# LM741 Operational Amplifier

## 1 Features

- Overload Protection on the Input and Output
- No Latch-Up When the Common-Mode Range is Exceeded

## 2 Applications

- Comparators
- Multivibrators
- DC Amplifiers
- Summing Amplifiers
- Integrator or Differentiators
- Active Filters

## 3 Description

The LM741 series are general-purpose operational amplifiers which feature improved performance over industry standards like the LM709. They are direct, plug-in replacements for the 709C, LM201, MC1439, and 748 in most applications.

The amplifiers offer many features which make their application nearly foolproof: overload protection on the input and output, no latch-up when the common-mode range is exceeded, as well as freedom from oscillations.

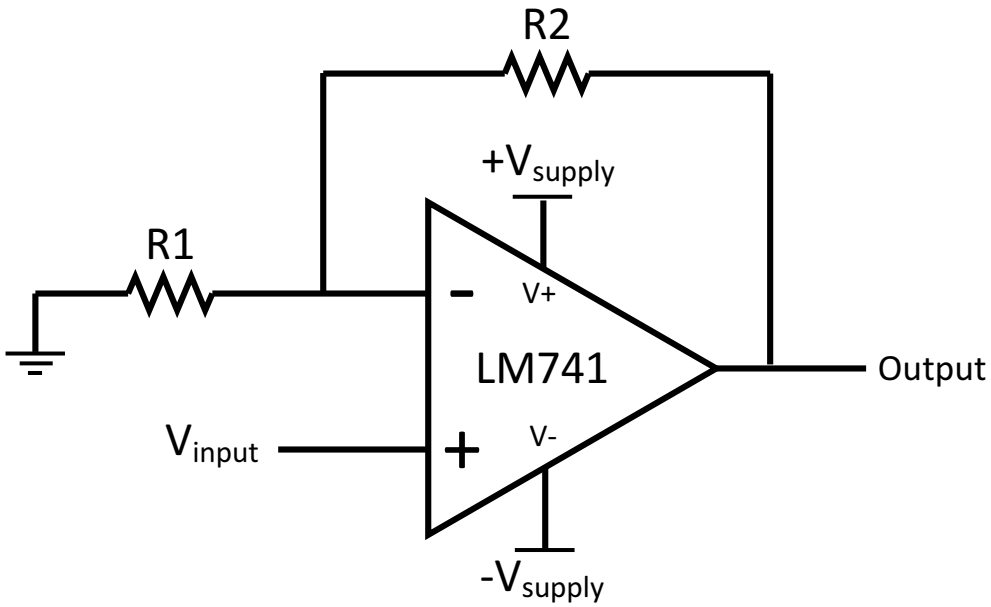
The LM741C is identical to the LM741 and LM741A except that the LM741C has their performance ensured over a 0°C to +70°C temperature range, instead of −55°C to +125°C.

**Device Information(1)**

| PART NUMBER | PACKAGE | BODY SIZE (NOM) |
|---|---|---|
| LM741 | TO-99 (8) | 9.08 mm × 9.08 mm |
| | CDIP (8) | 10.16 mm × 6.502 mm |
| | PDIP (8) | 9.81 mm × 6.35 mm |

(1) For all available packages, see the orderable addendum at the end of the data sheet.

**Typical Application**



## Table of Contents



## 4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

**Changes from Revision C (October 2004) to Revision D** **Page**

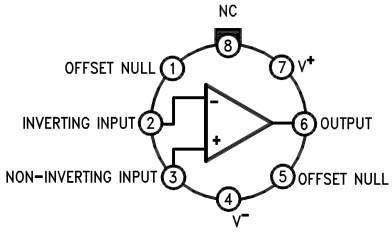
- Added *Applications* section, *Pin Configuration and Functions* section, *ESD Ratings* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section ... 1
- Removed NAD 10-Pin CLGA pinout ... 3
- Removed obselete M (S0-8) package from the data sheet ... 4
- Added recommended operating supply voltage spec ... 4
- Added recommended operating temperature spec ... 4

**Changes from Revision C (March 2013) to Revision D** **Page**

- Added *Applications* section, *Pin Configuration and Functions* section, *ESD Ratings* table, *Feature Description* section, *Device Functional Modes*, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section ... 1
- Removed NAD 10-Pin CLGA pinout ... 3
- Removed obselete M (S0-8) package from the data sheet ... 4
- Added recommended operating supply voltage spec ... 4
- Added recommended operating temperature spec ... 4

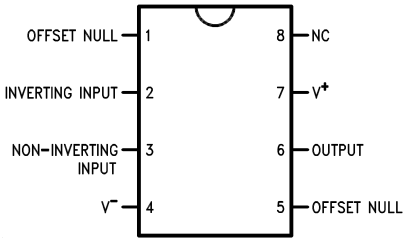
# 5 Pin Configuration and Functions

**LMC Package**
**8-Pin TO-99**
**Top View**




LM741H is available per JM38510/10101

**NAB Package**
**8-Pin CDIP or PDIP**
**Top View**




**Pin Functions**

| PIN | | I/O | DESCRIPTION |
|---|---|---|---|
| NAME | NO. | | |
| INVERTING INPUT | 2 | I | Inverting signal input |
| NC | 8 | N/A | No Connect, should be left floating |
| NONINVERTING INPUT | 3 | I | Noninverting signal input |
| OFFSET NULL | 1, 5 | I | Offset null pin used to eliminate the offset voltage and balance the input voltages. |
| OFFSET NULL | | | |
| OUTPUT | 6 | O | Amplified signal output |
| V+ | 7 | I | Positive supply voltage |
| V– | 4 | I | Negative supply voltage |

