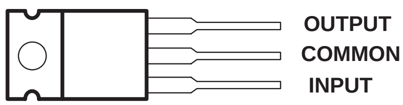
SLVS055D – APRIL 1981 – REVISED JULY 1997

- **±1% Output Tolerance at 25°C**
- **±2% Output Tolerance Over Full Operating Range**
- **Thermal Shutdown**
- **Internal Short-Circuit Current Limiting**
- **Pinout Identical to µA7800 Series**
- **Improved Version of µA7800 Series**

description

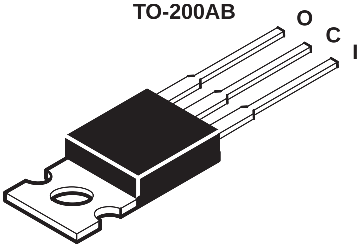
Each fixed-voltage precision regulator in this series is capable of supplying 1.5 A of load current. A unique temperature-compensation technique coupled with an internally trimmed band-gap reference has resulted in improved accuracy when compared to other 3-terminal regulators. Advanced layout techniques provide excellent line, load, and thermal regulation. The internal current limiting and thermal shutdown features make the devices essentially immune to overload.

KC PACKAGE
(TOP VIEW)

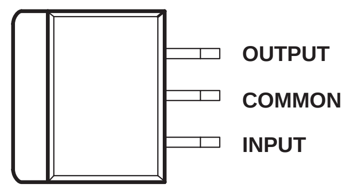


The common terminal is in electrical contact with the mounting base.

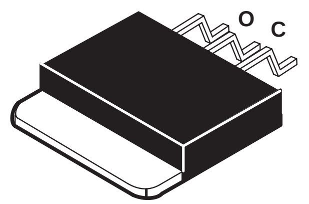
TO-200AB



KTE PACKAGE
(TOP VIEW)



The common terminal is in electrical contact with the mounting base.

