$=4.5~7V, $I_O$=0A~5A, $T_j$=25°C | - | 1 | - | V |
| | | $V_{IN}$=4.5~7V, $I_O$=0A~5A, Over Temp. | - | 1 | 1.2 | |
| Current Limit | $I_S$ | $V_{IN}$=4.5~7V, Over Temp. | 5 | 7.5 | - | A |
| Quiescent Current<br>Fixed Model | $I_Q$ | $V_{IN}$=5V, $I_O$=0A~5A,Over Temp. | - | 12 | 13 | mA |
| Temperature Coeff. | $T_C$ | $V_{IN}$=4.5~7V, $I_O$=0A~5A | - | 0.005 | - | %/°C |
| Temperature Stability | $T_S$ | $V_{IN}$=5V, $I_O$=500mA, Over Temp. | - | 0.5 | - | % |
| RMS Output Noise | $V_N$ | $T_j$=25°C | - | 0.003 | - | %$V_O$ |
| Ripple Rejection Ratio | $R_A$ | $V_{IN}$=5V, $I_O$=5A, Over Temp. | - | 72 | - | dB |

## Applications Description

- Output Voltage Adjustment

Like most regulators, the H1084E regulates the output by comparing the output voltage to an internally generated reference voltage. On the adjustable version, the $V_{REF}$ is available externally as 1.25V between $V_{OUT}$ and ADJ. The voltage ratio formed by $R_1$ and $R_2$ should be set to conduct 10mA (minimum output load). The output voltage is given by the following equation : $V_{OUT} = V_{REF} (1+R_2/R_1) + I_{ADJ} R_2$ On fixed versions of H1084E, the voltage divider is provided internally.




$V_{OUT} = V_{REF} (1+R_2/R_1) + I_{ADJ} R_2$

- Thermal Protection

H1084E has thermal protection which limits junction temperature to 150°C. However, device functionality is only guaranteed to a maximum junction temperature of +125°C.

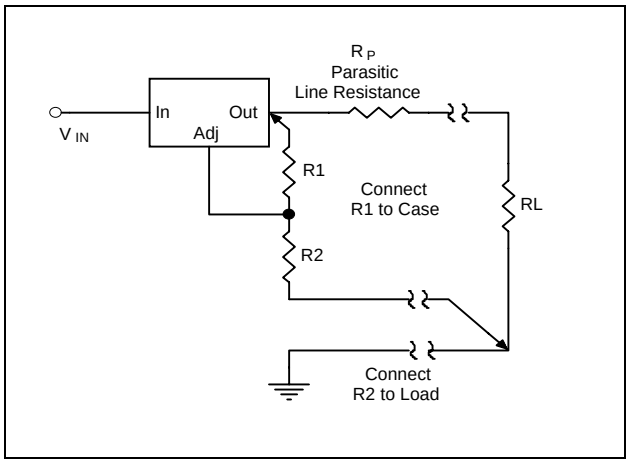
The power dissipation and junction temperature for H1084E in TO-220AB package given by $P_D=(V_{IN} - V_{OUT}) I_{OUT}$, $T_{JUNCTION}=T_{AMBIENT}+(P_D x \theta_{JA})$, Note : $T_{JUNCTION}$ must not exceed 125°C

- Current Limit Protection

H1084E is protected against overload conditions. Current protection is triggered at typically 7.5A.

- Stability And Load Regulation

H1084E requires a capacitor from $V_{OUT}$ to GND to provide compensation feedback to the internal gain stage. This is to ensure stability at the output terminal. Typically, a 10uF tantalum or 50uF aluminum electrolytic is sufficient. Note : It is important that the ESR for this capacitor does not exceed 0.5Ω.




The output capacitor does not have a theoretical upper limit and increasing its value will increase stability. $C_{OUT}$ = 100 uF or more is typical for high current regulator design.

