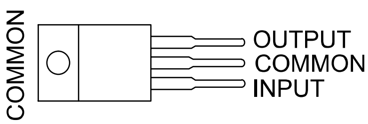
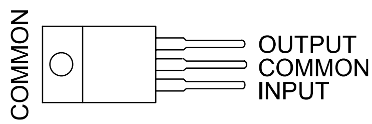
μA7800 SERIES POSITIVE-VOLTAGE REGULATORS

- **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**

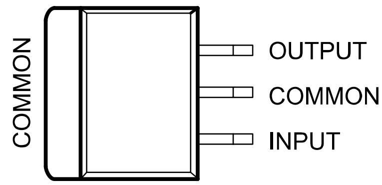
KC (TO-220) PACKAGE
(TOP VIEW)



KCS (TO-220) PACKAGE
(TOP VIEW)



KTE PACKAGE
(TOP VIEW)



description/ordering information

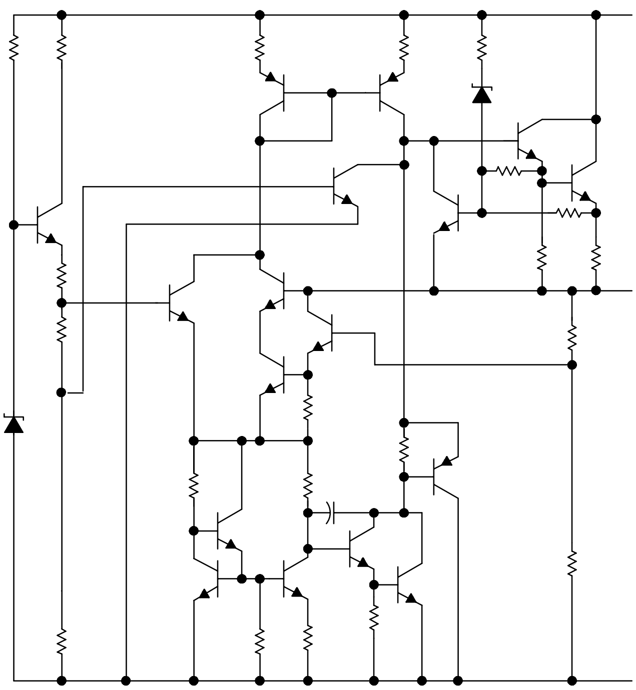
This series of fixed-voltage integrated-circuit voltage regulators is designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. Each of these regulators can deliver up to 1.5 A of 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.

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.

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, $P_D \le$ 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.

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

PARAMETER	TEST CONDITIONS	T_J†	μA7808C MIN	μA7808C TYP	μA7808C MAX	UNIT
Output voltage	I_O = 5 mA to 1 A, V_I = 10.5 V to 23 V, P_D ≤ 15 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 V to 25 V	25°C		6	160	mV
	V_I = 11 V to 17 V			2	80	
Ripple rejection	V_I = 11.5 V to 21.5 V, f = 120 Hz	0°C to 125°C	55	72		dB
Output voltage regulation	I_O = 5 mA to 1.5 A	25°C		12	160	mV
	I_O = 250 mA to 750 mA			4	80	
Output resistance	f = 1 kHz	0°C to 125°C		0.016		Ω
Temperature coefficient of output voltage	I_O = 5 mA	0°C to 125°C		–0.8		mV/°C
Output noise voltage	f = 10 Hz to 100 kHz	25°C		52		μV
Dropout voltage	I_O = 1 A	25°C		2		V
Bias current		25°C		4.3	8	mA
Bias current change	V_I = 10.5 V to 25 V	0°C to 125°C			1	mA
	I_O = 5 mA to 1 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 V, I_O = 500 mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS	T_J†	μA7810C MIN	μA7810C TYP	μA7810C MAX	UNIT
Output voltage	I_O = 5 mA to 1 A, V_I = 12.5 V to 25 V, P_D ≤ 15 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 V to 28 V	25°C		7	200	mV
	V_I = 14 V to 20 V			2	100	
Ripple rejection	V_I = 13 V to 23 V, f = 120 Hz	0°C to 125°C	55	71		dB
Output voltage regulation	I_O = 5 mA to 1.5 A	25°C		12	200	mV
	I_O = 250 mA to 750 mA			4	100	
Output resistance	f = 1 kHz	0°C to 125°C		0.018		Ω
Temperature coefficient of output voltage	I_O = 5 mA	0°C to 125°C		–1		mV/°C
Output noise voltage	f = 10 Hz to 100 kHz	25°C		70		μV
Dropout voltage	I_O = 1 A	25°C		2		V
Bias current		25°C		4.3	8	mA
Bias current change	V_I = 12.5 V to 28 V	0°C to 125°C			1	mA
	I_O = 5 mA to 1 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.

