

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

 Check for Samples: [LM123](#), [LM323-N](#), [LM323A](#)

### FEATURES

- Ensured 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<sup>+</sup> Product Enhancement tested

### 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-N. 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.

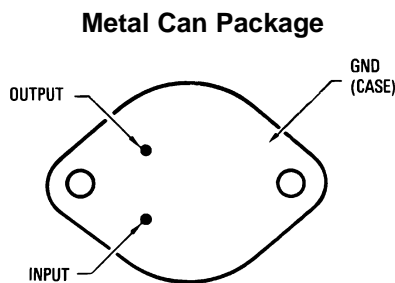
No external components are required for operation of the LM123. If the device is more than 4 inches from the filter capacitor, however, a 1 μF solid tantalum capacitor should be used on the input. A 0.1 μF or larger capacitor may be used on the output to reduce load transient spikes created by fast switching 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 specified 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-N. A hermetic TO-3 package is used for high reliability and low thermal resistance.

### Connection Diagram



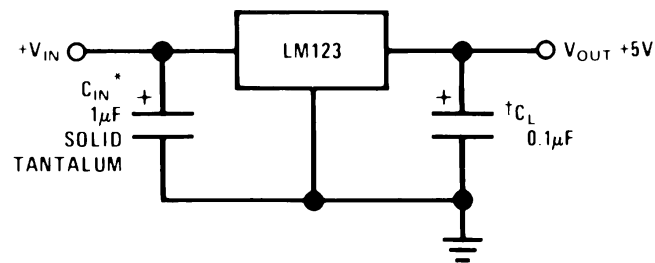
**Figure 1. See Package Number NDS**



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.

All trademarks are the property of their respective owners.

## Typical Applications



\*Required if LM123 is more than 4" from filter capacitor.

†Regulator is stable with no load capacitor into resistive loads.

**Figure 2. Basic 3 Amp Regulator**



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### Absolute Maximum Ratings<sup>(1) (2)(3)</sup>

Input Voltage		20V
Power Dissipation		Internally Limited
Operating Junction Temperature Range	LM123	-55°C to +150°C
	LM323A	-40°C to +125°C
	LM323-N	0°C to +125°C
Storage Temperature Range		-65°C to +150°C
Lead Temperature (Soldering, 10 sec.)		300°C
ESD Tolerance <sup>(4)</sup>		2000V

- (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 ensure specific performance limits.
- (2) Refer to RETS123K drawing for LM123K military specifications.
- (3) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/Distributors for availability and specifications.
- (4) Human body model, 1.5 kΩ in series with 100 pF.

### LM123 Electrical Characteristics<sup>(1)</sup>

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

- (1) Unless otherwise noted, specifications apply for  $-55^\circ\text{C} \leq T_j \leq +150^\circ\text{C}$  for the LM123,  $-40^\circ\text{C} \leq T_j \leq +125^\circ\text{C}$  for the LM323A, and  $0^\circ\text{C} \leq T_j \leq +125^\circ\text{C}$  for the LM323-N. Although power dissipation is internally limited, specifications apply only for  $P \leq 30\text{W}$ .
- (2) Load and line regulation are specified at constant junction temperature. Pulse testing is required with a pulse width  $\leq 1\text{ ms}$  and a duty cycle  $\leq 5\%$ .
- (3) Without a heat sink, the thermal resistance of the TO-3 package is about  $35^\circ\text{C}/\text{W}$ . With a heat sink, the effective thermal resistance can only approach the specified values of  $2^\circ\text{C}/\text{W}$ , depending on the efficiency of the heat sink.

**LM323A/LM323-N Electrical Characteristics** <sup>(1)</sup>

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

- (1) Unless otherwise noted, specifications apply for  $-55^\circ\text{C} \leq T_j \leq +150^\circ\text{C}$  for the LM123,  $-40^\circ\text{C} \leq T_j \leq +125^\circ\text{C}$  for the LM323A, and  $0^\circ\text{C} \leq T_j \leq +125^\circ\text{C}$  for the LM323-N. Although power dissipation is internally limited, specifications apply only for  $P \leq 30\text{W}$ .
- (2) Load and line regulation are specified at constant junction temperature. Pulse testing is required with a pulse width  $\leq 1\text{ ms}$  and a duty cycle  $\leq 5\%$ .
- (3) Without a heat sink, the thermal resistance of the TO-3 package is about  $35^\circ\text{C/W}$ . With a heat sink, the effective thermal resistance can only approach the specified values of  $2^\circ\text{C/W}$ , depending on the efficiency of the heat sink.

