National Semiconductor

LM78LXX Series 3-Terminal Positive Regulators

General Description

The LM78LXX series of three terminal positive regulators is available with several fixed output voltages making them useful in a wide range of applications. When used as a zener diode/resistor combination replacement, the LM78LXX usually results in an effective output impedance improvement of two orders of magnitude, and lower quiescent current. These regulators can provide local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow the LM78LXX to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment. Although designed primarily as fixed voltage regulators these devices can be used with external components to obtain adjustment voltages and currents.

The LM78LXX is available in the metal three lead TO-39(H) the plastic TO-92 (Z), and SO-8 plastic. With adequate heat sinking the regulator can deliver 100 mA output current. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistors is provided to limit internal power dissipation. If internal power dissipation becomes too high for the heat sinking provided, the thermal shutdown circuit takes over preventing the IC from overheating.

For output voltage other than 5V, 12V and 15V the LM117L series provides an output voltage range from 1.2V to 37V.

Features

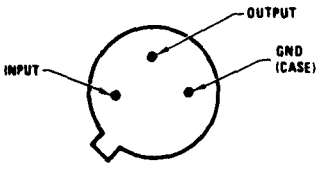
- Output voltage tolerances of ±5% (LM78LXXAC) over the temperature range
- Output current of 100 mA
- Internal thermal overload protection
- Output transistor safe area protection
- Internal short circuit current limit
- Available in plastic TO-92 and metal TO-39 and plastic SO-8 low profile packages

Voltage Range

LM78L05	5V
LM78L12	12V
LM78L15	15V

Connection Diagrams

Metal Can Package



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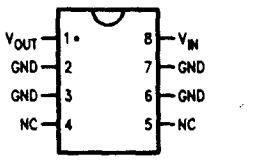
Bottom View

Order Number LM78L05ACH, LM78L12ACH or LM78L15ACH
See NS Package Number H03A

SO-8 Plastic (Narrow Body)



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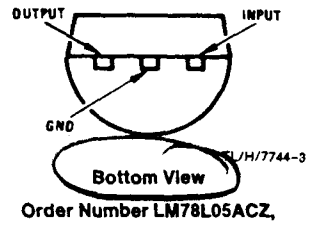
Top View

Order Number LM78L05ACM, LM78L12ACM or LM78L15ACM
See NS Package Number M08A

Plastic Package



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Bottom View

Order Number LM78L05ACZ, LM78L12ACZ or LM78L15ACZ
See NS Package Number Z03A

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Input Voltage	
V_O = 5V	30V
V_O = 12V to 15V	35V
Internal Power Dissipation (Note 1)	Internally Limited
Operating Temperature Range	0°C to +70°C
Maximum Junction Temperature	125°C
Storage Temperature Range	
Metal Can (H Package)	−65°C to +150°C
Molded TO-92 (Z Package)	−55°C to +150°C
Lead Temperature (Soldering, 10 sec.)	260°C
ESD Tolerance (Note 5)	2000V

LM78LXXAC Electrical Characteristics

(Note 2) T_j = 0°C to 125°C, I_O = 40 mA, C_{IN} = 0.33 µF, C_O = 0.1 µF (unless noted)

