

# μA7800 SERIES POSITIVE-VOLTAGE REGULATORS

SLVS056G – MAY 1976 – REVISED OCTOBER 2001

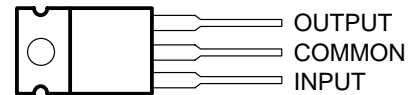
- 3-Terminal Regulators
- Output Current up to 1.5 A
- Internal Thermal-Overload Protection
- High Power-Dissipation Capability
- Internal Short-Circuit Current Limiting
- Output Transistor Safe-Area Compensation
- Direct Replacements for Fairchild μA7800 Series

## description

This series of fixed-voltage monolithic 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.

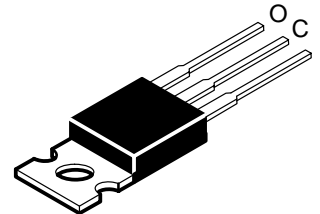
The μA7800C series is characterized for operation over the virtual junction temperature range of 0°C to 125°C.

KC PACKAGE  
(TOP VIEW)

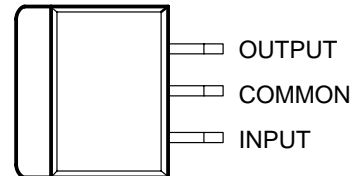


The COMMON terminal is in electrical contact with the mounting base.

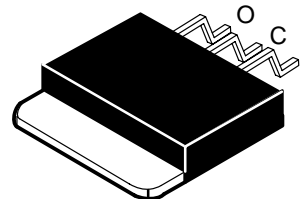
TO-220AB



KTE PACKAGE  
(TOP VIEW)



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



## AVAILABLE OPTIONS

T <sub>J</sub>	V <sub>O(NOM)</sub> (V)	PACKAGED DEVICES	
		PLASTIC FLANGE MOUNT (KC)	HEAT-SINK MOUNTED (KTE)
0°C to 125°C	5	μA7805CKC	μA7805CKTE
	8	μA7808CKC	μA7808CKTE
	10	μA7810CKC	μA7810CKTE
	12	μA7812CKC	μA7812CKTE
	15	μA7815CKC	μA7815CKTE
	24	μA7824CKC	μA7824CKTE

The KTE package is only available taped and reeled. Add the suffix R to the device type (e.g., μA7805CKTER).



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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**

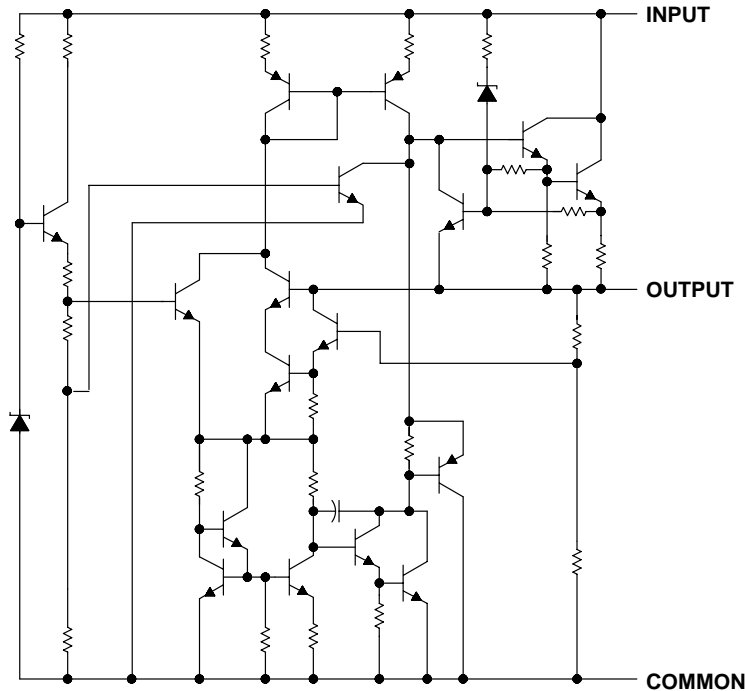
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## schematic



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

Input voltage, $V_I$ : μA7824C .....	40 V
All others .....	35 V
Package thermal impedance, $\theta_{JA}$ (see Notes 1 and 2): KC package .....	22°C/W
(see Notes 1 and 3): KTE package .....	23°C/W
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds .....	260°C
Virtual junction temperature range, $T_J$ .....	0°C to 150°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  $T_J(\max)$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\max) - T_A)/\theta_{JA}$ . Selecting the maximum of 150°C can impact reliability.  
 2. The package thermal impedance is calculated in accordance with JESD 51-7.  
 3. The package thermal impedance is calculated in accordance with JESD 51-5.