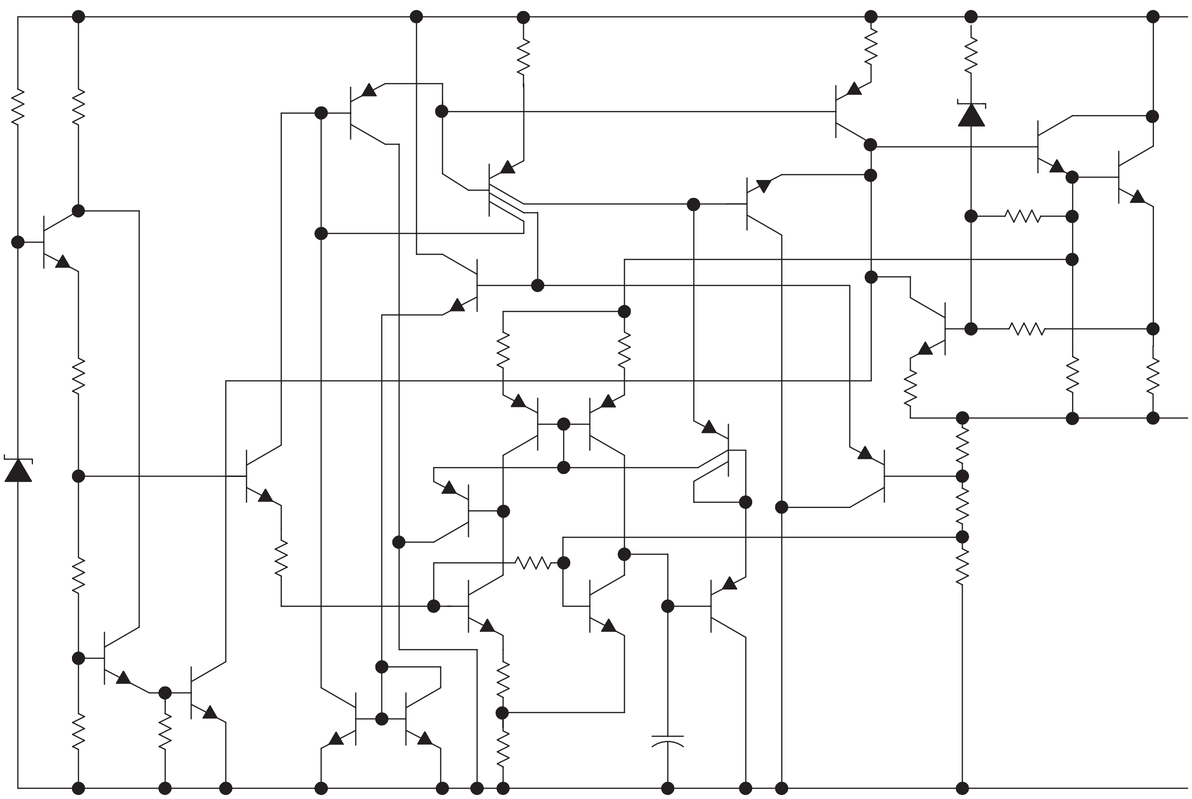


AVAILABLE OPTIONS

T_J	V_OTYP (V)	PACKAGED DEVICES		CHIP FORM (Y)
		HEAT-SINK MOUNTED (KC)	PLASTIC FLANGE MOUNTED (KTE)†	
0°C to 125°C	5	TL78005CKC	TL78005CKTE	TL78005Y
	12	TL78012CKC	TL78012CKTE	TL78012Y
	15	TL78015CKC	TL78015CKTE	TL78015Y

† The KTE package is also available taped and reeled.

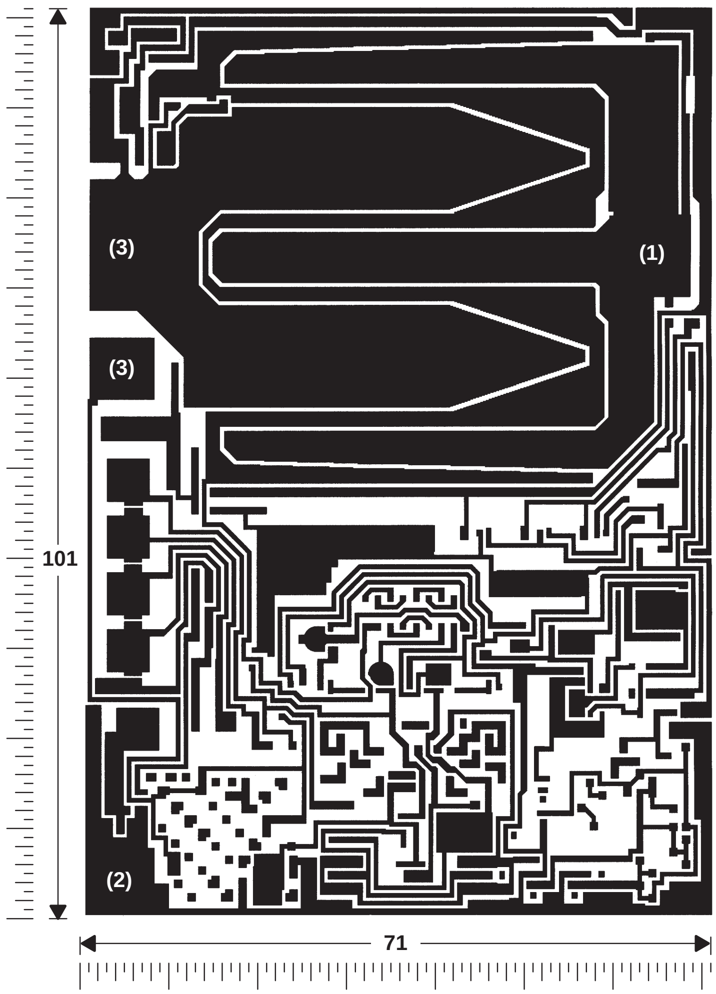
schematic

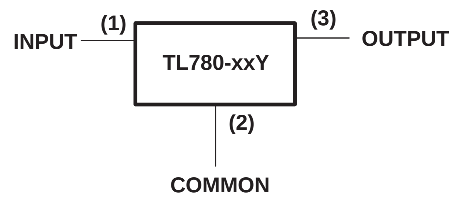


TL780-05Y, TL780-12Y, and TL780-15Y chip information

These chips, when properly assembled, display characteristics similar to the TL780-xxC Series. Thermal compression or ultrasonic bonding may be used on the doped aluminum bonding pads. The chips may be mounted with conductive epoxy or a gold-silicon preform.

