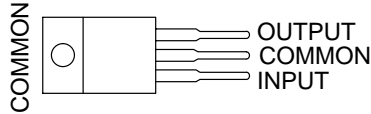


μA7800 SERIES POSITIVE-VOLTAGE REGULATORS

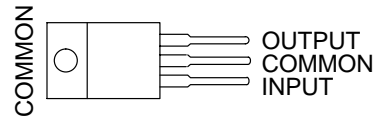
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- 3-Terminal Regulators
- Output Current up to 1.5 A
- Internal Thermal-Overload Protection
- High Power-Dissipation Capability
- Internal Short-Circuit Current Limiting
- Output Transistor Safe-Area Compensation

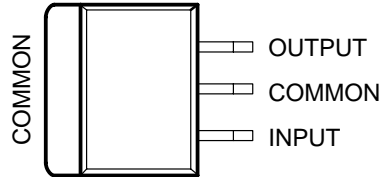
**KC (TO-220) PACKAGE
(TOP VIEW)**



**KCS (TO-220) PACKAGE
(TOP VIEW)**



**KTE PACKAGE
(TOP VIEW)**



description/ordering information

This series of fixed-voltage integrated-circuit voltage regulators is designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. Each of these regulators can deliver up to 1.5 A of output current. The internal current-limiting and thermal-shutdown features of these regulators essentially make them immune to overload. In addition to use as fixed-voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents, and also can be used as the power-pass element in precision regulators.

ORDERING INFORMATION

| T _J | V _{O(NOM)} (V) | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|------------------------------|----------------------------|------------------------------|--------------|--------------------------|---------------------|
| 0°C to 125°C | 5 | POWER-FLEX (KTE) | Reel of 2000 | μA7805CKTER | μA7805C |
| | | TO-220 (KC) | Tube of 50 | μA7805CKC | μA7805C |
| | | TO-220, short shoulder (KCS) | Tube of 20 | μA7805CKCS | |
| | 8 | POWER-FLEX (KTE) | Reel of 2000 | μA7808CKTER | μA7808C |
| | | TO-220 (KC) | Tube of 50 | μA7808CKC | μA7808C |
| | | TO-220, short shoulder (KCS) | Tube of 20 | μA7808CKCS | |
| | 10 | POWER-FLEX (KTE) | Reel of 2000 | μA7810CKTER | μA7810C |
| | | TO-220 (KC) | Tube of 50 | μA7810CKC | μA7810C |
| | 12 | POWER-FLEX (KTE) | Reel of 2000 | μA7812CKTER | μA7812C |
| | | TO-220 (KC) | Tube of 50 | μA7812CKC | μA7812C |
| | | TO-220, short shoulder (KCS) | Tube of 20 | μA7812CKCS | |
| | 15 | POWER-FLEX (KTE) | Reel of 2000 | μA7815CKTER | μA7815C |
| TO-220 (KC) | | Tube of 50 | μA7815CKC | μA7815C | |
| TO-220, short shoulder (KCS) | | Tube of 20 | μA7815CKCS | | |
| 24 | POWER-FLEX (KTE) | Reel of 2000 | μA7824CKTER | μA7824C | |
| | TO-220 (KC) | Tube of 50 | μA7824CKC | μA7824C | |

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



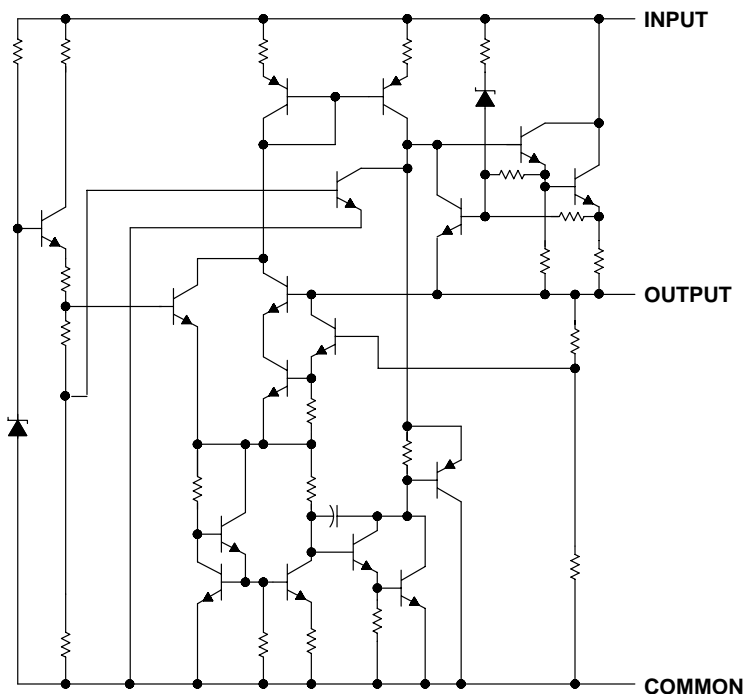
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μA7800 SERIES POSITIVE-VOLTAGE REGULATORS

