

μ A78L00 SERIES POSITIVE-VOLTAGE REGULATORS

SLVS010P – JANUARY 1976 – REVISED JUNE 2002

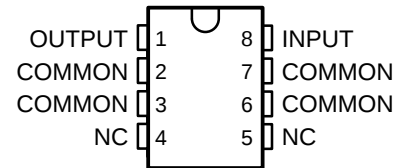
- 3-Terminal Regulators
- Output Current up to 100 mA
- No External Components
- Internal Thermal-Overload Protection
- Internal Short-Circuit Current Limiting
- Direct Replacements for Fairchild μ A78L00 Series

description

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. In addition, they can be used with power-pass elements to make high-current voltage regulators. One of these regulators can deliver up to 100 mA of output current. The internal limiting and thermal-shutdown features of these regulators essentially make them immune to overload. When used as a replacement for a zener diode-resistor combination, an effective improvement in output impedance can be obtained, together with lower bias current.

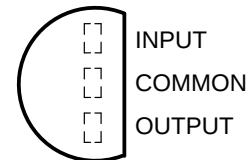
The μ A78L00C and μ A78L00AC series are characterized for operation over the virtual junction temperature range of 0°C to 125°C. The μ A78L05AI is characterized for operation over the virtual junction temperature range of –40°C to 125°C.

**D PACKAGE
(TOP VIEW)**



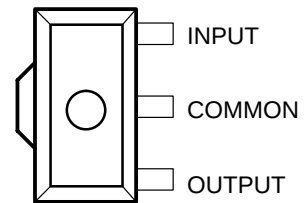
NC – No internal connection

**LP PACKAGE
(TOP VIEW)**



TO-226AA

**PK PACKAGE
(TOP VIEW)**



The center lead is in electrical contact with the tab.



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**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2002, Texas Instruments Incorporated

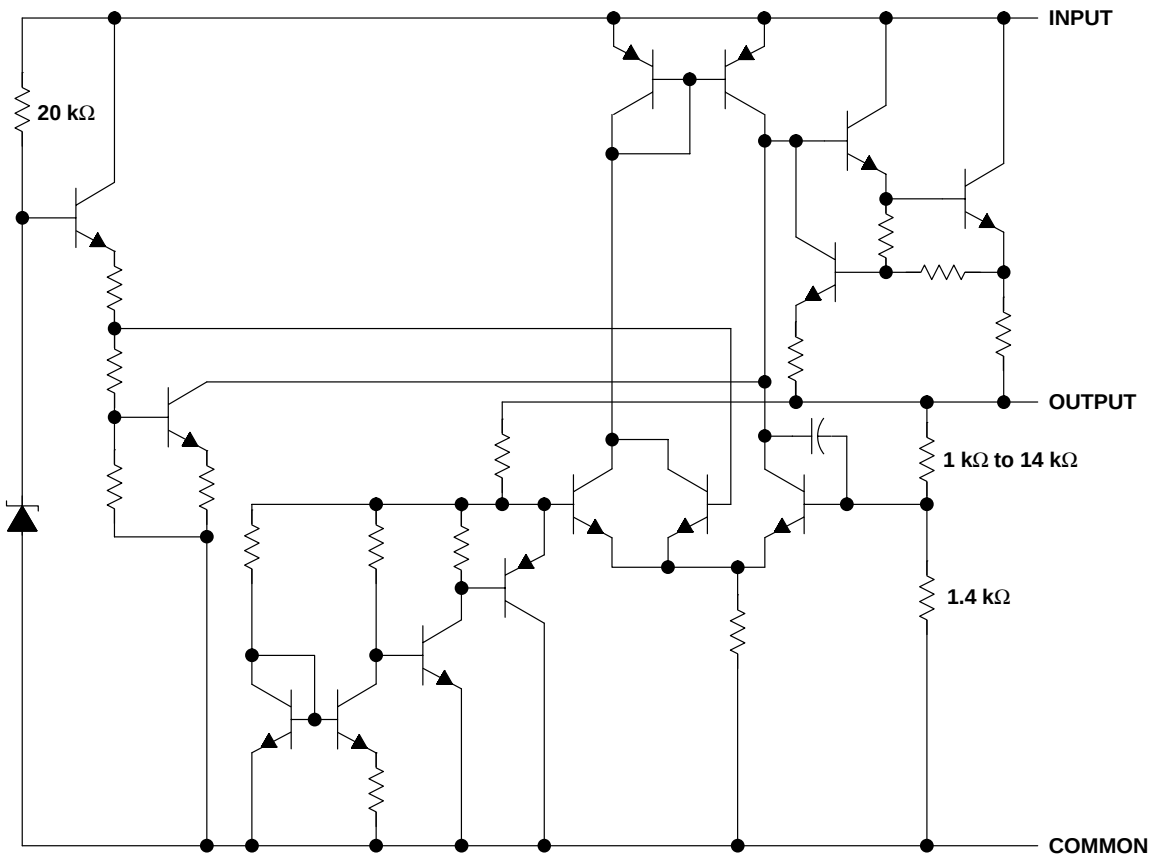
μA78L00 SERIES
 POSITIVE-VOLTAGE REGULATORS