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

PARAMETER	TEST CONDITIONS		T_J†	μA7812C MIN	μA7812C TYP	μA7812C MAX	UNIT
Output voltage	I_O = 5 mA to 1 A, $P_D \leq$ 15 W	V_I = 14.5 V to 27 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 V to 30 V		25°C		10	240	mV
	V_I = 16 V to 22 V				3	120	
Ripple rejection	V_I = 15 V to 25 V,	f = 120 Hz	0°C to 125°C	55	71		dB
Output voltage regulation	I_O = 5 mA to 1.5 A		25°C		12	240	mV
	I_O = 250 mA to 750 mA				4	120	
Output resistance	f = 1 kHz		0°C to 125°C		0.018		Ω
Temperature coefficient of output voltage	I_O = 5 mA		0°C to 125°C		–1		mV/°C
Output noise voltage	f = 10 Hz to 100 kHz		25°C		75		μV
Dropout voltage	I_O = 1 A		25°C		2		V
Bias current			25°C		4.3	8	mA
Bias current change	V_I = 14.5 V to 30 V		0°C to 125°C			1	mA
	I_O = 5 mA to 1 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 V, I_O = 500 mA (unless otherwise noted)

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

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

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

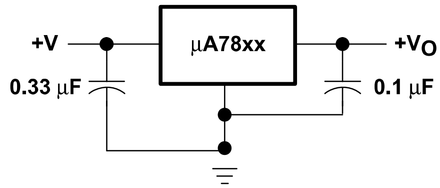


Figure 1. Fixed-Output Regulator

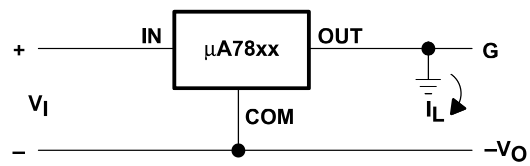
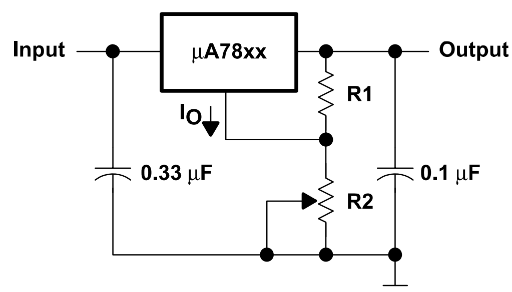


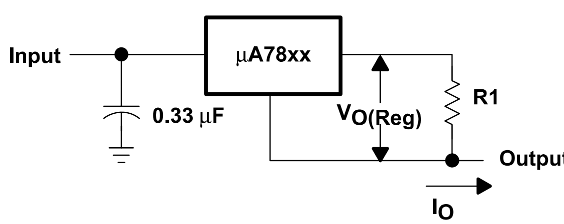
Figure 2. Positive Regulator in Negative Configuration (V_I Must Float)



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

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

Figure 3. Adjustable-Output Regulator



$I_O = (V_O/R1) + I_O$ Bias Current

Figure 4. Current Regulator

APPLICATION INFORMATION

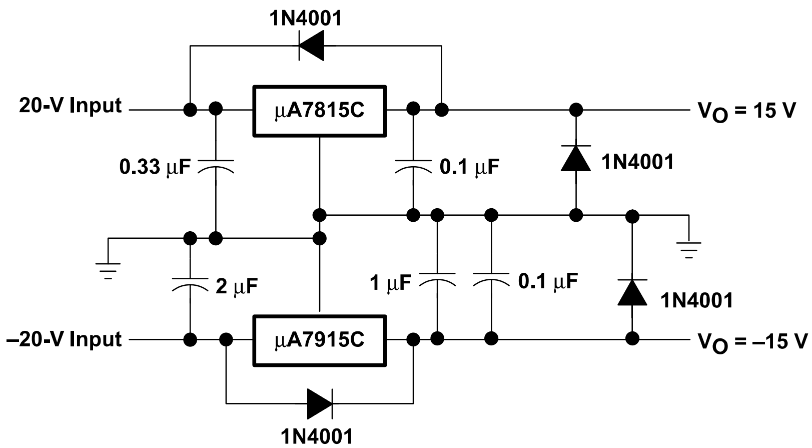


Figure 5. Regulated Dual Supply

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.