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schematic



absolute maximum ratings over virtual junction temperature range (unless otherwise noted)†

| | |
|--|----------------|
| Input voltage, V_I : μA7824C | 40 V |
| All others | 35 V |
| Operating virtual junction temperature, T_J | 150°C |
| Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds | 260°C |
| Storage temperature range, T_{stg} | -65°C to 150°C |

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

package thermal data (see Note 1)

| PACKAGE | BOARD | θ_{JC} | θ_{JA} |
|------------------|-------------------|---------------|---------------|
| POWER-FLEX (KTE) | High K, JESD 51-5 | 3°C/W | 23°C/W |
| TO-220 (KC/KCS) | High K, JESD 51-5 | 3°C/W | 19°C/W |

NOTE 1: Maximum power dissipation is a function of $T_J(\max)$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(\max) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.



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μA7800 SERIES POSITIVE-VOLTAGE REGULATORS

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recommended operating conditions

| | | MIN | MAX | UNIT |
|--|----------------|------|-----|------|
| V_I Input voltage | μA7805C | 7 | 25 | V |
| | μA7808C | 10.5 | 25 | |
| | μA7810C | 12.5 | 28 | |
| | μA7812C | 14.5 | 30 | |
| | μA7815C | 17.5 | 30 | |
| | μA7824C | 27 | 38 | |
| I_O Output current | | 1.5 | | A |
| T_J Operating virtual junction temperature | μA7800C series | 0 | 125 | °C |

electrical characteristics at specified virtual junction temperature, $V_I = 10$ V, $I_O = 500$ mA (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | T_J † | μA7805C | | | UNIT |
|---|---|--------------|---------|-------|------|-------|
| | | | MIN | TYP | MAX | |
| Output voltage | $I_O = 5$ mA to 1 A, $V_I = 7$ V to 20 V, $P_D \leq 15$ W | 25°C | 4.8 | 5 | 5.2 | V |
| | | 0°C to 125°C | 4.75 | | 5.25 | |
| Input voltage regulation | $V_I = 7$ V to 25 V | 25°C | | 3 | 100 | mV |
| | $V_I = 8$ V to 12 V | | | 1 | 50 | |
| Ripple rejection | $V_I = 8$ V to 18 V, $f = 120$ Hz | 0°C to 125°C | 62 | 78 | | dB |
| Output voltage regulation | $I_O = 5$ mA to 1.5 A | 25°C | | 15 | 100 | mV |
| | $I_O = 250$ mA to 750 mA | | | 5 | 50 | |
| Output resistance | $f = 1$ kHz | 0°C to 125°C | | 0.017 | | Ω |
| Temperature coefficient of output voltage | $I_O = 5$ mA | 0°C to 125°C | | -1.1 | | mV/°C |
| Output noise voltage | $f = 10$ Hz to 100 kHz | 25°C | | 40 | | μV |
| Dropout voltage | $I_O = 1$ A | 25°C | | 2 | | V |
| Bias current | | 25°C | | 4.2 | 8 | mA |
| Bias current change | $V_I = 7$ V to 25 V | 0°C to 125°C | | | 1.3 | mA |
| | $I_O = 5$ mA to 1 A | | | | 0.5 | |
| Short-circuit output current | | 25°C | | 750 | | mA |
| Peak output current | | 25°C | | 2.2 | | A |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

