National Semiconductor

April 1998

LM123/LM323A/LM323
3-Amp, 5-Volt Positive Regulator

General Description

The LM123 is a three-terminal positive regulator with a preset 5V output and a load driving capability of 3 amps. New circuit design and processing techniques are used to provide the high output current without sacrificing the regulation characteristics of lower current devices.

The LM323A offers improved precision over the standard LM323. Parameters with tightened specifications include output voltage tolerance, line regulation, and load regulation.

The 3 amp regulator is virtually blowout proof. Current limiting, power limiting, and thermal shutdown provide the same high level of reliability obtained with these techniques in the LM109 1 amp regulator.

No external components are required for operation of the LM123. If the device is more than 4 inches from the filter capacitor, however, a 1 µF solid tantalum capacitor should be used on the input. A 0.1 µF or larger capacitor may be used on the output to reduce load transient spikes created by fast switching digital logic, or to swamp out stray load capacitance.

An overall worst case specification for the combined effects of input voltage, load currents, ambient temperature, and power dissipation ensure that the LM123 will perform satisfactorily as a system element.

For applications requiring other voltages, see LM150 series adjustable regulator data sheet.

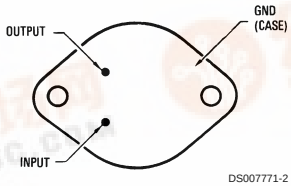
Operation is guaranteed over the junction temperature range −55˚C to +150˚C for LM123, −40˚C to +125˚C for LM323A, and 0˚C to +125˚C for LM323. A hermetic TO-3 package is used for high reliability and low thermal resistance.

Features

- Guaranteed 1% initial accuracy (A version)
- 3 amp output current
- Internal current and thermal limiting
- 0.01Ω typical output impedance
- 7.5V minimum input voltage
- 30W power dissipation
- P^+ Product Enhancement tested

Connection Diagram

Metal Can Package

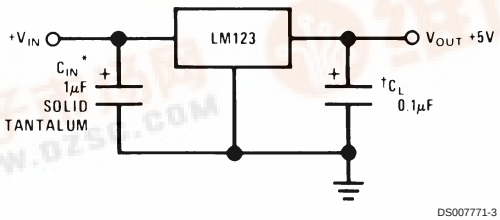


DS007771-2

Order Number LM123K STEEL, LM323AK STEEL or LM323K STEEL
See NS Package Number K02A
Order Number LM123K/883
See NS Package Number K02C

Typical Applications

Basic 3 Amp Regulator



DS007771-3

*Required if LM123 is more than 4" from filter capacitor.
†Regulator is stable with no load capacitor into resistive loads.

Absolute Maximum Ratings (Note 1)

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

(Note 5)

Input Voltage	20V
Power Dissipation	Internally Limited

Operating Junction Temperature Range	
LM123	−55˚C to +150˚C
LM323A	−40˚C to +125˚C
LM323	0˚C to +125˚C
Storage Temperature Range	−65˚C to +150˚C
Lead Temperature (Soldering, 10 sec.)	300˚C
ESD Tolerance (Note 5)	2000V

LM123 Electrical Characteristics (Note 2)

Parameter	Conditions	LM123			Units
		Min	Typ	Max	
Output Voltage	T_j = 25˚C V_{IN} = 7.5V, I_{OUT} = 0A	4.7	5	5.3	V
	7.5V ≤ V_{IN} ≤ 15V 0A ≤ I_{OUT} ≤ 3A, P ≤ 30W	4.6		5.4	V
Line Regulation (Note 4)	T_j = 25˚C 7.5V ≤ V_{IN} ≤ 15V		5	25	mV
Load Regulation (Note 4)	T_j = 25˚C, V_{IN} = 7.5V, 0A ≤ I_{OUT} ≤ 3A		25	100	mV
Quiescent Current	7.5V ≤ V_{IN} ≤ 15V, 0A ≤ I_{OUT} ≤ 3A		12	20	mA
Output Noise Voltage	T_j = 25˚C 10 Hz ≤ f ≤ 100 kHz		40		µVrms
Short Circuit Current Limit	T_j = 25˚C V_{IN} = 15V V_{IN} = 7.5V		 3 4	 4.5 5	 A A
Long Term Stability				35	mV
Thermal Resistance Junction to Case (Note 3)			2		˚C/W

