

LM741

Operational Amplifier

General 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

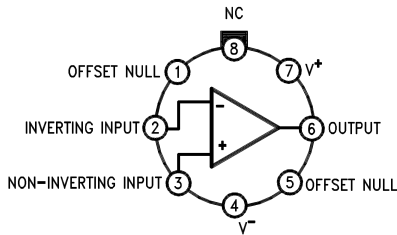
output, no latch-up when the common mode range is exceeded, as well as freedom from oscillations.

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

Features

Connection Diagrams

Metal Can Package

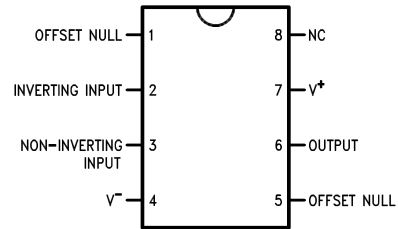


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Note 1: LM741H is available per JM38510/10101

**Order Number LM741H, LM741H/883 (Note 1),
LM741AH/883 or LM741CH**
See NS Package Number H08C

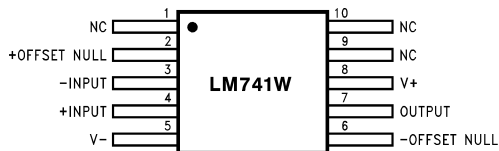
Dual-In-Line or S.O. Package



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Order Number LM741J, LM741J/883, LM741CN
See NS Package Number J08A, M08A or N08E

Ceramic Flatpak

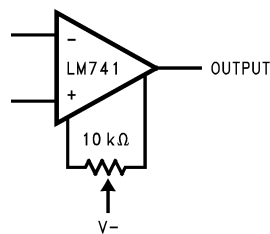


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Order Number LM741W/883
See NS Package Number W10A

Typical Application

Offset Nulling Circuit



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Absolute Maximum Ratings (Note 2)

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

(Note 7)

| | LM741A | LM741 | LM741C |
|---|-----------------|-----------------|-----------------|
| Supply Voltage | ±22V | ±22V | ±18V |
| Power Dissipation (Note 3) | 500 mW | 500 mW | 500 mW |
| Differential Input Voltage | ±30V | ±30V | ±30V |
| Input Voltage (Note 4) | ±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 | | | |
| N-Package (10 seconds) | 260°C | 260°C | 260°C |
| J- or H-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 |
| See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods of soldering surface mount devices. | | | |
| ESD Tolerance (Note 8) | 400V | 400V | 400V |

Electrical Characteristics (Note 5)

| Parameter | 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 |
| | | | | 15 | | | | | | | $\mu\text{V}/^\circ\text{C}$ |
| Average Input Offset Voltage Drift | | | | 15 | | | | | | | $\mu\text{V}/^\circ\text{C}$ |
| 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 | nA |
| Average Input Offset Current Drift | | | | 0.5 | | | | | | | $\text{nA}/^\circ\text{C}$ |
| 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 | | $\text{M}\Omega$ |
| | $T_{AMIN} \leq T_A \leq T_{AMAX}$, $V_S = \pm 20\text{V}$ | 0.5 | | | | | | | | | $\text{M}\Omega$ |
| Input Voltage Range | $T_A = 25^\circ\text{C}$ | | | | | | | ±12 | ±13 | | V |
| | $T_{AMIN} \leq T_A \leq T_{AMAX}$ | | | | ±12 | ±13 | | | | | V |

Electrical Characteristics (Note 5) (Continued)