μA7800 SERIES POSITIVE-VOLTAGE REGULATORS

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electrical characteristics at specified virtual junction temperature, $V_I = 14\text{ V}$, $I_O = 500\text{ mA}$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | T_J † | μA7808C | | | UNIT |
|---|--|--------------|---------|-----|-----|-------|
| | | | MIN | TYP | MAX | |
| Output voltage | $I_O = 5\text{ mA to }1\text{ A}$, $V_I = 10.5\text{ V to }23\text{ V}$, $P_D \leq 15\text{ W}$ | 25°C | 7.7 | 8 | 8.3 | V |
| | | 0°C to 125°C | 7.6 | | 8.4 | |
| Input voltage regulation | $V_I = 10.5\text{ V to }25\text{ V}$ | 25°C | | 6 | 160 | mV |
| | $V_I = 11\text{ V to }17\text{ V}$ | | | 2 | 80 | |
| Ripple rejection | $V_I = 11.5\text{ V to }21.5\text{ V}$, $f = 120\text{ Hz}$ | 0°C to 125°C | 55 | 72 | | dB |
| Output voltage regulation | $I_O = 5\text{ mA to }1.5\text{ A}$ | 25°C | | 12 | 160 | mV |
| | $I_O = 250\text{ mA to }750\text{ mA}$ | | | 4 | 80 | |
| Output resistance | $f = 1\text{ kHz}$ | 0°C to 125°C | 0.016 | | | Ω |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$ | 0°C to 125°C | -0.8 | | | mV/°C |
| Output noise voltage | $f = 10\text{ Hz to }100\text{ kHz}$ | 25°C | 52 | | | μV |
| Dropout voltage | $I_O = 1\text{ A}$ | 25°C | 2 | | | V |
| Bias current | | 25°C | 4.3 | | 8 | mA |
| Bias current change | $V_I = 10.5\text{ V to }25\text{ V}$ | 0°C to 125°C | | | 1 | mA |
| | $I_O = 5\text{ mA to }1\text{ A}$ | | | | 0.5 | |
| Short-circuit output current | | 25°C | 450 | | | mA |
| Peak output current | | 25°C | 2.2 | | | A |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

electrical characteristics at specified virtual junction temperature, $V_I = 17\text{ V}$, $I_O = 500\text{ mA}$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | T_J † | μA7810C | | | UNIT |
|---|--|--------------|---------|-----|------|-------|
| | | | MIN | TYP | MAX | |
| Output voltage | $I_O = 5\text{ mA to }1\text{ A}$, $V_I = 12.5\text{ V to }25\text{ V}$, $P_D \leq 15\text{ W}$ | 25°C | 9.6 | 10 | 10.4 | V |
| | | 0°C to 125°C | 9.5 | 10 | 10.5 | |
| Input voltage regulation | $V_I = 12.5\text{ V to }28\text{ V}$ | 25°C | | 7 | 200 | mV |
| | $V_I = 14\text{ V to }20\text{ V}$ | | | 2 | 100 | |
| Ripple rejection | $V_I = 13\text{ V to }23\text{ V}$, $f = 120\text{ Hz}$ | 0°C to 125°C | 55 | 71 | | dB |
| Output voltage regulation | $I_O = 5\text{ mA to }1.5\text{ A}$ | 25°C | | 12 | 200 | mV |
| | $I_O = 250\text{ mA to }750\text{ mA}$ | | | 4 | 100 | |
| Output resistance | $f = 1\text{ kHz}$ | 0°C to 125°C | 0.018 | | | Ω |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$ | 0°C to 125°C | -1 | | | mV/°C |
| Output noise voltage | $f = 10\text{ Hz to }100\text{ kHz}$ | 25°C | 70 | | | μV |
| Dropout voltage | $I_O = 1\text{ A}$ | 25°C | 2 | | | V |
| Bias current | | 25°C | 4.3 | | 8 | mA |
| Bias current change | $V_I = 12.5\text{ V to }28\text{ V}$ | 0°C to 125°C | | | 1 | mA |
| | $I_O = 5\text{ mA to }1\text{ A}$ | | | | 0.5 | |
| Short-circuit output current | | 25°C | 400 | | | mA |
| Peak output current | | 25°C | 2.2 | | | A |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.



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electrical characteristics at specified virtual junction temperature, $V_I = 19\text{ V}$, $I_O = 500\text{ mA}$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | T_J † | μA7812C | | | UNIT | |
|---|---|--------------|---------|-----|------|-------|----|
| | | | MIN | TYP | MAX | | |
| Output voltage | $I_O = 5\text{ mA to }1\text{ A}$, $P_D \leq 15\text{ W}$ | 25°C | 11.5 | 12 | 12.5 | V | |
| | | 0°C to 125°C | 11.4 | | 12.6 | | |
| Input voltage regulation | $V_I = 14.5\text{ V to }30\text{ V}$ | 25°C | | 10 | 240 | mV | |
| | $V_I = 16\text{ V to }22\text{ V}$ | | | 3 | 120 | | |
| Ripple rejection | $V_I = 15\text{ V to }25\text{ V}$, $f = 120\text{ Hz}$ | 0°C to 125°C | 55 | 71 | | dB | |
| Output voltage regulation | $I_O = 5\text{ mA to }1.5\text{ A}$ | 25°C | | 12 | 240 | mV | |
| | $I_O = 250\text{ mA to }750\text{ mA}$ | | | 4 | 120 | | |
| Output resistance | $f = 1\text{ kHz}$ | 0°C to 125°C | 0.018 | | | Ω | |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$ | 0°C to 125°C | -1 | | | mV/°C | |
| Output noise voltage | $f = 10\text{ Hz to }100\text{ kHz}$ | 25°C | 75 | | | μV | |
| Dropout voltage | $I_O = 1\text{ A}$ | 25°C | 2 | | | V | |
| Bias current | | 25°C | 4.3 | | | 8 mA | |
| Bias current change | $V_I = 14.5\text{ V to }30\text{ V}$ | 0°C to 125°C | | | | 1 | mA |
| | $I_O = 5\text{ mA to }1\text{ A}$ | | | | | 0.5 | |
| Short-circuit output current | | 25°C | 350 | | | mA | |
| Peak output current | | 25°C | 2.2 | | | A | |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.