Typical Performance Characteristics

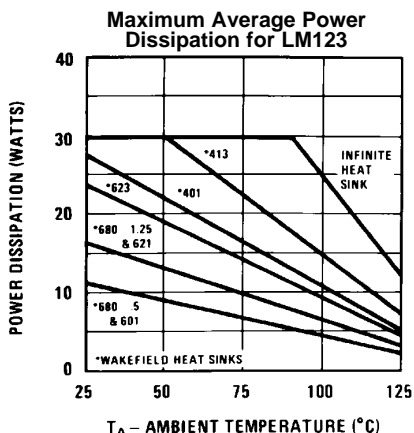


Figure 3.

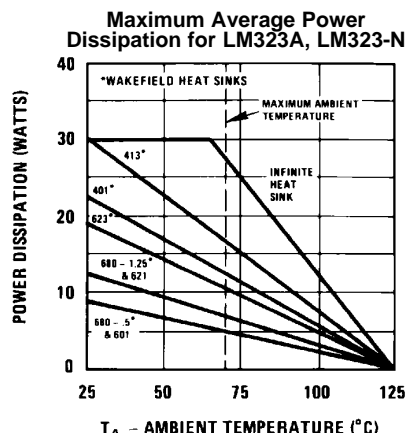


Figure 4.

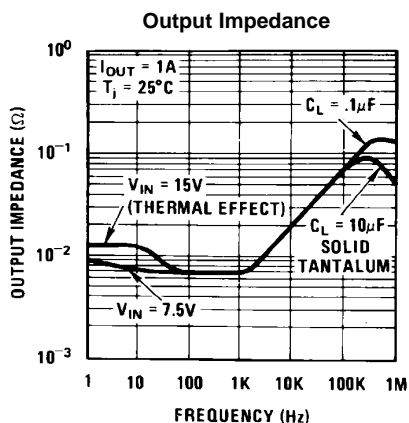


Figure 5.

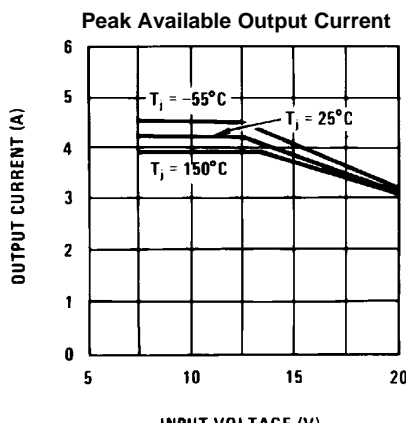


Figure 6.

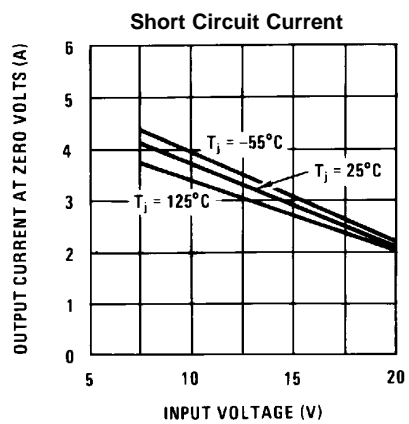


Figure 7.

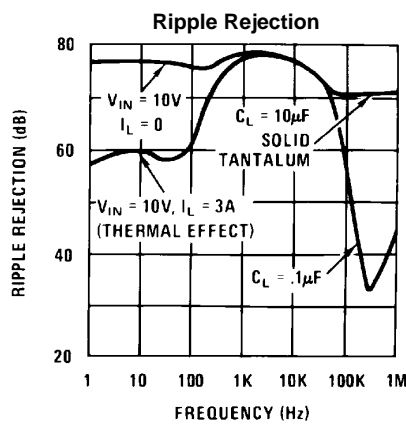


Figure 8.

