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

Check for Samples: LM123, LM323-N, LM323A

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**

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.

Connection Diagram

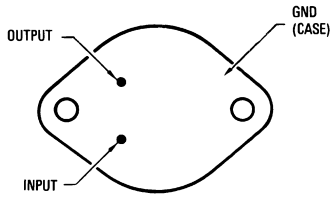
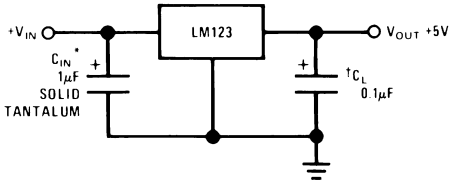


Figure 1. Metal Can Package See NS Package Number K02C

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 (1) (2)

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

(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.
(2) Refer to RETS123K drawing for LM123K military specifications.

LM123 Electrical Characteristics (1)

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

(1) Unless otherwise noted, specifications apply for −55°C ≤ T_j ≤ +150°C for the LM123, −40°C ≤ T_j ≤ +125°C for the LM323A, and 0°C ≤ T_j ≤ +125°C for the LM323. Although power dissipation is internally limited, specifications apply only for P ≤ 30W.
(2) 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%.
(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.

LM323A/LM323 Electrical Characteristics (1)

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

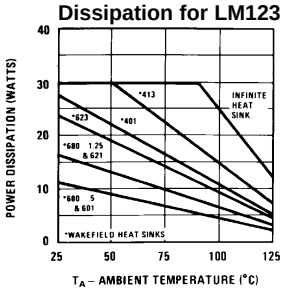
(1) Unless otherwise noted, specifications apply for −55°C ≤ T_j ≤ +150°C for the LM123, −40°C ≤ T_j ≤ +125°C for the LM323A, and 0°C ≤ T_j ≤ +125°C for the LM323. Although power dissipation is internally limited, specifications apply only for P ≤ 30W.

(2) 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%.

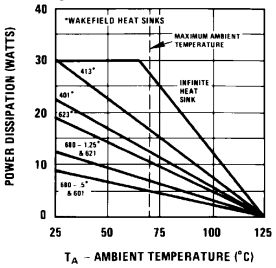
(3) Without a heat sink, the thermal resistance of the TO-3 package is about 35°C/W. With a heat sink, the effective thermal resistance can only approach the specified values of 2°C/W, depending on the efficiency of the heat sink.

Typical Performance Characteristics

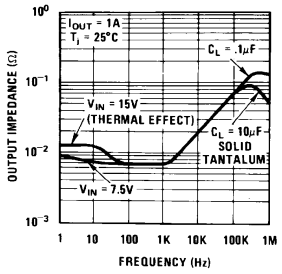
Maximum Average Power Dissipation for LM123



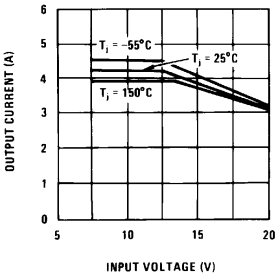
Maximum Average Power Dissipation for LM323A, LM323