electrical characteristics at specified virtual junction temperature, $V_I = 23\text{ V}$, $I_O = 500\text{ mA}$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | T_J † | μA7815C | | | UNIT | |
|---|---|--------------|---------|-----|-------|-------|----|
| | | | MIN | TYP | MAX | | |
| Output voltage | $I_O = 5\text{ mA to }1\text{ A}$, $P_D \leq 15\text{ W}$ | 25°C | 14.4 | 15 | 15.6 | V | |
| | | 0°C to 125°C | 14.25 | | 15.75 | | |
| Input voltage regulation | $V_I = 17.5\text{ V to }30\text{ V}$ | 25°C | | 11 | 300 | mV | |
| | $V_I = 20\text{ V to }26\text{ V}$ | | | 3 | 150 | | |
| Ripple rejection | $V_I = 18.5\text{ V to }28.5\text{ V}$, $f = 120\text{ Hz}$ | 0°C to 125°C | 54 | 70 | | dB | |
| Output voltage regulation | $I_O = 5\text{ mA to }1.5\text{ A}$ | 25°C | | 12 | 300 | mV | |
| | $I_O = 250\text{ mA to }750\text{ mA}$ | | | 4 | 150 | | |
| Output resistance | $f = 1\text{ kHz}$ | 0°C to 125°C | 0.019 | | | Ω | |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$ | 0°C to 125°C | -1 | | | mV/°C | |
| Output noise voltage | $f = 10\text{ Hz to }100\text{ kHz}$ | 25°C | 90 | | | μV | |
| Dropout voltage | $I_O = 1\text{ A}$ | 25°C | 2 | | | V | |
| Bias current | | 25°C | 4.4 | | | 8 mA | |
| Bias current change | $V_I = 17.5\text{ V to }30\text{ V}$ | 0°C to 125°C | | | | 1 | mA |
| | $I_O = 5\text{ mA to }1\text{ A}$ | | | | | 0.5 | |
| Short-circuit output current | | 25°C | 230 | | | mA | |
| Peak output current | | 25°C | 2.1 | | | A | |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.



μA7800 SERIES POSITIVE-VOLTAGE REGULATORS

SLVS056J – MAY 1976 – REVISED MAY 2003

electrical characteristics at specified virtual junction temperature, $V_I = 33\text{ V}$, $I_O = 500\text{ mA}$ (unless otherwise noted)

| PARAMETER | TEST CONDITIONS | T_J † | μA7824C | | | UNIT |
|---|---|--------------|---------|-----|------|-------|
| | | | MIN | TYP | MAX | |
| Output voltage | $I_O = 5\text{ mA to }1\text{ A}$, $P_D \leq 15\text{ W}$ | 25°C | 23 | 24 | 25 | V |
| | | 0°C to 125°C | 22.8 | | 25.2 | |
| Input voltage regulation | $V_I = 27\text{ V to }38\text{ V}$ | 25°C | | 18 | 480 | mV |
| | $V_I = 30\text{ V to }36\text{ V}$ | | | 6 | 240 | |
| Ripple rejection | $V_I = 28\text{ V to }38\text{ V}$, $f = 120\text{ Hz}$ | 0°C to 125°C | 50 | 66 | | dB |
| Output voltage regulation | $I_O = 5\text{ mA to }1.5\text{ A}$ | 25°C | | 12 | 480 | mV |
| | $I_O = 250\text{ mA to }750\text{ mA}$ | | | 4 | 240 | |
| Output resistance | $f = 1\text{ kHz}$ | 0°C to 125°C | 0.028 | | | Ω |
| Temperature coefficient of output voltage | $I_O = 5\text{ mA}$ | 0°C to 125°C | -1.5 | | | mV/°C |
| Output noise voltage | $f = 10\text{ Hz to }100\text{ kHz}$ | 25°C | 170 | | | μV |
| Dropout voltage | $I_O = 1\text{ A}$ | 25°C | 2 | | | V |
| Bias current | | 25°C | 4.6 | 8 | | mA |
| Bias current change | $V_I = 27\text{ V to }38\text{ V}$ | 0°C to 125°C | | | 1 | mA |
| | $I_O = 5\text{ mA to }1\text{ A}$ | | | | 0.5 | |
| Short-circuit output current | | 25°C | 150 | | | mA |
| Peak output current | | 25°C | 2.1 | | | A |

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.



