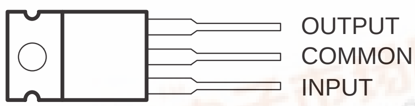
- **±1% Output Tolerance at 25°C**
- **±2% Output Tolerance Over Full Operating Range**
- **Thermal Shutdown**
- **Internal Short-Circuit Current Limiting**
- **Pinout Identical to µA7800 Series**
- **Improved Version of µA7800 Series**

description

Each fixed-voltage precision regulator in the TL780 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 three-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.

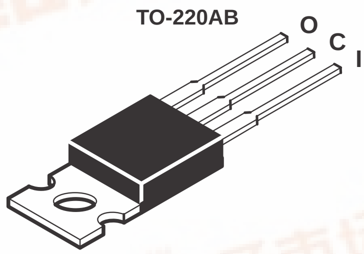
The TL780-xxC series regulators are characterized for operation over the virtual junction temperature range of 0°C to 125°C.

KC PACKAGE
(TOP VIEW)

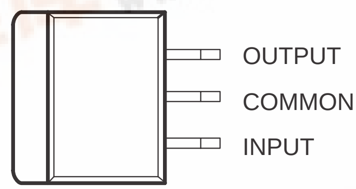


The COMMON terminal is in electrical contact with the mounting base.

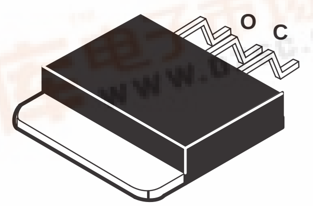
TO-220AB



KTE PACKAGE
(TOP VIEW)



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



AVAILABLE OPTIONS

T_J	V_O TYP (V)	PACKAGED DEVICES		CHIP FORM (Y)
		HEAT-SINK MOUNTED (KC)	PLASTIC FLANGE MOUNTED (KTE)	
0°C to 125°C	5	TL780-05CKC	TL780-05CKTE	TL780-05Y
	12	TL780-12CKC	TL780-12CKTE	TL780-12Y
	15	TL780-15CKC	TL780-15CKTE	TL780-15Y

The KTE package is available taped and reeled. Add the suffix R to the device type (e.g., TL780-05CKTER). Chip forms are tested at 25°C.

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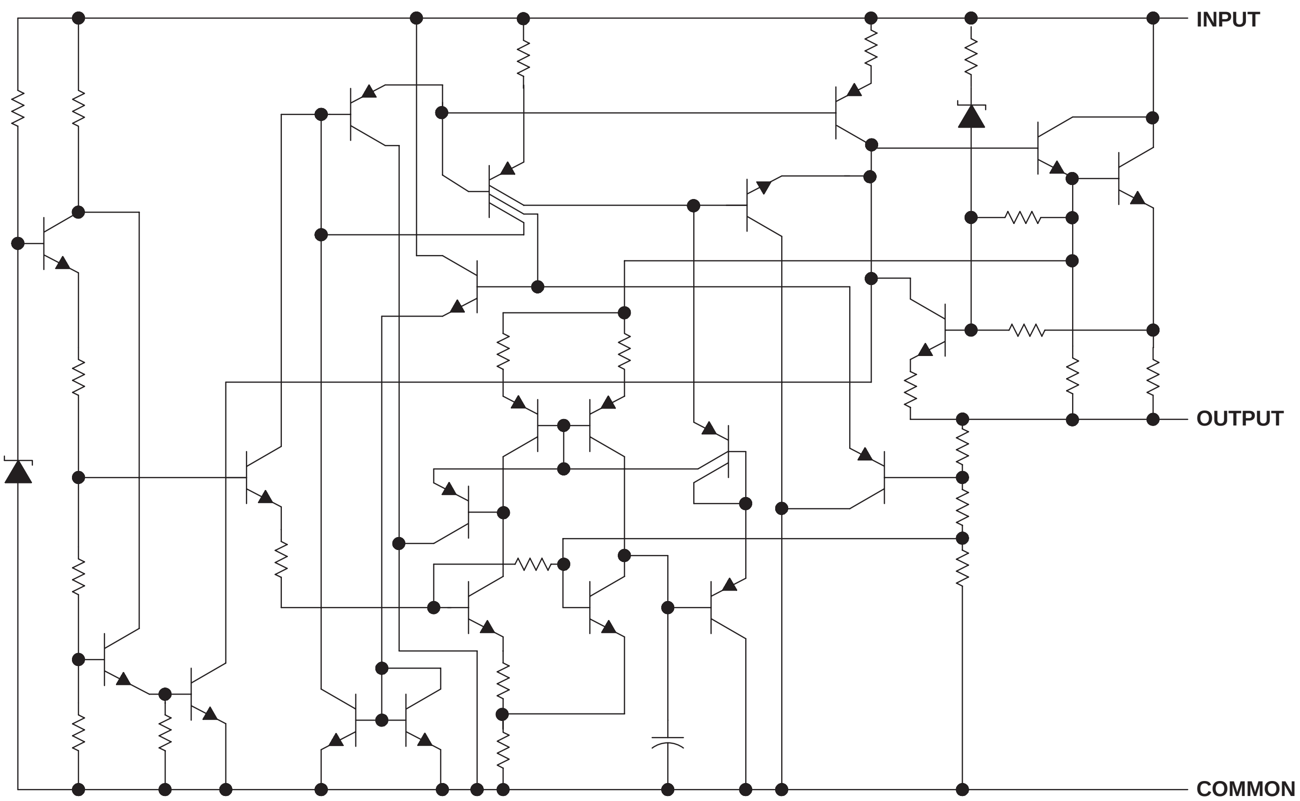
schematic