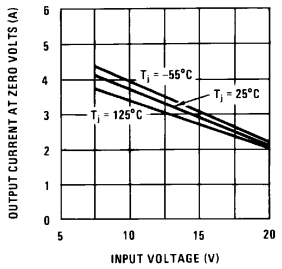
Output Impedance



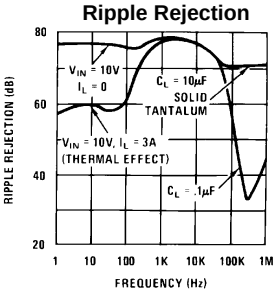
Peak Available Output Current



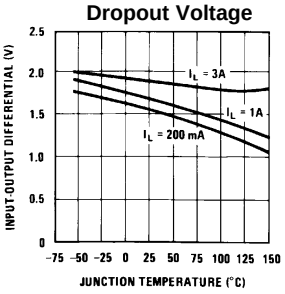
Short Circuit Current



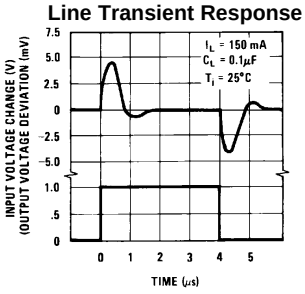
Ripple Rejection



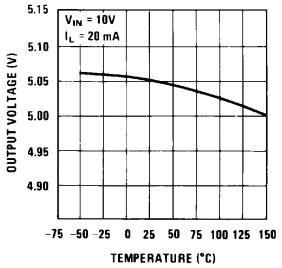
Dropout Voltage



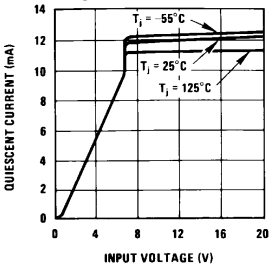
Line Transient Response



Output Voltage

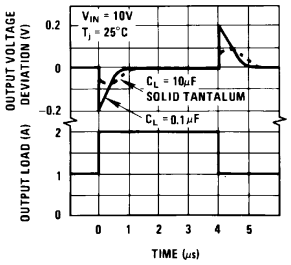


Quiescent Current

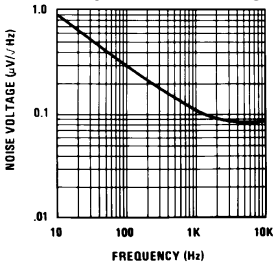


Typical Performance Characteristics (continued)