APPLICATION INFORMATION

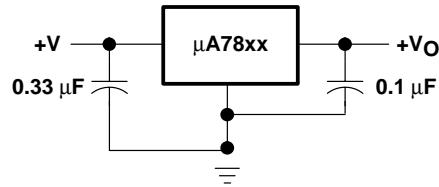


Figure 1. Fixed-Output Regulator

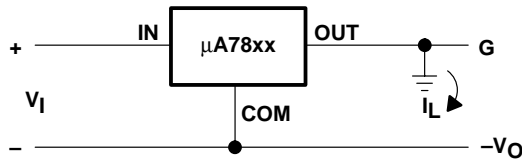
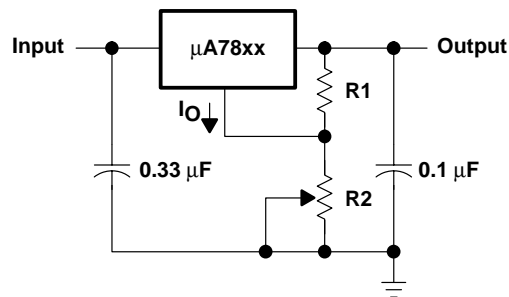


Figure 2. Positive Regulator in Negative Configuration (V_I Must Float)



NOTE A: The following formula is used when V_{xx} is the nominal output voltage (output to common) of the fixed regulator:

$$V_O = V_{xx} + \left(\frac{V_{xx}}{R1} + I_O \right) R2$$

Figure 3. Adjustable-Output Regulator

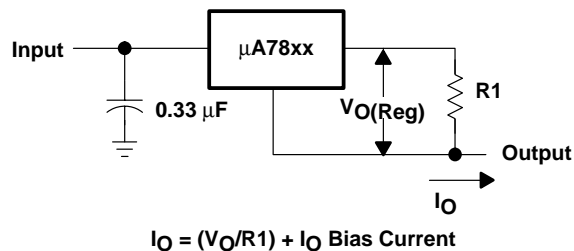


Figure 4. Current Regulator

APPLICATION INFORMATION

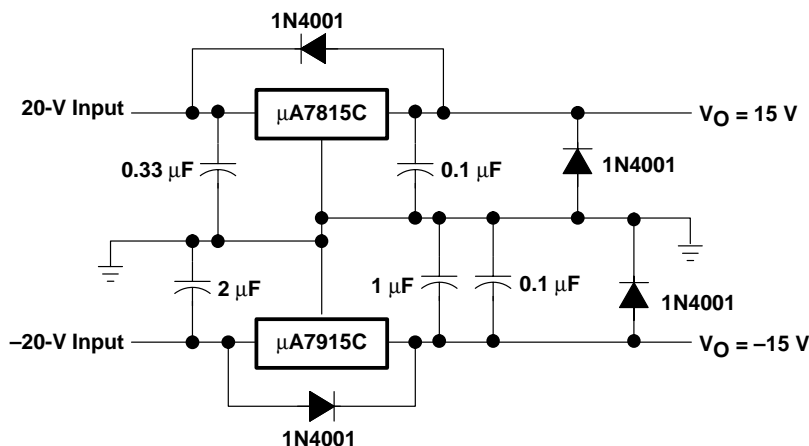


Figure 5. Regulated Dual Supply

operation with a load common to a voltage of opposite polarity

In many cases, a regulator powers a load that is not connected to ground but, instead, is connected to a voltage source of opposite polarity (e.g., operational amplifiers, level-shifting circuits, etc.). In these cases, a clamp diode should be connected to the regulator output as shown in Figure 6. This protects the regulator from output polarity reversals during startup and short-circuit operation.