BONDING PAD ASSIGNMENTS





CHIP THICKNESS: 15 MILS TYPICAL

BONDING PADS: 4 × 4 MILS MINIMUM

$T_J$max = 150°C

TOLERANCES ARE ±10%

ALL DIMENSIONS ARE IN MILS

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

Input voltage, V_I . . . . 35 V
Continuous total power dissipation at T_A = 25°C (see Note 1) . . . . . . See Dissipation Rating Tables
Continuous total power dissipation at (or below) T_C = 25°C (see Note 1) . . . See Dissipation Rating Tables
Operating free-air, T_A, case, T_C, or virtual junction, T_J, temperature range . . . . . . 0°C to 150°C
Storage temperature range, T_{stg} . . . . –65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . 260°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.

NOTE 1: For operation above T_A = 25°C or T_C = 25°C, refer to Figure 1 and Figure 2. To avoid exceeding the design maximum virtual junction temperature, these ratings should not be exceeded. Due to variations in individual device electrical characteristics and thermal resistance, the built-in thermal overload protection may be activated at power levels slightly above or below the rated dissipation.

DISSIPATION RATING TABLE — FREE-AIR TEMPERATURE

PACKAGE	T_A ≤ 25°C POWER RATING	DERATING FACTOR ABOVE T_A = 25°C	T_A = 70°C POWER RATING	T_A = 105°C POWER RATING	T_A = 125°C POWER RATING
KC	2000 mW	16.0 mW/°C	1280 mW	720 mW	400 mW
KTE	1900 mW	15.2 mW/°C	1216 mW	684 mW	380 mW

DISSIPATION RATING TABLE — CASE TEMPERATURE

PACKAGE	T_C ≤ 90°C POWER RATING	DERATING FACTOR ABOVE T_C = 90°C	T_A = 125°C POWER RATING
KC	15000 mW	250.0 mW/°C	6250 mW
KTE	14300 mW	238.0 mW/°C	5970 mW