LM78LXXAC Output Voltage			5V			12V			15V			Units
Input Voltage (unless otherwise noted)			10V			19V			23V			
Symbol	Parameter	Conditions	Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
V_O	Output Voltage (Note 4)	T_j = 25°C	4.8	5	5.2	11.5	12	12.5	14.4	15	15.6	V
		1 mA ≤ I_O ≤ 70 mA	4.75		5.25	11.4		12.6	14.25		15.75	V
		1 mA ≤ I_O ≤ 40 mA and V_{MIN} ≤ V_{IN} ≤ V_{MAX}	4.75 (7 ≤ V_{IN} ≤ 20)		5.25	11.4 (14.5 ≤ V_{IN} ≤ 27)		12.6	14.25 (17.5 ≤ V_{IN} ≤ 30)		15.75	V
ΔV_O	Line Regulation	T_j = 25°C		10	54		20	110		25	140	mV
			(8 ≤ V_{IN} ≤ 20)			(16 ≤ V_{IN} ≤ 27)			(20 ≤ V_{IN} ≤ 30)			V
				18	75		30	180		37	250	mV
			(7 ≤ V_{IN} ≤ 20)			(14.5 ≤ V_{IN} ≤ 27)			(17.5 ≤ V_{IN} ≤ 30)			V
ΔV_O	Load Regulation	T_j = 25°C, 1 mA ≤ I_O ≤ 40 mA		5	30		10	50		12	75	mV
		T_j = 25°C, 1 mA ≤ I_O ≤ 100 mA		20	60		30	100		35	150	mV
ΔV_O	Long Term Stability			12			24			30		mV/1000 hrs
I_Q	Quiescent Current	T_j = 25°C		3	5		3	5		3.1	5	mA
		T_j = 125°C			4.7			4.7			4.7	
ΔI_Q	Quiescent Current Change	1 mA ≤ I_O ≤ 40 mA			0.1			0.1			0.1	mA
		V_{MIN} ≤ V_{IN} ≤ V_{MAX}			1.0			1.0			1.0	mA
			(8 ≤ V_{IN} ≤ 20)			(16 ≤ V_{IN} ≤ 27)			(20 ≤ V_{IN} ≤ 30)			V
V_n	Output Noise Voltage	T_j = 25°C, (Note 3) f = 10 Hz − 10 kHz		40			80			90		µV
$\frac{\Delta V_{IN}}{\Delta V_{OUT}}$	Ripple Rejection	f = 120 Hz	47	62		40	54		37	51		dB
			(8 ≤ V_{IN} ≤ 16)			(15 ≤ V_{IN} ≤ 25)			(18.5 ≤ V_{IN} ≤ 28.5)			V
	Input Voltage Required to Maintain Line Regulation	T_j = 25°C	7			14.5			17.5			V

Note 1: Thermal resistance of H package is typically 26°C/W θ_{jc} still Air, and 94°C/W θ_{ja} 400 ft/min of air. For the Z package is 60°C/W θ_{jc}, 232°C/W θ_{ja} still air, and 88°C/W θ_{ja} at 400 ft/min of air. For the M package, θ_{ja} is 180°C/W in still air. The maximum junction temperature shall not exceed 125°C on Electrical parameters.

Note 2: The maximum steady state usable output current and input voltage are very dependent on the heat sinking and/or lead length of the package. The data above represent pulse test conditions with junction temperatures as indicated at the initiation of test.

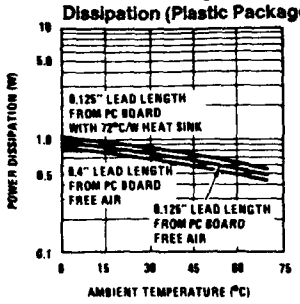
Note 3: Recommended minimum load capacitance of 0.01 µF to limit high frequency noise bandwidth.

Note 4: The temperature coefficient of V_{OUT} is typically within ±0.01% V_O/°C.

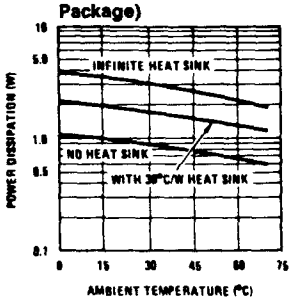
Note 5: *Human body model, 1.5 kΩ in series with 100 pF.*

Typical Performance Characteristics

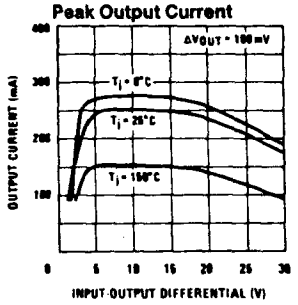
Maximum Average Power Dissipation (Plastic Package)



Maximum Average Power Dissipation (Metal Can Package)



Peak Output Current



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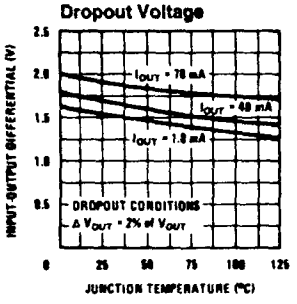
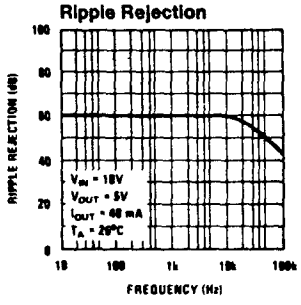
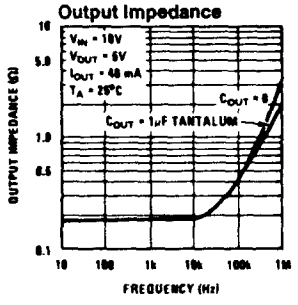
Dropout Voltage