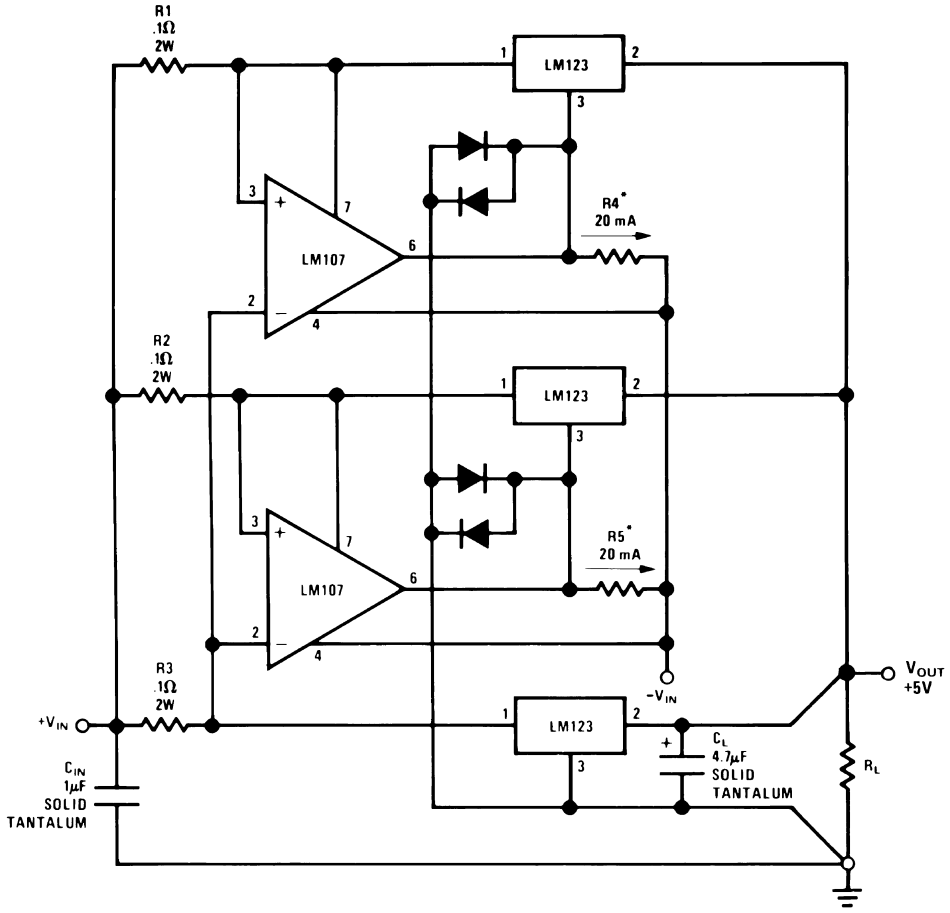
Load Transient Response



Output Noise Voltage

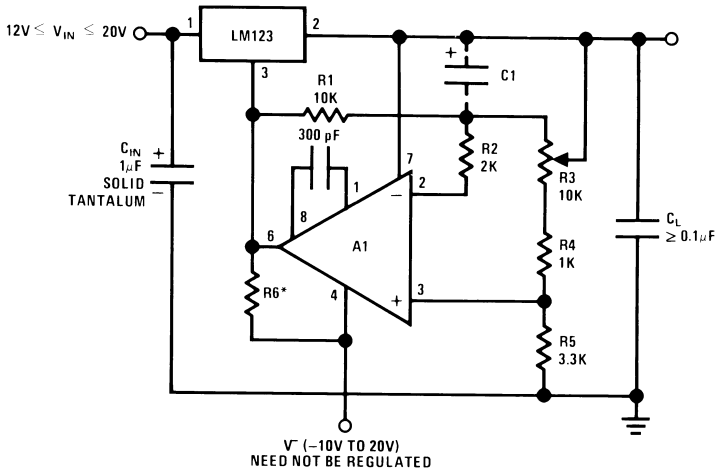


Typical Applications



*Select for 20 mA Current from Unregulated Negative Supply

Figure 3. 10 Amp Regulator with Complete Overload Protection



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

A_1—LM101A

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

Figure 4. Adjustable Regulator 0V−10V @ 3A

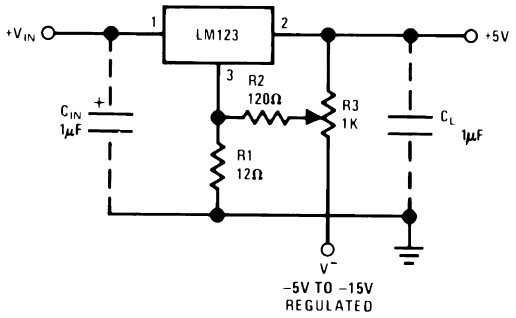
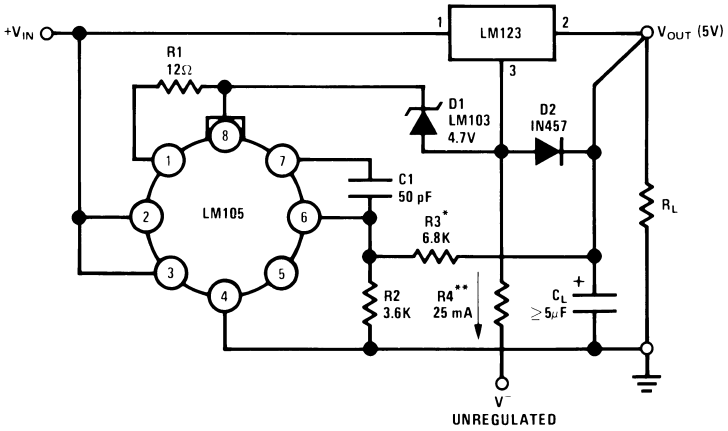