SLVS010P – JANUARY 1976 – REVISED JUNE 2002

AVAILABLE OPTIONS							
T _J	V _{O(NOM)} (V)	PACKAGE					
		SMALL OUTLINE (D)		PLASTIC CYLINDRICAL (LP)		SOT-89 (PK)	
		OUTPUT VOLTAGE TOLERANCE					
		5%	10%	5%	10%	5%	10%
0°C to 125°C	2.6	μA78L02ACD	—	μA78L02ACLP	—	—	—
	5	μA78L05ACD	μA78L05CD	μA78L05ACLP	μA78L05CLP	μA78L05ACPK	μA78L05CPK
	6.2	—	—	μA78L06ACLP	—	μA78L06ACPK	—
	8	μA78L08ACD	μA78L08CD	μA78L08ACLP	—	μA78L08ACPK	μA78L08CPK
	9	μA78L09ACD	—	μA78L09ACLP	μA78L09CLP	μA78L09ACPK	—
	10	μA78L10ACD	—	μA78L10ACLP	—	μA78L10ACPK	—
	12	μA78L12ACD	—	μA78L12ACLP	—	μA78L12ACPK	—
	15	μA78L15ACD	—	μA78L15ACLP	—	μA78L15ACPK	—
−40°C to 125°C	5	—	—	μA78L05AILP	—	—	—

D and LP packages are available taped and reeled. Add the suffix R to the device type (e.g., μA78L05ACDR). The PK package is only available taped and reeled (do not add the suffix R to the device type).

schematic



NOTE A: Resistor values shown are nominal.

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

Input voltage, V_I : μA78L02AC, μA78L05C–μA78L09C, μA78L10AC	30 V
μA78L12C, μA78L12AC, μA78L15C, μA78L15AC	35 V
Package thermal impedance, θ_{JA} (see Notes 1 and 2): D package	97°C/W
LP package	156°C/W
PK package	52°C/W
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.

- NOTES: 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. 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 51-7.

recommended operating conditions

		MIN	MAX	UNIT
V_I	Input voltage	μA78L02AC	4.75	20
		μA78L05C, μA78L05AC	7	20
		μA78L06C, μA78L06AC	8.5	20
		μA78L08C, μA78L08AC	10.5	23
		μA78L09C, μA78L09AC	11.5	24
		μA78L10AC	12.5	25
		μA78L12C, μA78L12AC	14.5	27
		μA78L15C, μA78L15AC	17.5	30
I_O	Output current		100	mA
T_J	Operating virtual junction temperature range	μA78LxxC and μA78LxxAC series	0	125
		μA78L05AI	–40	125