# 6 Specifications

## 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)[1][2][3]

| | | MIN | MAX | UNIT |
|---|---|---|---|---|
| Supply voltage | LM741, LM741A | | ±22 | V |
| | LM741C | | ±18 | |
| Power dissipation [4] | | | 500 | mW |
| Differential input voltage | | | ±30 | V |
| Input voltage [5] | | | ±15 | V |
| Output short circuit duration | | Continuous | | |
| Operating temperature | LM741, LM741A | –50 | 125 | °C |
| | LM741C | 0 | 70 | |
| Junction temperature | LM741, LM741A | | 150 | °C |
| | LM741C | | 100 | |
| Soldering information | PDIP package (10 seconds) | | 260 | °C |
| | CDIP or TO-99 package (10 seconds) | | 300 | °C |
| Storage temperature, $T_{stg}$ | | –65 | 150 | °C |

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
(2) For military specifications see RETS741X for LM741 and RETS741AX for LM741A.
(3) If Military/Aerospace specified devices are required, please contact the TI Sales Office/Distributors for availability and specifications.
(4) For operation at elevated temperatures, these devices must be derated based on thermal resistance, and $T_j$ max. (listed under "Absolute Maximum Ratings"). $T_j = T_A + (\theta_{jA} P_D)$.
(5) For supply voltages less than ±15 V, the absolute maximum input voltage is equal to the supply voltage.

## 6.2 ESD Ratings

| | | | VALUE | UNIT |
|---|---|---|---|---|
| $V_{(ESD)}$ | Electrostatic discharge | Human body model (HBM), per ANSI/ESDA/JEDEC JS-001[1] | ±400 | V |

(1) Level listed above is the passing level per ANSI, ESDA, and JEDEC JS-001. JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

## 6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

| | | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|---|
| Supply voltage (VDD-GND) | LM741, LM741A | ±10 | ±15 | ±22 | V |
| | LM741C | ±10 | ±15 | ±18 | |
| Temperature | LM741, LM741A | –55 | | 125 | °C |
| | LM741C | 0 | | 70 | |

## 6.4 Thermal Information

| THERMAL METRIC[1] | | LM741 | | | UNIT |
|---|---|---|---|---|---|
| | | LMC (TO-99) | NAB (CDIP) | P (PDIP) | |
| | | 8 PINS | 8 PINS | 8 PINS | |
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 170 | 100 | 100 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | 25 | — | — | °C/W |

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, SPRA953.

## 6.5 Electrical Characteristics, LM741 (1)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| Input offset voltage | | $R_S \le 10\ k\Omega$ | $T_A = 25°C$ | | 1 | 5 | mV |
| | | | $T_{AMIN} \le T_A \le T_{AMAX}$ | | | 6 | mV |
| Input offset voltage adjustment range | | $T_A = 25°C$, $V_S = \pm 20$ V | | | ±15 | | mV |
| Input offset current | | $T_A = 25°C$ | | | 20 | 200 | nA |
| | | $T_{AMIN} \le T_A \le T_{AMAX}$ | | | 85 | 500 | |
| Input bias current | | $T_A = 25°C$ | | | 80 | 500 | nA |
| | | $T_{AMIN} \le T_A \le T_{AMAX}$ | | | | 1.5 | µA |
| Input resistance | | $T_A = 25°C$, $V_S = \pm 20$ V | | 0.3 | 2 | | MΩ |
| Input voltage range | | $T_{AMIN} \le T_A \le T_{AMAX}$ | | ±12 | ±13 | | V |
| Large signal voltage gain | | $V_S = \pm 15$ V, $V_O = \pm 10$ V, $R_L \ge 2$ kΩ | $T_A = 25°C$ | 50 | 200 | | V/mV |
| | | | $T_{AMIN} \le T_A \le T_{AMAX}$ | 25 | | | |
| Output voltage swing | | $V_S = \pm 15$ V | $R_L \ge 10$ kΩ | ±12 | ±14 | | V |
| | | | $R_L \ge 2$ kΩ | ±10 | ±13 | | |
| Output short circuit current | | $T_A = 25°C$ | | | 25 | | mA |
| Common-mode rejection ratio | | $R_S \le 10\ \Omega$, $V_{CM} = \pm 12$ V, $T_{AMIN} \le T_A \le T_{AMAX}$ | | 80 | 95 | | dB |
| Supply voltage rejection ratio | | $V_S = \pm 20$ V to $V_S = \pm 5$ V, $R_S \le 10\ \Omega$, $T_{AMIN} \le T_A \le T_{AMAX}$ | | 86 | 96 | | dB |
| Transient response | Rise time | $T_A = 25°C$, unity gain | | | 0.3 | | µs |
| | Overshoot | | | | 5% | | |
| Slew rate | | $T_A = 25°C$, unity gain | | | 0.5 | | V/µs |
| Supply current | | $T_A = 25°C$ | | | 1.7 | 2.8 | mA |
| Power consumption | | $V_S = \pm 15$ V | $T_A = 25°C$ | | 50 | 85 | mW |
| | | | $T_A = T_{AMIN}$ | | 60 | 100 | |
| | | | $T_A = T_{AMAX}$ | | 45 | 75 | |

(1) Unless otherwise specified, these specifications apply for $V_S = \pm 15$ V, −55°C ≤ $T_A$ ≤ +125°C (LM741/LM741A). For the LM741C/LM741E, these specifications are limited to 0°C ≤ $T_A$ ≤ +70°C.

