

LM741 Operational Amplifier

Check for Samples: [LM741](#)

FEATURES

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

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/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.

Connection Diagrams

LM741H is available per JM38510/10101

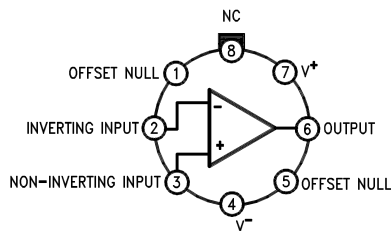


Figure 1. TO-99 Package
See Package Number LMC0008C

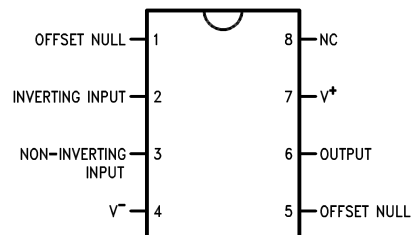


Figure 2. CDIP or PDIP Package
See Package Number NAB0008A, P0008E

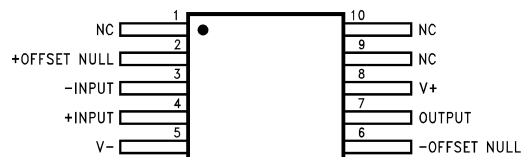


Figure 3. CLGA Package
See Package Number NAD0010A



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Typical Application

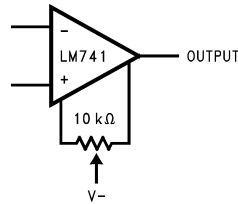


Figure 4. Offset Nulling Circuit



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⁾⁽³⁾

| | LM741A | LM741 | LM741C |
|--|-----------------|-----------------|-----------------|
| Supply Voltage | ±22V | ±22V | ±18V |
| Power Dissipation ⁽⁴⁾ | 500 mW | 500 mW | 500 mW |
| Differential Input Voltage | ±30V | ±30V | ±30V |
| Input Voltage ⁽⁵⁾ | ±15V | ±15V | ±15V |
| Output Short Circuit Duration | Continuous | Continuous | Continuous |
| Operating Temperature Range | -55°C to +125°C | -55°C to +125°C | 0°C to +70°C |
| Storage Temperature Range | -65°C to +150°C | -65°C to +150°C | -65°C to +150°C |
| Junction Temperature | 150°C | 150°C | 100°C |
| Soldering Information | | | |
| P0008E-Package (10 seconds) | 260°C | 260°C | 260°C |
| NAB0008A- or LMC0008C-Package (10 seconds) | 300°C | 300°C | 300°C |
| M-Package | | | |
| Vapor Phase (60 seconds) | 215°C | 215°C | 215°C |
| Infrared (15 seconds) | 215°C | 215°C | 215°C |
| ESD Tolerance ⁽⁶⁾ | 400V | 400V | 400V |

- (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) 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 ±15V, the absolute maximum input voltage is equal to the supply voltage.
- (6) Human body model, 1.5 kΩ in series with 100 pF.

Electrical Characteristics⁽¹⁾

| Parameter | Test Conditions | LM741A | | | LM741 | | | LM741C | | | Units |
|------------------------------------|--|--------|-----|-----|-------|-----|-----|--------|-----|-----|------------------------------|
| | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| Input Offset Voltage | $T_A = 25^\circ\text{C}$ $R_S \leq 10\text{ k}\Omega$ $R_S \leq 50\Omega$ | | 0.8 | 3.0 | | 1.0 | 5.0 | | 2.0 | 6.0 | mV |
| | $T_{AMIN} \leq T_A \leq T_{AMAX}$ $R_S \leq 50\Omega$ $R_S \leq 10\text{ k}\Omega$ | | | 4.0 | | | 6.0 | | | 7.5 | mV |
| Average Input Offset Voltage Drift | | | | 15 | | | | | | | $\mu\text{V}/^\circ\text{C}$ |

- (1) Unless otherwise specified, these specifications apply for $V_S = \pm 15\text{V}$, $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$ (LM741/LM741A). For the LM741C/LM741E, these specifications are limited to $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$.