LM323A/LM323 Electrical Characteristics (Note 2)

Parameter	Conditions	LM323A			LM323			Units
		Min	Typ	Max	Min	Typ	Max	
Output Voltage	T_j = 25˚C V_{IN} = 7.5V, I_{OUT} = 0A	4.95	5	5.05	4.8	5	5.2	V
	7.5V ≤ V_{IN} ≤ 15V 0A ≤ I_{OUT} ≤ 3A, P ≤ 30W	4.85		5.15	4.75		5.25	V
Line Regulation (Note 4)	T_j = 25˚C 7.5V ≤ V_{IN} ≤ 15V		5	10		5	25	mV
Load Regulation (Note 4)	T_j = 25˚C, V_{IN} = 7.5V, 0A ≤ I_{OUT} ≤ 3A		25	50		25	100	mV
Quiescent Current	7.5V ≤ V_{IN} ≤ 15V, 0A ≤ I_{OUT} ≤ 3A		12	20		12	20	mA
Output Noise Voltage	T_j = 25˚C 10 Hz ≤ f ≤ 100 kHz		40			40		µVrms
Short Circuit Current Limit	T_j = 25˚C V_{IN} = 15V V_{IN} = 7.5V		 3 4	 4.5 6		 3 4	 4.5 5	 A A
Long Term Stability				35			35	mV
Thermal Resistance Junction to Case (Note 3)			2			2		˚C/W

LM323A/LM323 Electrical Characteristics (Note 2) (Continued)

Note 1: "Absolute Maximum Ratings" indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits.

Note 2: Unless otherwise noted, specifications apply for $-55^{\circ}C \le T_j \le +150^{\circ}C$ for the LM123, $-40^{\circ}C \le T_j \le +125^{\circ}C$ for the LM323A, and $0^{\circ}C \le T_j \le +125^{\circ}C$ for the LM323. Although power dissipation is internally limited, specifications apply only for $P \le 30W$.

Note 3: Without a heat sink, the thermal resistance of the TO-3 package is about 35°C/W. With a heat sink, the effective thermal resistance can only approach the specified values of 2°C/W, depending on the efficiency of the heat sink.

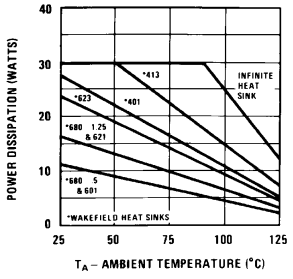
Note 4: Load and line regulation are specified at constant junction temperature. Pulse testing is required with a pulse width ≤ 1 ms and a duty cycle ≤ 5%.

Note 5: Refer to RETS123K drawing for LM123K military specifications.

Note 6: Human body model, 1.5 kΩ in series with 100 pF.