## 6.6 Electrical Characteristics, LM741A (1)

| PARAMETER | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Input offset voltage | $R_S \le 50\ \Omega$ | $T_A = 25°C$ | | 0.8 | 3 | mV |
| | | $T_{AMIN} \le T_A \le T_{AMAX}$ | | | 4 | mV |
| Average input offset voltage drift | | | | | 15 | µV/°C |
| Input offset voltage adjustment range | $T_A = 25°C$, $V_S = \pm 20$ V | | ±10 | | | mV |
| Input offset current | $T_A = 25°C$ | | | 3 | 30 | nA |
| | $T_{AMIN} \le T_A \le T_{AMAX}$ | | | | 70 | |
| Average input offset current drift | | | | | 0.5 | nA/°C |
| Input bias current | $T_A = 25°C$ | | | 30 | 80 | nA |
| | $T_{AMIN} \le T_A \le T_{AMAX}$ | | | | 0.21 | µA |
| Input resistance | $T_A = 25°C$, $V_S = \pm 20$ V | | 1 | 6 | | MΩ |
| | $T_{AMIN} \le T_A \le T_{AMAX}$, $V_S = \pm 20$ V | | 0.5 | | | |
| Large signal voltage gain | $V_S = \pm 20$ V, $V_O = \pm 15$ V, $R_L \ge 2$ kΩ | $T_A = 25°C$ | 50 | | | V/mV |
| | | $T_{AMIN} \le T_A \le T_{AMAX}$ | 32 | | | |
| | $V_S = \pm 5$ V, $V_O = \pm 2$ V, $R_L \ge 2$ kΩ, $T_{AMIN} \le T_A \le T_{AMAX}$ | | 10 | | | |

(1) Unless otherwise specified, these specifications apply for $V_S = \pm 15$ V, −55°C ≤ $T_A$ ≤ +125°C (LM741/LM741A). For the LM741C/LM741E, these specifications are limited to 0°C ≤ $T_A$ ≤ +70°C.

## Electrical Characteristics, LM741A[1] (continued)

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| Output voltage swing | | $V_S$ = ±20 V | $R_L$ ≥ 10 kΩ | ±16 | | | V |
| | | | $R_L$ ≥ 2 kΩ | ±15 | | | |
| Output short circuit current | | $T_A$ = 25°C | | 10 | 25 | 35 | mA |
| | | $T_{AMIN} \le T_A \le T_{AMAX}$ | | 10 | | 40 | |
| Common-mode rejection ratio | | $R_S$ ≤ 50 Ω, $V_{CM}$ = ±12 V, $T_{AMIN} \le T_A \le T_{AMAX}$ | | 80 | 95 | | dB |
| Supply voltage rejection ratio | | $V_S$ = ±20 V to $V_S$ = ±5 V, $R_S$ ≤ 50 Ω, $T_{AMIN} \le T_A \le T_{AMAX}$ | | 86 | 96 | | dB |
| Transient response | Rise time | $T_A$ = 25°C, unity gain | | | 0.25 | 0.8 | µs |
| | Overshoot | | | | 6% | 20% | |
| Bandwidth [2] | | $T_A$ = 25°C | | 0.437 | 1.5 | | MHz |
| Slew rate | | $T_A$ = 25°C, unity gain | | 0.3 | 0.7 | | V/µs |
| Power consumption | | $V_S$ = ±20 V | $T_A$ = 25°C | | 80 | 150 | mW |
| | | | $T_A = T_{AMIN}$ | | | 165 | |
| | | | $T_A = T_{AMAX}$ | | | 135 | |

(2) Calculated value from: BW (MHz) = 0.35/Rise Time (µs).