| Parameter | Conditions | LM741A | | | LM741 | | | LM741C | | | Units | |
|--------------------------------|--|----------------------|------|-----|----------------------|----------------------|-----------|----------------------|----------------------|-----|------------------|--|
| | | Min | Typ | Max | Min | Typ | Max | Min | Typ | Max | | |
| 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 | | | 50 | 200 | | 20 | 200 | | V/mV 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 | | | 25 | | | 15 | | | V/mV V/mV | |
| | $V_S = \pm 5\text{V}$, $V_O = \pm 2\text{V}$ | 10 | | | | | | | | | V/mV | |
| 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 | |
| | $V_S = \pm 15\text{V}$ $R_L \geq 10\text{ k}\Omega$ $R_L \geq 2\text{ k}\Omega$ | | | | ± 12 ± 10 | ± 14 ± 13 | | ± 12 ± 10 | ± 14 ± 13 | | V V | |
| | | | | | | | | | | | | |
| Output Short Circuit Current | $T_A = 25^\circ\text{C}$ | 10 | 25 | 35 | | 25 | | | 25 | | mA | |
| | $T_{AMIN} \leq T_A \leq T_{AMAX}$ | 10 | | 40 | | | | | | | mA | |
| Common-Mode Rejection Ratio | $T_{AMIN} \leq T_A \leq T_{AMAX}$ $R_S \leq 10\text{ k}\Omega$, $V_{CM} = \pm 12\text{V}$ | | | | 70 | 90 | | 70 | 90 | | dB | |
| | $R_S \leq 50\Omega$, $V_{CM} = \pm 12\text{V}$ | 80 | 95 | | | | | | | | dB | |
| Supply Voltage Rejection Ratio | $T_{AMIN} \leq T_A \leq T_{AMAX}$, $V_S = \pm 20\text{V}$ to $V_S = \pm 5\text{V}$ $R_S \leq 50\Omega$ | 86 | 96 | | | | | | | | dB | |
| | $R_S \leq 10\text{ k}\Omega$ | | | | 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 (Note 6) | $T_A = 25^\circ\text{C}$ | 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 | $T_A = 25^\circ\text{C}$ $V_S = \pm 20\text{V}$ $V_S = \pm 15\text{V}$ | | 80 | 150 | | | | | | | mW mW | |
| | $V_S = \pm 20\text{V}$ $T_A = T_{AMIN}$ $T_A = T_{AMAX}$ | | | | | | | | | | mW mW | |
| | LM741A | | | | | | | | | | | |
| | | | | | | | | | | | | |
| LM741 | $V_S = \pm 15\text{V}$ $T_A = T_{AMIN}$ $T_A = T_{AMAX}$ | | | | | 60 45 | 100 75 | | | | mW mW | |

Note 2: "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.

Electrical Characteristics (Note 5) (Continued)

Note 3: For operation at elevated temperatures, these devices must be derated based on thermal resistance, and T_j max. (listed under "Absolute Maximum Ratings"). $T_j = T_A + (\theta_{JA} P_D)$.

| Thermal Resistance | Cerdip (J) | DIP (N) | HO8 (H) | 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 |

Note 4: For supply voltages less than $\pm 15V$, the absolute maximum input voltage is equal to the supply voltage.

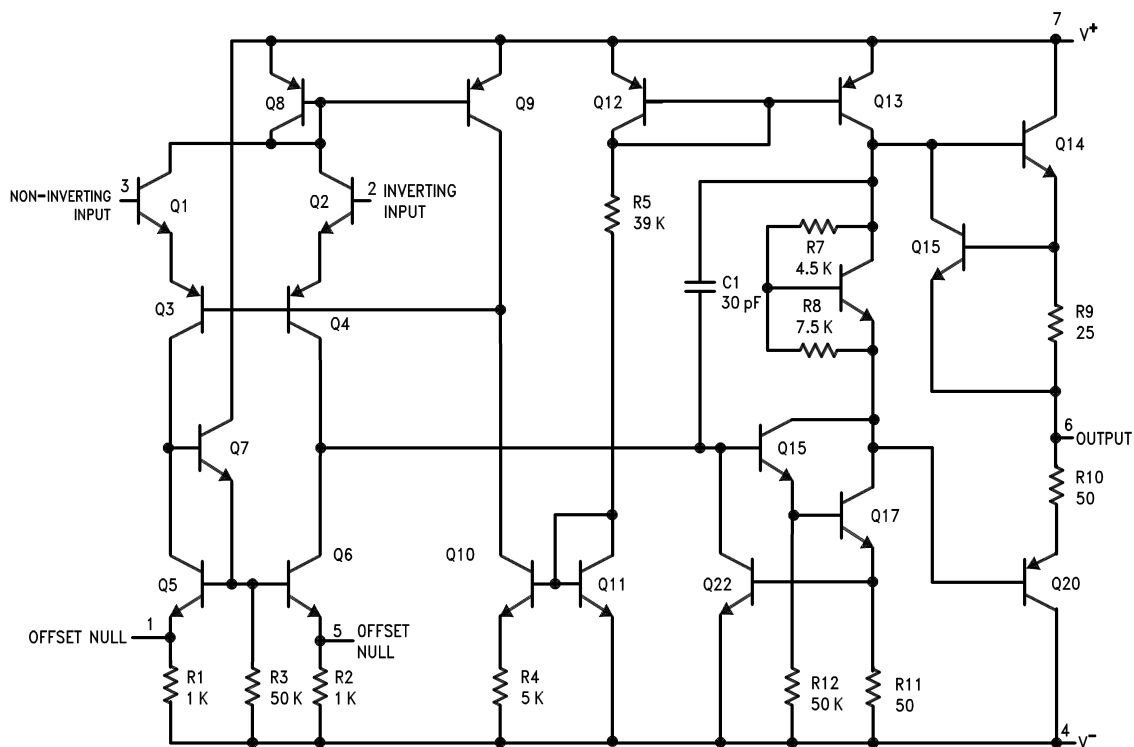
Note 5: Unless otherwise specified, these specifications apply for $V_S = \pm 15V$, $-55^\circ C \leq T_A \leq +125^\circ C$ (LM741/LM741A). For the LM741C/LM741E, these specifications are limited to $0^\circ C \leq T_A \leq +70^\circ C$.