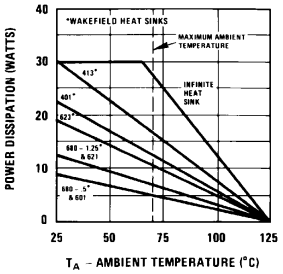
Typical Performance Characteristics

Maximum Average Power Dissipation for LM123



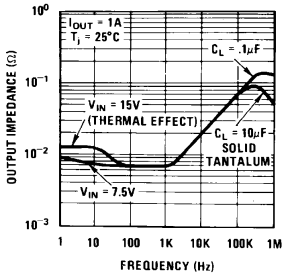
DS007771-9

Maximum Average Power Dissipation for LM323A, LM323



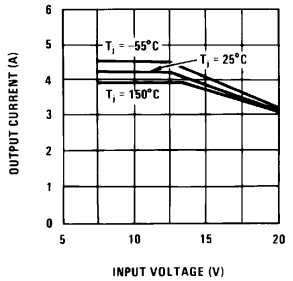
DS007771-10

Output Impedance



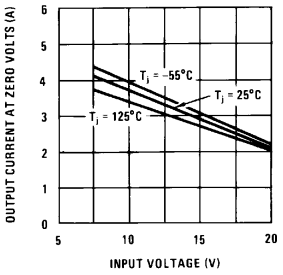
DS007771-11

Peak Available Output Current



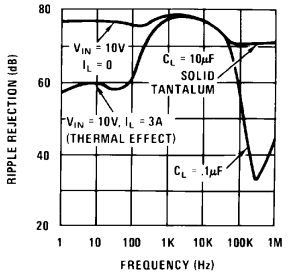
DS007771-12

Short Circuit Current



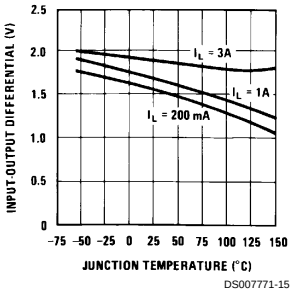
DS007771-13

Ripple Rejection



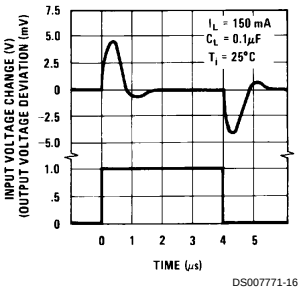
DS007771-14

Dropout Voltage



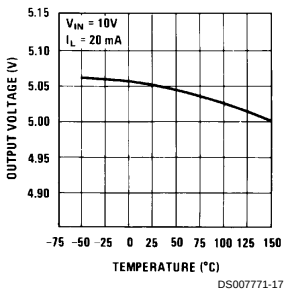
DS007771-15

Line Transient Response



DS007771-16

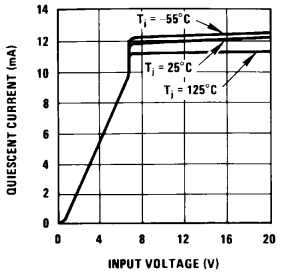
Output Voltage



DS007771-17

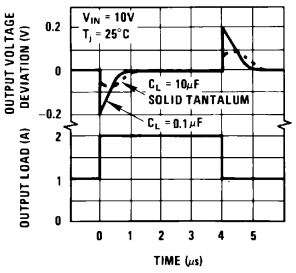
Typical Performance Characteristics (Continued)