## 6.7 Electrical Characteristics, LM741C[1]

| PARAMETER | | TEST CONDITIONS | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| Input offset voltage | | $R_S$ ≤ 10 kΩ | $T_A$ = 25°C | | 2 | 6 | mV |
| | | | $T_{AMIN} \le T_A \le T_{AMAX}$ | | | 7.5 | mV |
| Input offset voltage adjustment range | | $T_A$ = 25°C, $V_S$ = ±20 V | | | ±15 | | mV |
| Input offset current | | $T_A$ = 25°C | | | 20 | 200 | nA |
| | | $T_{AMIN} \le T_A \le T_{AMAX}$ | | | | 300 | |
| Input bias current | | $T_A$ = 25°C | | | 80 | 500 | nA |
| | | $T_{AMIN} \le T_A \le T_{AMAX}$ | | | | 0.8 | µA |
| Input resistance | | $T_A$ = 25°C, $V_S$ = ±20 V | | 0.3 | 2 | | MΩ |
| Input voltage range | | $T_A$ = 25°C | | ±12 | ±13 | | V |
| Large signal voltage gain | | $V_S$ = ±15 V, $V_O$ = ±10 V, $R_L$ ≥ 2 kΩ | $T_A$ = 25°C | 20 | 200 | | V/mV |
| | | | $T_{AMIN} \le T_A \le T_{AMAX}$ | 15 | | | |
| Output voltage swing | | $V_S$ = ±15 V | $R_L$ ≥ 10 kΩ | ±12 | ±14 | | V |
| | | | $R_L$ ≥ 2 kΩ | ±10 | ±13 | | |
| Output short circuit current | | $T_A$ = 25°C | | | 25 | | mA |
| Common-mode rejection ratio | | $R_S$ ≤ 10 kΩ, $V_{CM}$ = ±12 V, $T_{AMIN} \le T_A \le T_{AMAX}$ | | 70 | 90 | | dB |
| Supply voltage rejection ratio | | $V_S$ = ±20 V to $V_S$ = ±5 V, $R_S$ ≤ 10 Ω, $T_{AMIN} \le T_A \le T_{AMAX}$ | | 77 | 96 | | dB |
| Transient response | Rise time | $T_A$ = 25°C, Unity Gain | | | 0.3 | | µs |
| | Overshoot | | | | 5% | | |
| Slew rate | | $T_A$ = 25°C, Unity Gain | | | 0.5 | | V/µs |
| Supply current | | $T_A$ = 25°C | | | 1.7 | 2.8 | mA |
| Power consumption | | $V_S$ = ±15 V, $T_A$ = 25°C | | | 50 | 85 | mW |

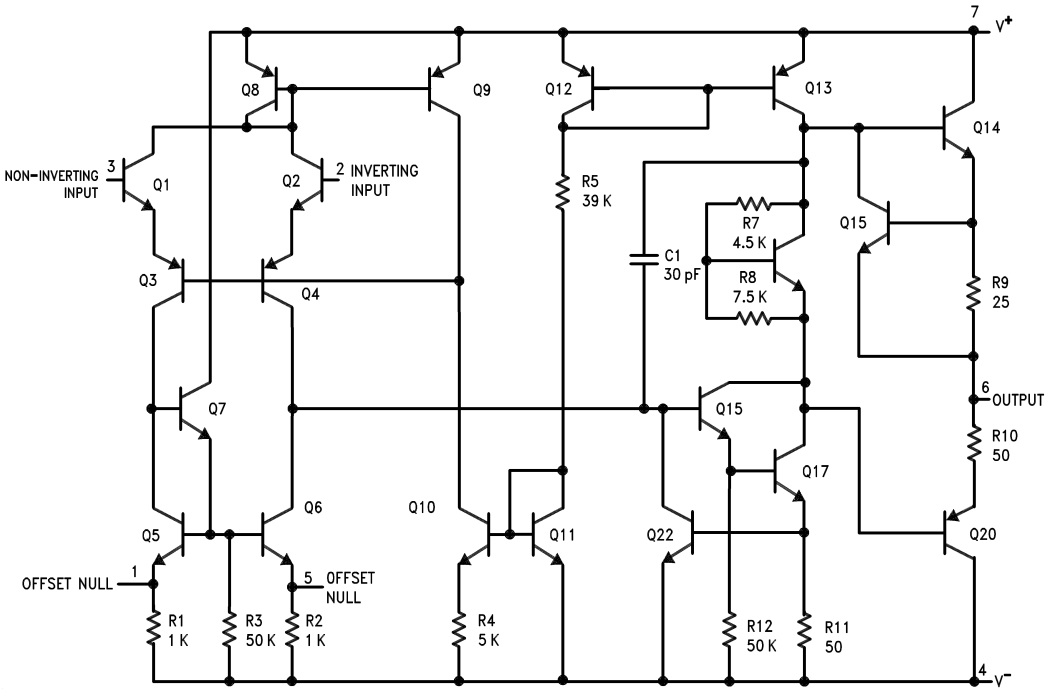
(1) Unless otherwise specified, these specifications apply for $V_S$ = ±15 V, −55°C ≤ $T_A$ ≤ +125°C (LM741/LM741A). For the LM741C/LM741E, these specifications are limited to 0°C ≤ $T_A$ ≤ +70°C.

# 7 Detailed Description

## 7.1 Overview

The LM74 devices are general-purpose operational amplifiers which feature improved performance over industry standards like the LM709. It is intended for a wide range of analog applications. The high gain and wide range of operating voltage provide superior performance in integrator, summing amplifier, and general feedback applications. The LM741 can operate with a single or dual power supply voltage. The LM741 devices are direct, plug-in replacements for the 709C, LM201, MC1439, and 748 in most applications.

## 7.2 Functional Block Diagram




## 7.3 Feature Description

### 7.3.1 Overload Protection

The LM741 features overload protection circuitry on the input and output. This prevents possible circuit damage to the device.

### 7.3.2 Latch-up Prevention

The LM741 is designed so that there is no latch-up occurrence when the common-mode range is exceeded. This allows the device to function properly without having to power cycle the device.

### 7.3.3 Pin-to-Pin Capability

The LM741 is pin-to-pin direct replacements for the LM709C, LM201, MC1439, and LM748 in most applications. Direct replacement capabilities allows flexibility in design for replacing obsolete parts.