Figure 5. Trimming Output to 5V

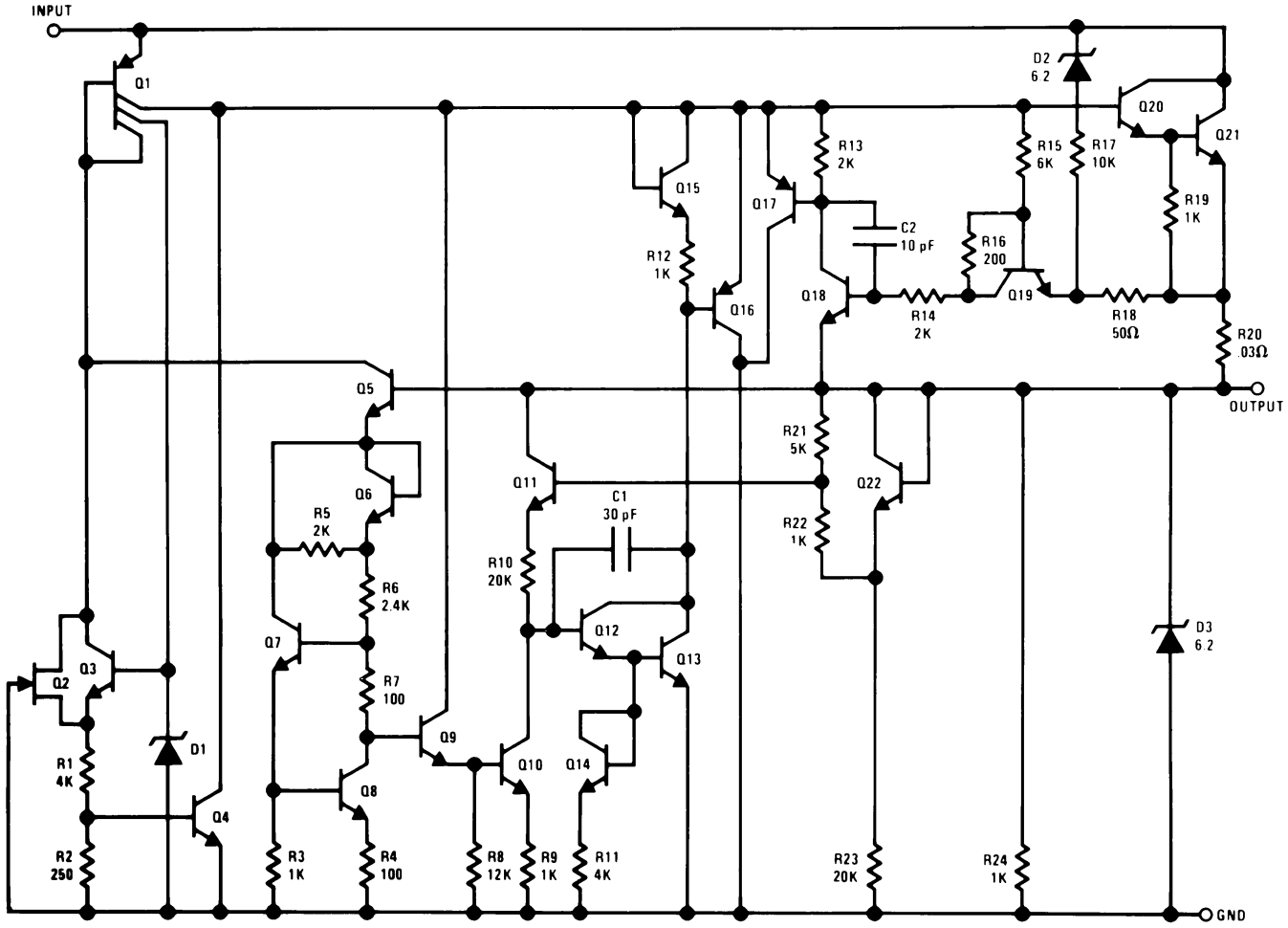


*Select to Set Output Voltage

**Select to Draw 25 mA from V^-

Figure 6. 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/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
LM323K STEEL	ACTIVE	TO-3	NDS	2	50	TBD	Call TI	Call TI	0 to 125	LM323K STEEL	Samples
LM323K STEEL/NOPB	ACTIVE	TO-3	NDS	2	50	Green (RoHS & no Sb/Br)	POST-PLATE	Level-1-NA-UNLIM	0 to 125	LM323K STEEL	Samples

