

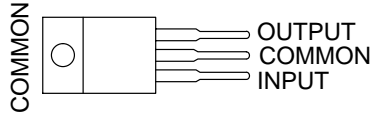
μ A7800 SERIES POSITIVE-VOLTAGE REGULATORS

SLVS056J – MAY 1976 – REVISED MAY 2003

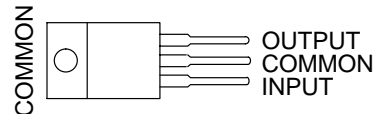
- 3-Terminal Regulators
- Output Current up to 1.5 A
- Internal Thermal-Overload Protection

- High Power-Dissipation Capability
- Internal Short-Circuit Current Limiting
- Output Transistor Safe-Area Compensation

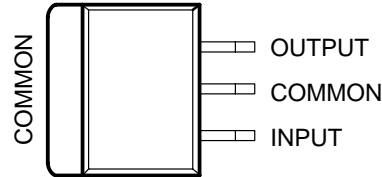
KC (TO-220) PACKAGE
(TOP VIEW)



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	μ A7805CKTER	μ A7805C
		TO-220 (KC)	Tube of 50	μ A7805CKC	μ A7805C
		TO-220, short shoulder (KCS)	Tube of 20	μ A7805CKCS	
	8	POWER-FLEX (KTE)	Reel of 2000	μ A7808CKTER	μ A7808C
		TO-220 (KC)	Tube of 50	μ A7808CKC	μ A7808C
		TO-220, short shoulder (KCS)	Tube of 20	μ A7808CKCS	
	10	POWER-FLEX (KTE)	Reel of 2000	μ A7810CKTER	μ A7810C
		TO-220 (KC)	Tube of 50	μ A7810CKC	μ A7810C
	12	POWER-FLEX (KTE)	Reel of 2000	μ A7812CKTER	μ A7812C
		TO-220 (KC)	Tube of 50	μ A7812CKC	μ A7812C
		TO-220, short shoulder (KCS)	Tube of 20	μ A7812CKCS	
	15	POWER-FLEX (KTE)	Reel of 2000	μ A7815CKTER	μ A7815C
		TO-220 (KC)	Tube of 50	μ A7815CKC	μ A7815C
		TO-220, short shoulder (KCS)	Tube of 20	μ A7815CKCS	
	24	POWER-FLEX (KTE)	Reel of 2000	μ A7824CKTER	μ A7824C
		TO-220 (KC)	Tube of 50	μ A7824CKC	μ A7824C

† 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.

**TEXAS
INSTRUMENTS**

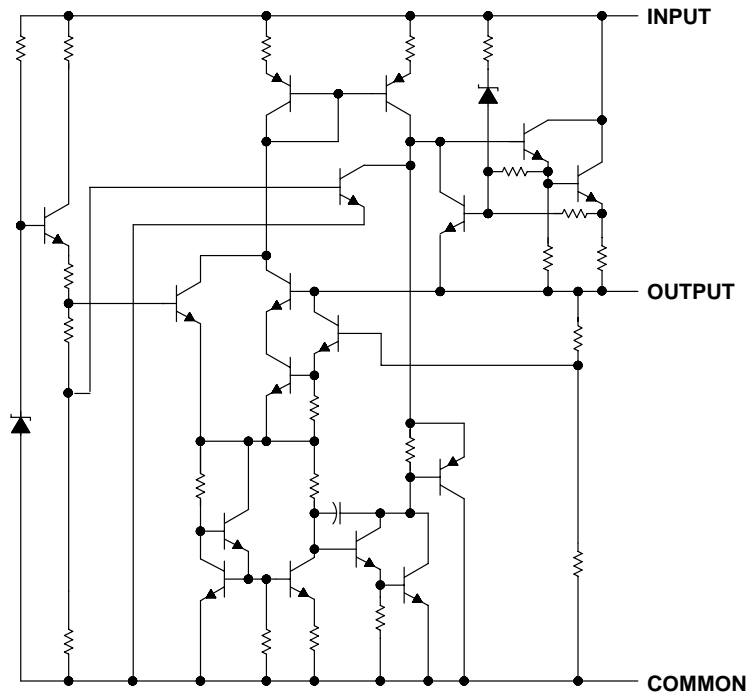
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μA7800 SERIES
 POSITIVE-VOLTAGE REGULATORS

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

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.