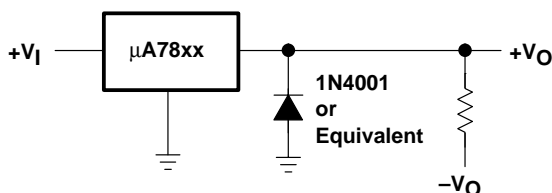


Figure 6. Output Polarity-Reversal-Protection Circuit

reverse-bias protection

Occasionally, the input voltage to the regulator can collapse faster than the output voltage. This can occur, for example, when the input supply is crowbarred during an output overvoltage condition. If the output voltage is greater than approximately 7 V, the emitter-base junction of the series-pass element (internal or external) could break down and be damaged. To prevent this, a diode shunt can be used as shown in Figure 7.

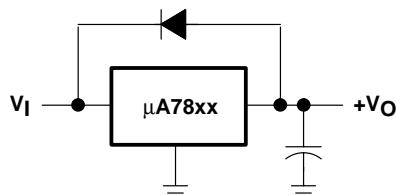
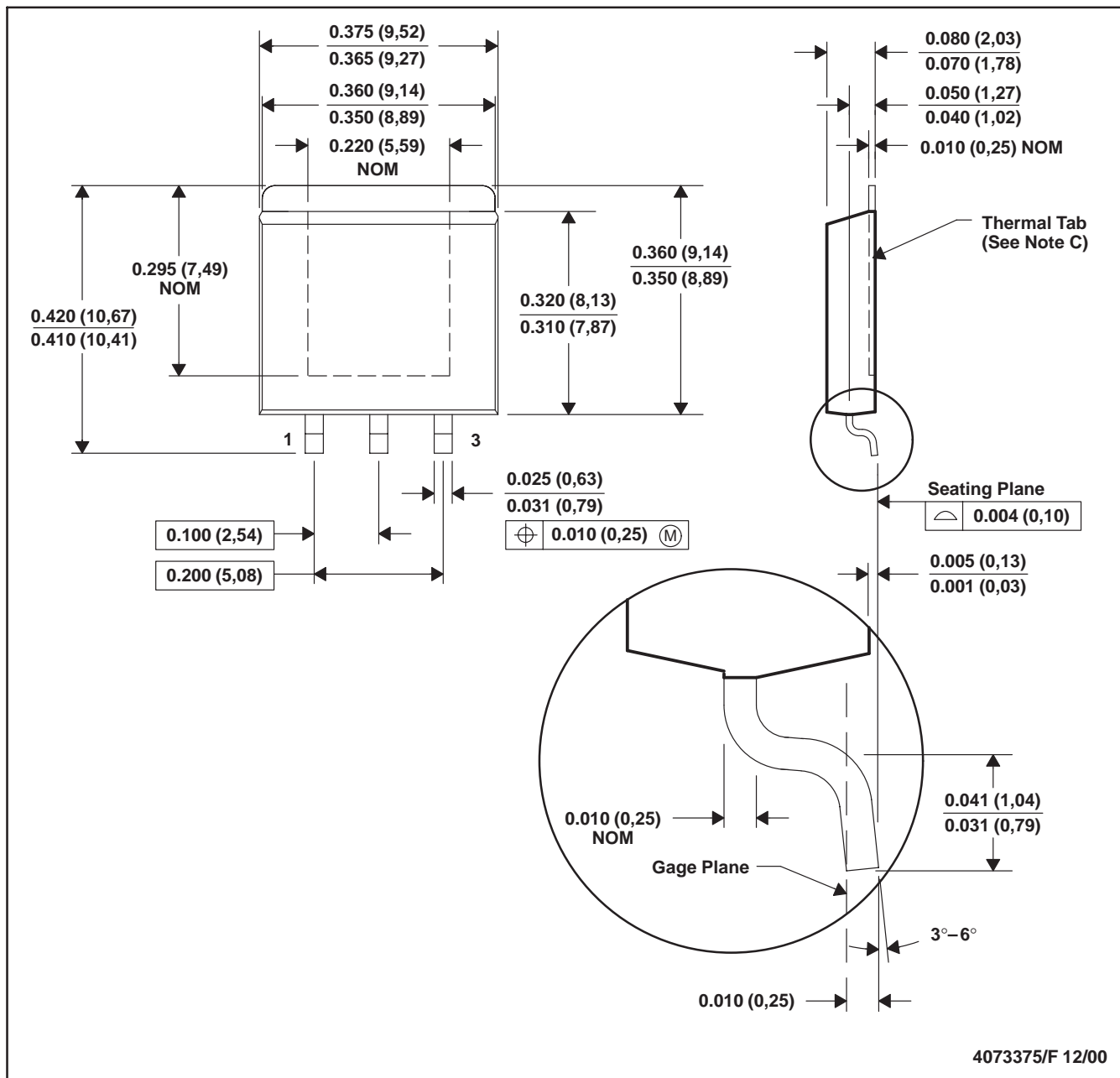