Note 6: Calculated value from: BW (MHz) = $0.35/\text{Rise Time}(\mu s)$.

Note 7: For military specifications see RETS741X for LM741 and RETS741AX for LM741A.

Note 8: Human body model, $1.5\text{ k}\Omega$ in series with 100 pF .

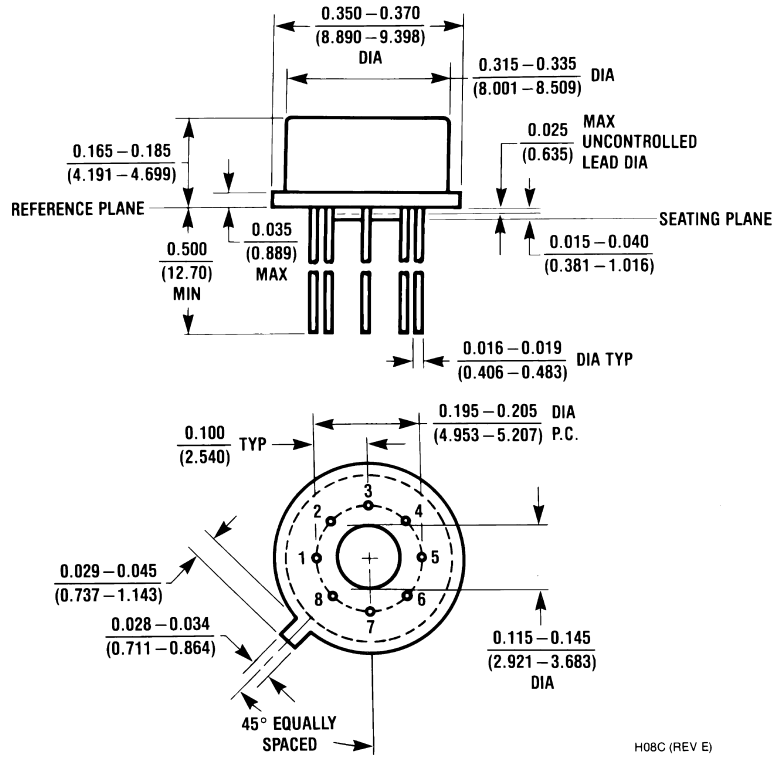
Schematic Diagram



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Physical Dimensions inches (millimeters)

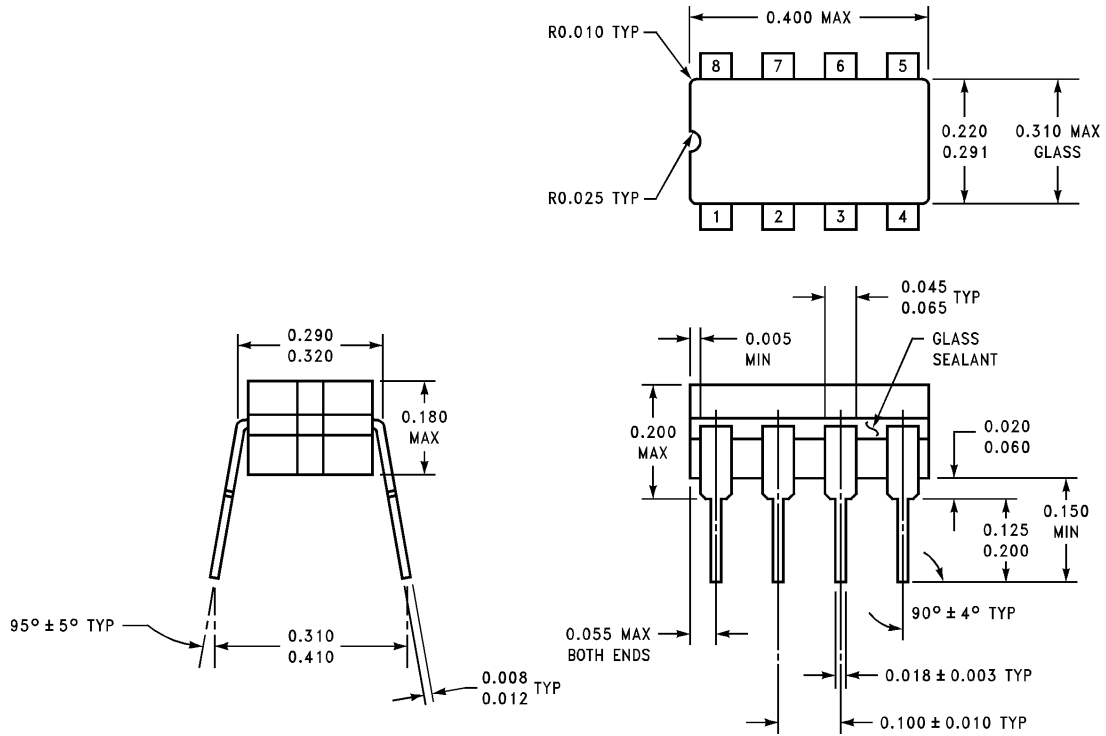
unless otherwise noted



H08C (REV E)