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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^\dagger	μA7808C			UNIT
			MIN	TYP	MAX	
Output voltage	$I_O = 5\text{ mA to }1\text{ A}$, $P_D \leq 15\text{ W}$, $V_I = 10.5\text{ V to }23\text{ V}$	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^\dagger	μA7810C			UNIT
			MIN	TYP	MAX	
Output voltage	$I_O = 5\text{ mA to }1\text{ A}$, $P_D \leq 15\text{ W}$, $V_I = 12.5\text{ V to }25\text{ V}$	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

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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^\dagger	μA7812C			UNIT
			MIN	TYP	MAX	
Output voltage	$I_O = 5\text{ mA to }1\text{ A}$, $P_D \leq 15\text{ W}$, $V_I = 14.5\text{ V to }27\text{ V}$	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^\dagger	μA7815C			UNIT
			MIN	TYP	MAX	
Output voltage	$I_O = 5\text{ mA to }1\text{ A}$, $P_D \leq 15\text{ W}$, $V_I = 17.5\text{ V to }30\text{ V}$	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**

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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^\dagger	μA7824C			UNIT
			MIN	TYP	MAX	
Output voltage	$I_O = 5\text{ mA to }1\text{ A}$, $P_D \leq 15\text{ W}$, $V_I = 27\text{ V to }38\text{ V}$	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

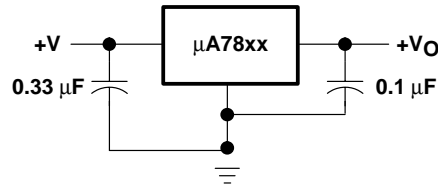


Figure 1. Fixed-Output Regulator

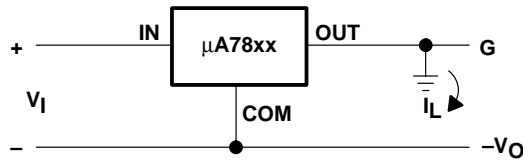
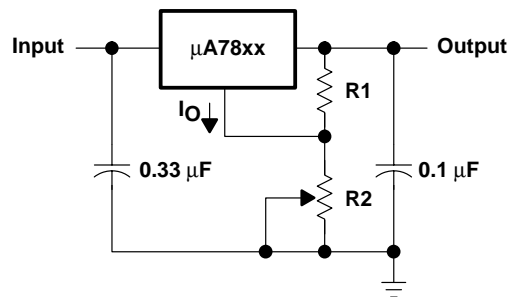


Figure 2. Positive Regulator in Negative Configuration (V_I Must Float)



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

$$V_O = V_{xx} + \left(\frac{V_{xx}}{R_1} + I_O \right) R_2$$

Figure 3. Adjustable-Output Regulator

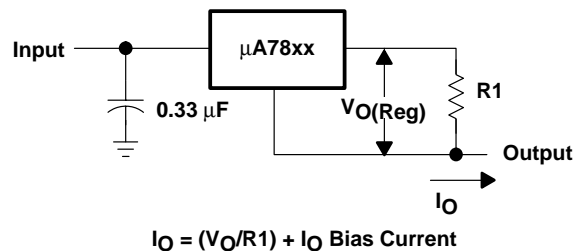


Figure 4. Current Regulator

APPLICATION INFORMATION

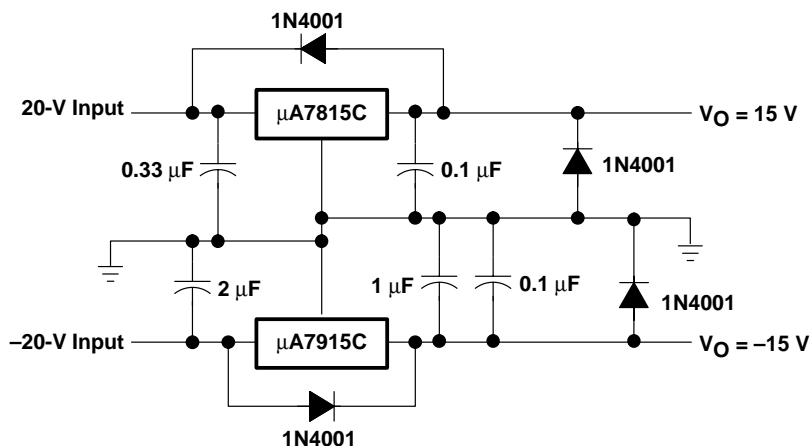


Figure 5. Regulated Dual Supply

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.