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

Input voltage, V_I		35 V
Package thermal impedance, θ_{JA} (see Notes 1 and 2):	KC package	22°C/W
	KTE package	23°C/W
Operating free-air, T_A; case, T_C; or virtual junction, T_J, temperature range		0°C to 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.

NOTES: 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 impact reliability. 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.

2. The package thermal impedance is calculated in accordance with JESD 51.

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 MIN	TYP	MAX	UNIT
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		W
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		W
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°C to 125°C		0.0035		W
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 MIN	TL780-05Y TYP	TL780-05Y MAX	UNIT
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 MIN	TL780-12Y TYP	TL780-12Y MAX	UNIT
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

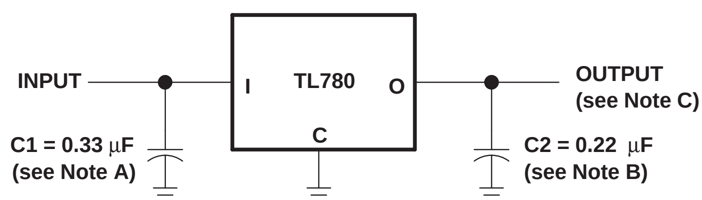
† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.22-μF capacitor across the output.

electrical characteristics, V_I = 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		W
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 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.

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 1. Test Circuit

APPLICATION INFORMATION

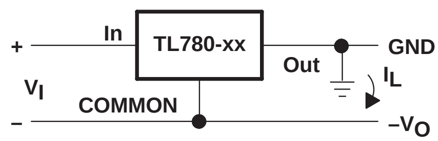


Figure 2. Positive Regulator in Negative Configuration (V_I Must Float)

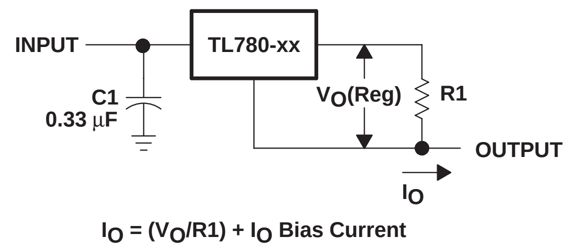


Figure 3. Current Regulator

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 4. This protects the regulator from output polarity reversals during startup and short-circuit operation.

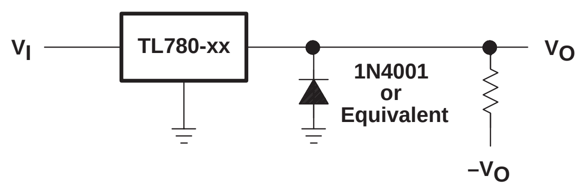


Figure 4. Output Polarity-Reversal-Protection Circuit

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 5.

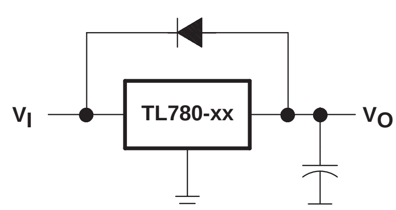


Figure 5. Reverse-Bias-Protection Circuit

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