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
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\(^{(1)(2)(3)}\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LM741A</th>
<th>LM741</th>
<th>LM741C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>±22V</td>
<td>±22V</td>
<td>±18V</td>
</tr>
<tr>
<td>Power Dissipation (^{(4)})</td>
<td>500 mW</td>
<td>500 mW</td>
<td>500 mW</td>
</tr>
<tr>
<td>Differential Input Voltage</td>
<td>±30V</td>
<td>±30V</td>
<td>±30V</td>
</tr>
<tr>
<td>Input Voltage (^{(5)})</td>
<td>±15V</td>
<td>±15V</td>
<td>±15V</td>
</tr>
<tr>
<td>Output Short Circuit Duration</td>
<td>Continuous</td>
<td>Continuous</td>
<td>Continuous</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>−55°C to +125°C</td>
<td>−55°C to +125°C</td>
<td>0°C to +70°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>−65°C to +150°C</td>
<td>−65°C to +150°C</td>
<td>−65°C to +150°C</td>
</tr>
<tr>
<td>Junction Temperature</td>
<td>150°C</td>
<td>150°C</td>
<td>100°C</td>
</tr>
</tbody>
</table>

Soldering Information

<table>
<thead>
<tr>
<th>Package</th>
<th>LM741</th>
<th>LM741A</th>
<th>LM741C</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0008E-Package (10 seconds)</td>
<td>260°C</td>
<td>260°C</td>
<td>260°C</td>
</tr>
<tr>
<td>NAB0008A- or LMC0008C-Package (10 seconds)</td>
<td>300°C</td>
<td>300°C</td>
<td>300°C</td>
</tr>
<tr>
<td>M-Package</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vapor Phase (60 seconds)</td>
<td>215°C</td>
<td>215°C</td>
<td>215°C</td>
</tr>
<tr>
<td>Infrared (15 seconds)</td>
<td>215°C</td>
<td>215°C</td>
<td>215°C</td>
</tr>
<tr>
<td>ESD Tolerance (^{(6)})</td>
<td>400V</td>
<td>400V</td>
<td>400V</td>
</tr>
</tbody>
</table>

(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 \( T_j = T_A + ( \theta_j A P_D ) \).

(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\(^{(1)}\)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>LM741A</th>
<th>LM741</th>
<th>LM741C</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Offset Voltage</td>
<td>( T_A = 25°C )</td>
<td>0.8</td>
<td>3.0</td>
<td>1.0</td>
<td>5.0</td>
</tr>
<tr>
<td></td>
<td>( R_S \leq 10 , \text{kΩ} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( R_S \leq 50 , \text{Ω} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>( T_{\text{AMIN}} \leq T_A \leq T_{\text{AMAX}} )</td>
<td></td>
<td></td>
<td>4.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( R_S \leq 50 , \text{Ω} )</td>
<td></td>
<td></td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( R_S \leq 10 , \text{kΩ} )</td>
<td></td>
<td></td>
<td>7.5</td>
<td></td>
</tr>
<tr>
<td>Average Input Offset Voltage Drift</td>
<td></td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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

(2) Calculated value from: \( \text{BW (MHz)} = 0.35 / \text{Rise Time (μs)} \).
### Electrical Characteristics (continued)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>LM741A</th>
<th></th>
<th></th>
<th>LM741</th>
<th></th>
<th></th>
<th>LM741C</th>
<th></th>
<th></th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM741A</td>
<td>V_s = ±20V</td>
<td></td>
<td></td>
<td></td>
<td>T_A = T_AMIN</td>
<td>165</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>T_A = T_AMAX</td>
<td>135</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>LM741</td>
<td>V_s = ±15V</td>
<td></td>
<td></td>
<td></td>
<td>T_A = T_AMIN</td>
<td>60</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>T_A = T_AMAX</td>
<td>45</td>
<td>75</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thermal Resistance</th>
<th>CDIP (NAB0008A)</th>
<th>PDIP (P0008E)</th>
<th>TO-99 (LMC0008C)</th>
<th>SO-8 (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>θ_j(A) (Junction to Ambient)</td>
<td>100°C/W</td>
<td>100°C/W</td>
<td>170°C/W</td>
<td>195°C/W</td>
</tr>
<tr>
<td>θ_j(C) (Junction to Case)</td>
<td>N/A</td>
<td>N/A</td>
<td>25°C/W</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### SCHEMATIC DIAGRAM