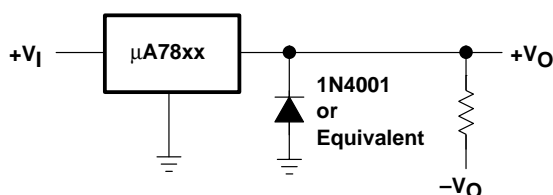


Figure 6. Output Polarity-Reversal-Protection Circuit

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.

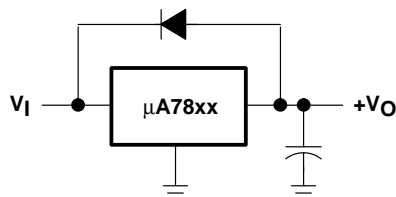
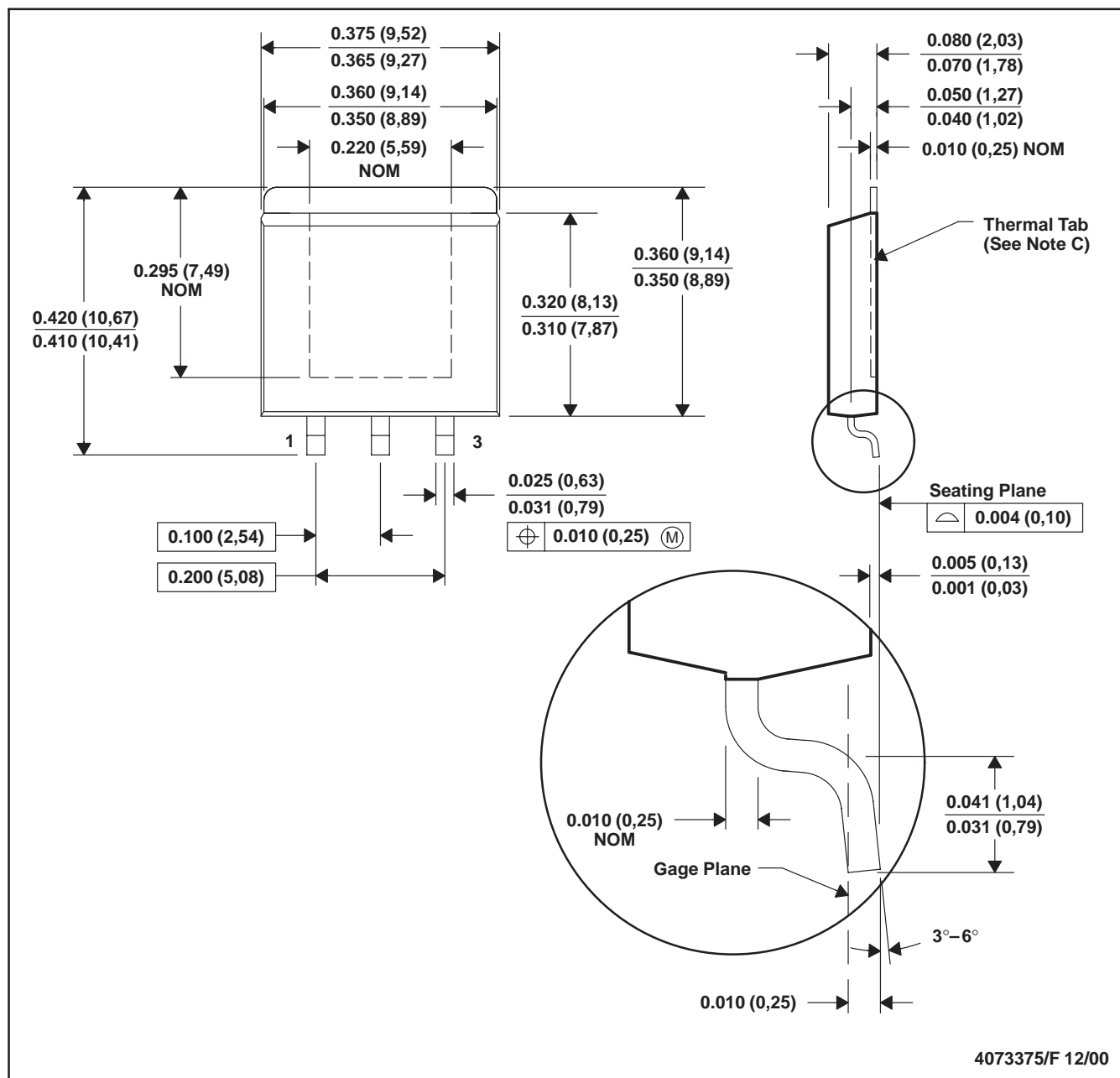