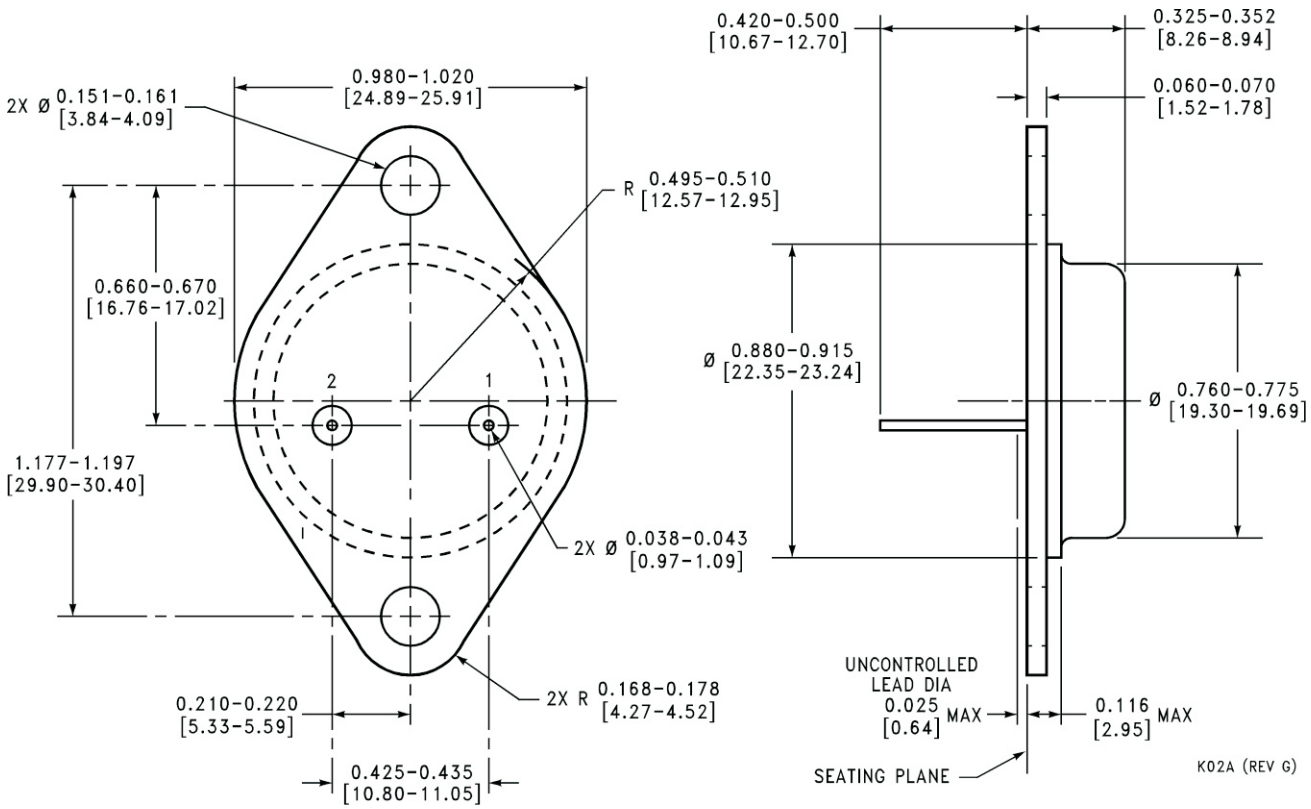
(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, 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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

(4) Only one of markings shown within the brackets will appear on the physical device.

NDS0002A


0.420-0.500
[10.67-12.70]
0.325-0.352
[8.26-8.94]
0.060-0.070
[1.52-1.78]
0.980-1.020
[24.89-25.91]
2X Ø 0.151-0.161
[3.84-4.09]
R 0.495-0.510
[12.57-12.95]
0.660-0.670
[16.76-17.02]
Ø 0.880-0.915
[22.35-23.24]
Ø 0.760-0.775
[19.30-19.69]
2
1
1.177-1.197
[29.90-30.40]
2X Ø 0.038-0.043
[0.97-1.09]
2X R 0.168-0.178
[4.27-4.52]
0.210-0.220
[5.33-5.59]
0.425-0.435
[10.80-11.05]
UNCONTROLLED
LEAD DIA
0.025
[0.64] MAX
0.116
[2.95] MAX
SEATING PLANE
K02A (REV G)

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

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

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license 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 significant portions of TI 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. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265