FREE-AIR TEMPERATURE DISSIPATION DERATING CURVE

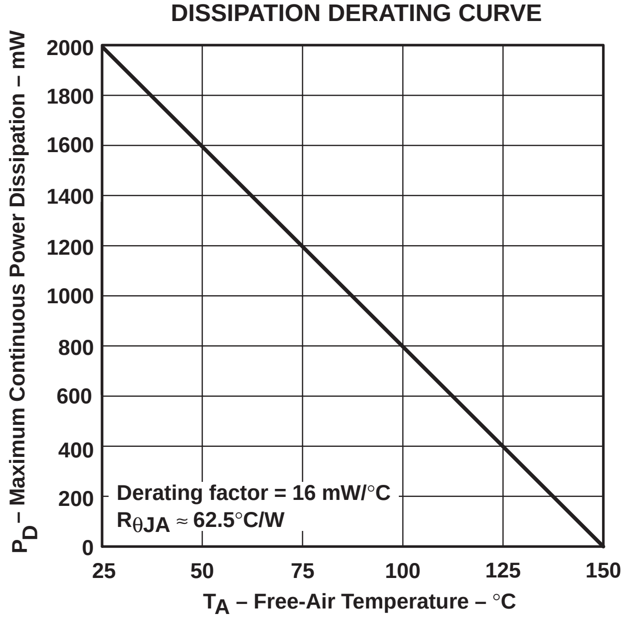


Figure 1

CASE TEMPERATURE DISSIPATION DERATING CURVE

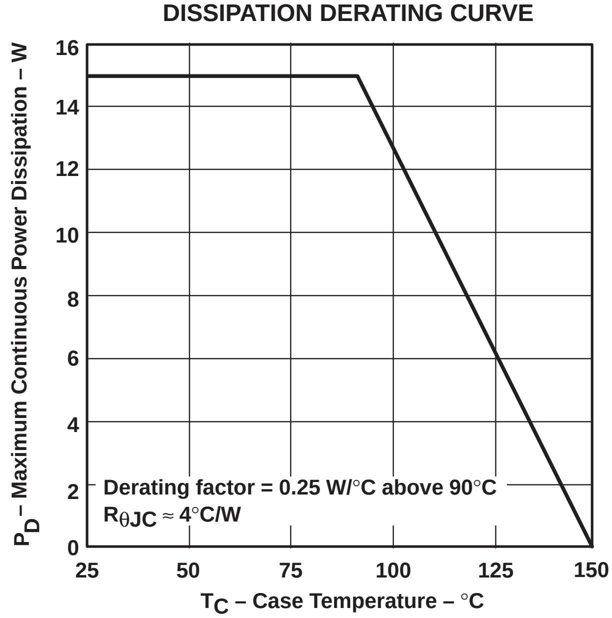


Figure 2

recommended operating conditions

		MIN	MAX	UNIT
Input voltage, V_I	TL780-05C	7	25	V
	TL780-12C	14.5	30	
	TL780-15C	17.5	30	
Output current, I_O			1.5	A
Operating virtual junction temperature, T_J		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†	TL780-05C			UNIT
			MIN	TYP	MAX	
Output voltage	I_O = 5 mA to 1 A, P ≤ 15 W, V_I = 7 V to 20 V	25°C	4.95	5	5.05	V
		0°C to 125°C	4.9		5.1	
Input voltage regulation	V_I = 7 V to 25 V	25°C		0.5	5	mV
	V_I = 8 V to 12 V			0.5	5	
Ripple rejection	V_I = 8 V to 18 V, f = 120 Hz	0°C to 125°C	70	85		dB
Output voltage regulation	I_O = 5 mA to 1.5 A	25°C		4	25	mV
	I_O = 250 mA to 750 mA			1.5	15	
Output resistance	f = 1 kHz	0°C to 125°C		0.0035		Ω
Temperature coefficient of output voltage	I_O = 5 mA	0°C to 125°C		0.25		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
Input bias current		25°C		5	8	mA
Input bias current change	V_I = 7 V to 25 V	0°C to 125°C		0.7	1.3	mA
	I_O = 5 mA to 1 A			0.003	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 0.22-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†	TL780-12C MIN	TL780-12C TYP	TL780-12C MAX	UNIT
Output voltage	I_O = 5 mA to 1 A, P ≤ 15 W, V_I = 14.5 V to 27 V	25°C	11.88	12	12.12	V
		0°C to 125°C	11.76		12.24	
Input voltage regulation	V_I = 14.5 V to 30 V	25°C		1.2	12	mV
	V_I = 16 V to 22 V			1.2	12	
Ripple rejection	V_I = 15 V to 25 V, f = 120 Hz	0°C to 125°C	65	80		dB
Output voltage regulation	I_O = 5 mA to 1.5 A	25°C		6.5	60	mV
	I_O = 250 mA to 750 mA			2.5	36	
Output resistance	f = 1 kHz	0°C to 125°C		0.0035		Ω
Temperature coefficient of output voltage	I_O = 5 mA	0°C to 125°C		0.6		mV/°C
Output noise voltage	f = 10 Hz to 100 kHz	25°C		180		µV
Dropout voltage	I_O = 1 A	25°C		2		V
Input bias current		25°C		5.5	8	mA
Input bias current change	V_I = 14.5 V to 30 V	0°C to 125°C		0.4	1.3	mA
	I_O = 5 mA to 1 A			0.03	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 0.22-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†	TL780-15C MIN	TL780-15C TYP	TL780-15C MAX	UNIT
Output voltage	I_O = 5 mA to 1 A, P ≤ 15 W, V_I = 17.5 V to 30 V	25°C	14.85	15	15.15	V
		0°C to 125°C	14.7		15.3	
Input voltage regulation	V_I = 17.5 V to 30 V	25°C		1.5	15	mV
	V_I = 20 V to 26 V			1.5	15	
Ripple rejection	V_I = 18.5 V to 28.5 V, f = 120 Hz	0°C to 125°C	60	75		dB
Output voltage regulation	I_O = 5 mA to 1.5 A	25°C		7	75	mV
	I_O = 250 mA to 750 mA			2.5	45	
Output resistance	f = 1 kHz			0.0035		Ω
Temperature coefficient of output voltage	I_O = 5 mA	0°C to 125°C		0.62		mV/°C
Output noise voltage	f = 10 Hz to 100 kHz	25°C		225		µV
Dropout voltage	I_O = 1 A	25°C		2		V
Input bias current		25°C		5.5	8	mA
Input bias current change	V_I = 17.5 V to 30 V	0°C to 125°C		0.4	1.3	mA
	I_O = 5 mA to 1 A			0.02	0.5	
Short-circuit output current		25°C		230		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 0.22-µF capacitor across the output.