Figure 7. Reverse-Bias-Protection Circuit

KTE (R-PSFM-G3)

PowerFLEX™ PLASTIC FLANGE-MOUNT

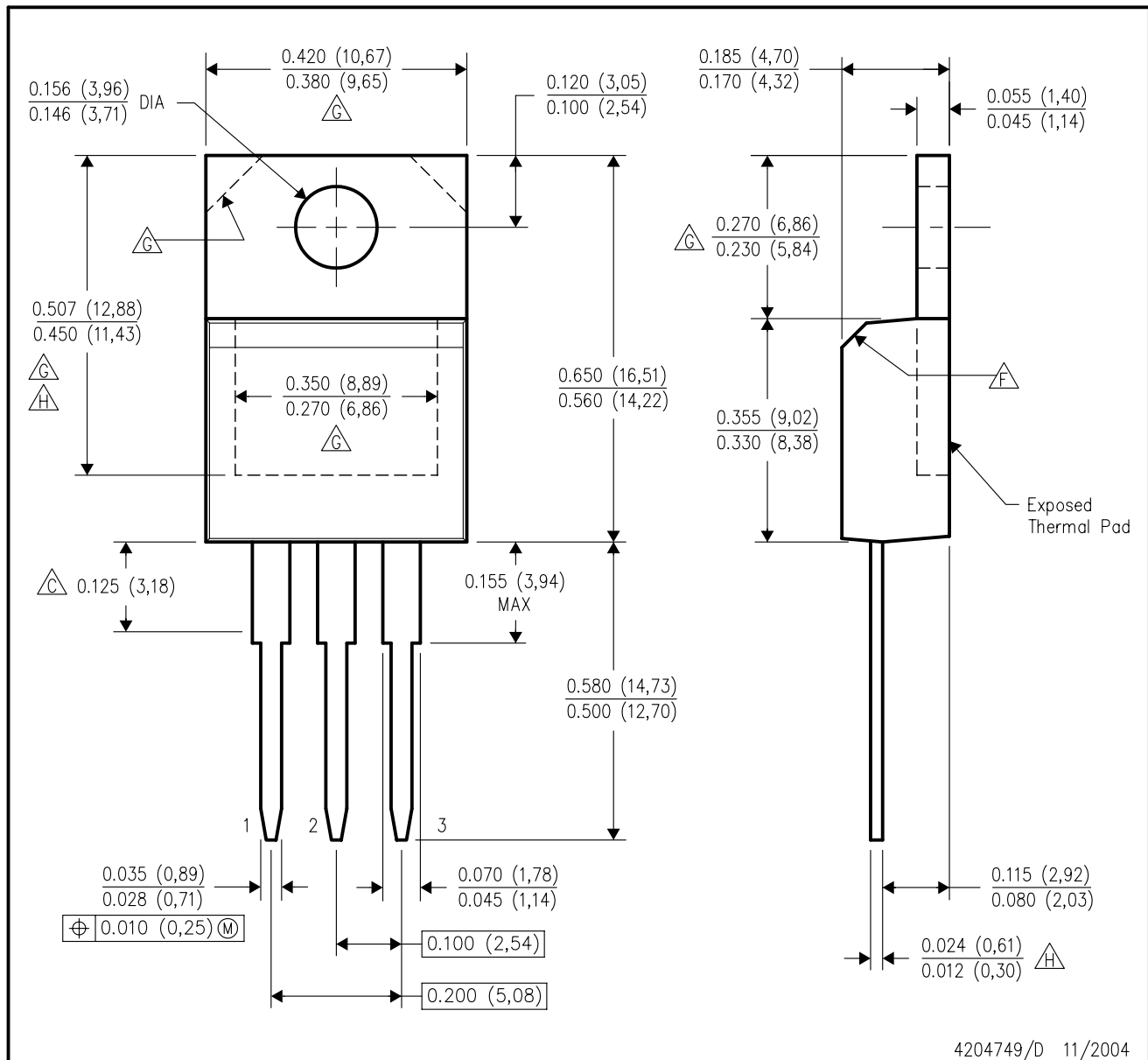


- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - The center lead is in electrical contact with the thermal tab.
 - Dimensions do not include mold protrusions, not to exceed 0.006 (0,15).
 - Falls within JEDEC MO-169

PowerFLEX is a trademark of Texas Instruments.