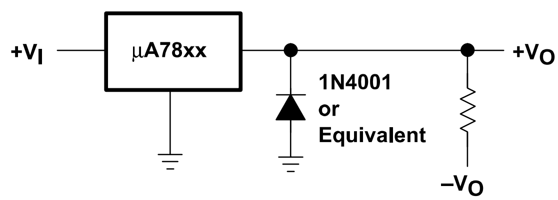


Figure 6. Output Polarity-Reversal-Protection Circuit

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.

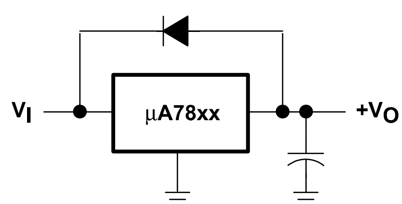
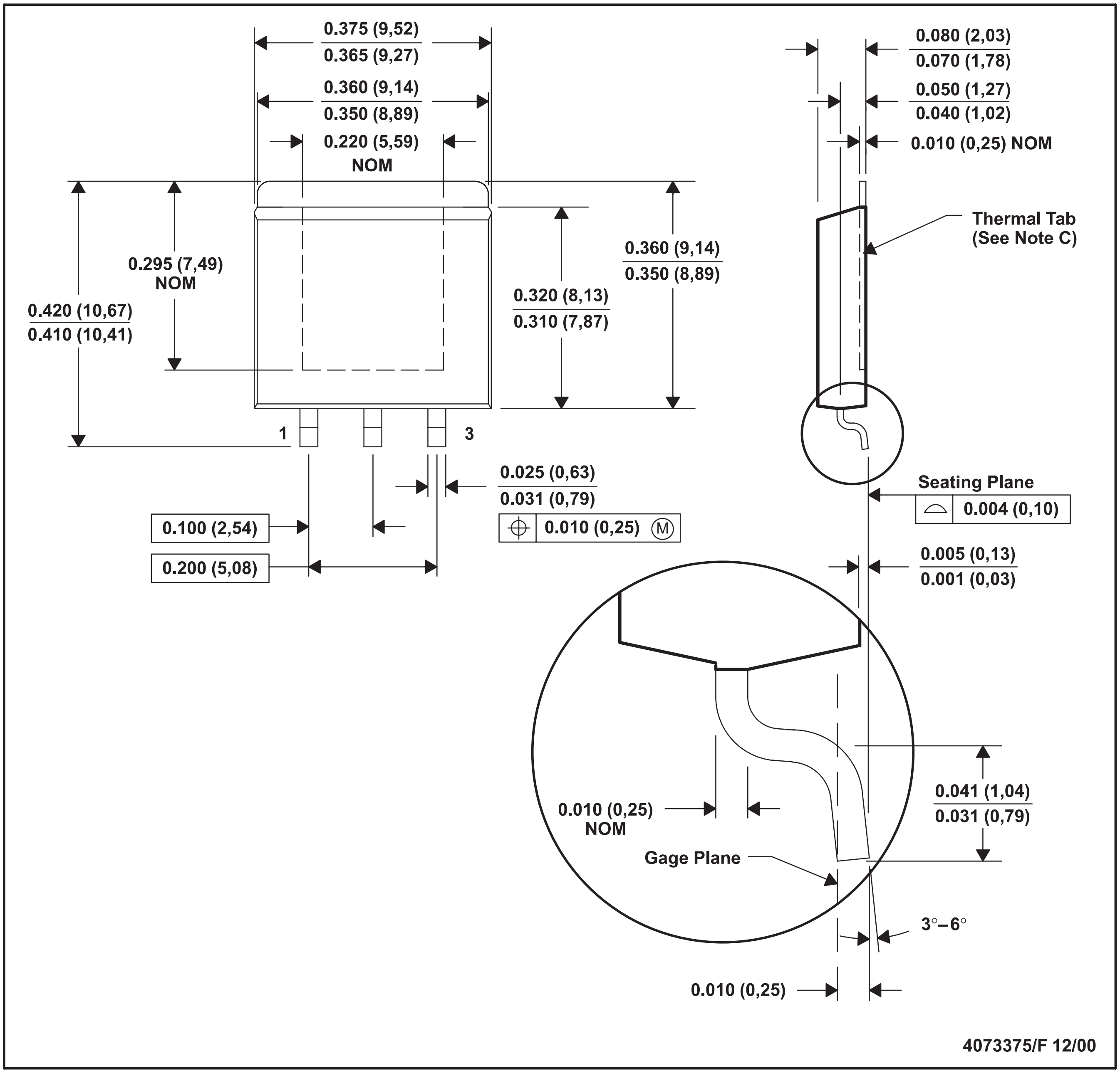