Quiescent Current



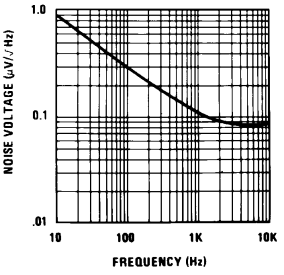
DS007771-18

Load Transient Response



DS007771-19

Output Noise Voltage



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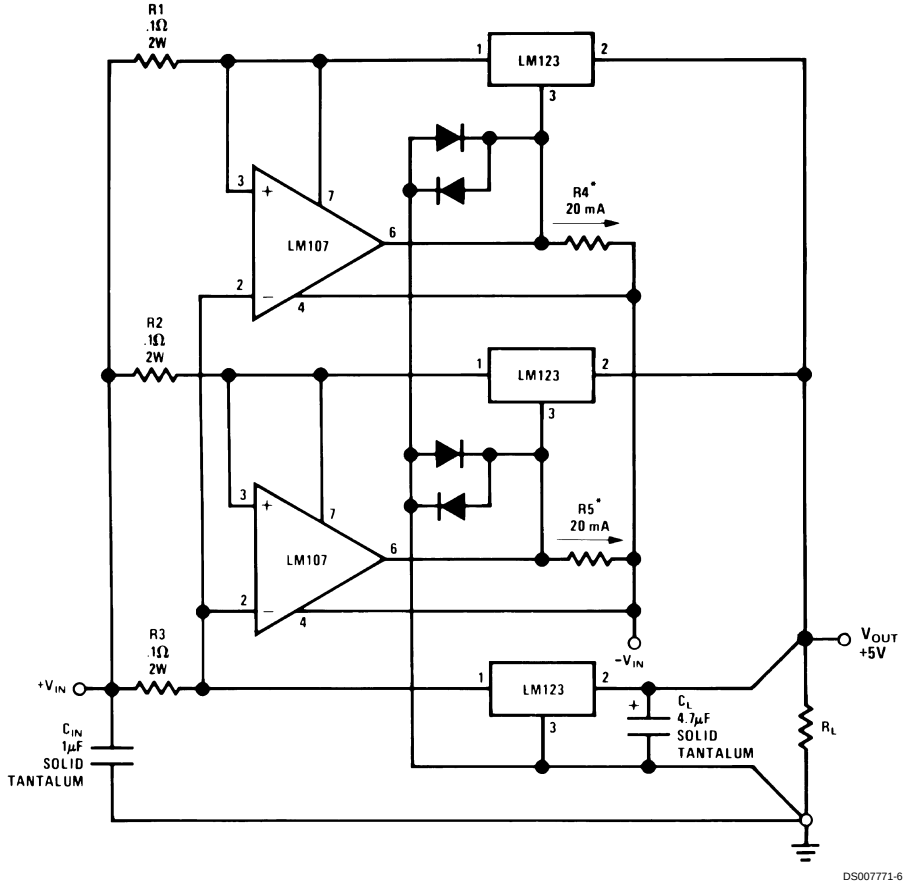
Typical Applications

10 Amp Regulator with Complete Overload Protection

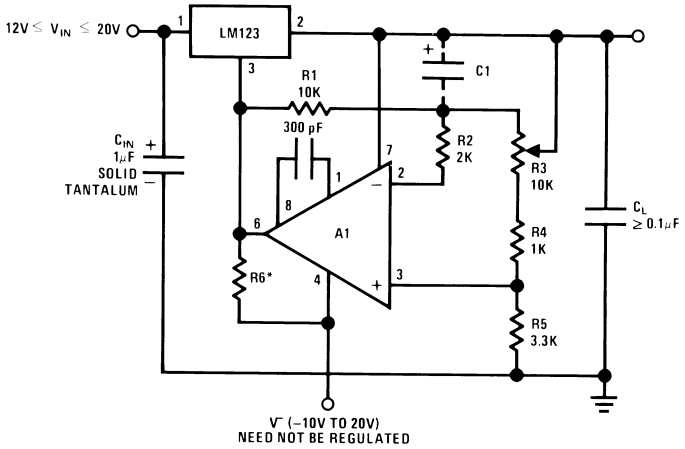


DS007771-6

*Select for 20 mA Current from Unregulated Negative Supply

Typical Applications (Continued)

Adjustable Regulator 0V−10V @ 3A

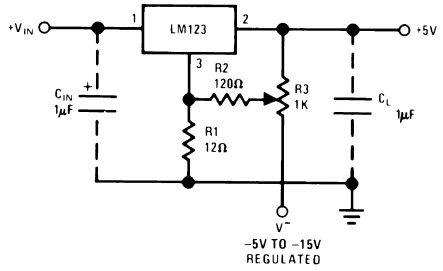


DS007771-7

$$*R6 = \frac{V^-}{12\ mA}$$

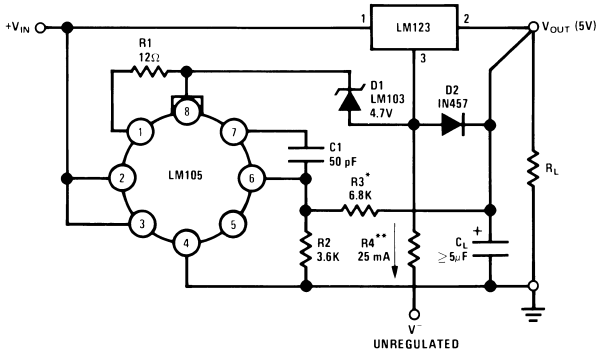
A_1 — LM101A
C_1 — 2 µF Optional — Improves Ripple Rejection, Noise, and Transient Response