KCS (R-PSFM-T3)

PLASTIC FLANGE-MOUNT PACKAGE

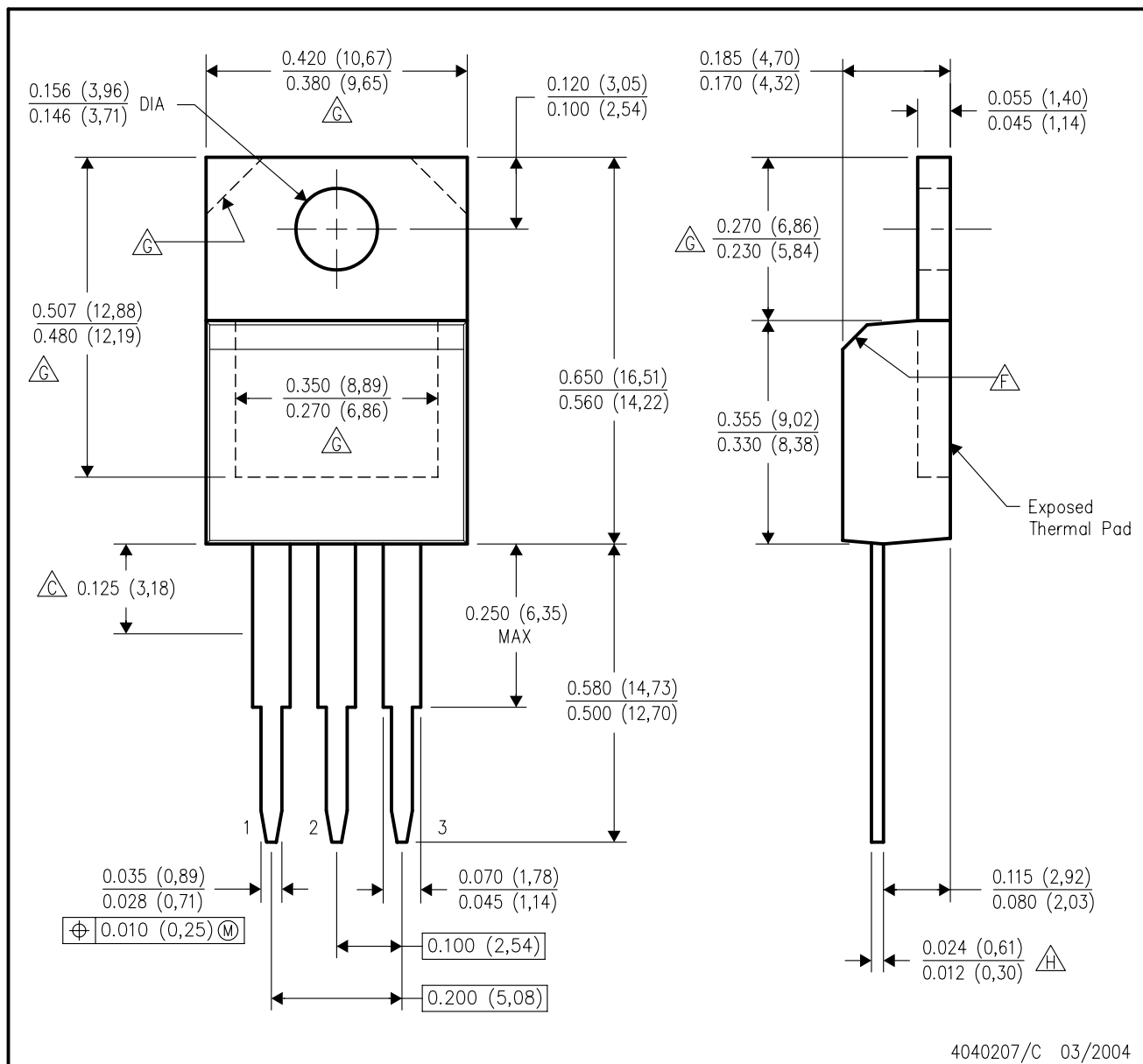


4204749/D 11/2004

- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ 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.
 - $\triangle F$ The chamfer is optional.
 - $\triangle G$ Thermal pad contour optional within these dimensions.
 - $\triangle H$ Falls within JEDEC TO-220 variation AB, except minimum lead thickness and minimum exposed pad length.

KC (R-PSFM-T3)

PLASTIC FLANGE-MOUNT PACKAGE



4040207/C 03/2004

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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