electrical characteristics, V_I = 10 V, I_O = 500 mA, T_J = 25°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS†	TL780-05Y			UNIT
		MIN	TYP	MAX	
Output voltage	I_O = 5 mA to 1 A, P ≤ 15 W,		5		V
Input voltage regulation	V_I = 7 V to 25 V		0.5		mV
	V_I = 8 V to 12 V		0.5		
Output voltage regulation	I_O = 5 mA to 1.5 A		4		mV
	I_O = 250 mA to 750 mA		1.5		
Output noise voltage	f = 10 Hz to 100 kHz		75		µV
Dropout voltage	I_O = 1 A		2		V
Input bias current			5		mA
Short-circuit output current			750		mA
Peak output current			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 0.22-µF capacitor across the output.

electrical characteristics, V_I = 19 V, I_O = 500 mA, T_J = 25°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS†	TL780-12Y			UNIT
		MIN	TYP	MAX	
Output voltage	I_O = 5 mA to 1 A, P ≤ 15 W,		12		V
Input voltage regulation	V_I = 14.5 V to 30 V		1.2		mV
	V_I = 16 V to 22 V		1.2		
Output voltage regulation	I_O = 5 mA to 1.5 A		6.5		mV
	I_O = 250 mA to 750 mA		2.5		
Output noise voltage	f = 10 Hz to 100 kHz		180		µV
Dropout voltage	I_O = 1 A		2		V
Input bias current			5.5		mA
Short-circuit output current			350		mA
Peak output current			2.2		A

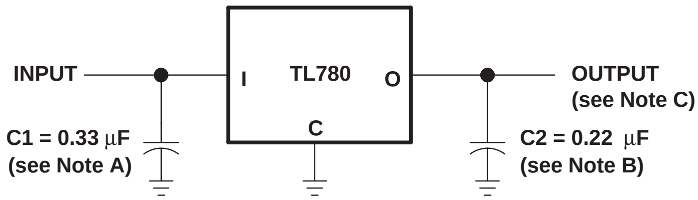
† Pulse-testing techniques the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-µF capacitor across the input and a 0.22-µF capacitor across the output.

electrical characteristics, V_I = 23 V, I_O = 500 mA, T_J = 25°C (unless otherwise noted)

PARAMETER	TEST CONDITIONS†	TL780-15Y			UNIT
		MIN	TYP	MAX	
Output voltage	I_O = 5 mA to 1 A, P ≤ 15 W,		15		V
Input voltage regulation	V_I = 17.5 V to 30 V		1.5		mV
	V_I = 20 V to 26 V		1.5		
Output voltage regulation	I_O = 5 mA to 1.5 A		7		mV
	I_O = 250 mA to 750 mA		2.5		
Output resistance	f = 1 kHz		0.0035		Ω
Output noise voltage	f = 10 Hz to 100 kHz		225		µV
Dropout voltage	I_O = 1 A		2		V
Input bias current			5.5		mA
Short-circuit output current			230		mA
Peak output current			2.2		A

† Pulse-testing techniques 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 0.22-µF capacitor across the output.

PARAMETER MEASUREMENT INFORMATION



NOTES: A. C1 is required when the regulator is far from the power supply filter.
B. C2 is not required for stability; however, transient response is improved.
C. Permanent damage can occur when output is pulled below ground.

Figure 3. Test Circuit

APPLICATION INFORMATION

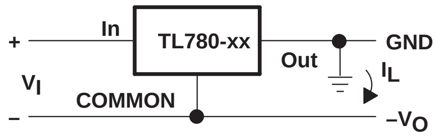


Figure 4. Positive Regulator in Negative Configuration (V_I Must Float)

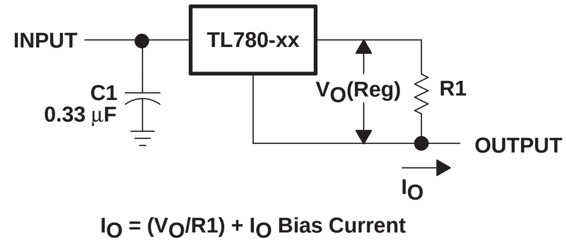


Figure 5. Current Regulator

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.

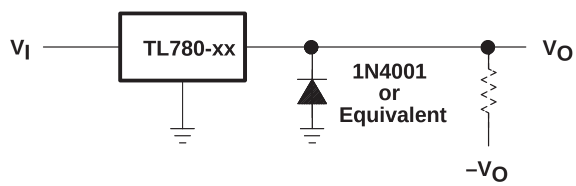


Figure 6. Output Polarity Reversal Protection Circuit

reverse-bias protection

Occasionally, the input voltage to the regulator can collapse faster than the output voltage. This, for example, could occur 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 employed, as shown in Figure 7.