Trimming Output to 5V



DS007771-8

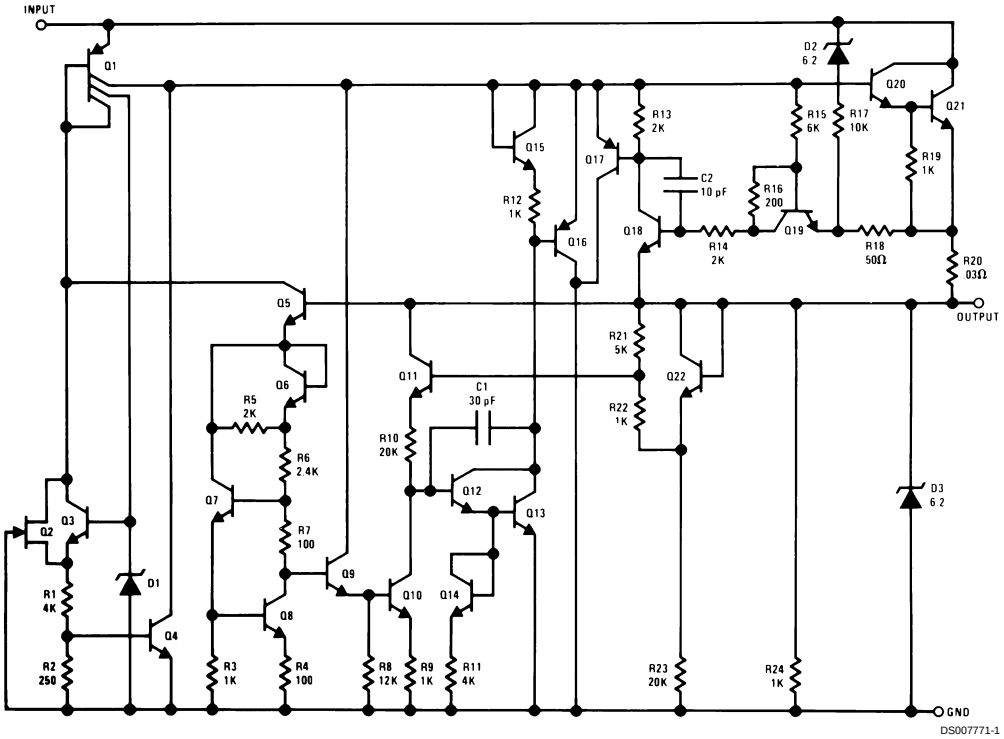
Adjustable Output 5V−10V 0.1% Regulation