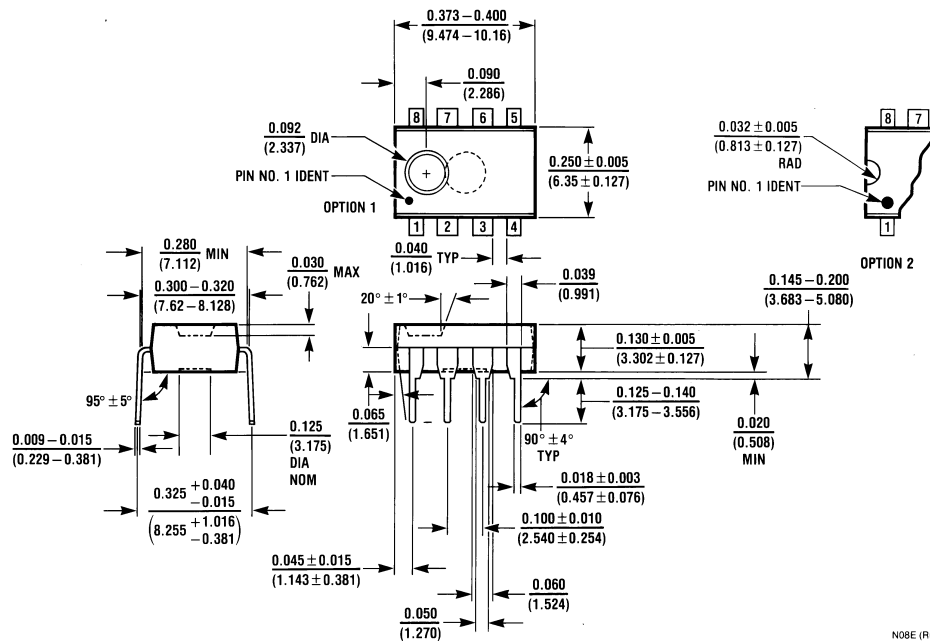
Metal Can Package (H)
Order Number LM741H, LM741H/883, LM741AH/883, LM741AH-MIL or LM741CH
NS Package Number H08C

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



J08A (REV K)

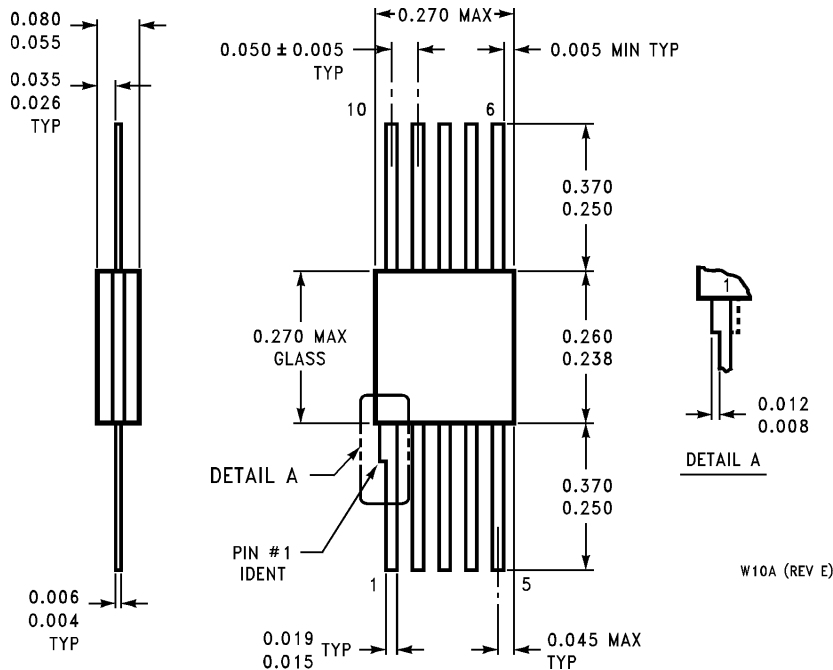
Ceramic Dual-In-Line Package (J)
Order Number LM741J/883
NS Package Number J08A



N08E (REV F)

Dual-In-Line Package (N)
Order Number LM741CN
NS Package Number N08E

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



10-Lead Ceramic Flatpak (W)
Order Number LM741W/883, LM741WG-MPR or LM741WG/883
NS Package Number W10A

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