Ripple Rejection



Output Impedance



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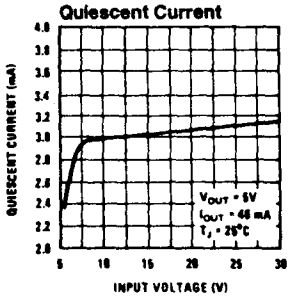
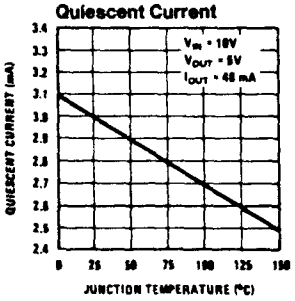
Quiescent Current



Quiescent Current



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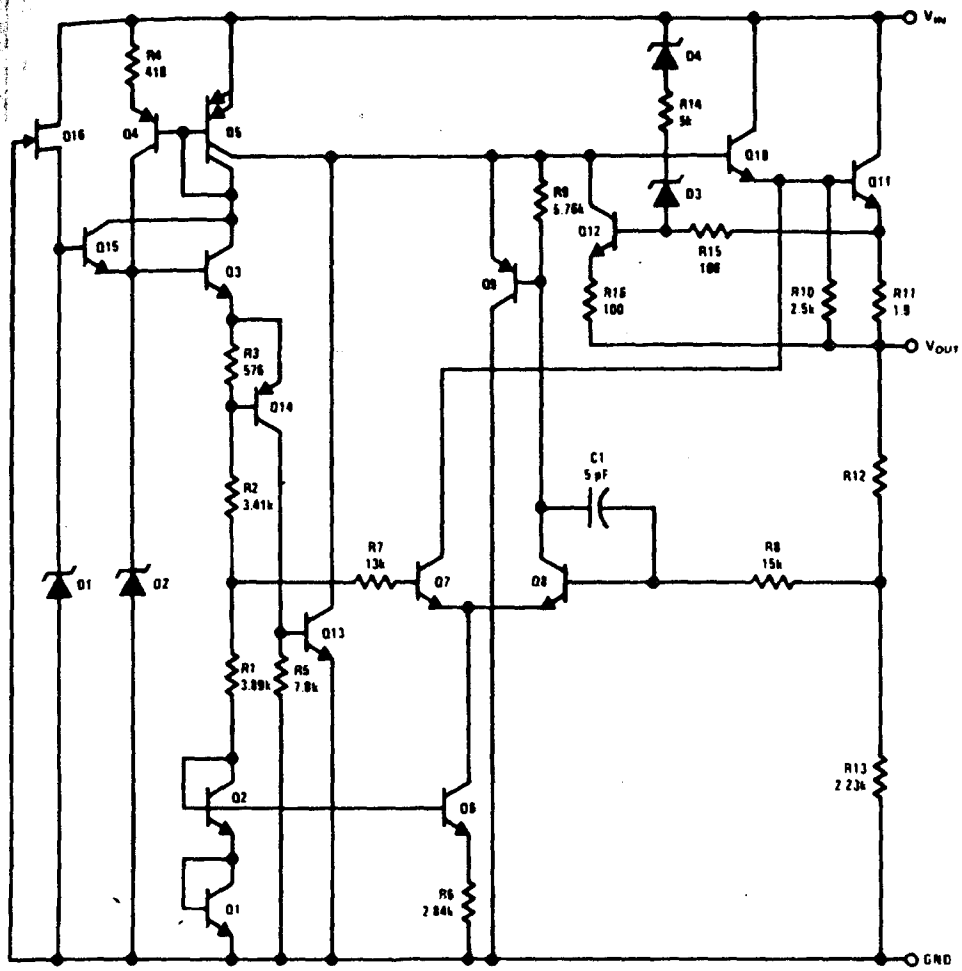
Equivalent Circuit