μA78L00 SERIES **POSITIVE-VOLTAGE REGULATORS**

SLVS010P – JANUARY 1976 – REVISED JUNE 2002

electrical characteristics at specified virtual junction temperature, $V_I = 9\text{ V}$, $I_O = 40\text{ mA}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J^\dagger$	μA78L02AC			UNIT
			MIN	TYP	MAX	
Output voltage	$V_I = 4.75\text{ V to }20\text{ V}$, $I_O = 1\text{ mA to }40\text{ mA}$	25°C	2.5	2.6	2.7	V
		0°C to 125°C	2.45		2.75	
	$I_O = 1\text{ mA to }70\text{ mA}$	0°C to 125°C	2.45		2.75	
Input voltage regulation	$V_I = 4.75\text{ V to }20\text{ V}$	25°C		20	100	mV
	$V_I = 5\text{ V to }20\text{ V}$			16	75	
Ripple rejection	$V_I = 6\text{ V to }20\text{ V}$, $f = 120\text{ Hz}$	25°C	43	51		dB
Output voltage regulation	$I_O = 1\text{ mA to }100\text{ mA}$	25°C		12	50	mV
	$I_O = 1\text{ mA to }40\text{ mA}$			6	25	
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C		30		μV
Dropout voltage		25°C		1.7		V
Bias current		25°C		3.6	6	mA
		125°C			5.5	
Bias current change	$V_I = 5\text{ V to }20\text{ V}$	0°C to 125°C			2.5	mA
	$I_O = 1\text{ mA to }40\text{ mA}$				0.1	

† Pulse-testing techniques maintain T_J as close to T_A 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, $V_I = 10\text{ V}$, $I_O = 40\text{ mA}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J^\ddagger$	μA78L05C			μA78L05AC μA78L05AI			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
Output voltage	$V_I = 7\text{ V to }20\text{ V}$, $I_O = 1\text{ mA to }40\text{ mA}$	25°C	4.6	5	5.4	4.8	5	5.2	V
		Full range	4.5		5.5	4.75		5.25	
	$I_O = 1\text{ mA to }70\text{ mA}$	Full range	4.5		5.5	4.75		5.25	
Input voltage regulation	$V_I = 7\text{ V to }20\text{ V}$	25°C		32	200		32	150	mV
	$V_I = 8\text{ V to }20\text{ V}$			26	150		26	100	
Ripple rejection	$V_I = 8\text{ V to }18\text{ V}$, $f = 120\text{ Hz}$	25°C	40	49		41	49		dB
Output voltage regulation	$I_O = 1\text{ mA to }100\text{ mA}$	25°C		15	60		15	60	mV
	$I_O = 1\text{ mA to }40\text{ mA}$			8	30		8	30	
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C		42			42		μV
Dropout voltage		25°C		1.7			1.7		V
Bias current		25°C		3.8	6		3.8	6	mA
		125°C			5.5			5.5	
Bias current change	$V_I = 8\text{ V to }20\text{ V}$	Full range			1.5			1.5	mA
	$I_O = 1\text{ mA to }40\text{ mA}$				0.2			0.1	

‡ Pulse-testing techniques maintain T_J as close to T_A 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. Full range for the μA78L05AC is $T_J = 0^\circ\text{C to }125^\circ\text{C}$ and full range for the μA78L05AI is $T_J = -40^\circ\text{C to }125^\circ\text{C}$.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

electrical characteristics at specified virtual junction temperature, $V_I = 12\text{ V}$, $I_O = 40\text{ mA}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J^\dagger$	μA78L06C			μA78L06AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
Output voltage	$V_I = 8.5\text{ V to }20\text{ V}$, $I_O = 1\text{ mA to }40\text{ mA}$	25°C	5.7	6.2	6.7	5.95	6.2	6.45	V
		0°C to 125°C	5.6		6.8	5.9		6.5	
	$I_O = 1\text{ mA to }70\text{ mA}$	0°C to 125°C	5.6		6.8	5.9		6.5	
Input voltage regulation	$V_I = 8.5\text{ V to }20\text{ V}$	25°C		35	200		35	175	mV
	$V_I = 9\text{ V to }20\text{ V}$			29	150		29	125	
Ripple rejection	$V_I = 10\text{ V to }20\text{ V}$, $f = 120\text{ Hz}$	25°C	39	48		40	48		dB
Output voltage regulation	$I_O = 1\text{ mA to }100\text{ mA}$	25°C		16	80		16	80	mV
	$I_O = 1\text{ mA to }40\text{ mA}$			9	40		9	40	
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C		46			46		μV
Dropout voltage		25°C		1.7			1.7		V
Bias current		25°C		3.9	6		3.9	6	mA
		125°C			5.5			5.5	
Bias current change	$V_I = 9\text{ V to }20\text{ V}$	0°C to 125°C			1.5			1.5	mA
	$I_O = 1\text{ mA to }40\text{ mA}$				0.2			0.1	