Electrical Characteristics⁽¹⁾ (continued)

| Parameter | Test Conditions | LM741A | | | LM741 | | | LM741C | | | Units |
|---------------------------------------|--|----------------------|------|----------|----------------------|----------------------|-----|----------------------|----------------------|-----|------------------|
| | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| Input Offset Voltage Adjustment Range | $T_A = 25^\circ\text{C}$, $V_S = \pm 20\text{V}$ | ± 10 | | | | ± 15 | | | ± 15 | | mV |
| Input Offset Current | $T_A = 25^\circ\text{C}$ | | 3.0 | 30 | | 20 | 200 | | 20 | 200 | nA |
| | $T_{AMIN} \leq T_A \leq T_{AMAX}$ | | | 70 | | 85 | 500 | | | 300 | |
| Average Input Offset Current Drift | | | | 0.5 | | | | | | | nA/°C |
| Input Bias Current | $T_A = 25^\circ\text{C}$ | | 30 | 80 | | 80 | 500 | | 80 | 500 | nA |
| | $T_{AMIN} \leq T_A \leq T_{AMAX}$ | | | 0.210 | | | 1.5 | | | 0.8 | μA |
| Input Resistance | $T_A = 25^\circ\text{C}$, $V_S = \pm 20\text{V}$ | 1.0 | 6.0 | | 0.3 | 2.0 | | 0.3 | 2.0 | | M Ω |
| | $T_{AMIN} \leq T_A \leq T_{AMAX}$, $V_S = \pm 20\text{V}$ | 0.5 | | | | | | | | | |
| Input Voltage Range | $T_A = 25^\circ\text{C}$ | | | | | | | ± 12 | ± 13 | | V |
| | $T_{AMIN} \leq T_A \leq T_{AMAX}$ | | | | ± 12 | ± 13 | | | | | |
| Large Signal Voltage Gain | $T_A = 25^\circ\text{C}$, $R_L \geq 2\text{ k}\Omega$ $V_S = \pm 20\text{V}$, $V_O = \pm 15\text{V}$ $V_S = \pm 15\text{V}$, $V_O = \pm 10\text{V}$ | 50 | | | | | | | | | V/mV |
| | $T_{AMIN} \leq T_A \leq T_{AMAX}$, $R_L \geq 2\text{ k}\Omega$, $V_S = \pm 20\text{V}$, $V_O = \pm 15\text{V}$ $V_S = \pm 15\text{V}$, $V_O = \pm 10\text{V}$ | 32 | | | | | | | | | V/mV |
| | $V_S = \pm 5\text{V}$, $V_O = \pm 2\text{V}$ | 10 | | | 25 | | | 15 | | | |
| Output Voltage Swing | $V_S = \pm 20\text{V}$ $R_L \geq 10\text{ k}\Omega$ $R_L \geq 2\text{ k}\Omega$ | ± 16 ± 15 | | | | | | | | | V |
| | $V_S = \pm 15\text{V}$ $R_L \geq 10\text{ k}\Omega$ $R_L \geq 2\text{ k}\Omega$ | | | | ± 12 ± 10 | ± 14 ± 13 | | ± 12 ± 10 | ± 14 ± 13 | | V |
| Output Short Circuit Current | $T_A = 25^\circ\text{C}$ $T_{AMIN} \leq T_A \leq T_{AMAX}$ | 10 10 | 25 | 35 40 | | 25 | | | 25 | | mA |
| Common-Mode Rejection Ratio | $T_{AMIN} \leq T_A \leq T_{AMAX}$ $R_S \leq 10\text{ k}\Omega$, $V_{CM} = \pm 12\text{V}$ $R_S \leq 50\Omega$, $V_{CM} = \pm 12\text{V}$ | 80 | 95 | | 70 | 90 | | 70 | 90 | | dB |
| Supply Voltage Rejection Ratio | $T_{AMIN} \leq T_A \leq T_{AMAX}$, $V_S = \pm 20\text{V}$ to $V_S = \pm 5\text{V}$ $R_S \leq 50\Omega$ $R_S \leq 10\text{ k}\Omega$ | 86 | 96 | | 77 | 96 | | 77 | 96 | | dB |
| Transient Response | $T_A = 25^\circ\text{C}$, Unity Gain | Rise Time | 0.25 | 0.8 | | 0.3 | | | 0.3 | | μs |
| | | Overshoot | 6.0 | 20 | | 5 | | | 5 | | % |
| Bandwidth ⁽²⁾ | $T_A = 25^\circ\text{C}$ | 0.437 | 1.5 | | | | | | | | MHz |
| Slew Rate | $T_A = 25^\circ\text{C}$, Unity Gain | 0.3 | 0.7 | | | 0.5 | | | 0.5 | | V/ μs |
| Supply Current | $T_A = 25^\circ\text{C}$ | | | | | 1.7 | 2.8 | | 1.7 | 2.8 | mA |
| Power Consumption | $T_A = 25^\circ\text{C}$ | | 80 | 150 | | | | | | | mW |
| | $V_S = \pm 20\text{V}$ $V_S = \pm 15\text{V}$ | | | | | 50 | 85 | | 50 | 85 | |