## 7.4 Device Functional Modes

### 7.4.1 Open-Loop Amplifier

The LM741 can be operated in an open-loop configuration. The magnitude of the open-loop gain is typically large thus for a small difference between the noninverting and inverting input terminals, the amplifier output will be driven near the supply voltage. Without negative feedback, the LM741 can act as a comparator. If the inverting input is held at 0 V, and the input voltage applied to the noninverting input is positive, the output will be positive. If the input voltage applied to the noninverting input is negative, the output will be negative.

### 7.4.2 Closed-Loop Amplifier

In a closed-loop configuration, negative feedback is used by applying a portion of the output voltage to the inverting input. Unlike the open-loop configuration, closed loop feedback reduces the gain of the circuit. The overall gain and response of the circuit is determined by the feedback network rather than the operational amplifier characteristics. The response of the operational amplifier circuit is characterized by the transfer function.

# 8 Application and Implementation

**NOTE**

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

## 8.1 Application Information

The LM741 is a general-purpose amplifier than can be used in a variety of applications and configurations. One common configuration is in a noninverting amplifier configuration. In this configuration, the output signal is in phase with the input (not inverted as in the inverting amplifier configuration), the input impedance of the amplifier is high, and the output impedance is low. The characteristics of the input and output impedance is beneficial for applications that require isolation between the input and output. No significant loading will occur from the previous stage before the amplifier. The gain of the system is set accordingly so the output signal is a factor larger than the input signal.

## 8.2 Typical Application

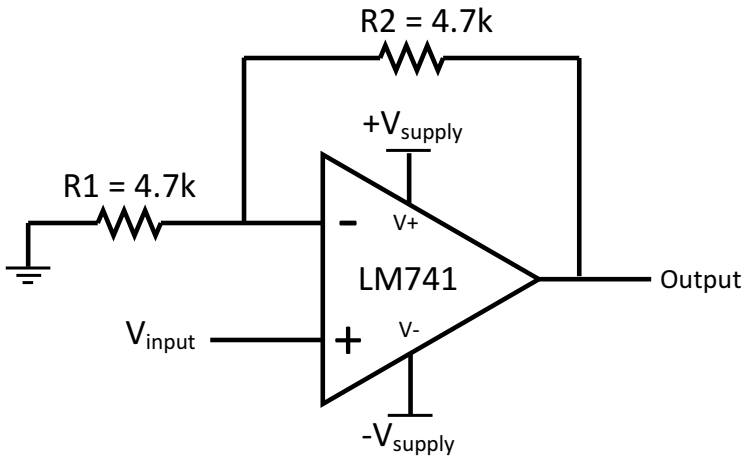



**Figure 1. LM741 Noninverting Amplifier Circuit**

### 8.2.1 Design Requirements

As shown in Figure 1, the signal is applied to the noninverting input of the LM741. The gain of the system is determined by the feedback resistor and input resistor connected to the inverting input. The gain can be calculated by Equation 1:

$$\text{Gain} = 1 + (R2/R1) \quad (1)$$

The gain is set to 2 for this application. R1 and R2 are 4.7-k resistors with 5% tolerance.

### 8.2.2 Detailed Design Procedure

The LM741 can be operated in either single supply or dual supply. This application is configured for dual supply with the supply rails at ±15 V. The input signal is connected to a function generator. A 1-Vpp, 10-kHz sine wave was used as the signal input. 5% tolerance resistors were used, but if the application requires an accurate gain response, use 1% tolerance resistors.

## Typical Application (continued)

### 8.2.3 Application Curve

The waveforms in Figure 2 show the input and output signals of the LM741 non-inverting amplifier circuit. The blue waveform (top) shows the input signal, while the red waveform (bottom) shows the output signal. The input signal is 1.06 Vpp and the output signal is 1.94 Vpp. With the 4.7-kΩ resistors, the theoretical gain of the system is 2. Due to the 5% tolerance, the gain of the system including the tolerance is 1.992. The gain of the system when measured from the mean amplitude values on the oscilloscope was 1.83.

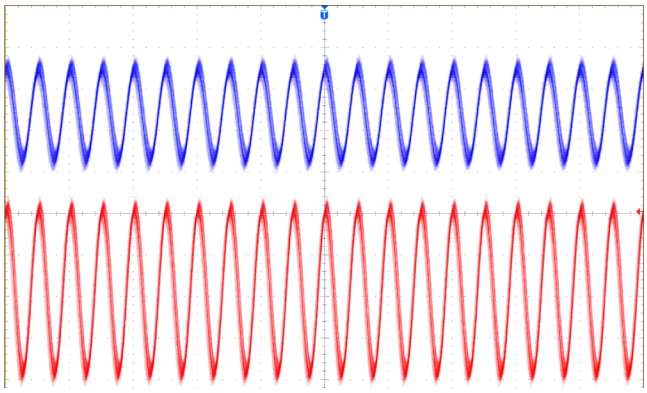


**Figure 2. Waveforms for LM741 Noninverting Amplifier Circuit**

## 9 Power Supply Recommendations

For proper operation, the power supplies must be properly decoupled. For decoupling the supply lines, a 0.1-µF capacitor is recommended and should be placed as close as possible to the LM741 power supply pins.