† Pulse-testing techniques maintain T_J as close to T_A 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, $V_I = 14\text{ V}$, $I_O = 40\text{ mA}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J^\dagger$	μA78L08C			μA78L08AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
Output voltage	$V_I = 10.5\text{ V to }23\text{ V}$, $I_O = 1\text{ mA to }40\text{ mA}$	25°C	7.36	8	8.64	7.7	8	8.3	V
		0°C to 125°C	7.2		8.8	7.6		8.4	
	$I_O = 1\text{ mA to }70\text{ mA}$	0°C to 125°C	7.2		8.8	7.6		8.4	
Input voltage regulation	$V_I = 10.5\text{ V to }23\text{ V}$	25°C		42	200		42	175	mV
	$V_I = 11\text{ V to }23\text{ V}$			36	150		36	125	
Ripple rejection	$V_I = 13\text{ V to }23\text{ V}$, $f = 120\text{ Hz}$	25°C	36	46		37	46		dB
Output voltage regulation	$I_O = 1\text{ mA to }100\text{ mA}$	25°C		18	80		18	80	mV
	$I_O = 1\text{ mA to }40\text{ mA}$			10	40		10	40	
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C		54			54		μV
Dropout voltage		25°C		1.7			1.7		V
Bias current		25°C		4	6		4	6	mA
		125°C			5.5			5.5	
Bias current change	$V_I = 5\text{ V to }20\text{ V}$	0°C to 125°C			1.5			1.5	mA
	$I_O = 1\text{ mA to }40\text{ mA}$				0.2			0.1	

† Pulse-testing techniques maintain T_J as close to T_A 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.

μA78L00 SERIES **POSITIVE-VOLTAGE REGULATORS**

SLVS010P – JANUARY 1976 – REVISED JUNE 2002

electrical characteristics at specified virtual junction temperature, $V_I = 16\text{ V}$, $I_O = 40\text{ mA}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J^\dagger$	μA78L09C			μA78L09AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
Output voltage	$V_I = 12\text{ V to }24\text{ V}$, $I_O = 1\text{ mA to }40\text{ mA}$	25°C	8.3	9	9.7	8.6	9	9.4	V
		0°C to 125°C	8.1		9.9	8.55		9.45	
	$I_O = 1\text{ mA to }70\text{ mA}$	0°C to 125°C	8.1		9.9	8.55		9.45	
Input voltage regulation	$V_I = 12\text{ V to }24\text{ V}$	25°C		45	225		45	175	mV
	$V_I = 13\text{ V to }24\text{ V}$			40	175		40	125	
Ripple rejection	$V_I = 15\text{ V to }25\text{ V}$, $f = 120\text{ Hz}$	25°C	36	45		38	45		dB
Output voltage regulation	$I_O = 1\text{ mA to }100\text{ mA}$	25°C		19	90		19	90	mV
	$I_O = 1\text{ mA to }40\text{ mA}$			11	40		11	40	
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C		58			58		μV
Dropout voltage		25°C		1.7			1.7		V
Bias current		25°C		4.1	6		4.1	6	mA
		125°C			5.5			5.5	
Bias current change	$V_I = 13\text{ V to }24\text{ V}$	0°C to 125°C			1.5			1.5	mA
	$I_O = 1\text{ mA to }40\text{ mA}$				0.2			0.1	