Typical Performance Characteristics (continued)

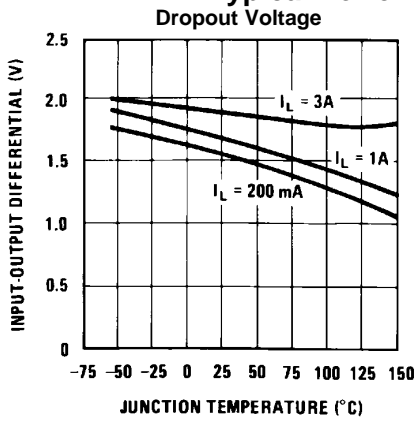


Figure 9.

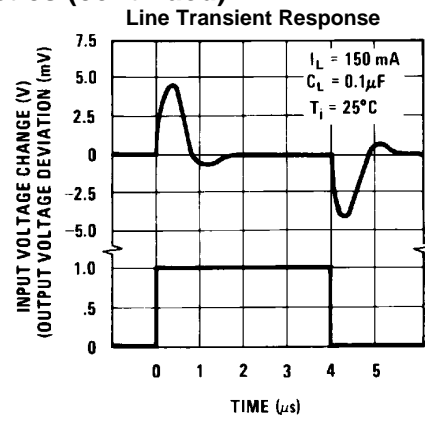


Figure 10.

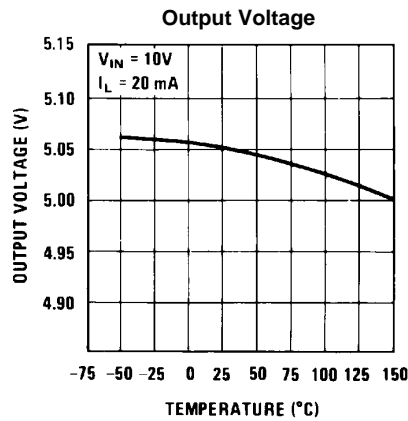


Figure 11.

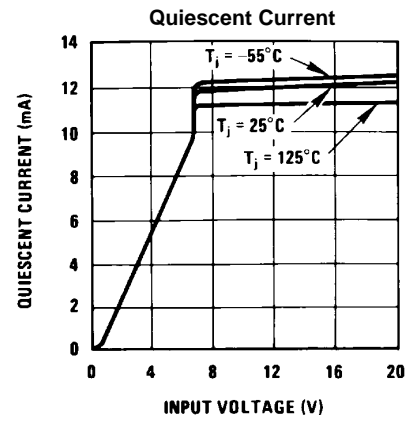


Figure 12.

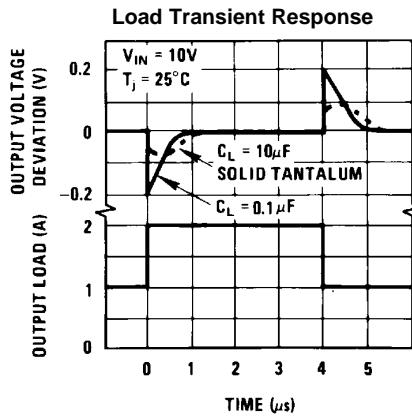


Figure 13.