![SCHEMATIC DIAGRAM](image-url)
## REVISION HISTORY

**Changes from Revision B (March 2013) to Revision C**

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changed layout of National Data Sheet to TI format</td>
</tr>
</tbody>
</table>
## Packaging Information

<table>
<thead>
<tr>
<th>Orderable Device</th>
<th>Status</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>Package Qty</th>
<th>Eco Plan</th>
<th>Lead/Ball Finish</th>
<th>MSL Peak Temp</th>
<th>Op Temp (°C)</th>
<th>Device Marking</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>LM741CH</td>
<td>ACTIVE</td>
<td>TO-99</td>
<td>LMC</td>
<td>8</td>
<td>500</td>
<td>TBD</td>
<td>Call TI</td>
<td>Call TI</td>
<td>0 to 70</td>
<td>LM741CH</td>
<td>Samples</td>
</tr>
<tr>
<td>LM741CH/NOPB</td>
<td>ACTIVE</td>
<td>TO-99</td>
<td>LMC</td>
<td>8</td>
<td>500</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>POST-PLATE</td>
<td>Level-1-NA-UNLIM</td>
<td>0 to 70</td>
<td>(LM741CH ~ LM741CH)</td>
<td>Samples</td>
</tr>
<tr>
<td>LM741CN</td>
<td>LIFEBUY</td>
<td>PDIP</td>
<td>P</td>
<td>8</td>
<td>40</td>
<td>TBD</td>
<td>Call TI</td>
<td>Call TI</td>
<td>0 to 70</td>
<td>LM741CN</td>
<td>Samples</td>
</tr>
<tr>
<td>LM741CN/NOPB</td>
<td>ACTIVE</td>
<td>PDIP</td>
<td>P</td>
<td>8</td>
<td>40</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>CU SN</td>
<td>Level-1-NA-UNLIM</td>
<td>0 to 70</td>
<td>LM741CN</td>
<td>Samples</td>
</tr>
<tr>
<td>LM741H</td>
<td>ACTIVE</td>
<td>TO-99</td>
<td>LMC</td>
<td>8</td>
<td>500</td>
<td>TBD</td>
<td>Call TI</td>
<td>Call TI</td>
<td>-55 to 125</td>
<td>(LM741H ~ LM741H)</td>
<td>Samples</td>
</tr>
<tr>
<td>LM741H/NOPB</td>
<td>ACTIVE</td>
<td>TO-99</td>
<td>LMC</td>
<td>8</td>
<td>500</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>POST-PLATE</td>
<td>Level-1-NA-UNLIM</td>
<td>-55 to 125</td>
<td>(LM741H ~ LM741H)</td>
<td>Samples</td>
</tr>
<tr>
<td>LM741J</td>
<td>ACTIVE</td>
<td>CDIP</td>
<td>NAB</td>
<td>8</td>
<td>40</td>
<td>TBD</td>
<td>Call TI</td>
<td>Call TI</td>
<td>-55 to 125</td>
<td>LM741J</td>
<td>Samples</td>
</tr>
<tr>
<td>U5B7741312</td>
<td>ACTIVE</td>
<td>TO-99</td>
<td>LMC</td>
<td>8</td>
<td>500</td>
<td>TBD</td>
<td>Call TI</td>
<td>Call TI</td>
<td>-55 to 125</td>
<td>(LM741H ~ LM741H)</td>
<td>Samples</td>
</tr>
<tr>
<td>U5B7741393</td>
<td>ACTIVE</td>
<td>TO-99</td>
<td>LMC</td>
<td>8</td>
<td>500</td>
<td>TBD</td>
<td>Call TI</td>
<td>Call TI</td>
<td>0 to 70</td>
<td>LM741CH</td>
<td>Samples</td>
</tr>
<tr>
<td>U9T7741393</td>
<td>LIFEBUY</td>
<td>PDIP</td>
<td>P</td>
<td>8</td>
<td>40</td>
<td>TBD</td>
<td>Call TI</td>
<td>Call TI</td>
<td>0 to 70</td>
<td>LM741CN</td>
<td>Samples</td>
</tr>
</tbody>
</table>

(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](http://www.ti.com/productcontent) for the latest availability information and additional product content details.

**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.

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