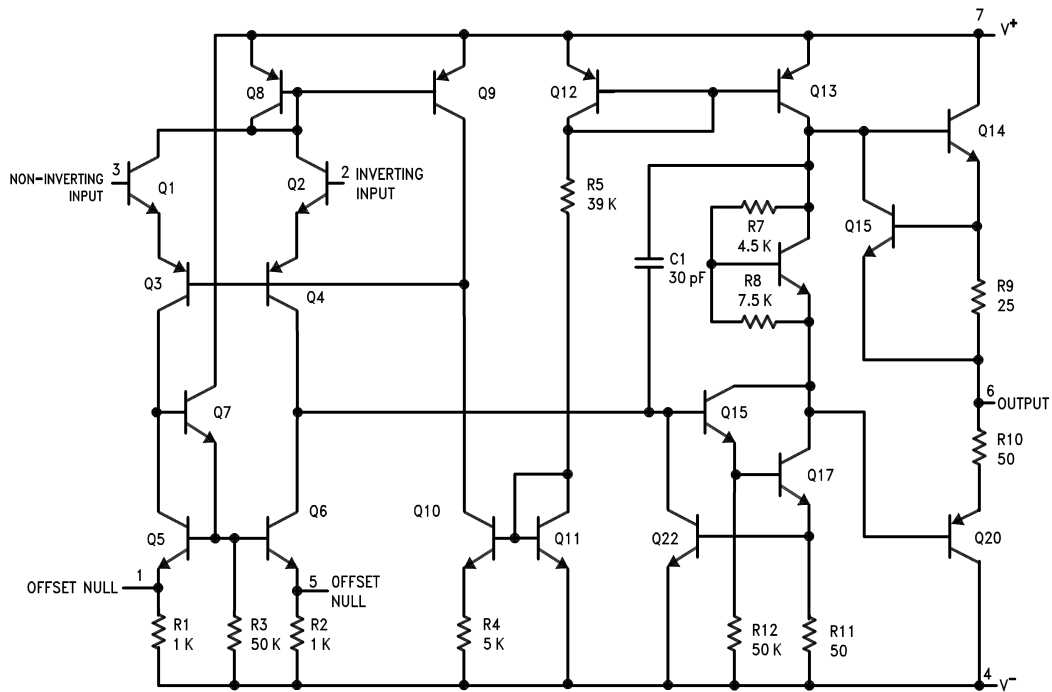
 (2) Calculated value from: BW (MHz) = 0.35/Rise Time (μs).