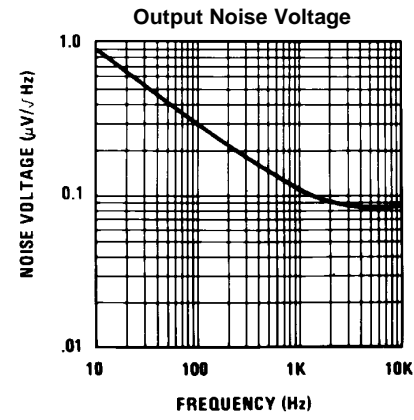
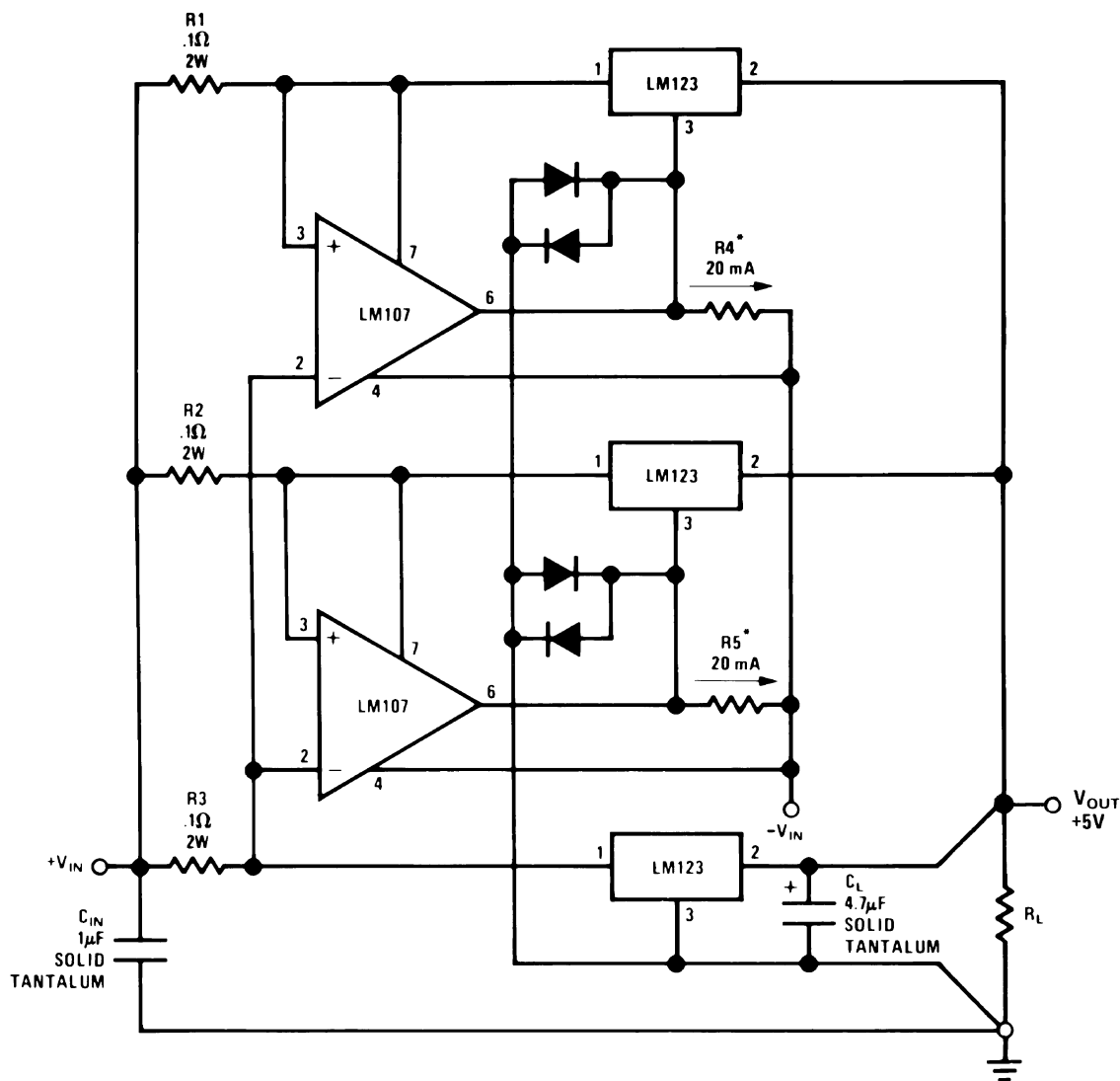