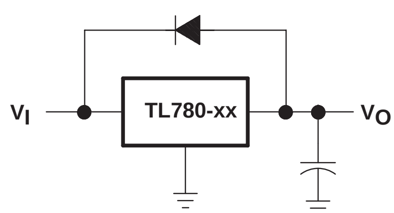
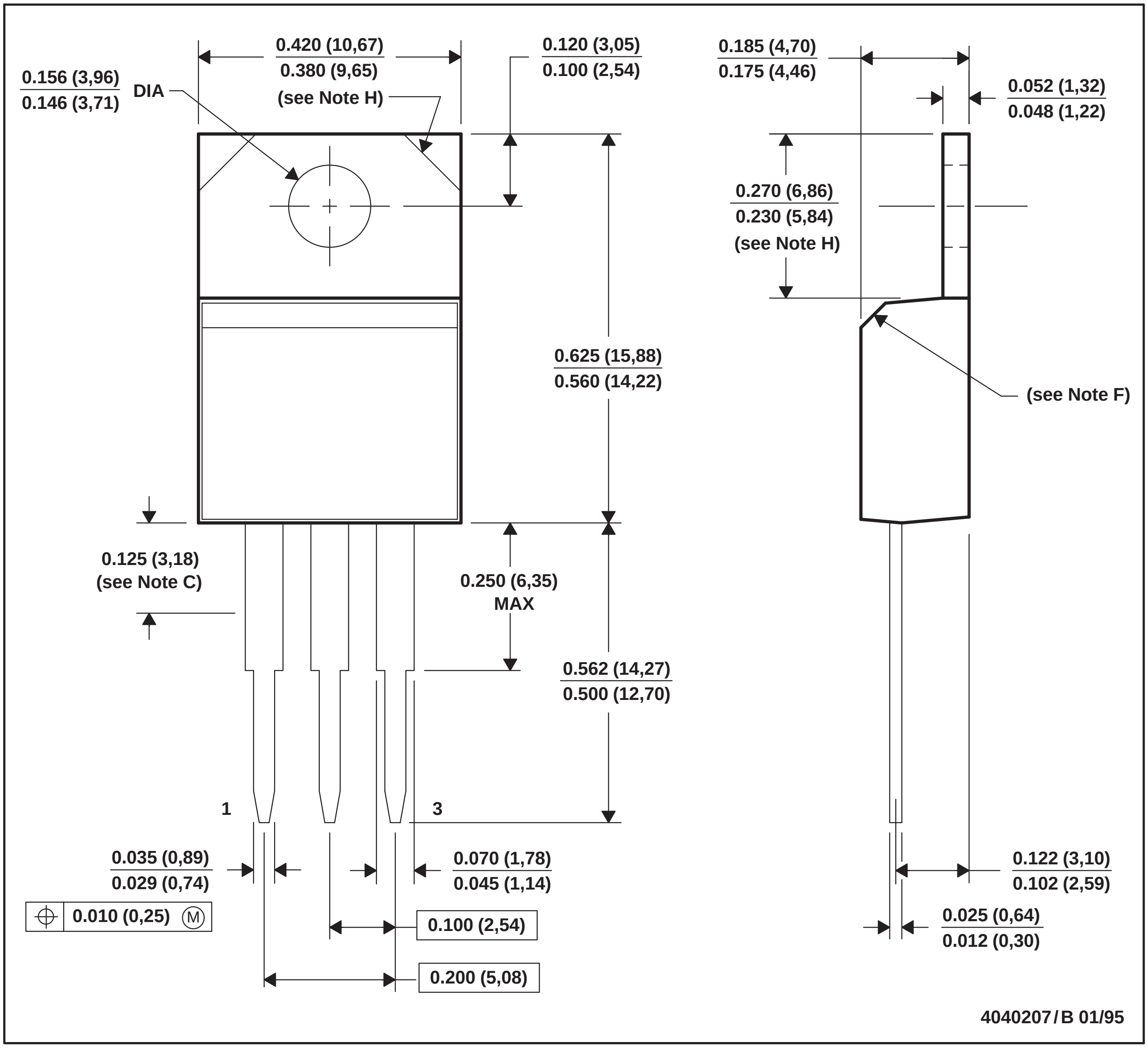