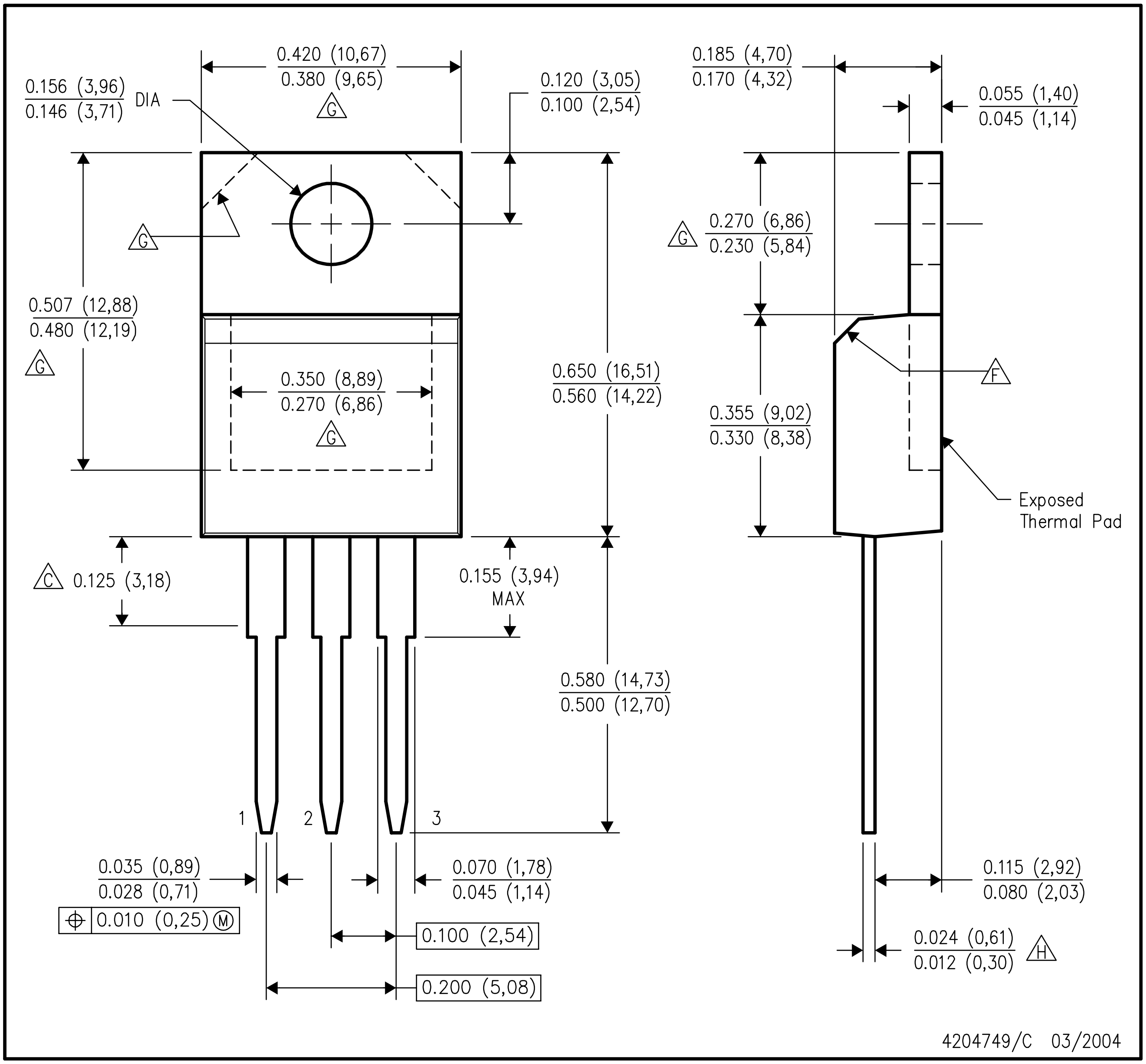
Figure 7. Reverse-Bias-Protection Circuit