LM78LXX



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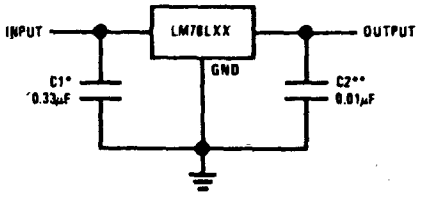
Typical Applications

Fixed Output Regulator



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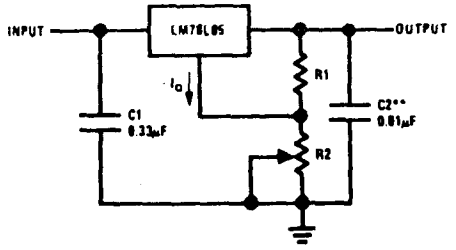
*Required if the regulator is located far from the power supply filter.

**See Note 3 in the electrical characteristics table.

Adjustable Output Regulator



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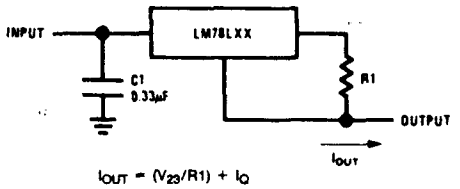
$V_{OUT} \approx 5V + (5V/R1 + I_Q)\,R2$

$5V/R1 > 3\ I_Q$, load regulation (L_r) $\approx [(R1 + R2)/R1]$ (L_r of LM78L05)

Typical Applications (Continued)

Current Regulator



$I_{OUT} = (V_{23}/R1) + I_Q$

$> I_Q$ = 1.5 mA over line and load changes

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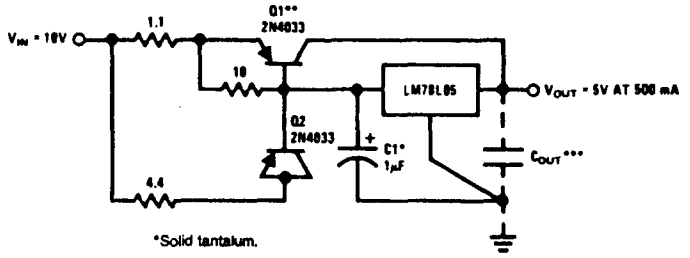
5V, 500 mA Regulator with Short Circuit Protection



*Solid tantalum.

**Heat sink Q1.

***Optional: Improves ripple rejection and transient response.

Load Regulation: 0.6% $0 \leq I_L \leq 250$ mA pulsed with t_{ON} = 50 ms.

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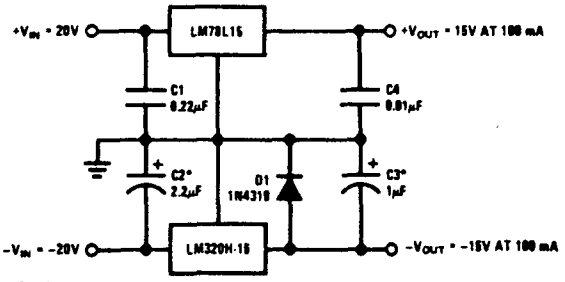
± 15V, 100 mA Dual Power Supply



*Solid tantalum.

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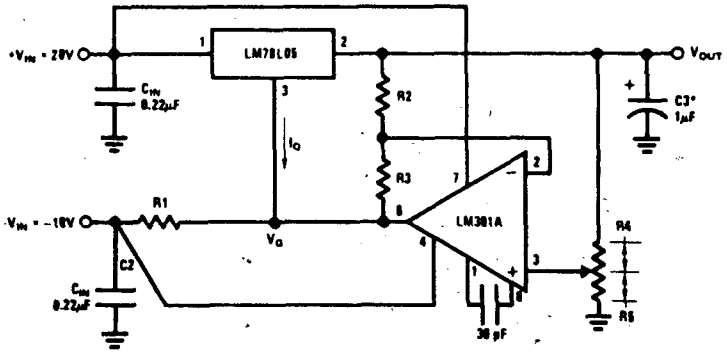
Variable Output Regulator 0.5V-18V



*Solid tantalum.

$V_{OUT} = V_O + 5V$, $R1 = (-V_{IN}/I_{Q\ LM78L05})$

$V_{OUT} = 5V\ (R2/R4)$ for $(R2 + R3) = (R4 + R5)$

A 0.5V output will correspond to $(R2/R4) = 0.1\ (R3/R4) = 0.9$

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