† Pulse-testing techniques maintain T_J as close to T_A 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, $V_I = 14\text{ V}$, $I_O = 40\text{ mA}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J^\dagger$	μA78L10AC			UNIT
			MIN	TYP	MAX	
Output voltage	$V_I = 13\text{ V to }25\text{ V}$, $I_O = 1\text{ mA to }40\text{ mA}$	25°C	9.6	10	10.4	V
		0°C to 125°C	9.5		10.5	
	$I_O = 1\text{ mA to }70\text{ mA}$	0°C to 125°C	9.5		10.5	
Input voltage regulation	$V_I = 13\text{ V to }25\text{ V}$	25°C		51	175	mV
	$V_I = 14\text{ V to }25\text{ V}$			42	125	
Ripple rejection	$V_I = 15\text{ V to }25\text{ V}$, $f = 120\text{ Hz}$	25°C	37	44		dB
Output voltage regulation	$I_O = 1\text{ mA to }100\text{ mA}$	25°C		20	90	mV
	$I_O = 1\text{ mA to }40\text{ mA}$			11	40	
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C		62		μV
Dropout voltage		25°C		1.7		V
Bias current		25°C		4.2	6	mA
		125°C			5.5	
Bias current change	$V_I = 14\text{ V to }25\text{ V}$	0°C to 125°C			1.5	mA
	$I_O = 1\text{ mA to }40\text{ mA}$				0.1	

† Pulse-testing techniques maintain T_J as close to T_A 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.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

electrical characteristics at specified virtual junction temperature, $V_I = 19\text{ V}$, $I_O = 40\text{ mA}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J^\dagger$	μA78L12C			μA78L12AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
Output voltage	$V_I = 14\text{ V to }27\text{ V}$, $I_O = 1\text{ mA to }40\text{ mA}$	25°C	11.1	12	12.9	11.5	12	12.5	V
		0°C to 125°C	10.8		13.2	11.4		12.6	
	$I_O = 1\text{ mA to }70\text{ mA}$	0°C to 125°C	10.8		13.2	11.4		12.6	
Input voltage regulation	$V_I = 14.5\text{ V to }27\text{ V}$	25°C		55	250		55	250	mV
	$V_I = 16\text{ V to }27\text{ V}$			49	200		49	200	
Ripple rejection	$V_I = 15\text{ V to }25\text{ V}$, $f = 120\text{ Hz}$	25°C	36	42		37	42		dB
Output voltage regulation	$I_O = 1\text{ mA to }100\text{ mA}$	25°C		22	100		22	100	mV
	$I_O = 1\text{ mA to }40\text{ mA}$			13	50		13	50	
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C		70			70		μV
Dropout voltage		25°C		1.7			1.7		V
Bias current		25°C		4.3	6.5		4.3	6.5	mA
		125°C			6			6	
Bias current change	$V_I = 16\text{ V to }27\text{ V}$	0°C to 125°C			1.5			1.5	mA
	$I_O = 1\text{ mA to }40\text{ mA}$				0.2			0.1	

† Pulse-testing techniques maintain T_J as close to T_A 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, $V_I = 23\text{ V}$, $I_O = 40\text{ mA}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J^\dagger$	μA78L15C			μA78L15AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
Output voltage	$V_I = 17.5\text{ V to }30\text{ V}$, $I_O = 1\text{ mA to }40\text{ mA}$	25°C	13.8	15	16.2	14.4	15	15.6	V
		0°C to 125°C	13.5		16.5	14.25		15.75	
	$I_O = 1\text{ mA to }70\text{ mA}$	0°C to 125°C	13.5		16.5	14.25		15.75	
Input voltage regulation	$V_I = 17.5\text{ V to }30\text{ V}$	25°C		65	300		65	300	mV
	$V_I = 20\text{ V to }30\text{ V}$			58	250		58	250	
Ripple rejection	$V_I = 18.5\text{ V to }28.5\text{ V}$, $f = 120\text{ Hz}$	25°C	33	39		34	39		dB
Output voltage regulation	$I_O = 1\text{ mA to }100\text{ mA}$	25°C		25	150		25	150	mV
	$I_O = 1\text{ mA to }40\text{ mA}$			15	75		15	75	
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C		82			82		μV
Dropout voltage		25°C		1.7			1.7		V
Bias current		25°C		4.6	6.5		4.6	6.5	mA
		125°C			6			6	
Bias current change	$V_I = 10\text{ V to }30\text{ V}$	0°C to 125°C			1.5			1.5	mA
	$I_O = 1\text{ mA to }40\text{ mA}$				0.2			0.1	