Figure 7. Reverse-Bias Protection Circuit

MECHANICAL INFORMATION

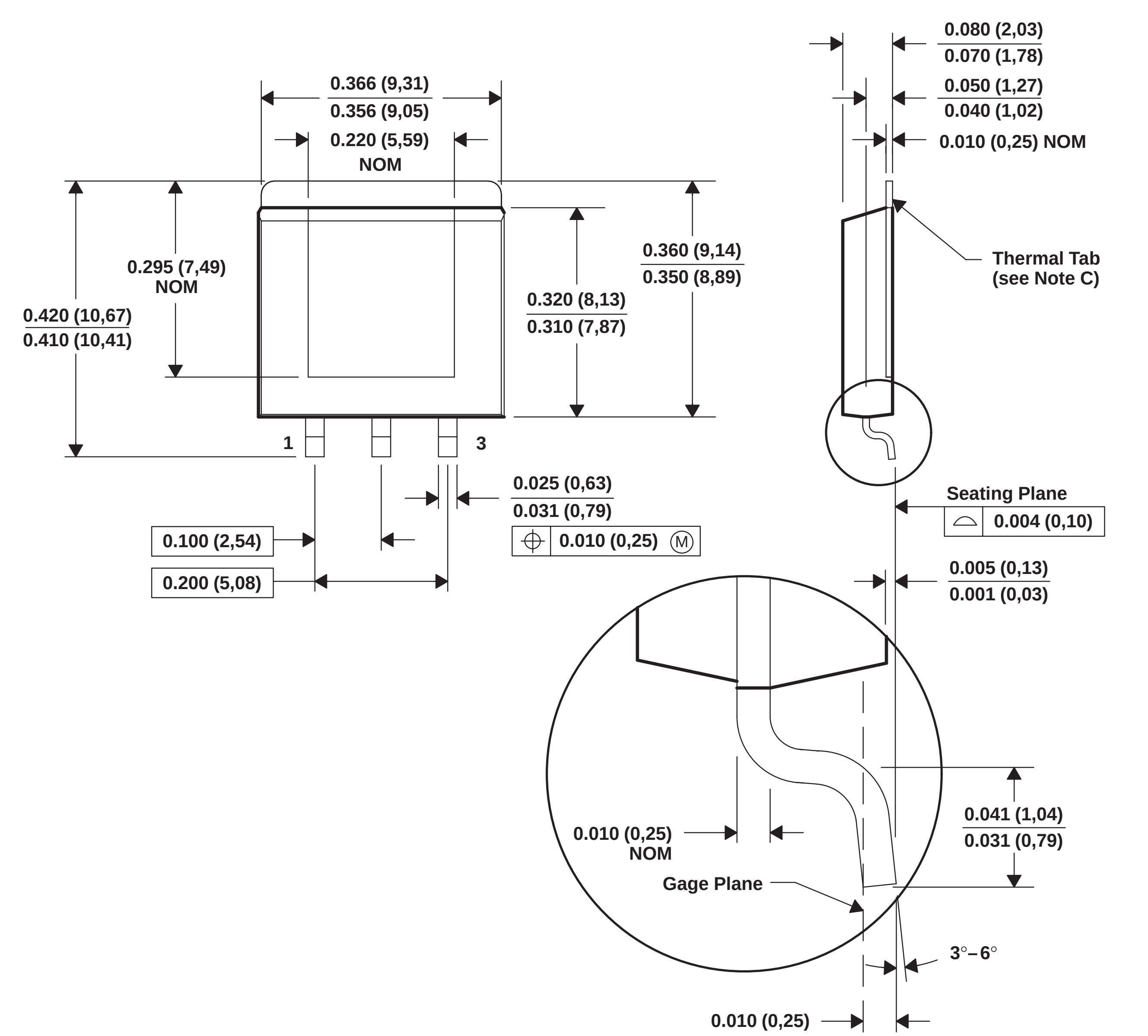
KC (R-PSFM-T3) **PLASTIC FLANGE-MOUNT PACKAGE**



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. Falls within JEDEC TO-220AB
- H. Tab contour optional within these dimensions

MECHANICAL INFORMATION

KTE (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. The center lead is in electrical contact with the thermal tab.

IMPORTANT NOTICE