# 10 Layout

## 10.1 Layout Guidelines

As with most amplifiers, take care with lead dress, component placement, and supply decoupling in order to ensure stability. For example, resistors from the output to an input should be placed with the body close to the input to minimize pick-up and maximize the frequency of the feedback pole by minimizing the capacitance from the input to ground. As shown in Figure 3, the feedback resistors and the decoupling capacitors are located close to the device to ensure maximum stability and noise performance of the system.

## 10.2 Layout Example

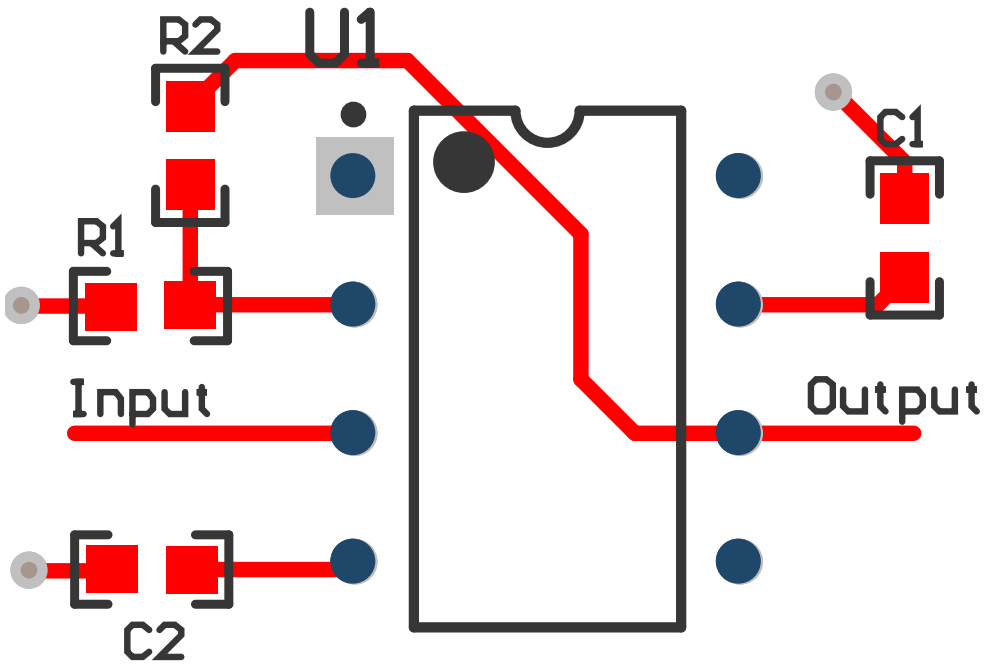



**Figure 3. LM741 Layout**

# 11 Device and Documentation Support

## 11.1 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

**TI E2E™ Online Community** ***TI's Engineer-to-Engineer (E2E) Community.*** Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** ***TI's Design Support*** Quickly find helpful E2E forums along with design support tools and contact information for technical support.

## 11.2 Trademarks

E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

## 11.3 Electrostatic Discharge Caution

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.

## 11.4 Glossary

SLYZ022 — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

# 12 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish (6) | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LM741C-MWC | ACTIVE | WAFERSALE | YS | 0 | 1 | Green (RoHS & no Sb/Br) | Call TI | Level-1-NA-UNLIM | -40 to 85 | | Samples |
| LM741CH | ACTIVE | TO-99 | LMC | 8 | 500 | TBD | Call TI | Call TI | 0 to 70 | ( LM741CH ~ LM741CH) | Samples |
| LM741CH/NOPB | ACTIVE | TO-99 | LMC | 8 | 500 | Green (RoHS & no Sb/Br) | Call TI | Level-1-NA-UNLIM | 0 to 70 | ( LM741CH ~ LM741CH) | Samples |
| LM741CN/NOPB | ACTIVE | PDIP | P | 8 | 40 | Green (RoHS & no Sb/Br) | CU SN | Level-1-NA-UNLIM | 0 to 70 | LM 741CN | Samples |
| LM741H | ACTIVE | TO-99 | LMC | 8 | 500 | TBD | Call TI | Call TI | -55 to 125 | ( LM741H ~ LM741H) | Samples |
| LM741H/NOPB | ACTIVE | TO-99 | LMC | 8 | 500 | Green (RoHS & no Sb/Br) | Call TI | Level-1-NA-UNLIM | -55 to 125 | ( LM741H ~ LM741H) | Samples |
| LM741J | ACTIVE | CDIP | NAB | 8 | 40 | TBD | Call TI | Call TI | -55 to 125 | LM741J | Samples |
| U5B7741312 | ACTIVE | TO-99 | LMC | 8 | 500 | TBD | Call TI | Call TI | -55 to 125 | ( LM741H ~ LM741H) | Samples |
| U5B7741393 | ACTIVE | TO-99 | LMC | 8 | 500 | TBD | Call TI | Call TI | 0 to 70 | ( LM741CH ~ LM741CH) | Samples |
| U9T7741393 | OBSOLETE | PDIP | P | 8 | | TBD | Call TI | Call TI | 0 to 70 | LM 741CN | |

(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)