Figure 7. Reverse-Bias-Protection Circuit

KTE (R-PSFM-G3)

PowerFLEX™ PLASTIC FLANGE-MOUNT



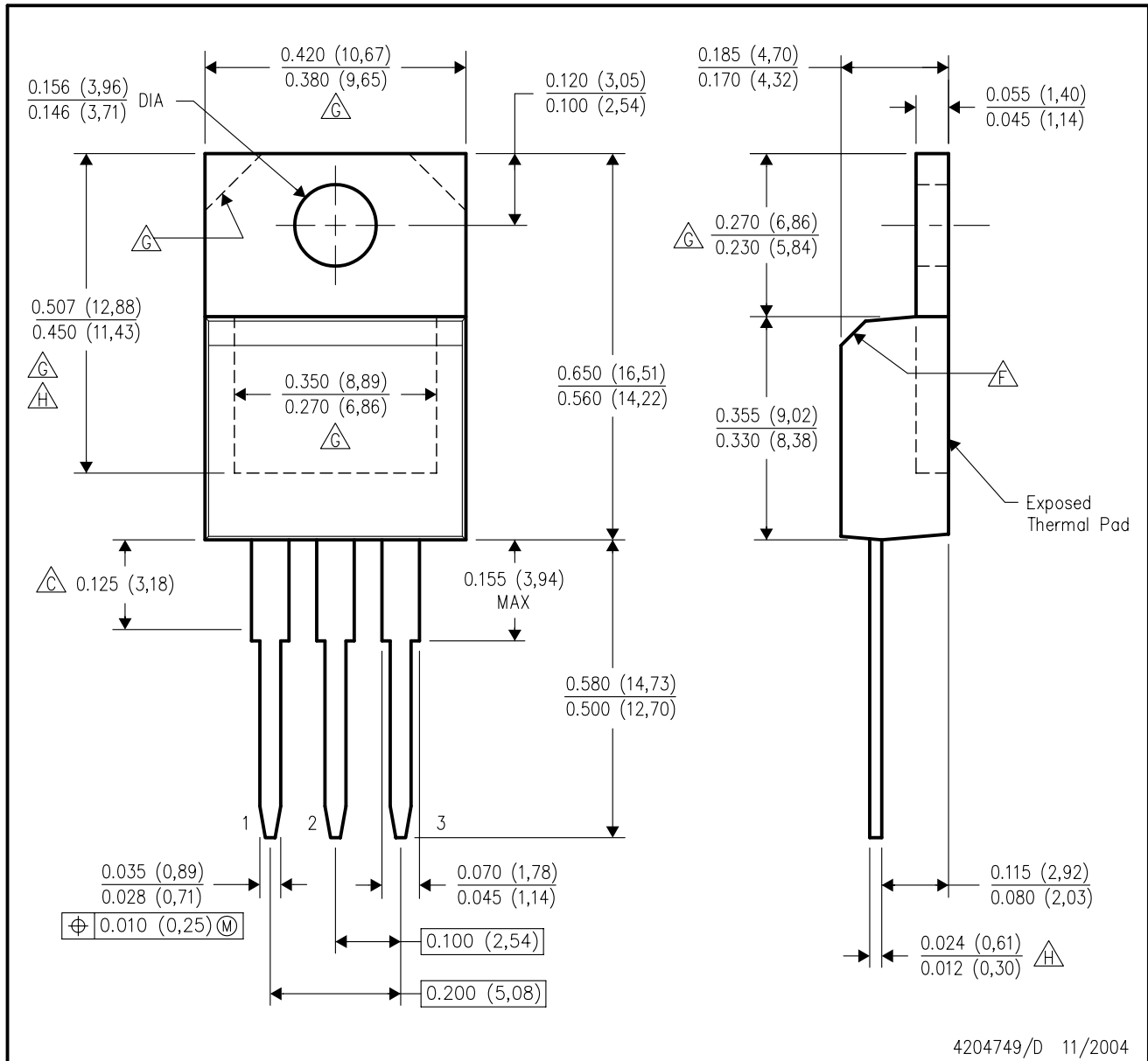
- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. The center lead is in electrical contact with the thermal tab.
 D. Dimensions do not include mold protrusions, not to exceed 0.006 (0,15).
 E. Falls within JEDEC MO-169

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KCS (R-PSFM-T3)