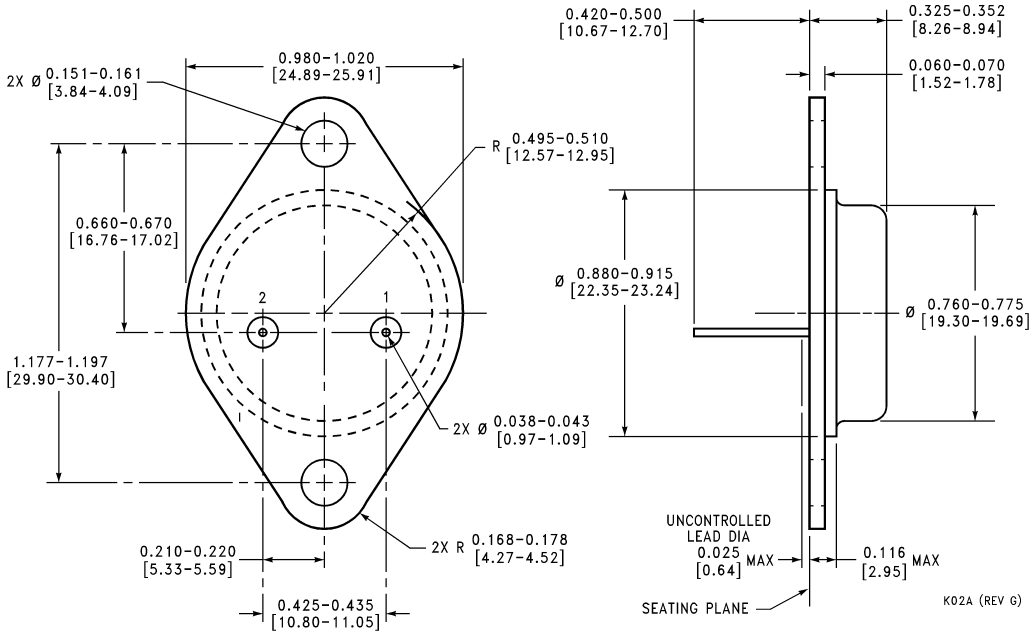
DS007771-4

*Select to Set Output Voltage
**Select to Draw 25 mA from V⁻

Schematic Diagram

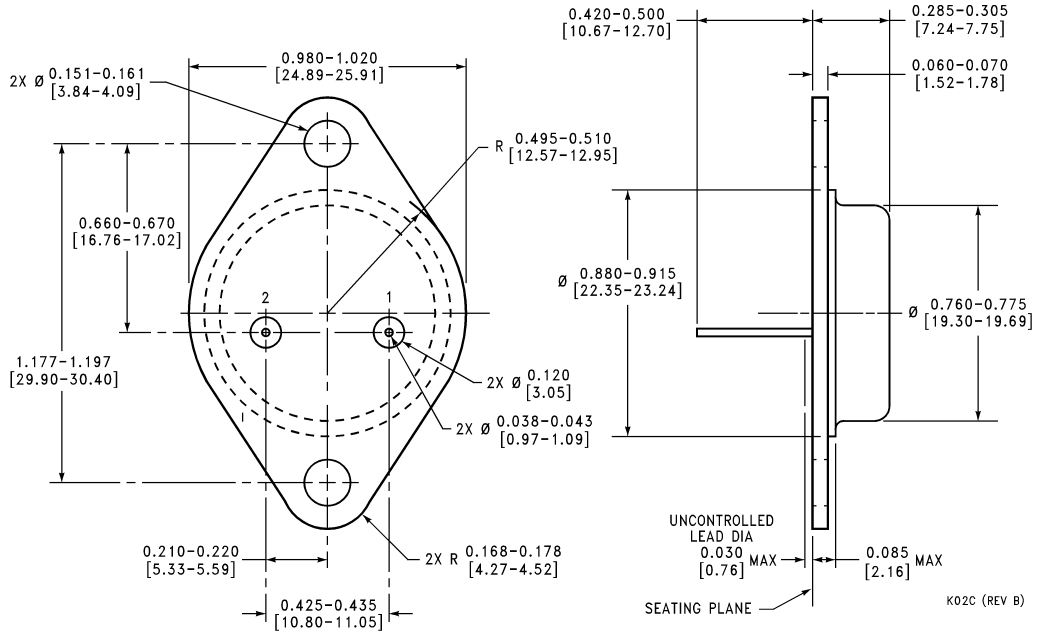


Physical Dimensions inches (millimeters) unless otherwise noted



Metal Can Package (K)
Order Number LM123K STEEL, LM323AK STEEL or LM323K STEEL
NS Package Number K02A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



Metal Can Package (K)
Mil-Aero Product
Order Number LM123K/883
NS Package Number K02C

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