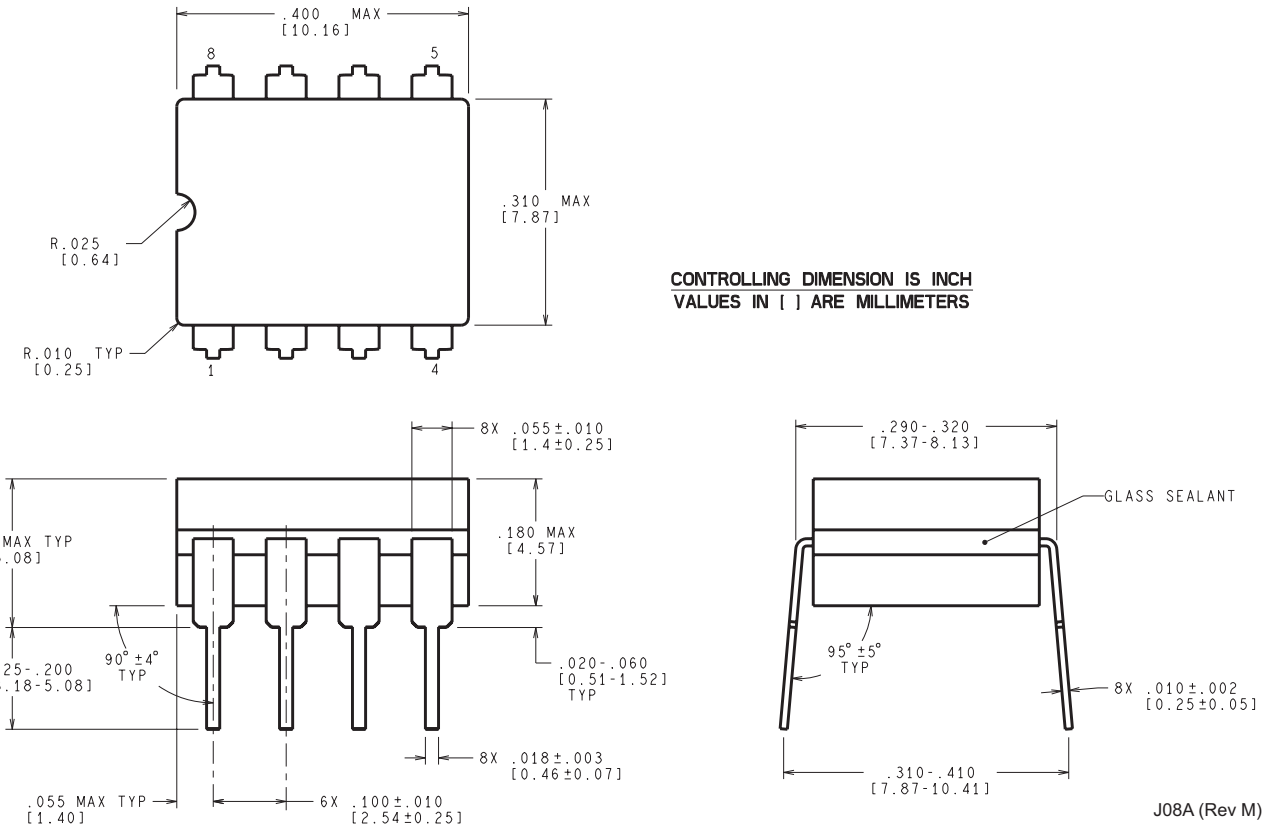
**(3)** MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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

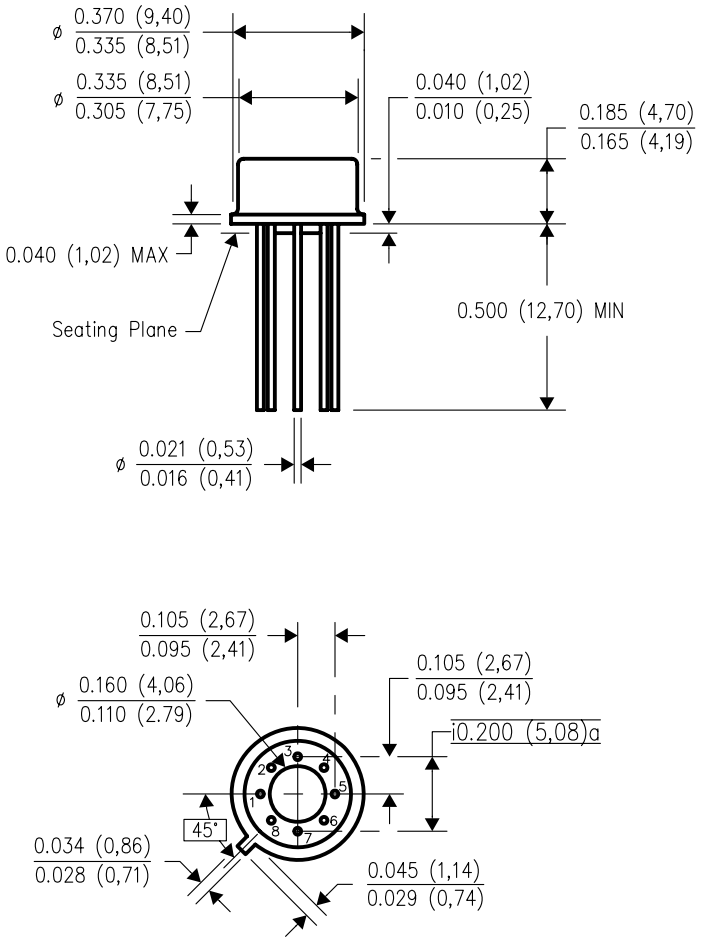
**(5)** Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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