KTE (R-PSFM-G3) **PowerFLEX™ PLASTIC FLANGE-MOUNT**



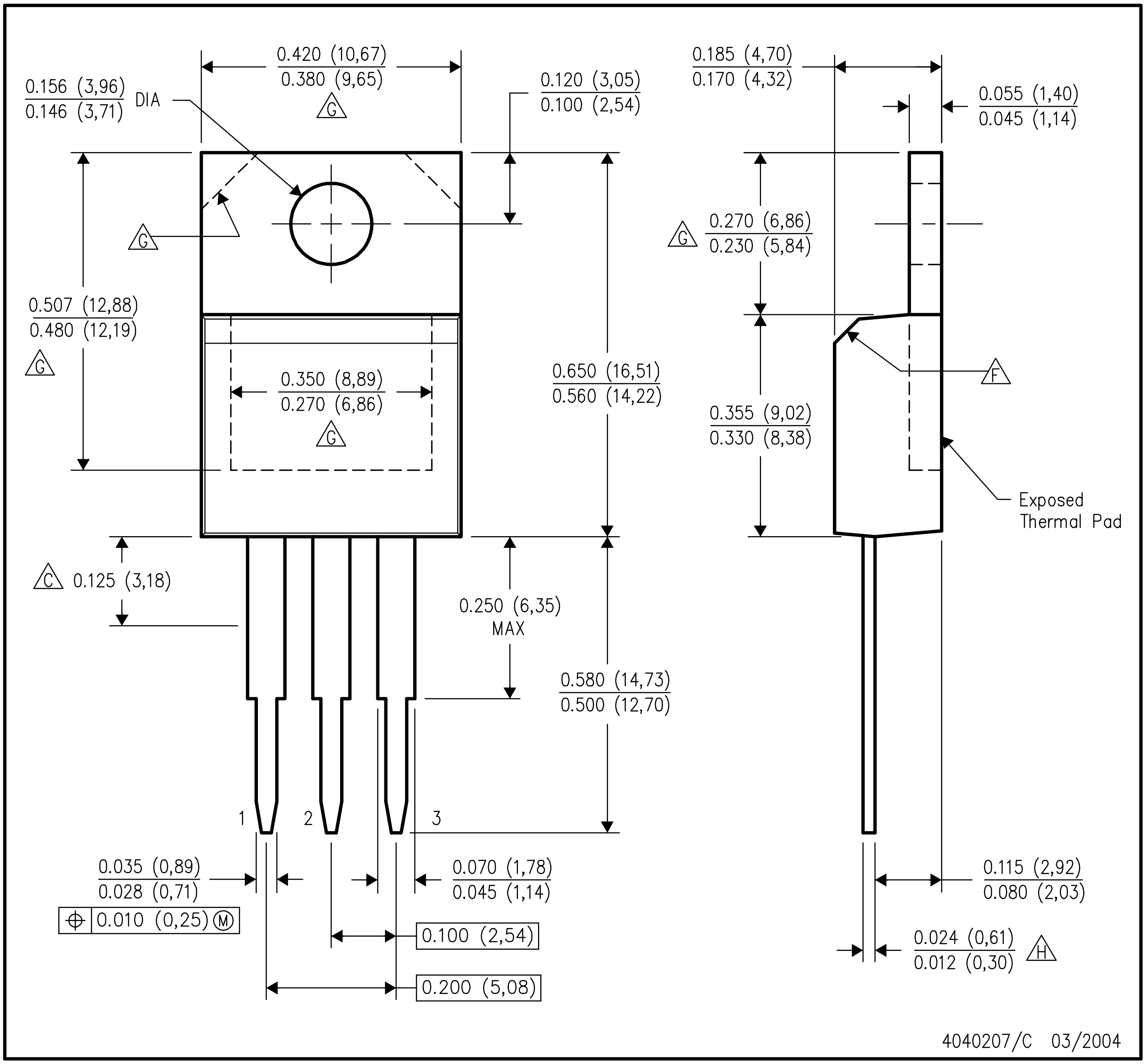
NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. The center lead is in electrical contact with the thermal tab.
D. Dimensions do not include mold protrusions, not to exceed 0.006 (0,15).
E. Falls within JEDEC MO-169

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.
- 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.

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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