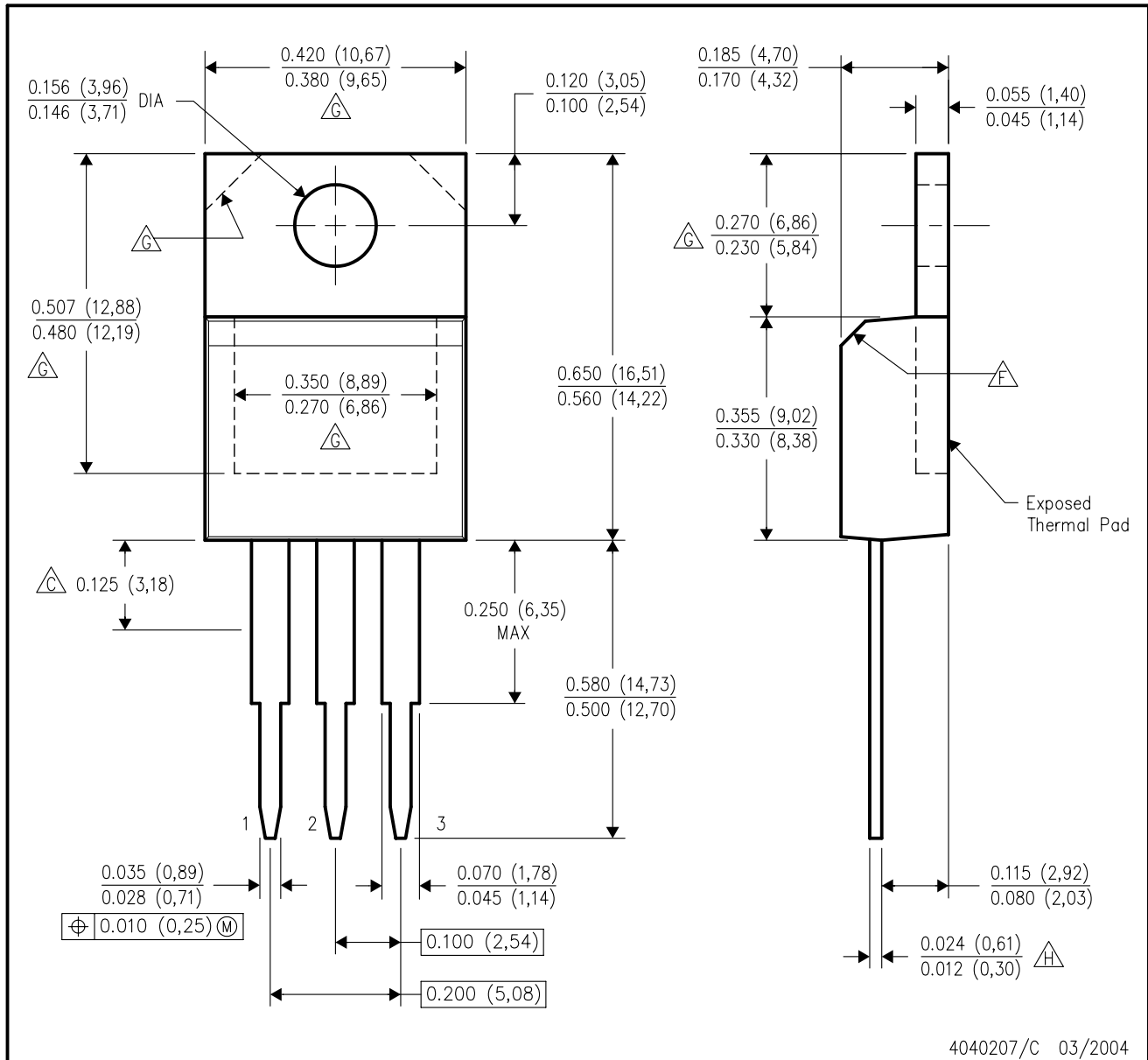
PLASTIC FLANGE-MOUNT PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\text{\textcircled{C}}$ Lead dimensions are not controlled within this area.
 - D. All lead dimensions apply before solder dip.
 - E. The center lead is in electrical contact with the mounting tab.
 - $\text{\textcircled{F}}$ The chamfer is optional.
 - $\text{\textcircled{G}}$ Thermal pad contour optional within these dimensions.
 - $\text{\textcircled{H}}$ Falls within JEDEC TO-220 variation AB, except minimum lead thickness and minimum exposed pad length.

KC (R-PSFM-T3)

PLASTIC FLANGE-MOUNT PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Lead dimensions are not controlled within this area.
 - D. All lead dimensions apply before solder dip.
 - E. The center lead is in electrical contact with the mounting tab.
 - F. The chamfer is optional.
 - G. Thermal pad contour optional within these dimensions.
 - H. Falls within JEDEC TO-220 variation AB, except minimum lead thickness.

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