# NAB0008A


.400 MAX
[10.16]
8
5
.310 MAX
[7.87]
R.025
[0.64]
R.010 TYP
[0.25]
1
4
CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS
8X .055±.010
[1.4±0.25]
.200 MAX TYP
[5.08]
.180 MAX
[4.57]
8X .125-.200
[3.18-5.08]
90° ±4°
TYP
.020-.060
[0.51-1.52]
TYP
8X .018±.003
[0.46±0.07]
.055 MAX TYP
[1.40]
6X .100±.010
[2.54±0.25]
.290-.320
[7.37-8.13]
GLASS SEALANT
95° ±5°
TYP
8X .010±.002
[0.25±0.05]
.310-.410
[7.87-10.41]
J08A (Rev M)

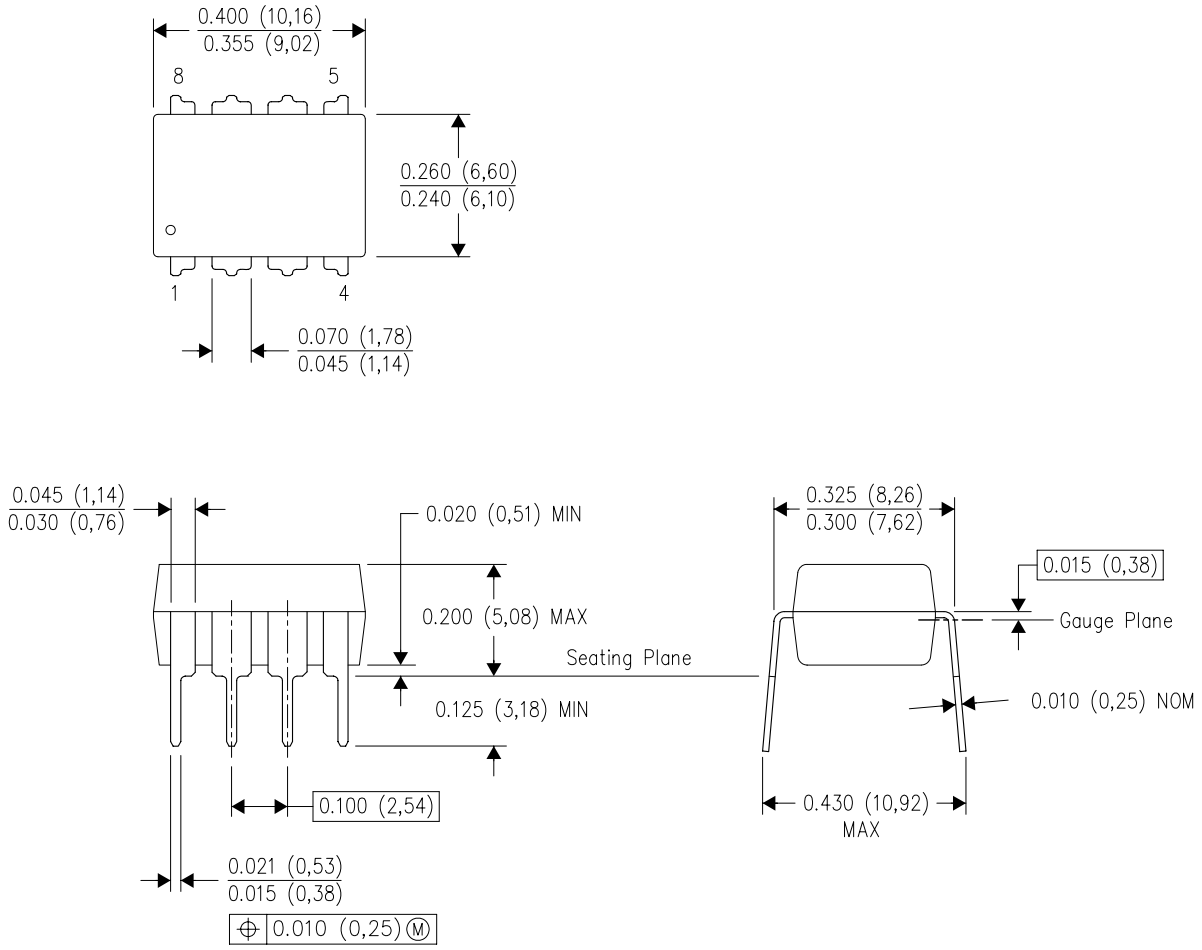
## LMC (O–MBCY–W8) METAL CYLINDRICAL PACKAGE




4202483/B 09/07

NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Leads in true position within 0.010 (0,25) R @ MMC at seating plane.
D. Pin numbers shown for reference only. Numbers may not be marked on package.
E. Falls within JEDEC MO–002/TO–99.

P (R–PDIP–T8) PLASTIC DUAL–IN–LINE PACKAGE




NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001 variation BA.

## 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