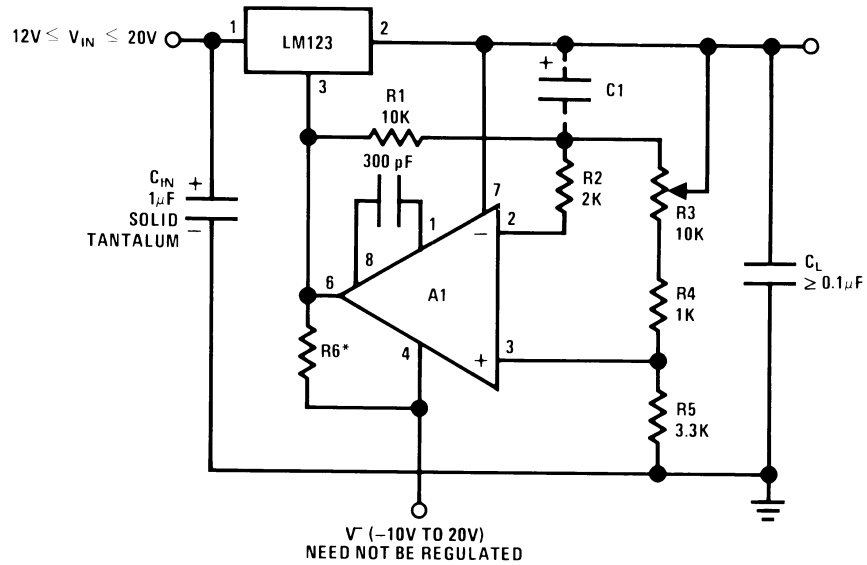
Figure 14.

TYPICAL APPLICATIONS



\*Select for 20 mA Current from Unregulated Negative Supply

Figure 15. 10 Amp Regulator with Complete Overload Protection

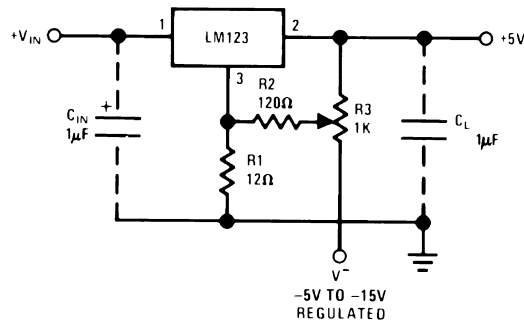


$$*R6 = \frac{V^-}{12 \text{ mA}}$$

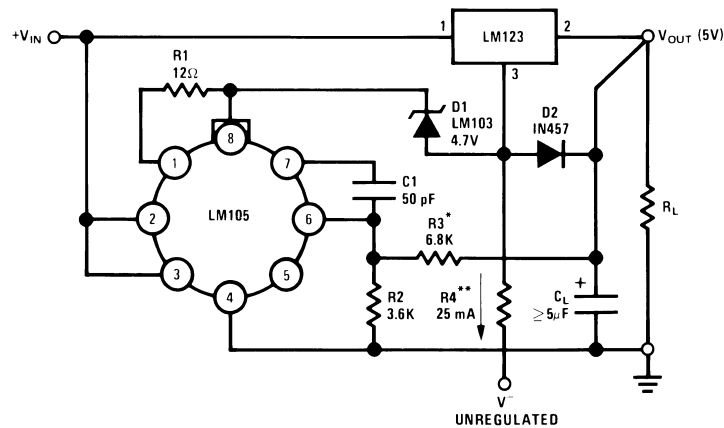
A<sub>1</sub>—LM101A

C<sub>1</sub>—2 μF Optional—Improves Ripple Rejection, Noise, and Transient Response

