

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

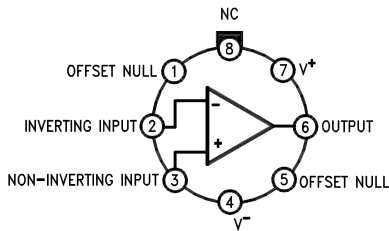


Figure 1. TO-99 Package
See Package Number LMC0008C

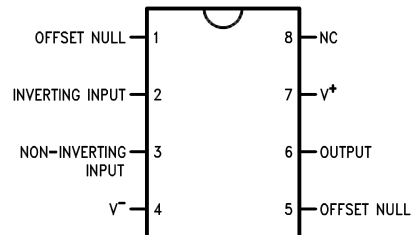


Figure 2. CDIP or PDIP Package
See Package Number NAB0008A, P0008E

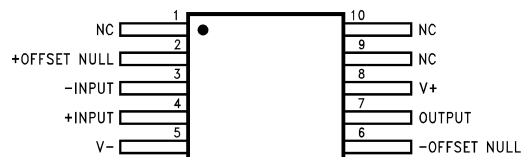


Figure 3. CLGA Package
See Package Number NAD0010A



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Typical Application

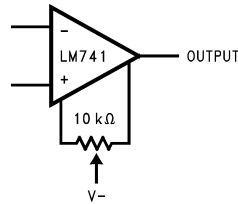


Figure 4. Offset Nulling Circuit



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	$T_A = 25^\circ\text{C}$ $R_S \leq 10\text{ k}\Omega$ $R_S \leq 50\Omega$					1.0	5.0		2.0	6.0	mV
	$T_{AMIN} \leq T_A \leq T_{AMAX}$ $R_S \leq 50\Omega$ $R_S \leq 10\text{ k}\Omega$		0.8	3.0						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	

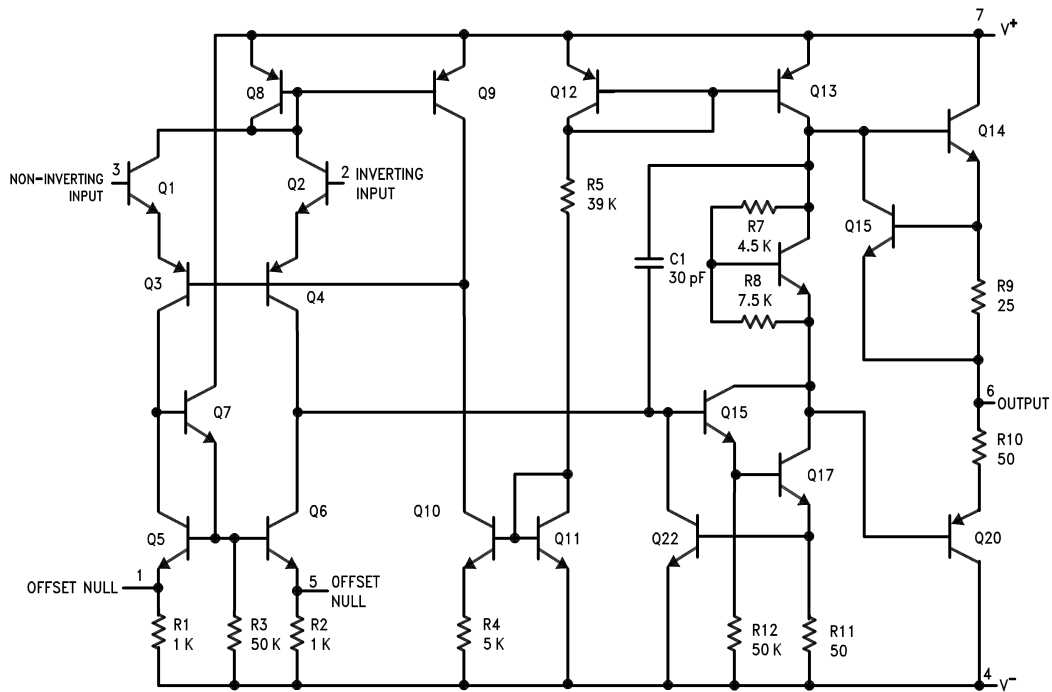
 (2) Calculated value from: BW (MHz) = 0.35/Rise Time (μs).

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
• Changed layout of National Data Sheet to TI format	4

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
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.

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NAB0008A



CONTROLLING DIMENSION IS INCH
VALUES IN [] ARE MILLIMETERS



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.

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