H1084E load regulation is limited by the resistance of the wire connecting it to the load($R_P$). For the adjustable version, the best load regulation is accomplished when the top of the resistor divider($R_1$) is connected directly to the output pin of the H1084E. When so connected, $R_P$ is not multiplied by the divider ratio. For fixed output versions, the top of $R_1$ is internally connected to the output and ground pin can be connected to low side of the load as a negative side sense if, so desired.

- Thermal Consideration

The H1084E series contain thermal limiting circuitry designed to protect itself for over-temperature conditions. Even for normal load conditions, maximum junction temperature ratings must not be exceeded. As mention in thermal protection section, we need to consider all sources of thermal resistance between junction and ambient. It contains junction-to-case, case-to-heat-sink interface and heat sink resistance itself. An additional heat sink is applied externally sometimes. It can increase the maximum power dissipation. For example, the equivalent junction temperature of 1A output current is 115°C without external heat sink. Under the same junction temperature IC can operates 3A with an adequate heat sink. Therefore, to attach an extra heat sink is recommended.

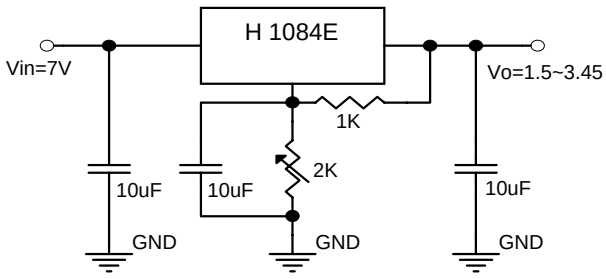
Junction-to-case thermal resistance is specified from the IC junction to the bottom of the case directly below the die. The bonding wires are appending paths. The former is the lowest resistance path. Proper mounting is required to ensure the best possible thermal flow this area of the package to the heat sink. Thermal compound at the case-to-heat-sink interface is strongly recommended. The case of all devices in this series is electrically connected to the output. Therefore, if the case of the device must be electrically isolated, a thermally conductive spacer can be used, as long its thermal resistance is considered.

- Protection Diode

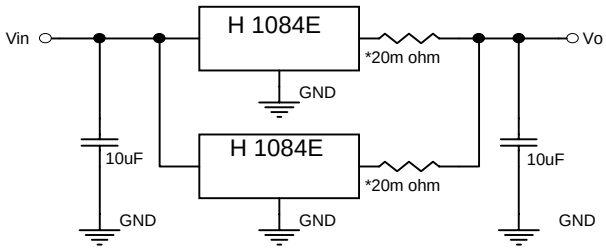
(The figure is shown as Regulator with Reverse Diode Protection in advanced applications)

In general operation, H1084E does not need any protection diodes. From the cross-section structure of H1084E, the output pin is connected to P+ substrate, and the input pin is connected to N- well. There is a parasitic reverse diode between them. It can handle microsecond surge currents of 50A to 100A. Even with large output capacitance, it is very difficult to get those values of surge currents in normal operation. Only with high value output capacitors, such as 1000uF. And with the input pin instantaneously shorted to ground. can damage occur. A crowbar circuit at the input of the H1084E can generate those kinds of currents, and a diode from output to input is recommended. Normal power supply cycling or even plugging and unplugging in the system will not generate currents large enough to do any damage.

- Advanced Applications

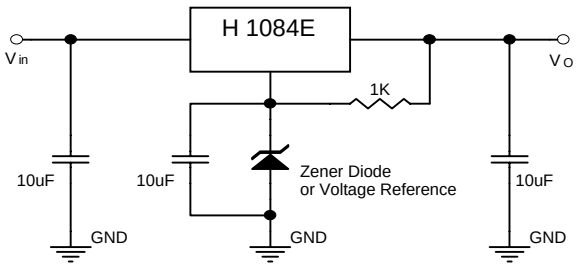



Adjustable Output Voltage



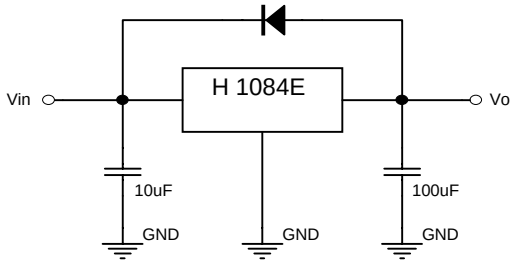

Paralleling Regulators

*20m ohm is ballast resistance..
The inter - connection of #18 wire could act as ballast resistance.