**Figure 16. Adjustable Regulator 0V–10V @ 3A**



**Figure 17. Trimming Output to 5V**



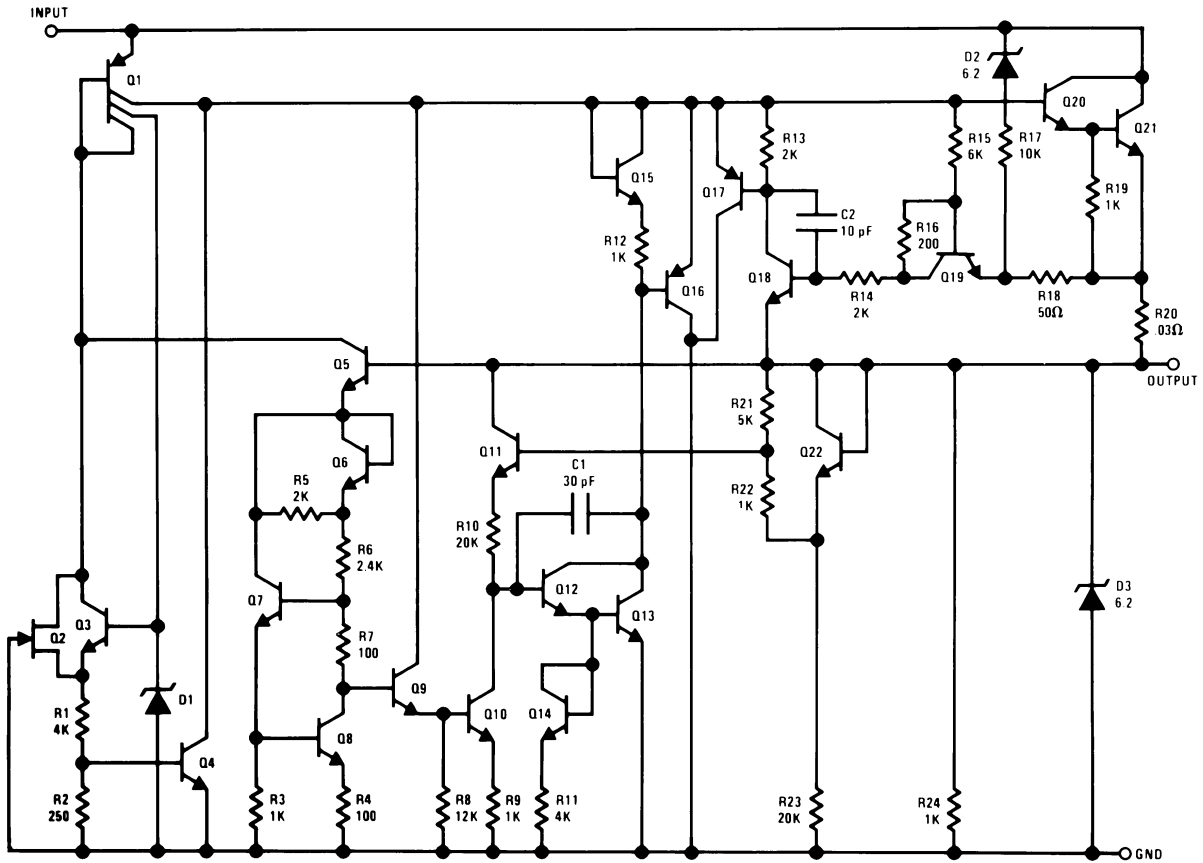
\*Select to Set Output Voltage

\*\*Select to Draw 25 mA from V<sup>-</sup>



**Figure 18. Adjustable Output 5V–10V 0.1% Regulation**



Schematic Diagram



**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
LM323K STEEL	ACTIVE	TO-3	NDS	2	50	Non-RoHS & Non-Green	Call TI	Call TI	0 to 125	LM323K STEEL	
LM323K STEEL/NOPB	ACTIVE	TO-3	NDS	2	50	RoHS & Green	Call TI	Level-1-NA-UNLIM	0 to 125	LM323K STEEL	

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

**Important Information and Disclaimer:**The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.



**TRAY**


Chamfer on Tray corner indicates Pin 1 orientation of packed units.

\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	Unit array matrix	Max temperature (°C)	L (mm)	W (mm)	K0 (µm)	P1 (mm)	CL (mm)	CW (mm)
LM323K STEEL	NDS	TO-CAN	2	50	9 X 6	NA	292.1	215.9	25654	3.87	22.3	25.4
LM323K STEEL/NOPB	NDS	TO-CAN	2	50	9 X 6	NA	292.1	215.9	25654	3.87	22.3	25.4

NDS0002A



## IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](http://ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2022, Texas Instruments Incorporated