† Pulse-testing techniques maintain T_J as close to T_A 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

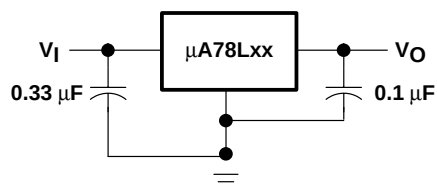


Figure 1. Fixed-Output Regulator

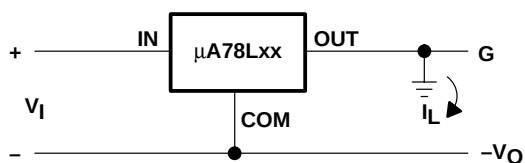


Figure 2. Positive Regulator in Negative Configuration (V_I Must Float)

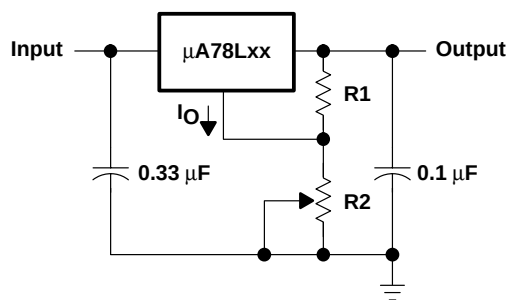
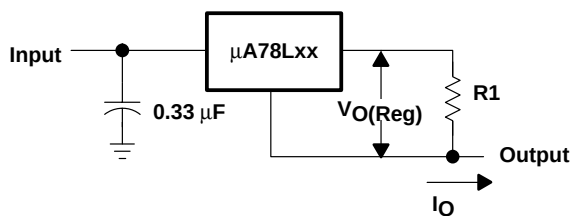


Figure 3. Adjustable-Output Regulator



$$I_O = (V_O/R1) + I_O \text{ Bias Current}$$

Figure 4. Current Regulator

APPLICATION INFORMATION

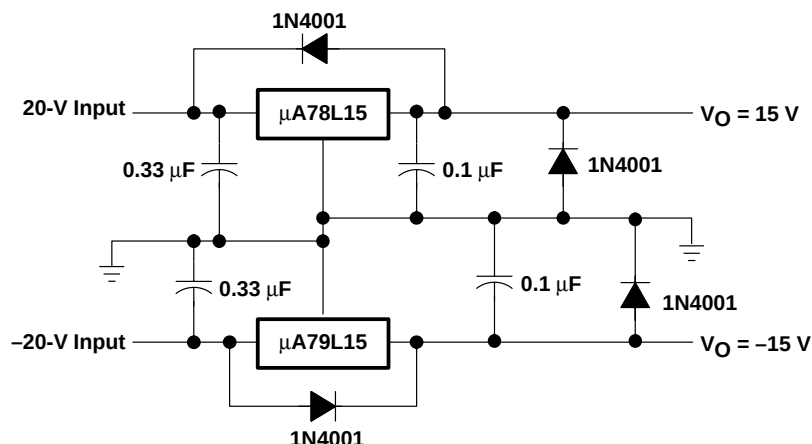


Figure 5. Regulated Dual Supply

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.

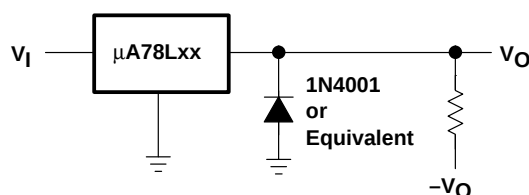


Figure 6. Output Polarity-Reversal-Protection Circuit

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 employed as shown in Figure 7.

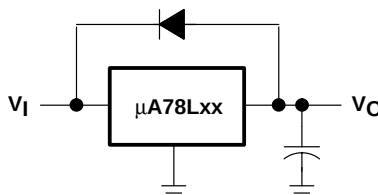


Figure 7. Reverse-Bias-Protection Circuit

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265