*Vo = Vref ( 1+R2/R1 ) + Iadj x R2
**Optional for improved ripple rejection.

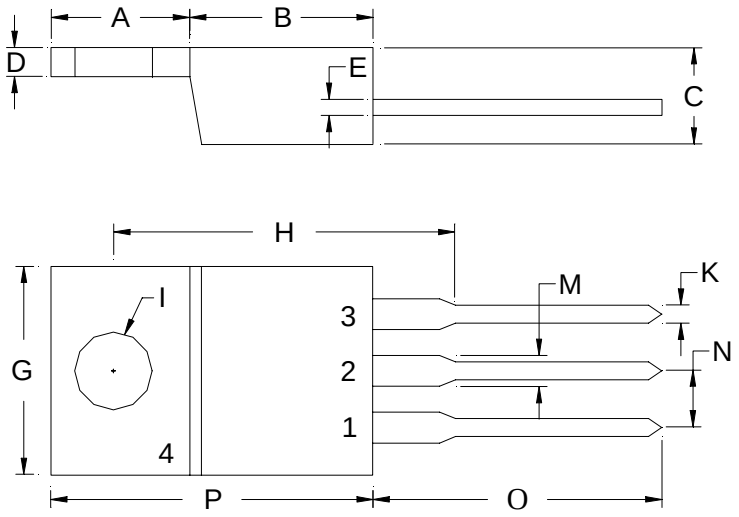
Regulator with Reference



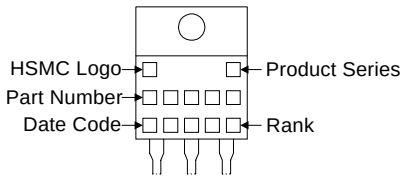

*Please refer to "protection diode section" for detailed description.

Regulator with Reverse Diode Protection

## TO-220AB Dimension




Marking :




Style : Pin 1.ADJ/COM 2.Vout 3.Vin
4.Vout

3-Lead TO-220AB Plastic Package
HSMC Package Code : E

*:Typical

| DIM | Inches | | Millimeters | | DIM | Inches | | Millimeters | |
|---|---|---|---|---|---|---|---|---|---|
| | Min. | Max. | Min. | Max. | | Min. | Max. | Min. | Max. |
| A | 0.2197 | 0.2949 | 5.58 | 7.49 | I | - | *0.1508 | - | *3.83 |
| B | 0.3299 | 0.3504 | 8.38 | 8.90 | K | 0.0295 | 0.0374 | 0.75 | 0.95 |
| C | 0.1732 | 0.185 | 4.40 | 4.70 | M | 0.0449 | 0.0551 | 1.14 | 1.40 |
| D | 0.0453 | 0.0547 | 1.15 | 1.39 | N | - | *0.1000 | - | *2.54 |
| E | 0.0138 | 0.0236 | 0.35 | 0.60 | O | 0.5000 | 0.5618 | 12.70 | 14.27 |
| G | 0.3803 | 0.4047 | 9.66 | 10.28 | P | 0.5701 | 0.6248 | 14.48 | 15.87 |
| H | - | *0.6398 | - | *16.25 | | | | | |

Notes : 1.Dimension and tolerance based on our Spec. dated Sep. 07,1997.
2.Controlling dimension : millimeters.
3.Maximum lead thickness includes lead finish thickness, and minimum lead thickness is the minimum thickness of base material.
4.If there is any question with packing specification or packing method, please contact your local HSMC sales office.

Material :

- Lead : 42 Alloy ; solder plating
- Mold Compound : Epoxy resin family, flammability solid burning class:UL94V-0



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