Electrical Characteristics⁽¹⁾ (continued)

| Parameter | Test Conditions | LM741A | | | LM741 | | | LM741C | | | Units |
|-----------|---|--------|-----|-----|-------|----------|-----------|--------|-----|-----|-------|
| | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | |
| LM741A | $V_S = \pm 20V$ $T_A = T_{AMIN}$ $T_A = T_{AMAX}$ | | | 165 | | | | | | | mW |
| LM741 | $V_S = \pm 15V$ $T_A = T_{AMIN}$ $T_A = T_{AMAX}$ | | | | | 60 45 | 100 75 | | | | mW |

| Thermal Resistance | CDIP (NAB0008A) | PDIP (P0008E) | TO-99 (LMC0008C) | SO-8 (M) |
|-------------------------------------|-----------------|---------------|------------------|----------|
| θ_{JA} (Junction to Ambient) | 100°C/W | 100°C/W | 170°C/W | 195°C/W |
| θ_{JC} (Junction to Case) | N/A | N/A | 25°C/W | N/A |

SCHEMATIC DIAGRAM



REVISION HISTORY

| Changes from Revision B (March 2013) to Revision C | Page |
|--|----------------------|
| <hr/> <ul style="list-style-type: none">• Changed layout of National Data Sheet to TI format <hr/> | <hr/> 4 <hr/> |

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 |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|------------------|----------------------|--------------|--------------------------|-------------------------|
| LM741CH | ACTIVE | TO-99 | LMC | 8 | 500 | TBD | Call TI | Call TI | 0 to 70 | LM741CH | Samples |
| LM741CH/NOPB | ACTIVE | TO-99 | LMC | 8 | 500 | Green (RoHS & no Sb/Br) | POST-PLATE | Level-1-NA-UNLIM | 0 to 70 | LM741CH | Samples |
| LM741CN | ACTIVE | PDIP | P | 8 | 40 | TBD | Call TI | Call TI | 0 to 70 | LM 741CN | Samples |
| LM741CN/NOPB | ACTIVE | PDIP | P | 8 | 40 | Green (RoHS & no Sb/Br) | 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 | Samples |
| LM741H/NOPB | ACTIVE | TO-99 | LMC | 8 | 500 | Green (RoHS & no Sb/Br) | POST-PLATE | Level-1-NA-UNLIM | -55 to 125 | 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 | Samples |
| U5B7741393 | ACTIVE | TO-99 | LMC | 8 | 500 | TBD | Call TI | Call TI | 0 to 70 | LM741CH | Samples |
| U9T7741393 | ACTIVE | PDIP | P | 8 | 40 | TBD | Call TI | Call TI | 0 to 70 | LM 741CN | 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.

OBSELETE: 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⁾ Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side Marking for that device.

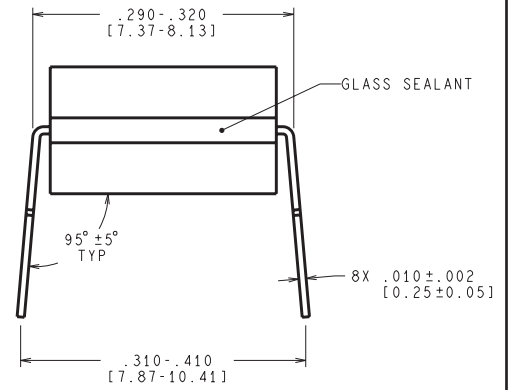
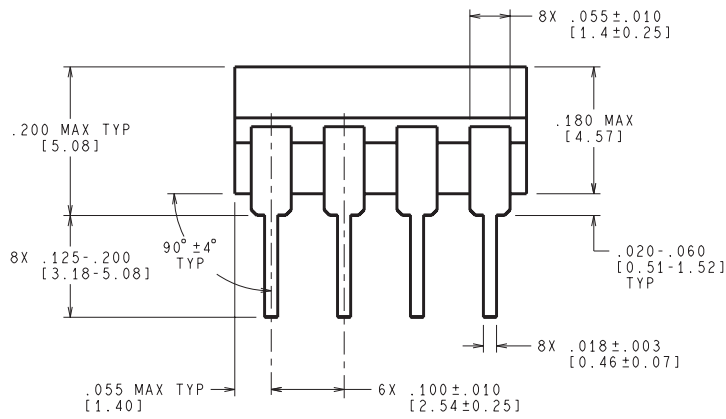
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NAB0008A



CONTROLLING DIMENSION IS INCH
VALUES IN [] ARE MILLIMETERS



J08A (Rev M)

LMC (O-MBCY-W8)

METAL CYLINDRICAL PACKAGE



- 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



4040082/E 04/2010

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