## 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



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

PARAMETER	TEST CONDITIONS	$T_J$ †	μA7805C			UNIT
			MIN	TYP	MAX	
Output voltage	$I_O = 5\text{ mA to }1\text{ A}$ , $P_D \leq 15\text{ W}$	25°C	4.8	5	5.2	V
		0°C to 125°C	4.75		5.25	
Input voltage regulation	$V_I = 7\text{ V to }25\text{ V}$	25°C	3		100	mV
	$V_I = 8\text{ V to }12\text{ V}$		1		50	
Ripple rejection	$V_I = 8\text{ V to }18\text{ V}$ , $f = 120\text{ Hz}$	0°C to 125°C	62	78		dB
Output voltage regulation	$I_O = 5\text{ mA to }1.5\text{ A}$	25°C	15		100	mV
	$I_O = 250\text{ mA to }750\text{ mA}$		5		50	
Output resistance	$f = 1\text{ kHz}$	0°C to 125°C	0.017			Ω
Temperature coefficient of output voltage	$I_O = 5\text{ mA}$	0°C to 125°C	-1.1			mV/°C
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C	40			μV
Dropout voltage	$I_O = 1\text{ A}$	25°C	2			V
Bias current		25°C	4.2	8		mA
Bias current change	$V_I = 7\text{ V to }25\text{ V}$	0°C to 125°C			1.3	mA
	$I_O = 5\text{ mA to }1\text{ A}$				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,  $V_I = 14\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_J$ †	μA7808C			UNIT
			MIN	TYP	MAX	
Output voltage	$I_O = 5\text{ mA to }1\text{ A}$ , $P_D \leq 15\text{ W}$	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

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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	$I_O = 5\text{ mA to }1\text{ A}$ , $P_D \leq 15\text{ W}$	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.

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.



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**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.

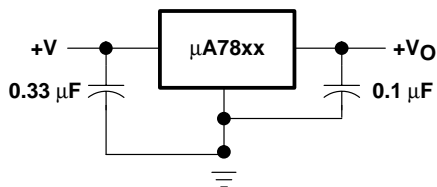
**electrical characteristics at specified virtual junction temperature,  $V_I = 33\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)**

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

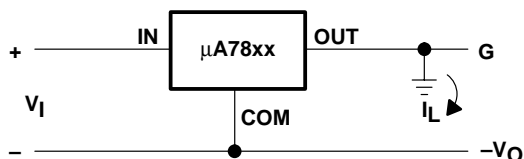
† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33-μF capacitor across the input and a 0.1-μF capacitor across the output.



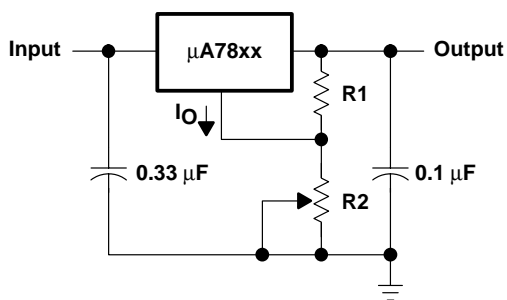
**APPLICATION INFORMATION**



**Figure 1. Fixed-Output Regulator**



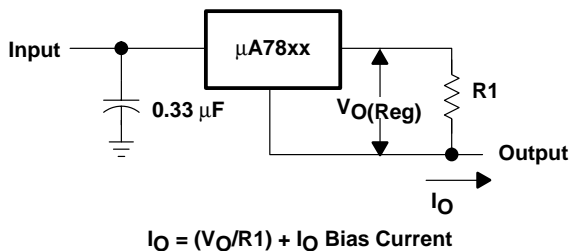
**Figure 2. Positive Regulator in Negative Configuration (V<sub>I</sub> Must Float)**



NOTE A: The following formula is used when V<sub>xx</sub> is the nominal output voltage (output to common) of the fixed regulator:

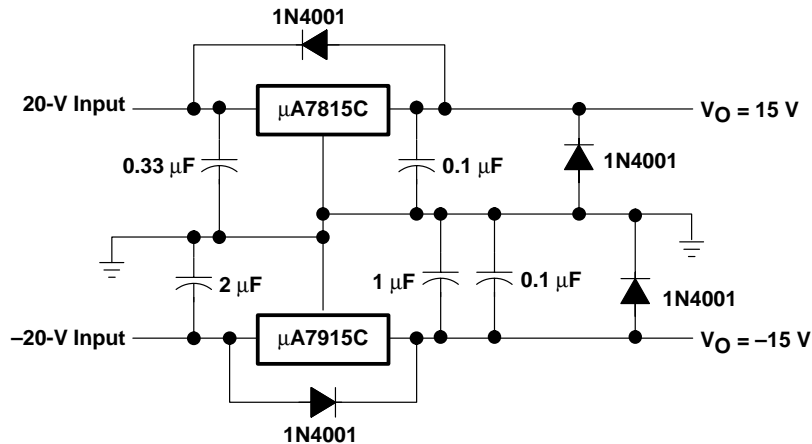
$$V_O = V_{xx} + \left( \frac{V_{xx}}{R_1} + I_Q \right) R_2$$

**Figure 3. Adjustable-Output Regulator**



**Figure 4. Current Regulator**

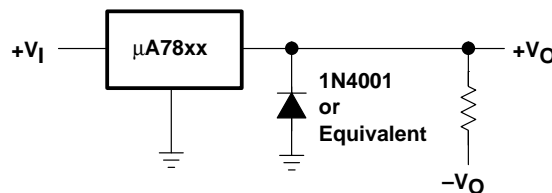
**APPLICATION INFORMATION**



**Figure 5. Regulated Dual Supply**

**operation with a load common to a voltage of opposite polarity**

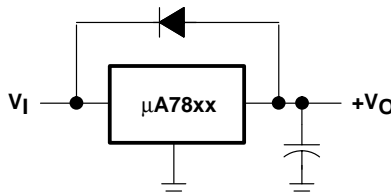
In many cases, a regulator powers a load that is not connected to ground but, instead, is connected to a voltage source of opposite polarity (e.g., operational amplifiers, level-shifting circuits, etc.). In these cases, a clamp diode should be connected to the regulator output as shown in Figure 6. This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

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