

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

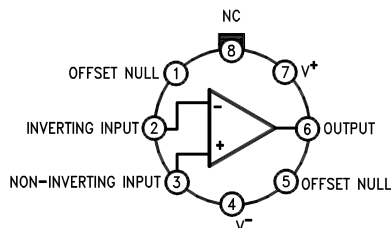
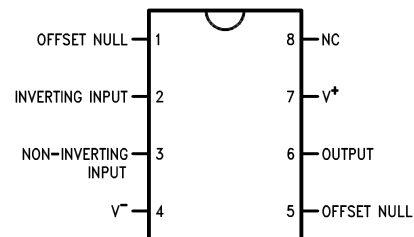
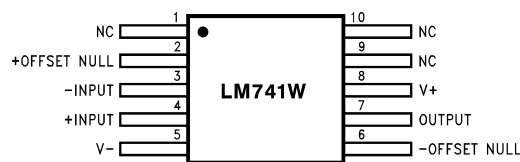
The LM741 series are general purpose operational amplifiers which feature improved performance over industry standards like the LM709. They are direct, plug-in replacements for the 709C, LM201, MC1439 and 748 in most applications.

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.

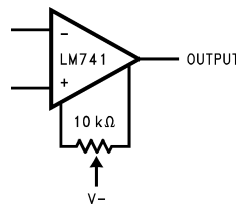
The LM741C is identical to the LM741/LM741A except that the LM741C has their performance guaranteed over a 0°C to +70°C temperature range, instead of –55°C to +125°C.

CONNECTION DIAGRAM

LM741H is available per JM38510/10101


Figure 1. Metal Can Package

Figure 2. Dual-In-Line or S.O. Package

Figure 3. Ceramic Flatpak

TYPICAL APPLICATION


Figure 4. Offset Nulling Circuit


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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)}

	LM741A	LM741	LM741C
Supply Voltage	±22V	±22V	±18V
Power Dissipation ⁽³⁾	500 mW	500 mW	500 mW
Differential Input Voltage	±30V	±30V	±30V
Input Voltage ⁽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 ⁽⁵⁾	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 guarantee specific performance limits.
- (2) For military specifications see RETS741X for LM741 and RETS741AX for LM741A.
- (3) For operation at elevated temperatures, these devices must be derated based on thermal resistance, and T_j max. (listed under "Absolute Maximum Ratings"). $T_j = T_A + (\theta_{JA} P_D)$.
- (4) For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.
- (5) Human body model, 1.5 kΩ in series with 100 pF.

Electrical Characteristics⁽¹⁾

Parameter	Conditions	LM741A			LM741			LM741C			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	$T_A = 25^\circ\text{C}$ $R_S \leq 10\text{ k}\Omega$					1.0	5.0		2.0	6.0	mV
	$R_S \leq 50\Omega$		0.8	3.0							mV
	$T_{AMIN} \leq T_A \leq T_{AMAX}$ $R_S \leq 50\Omega$			4.0							mV
	$R_S \leq 10\text{ k}\Omega$						6.0			7.5	mV
Average Input Offset Voltage Drift				15							μV/°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							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		MΩ
	$T_{AMIN} \leq T_A \leq T_{AMAX}$, $V_S = \pm 20\text{V}$	0.5									MΩ

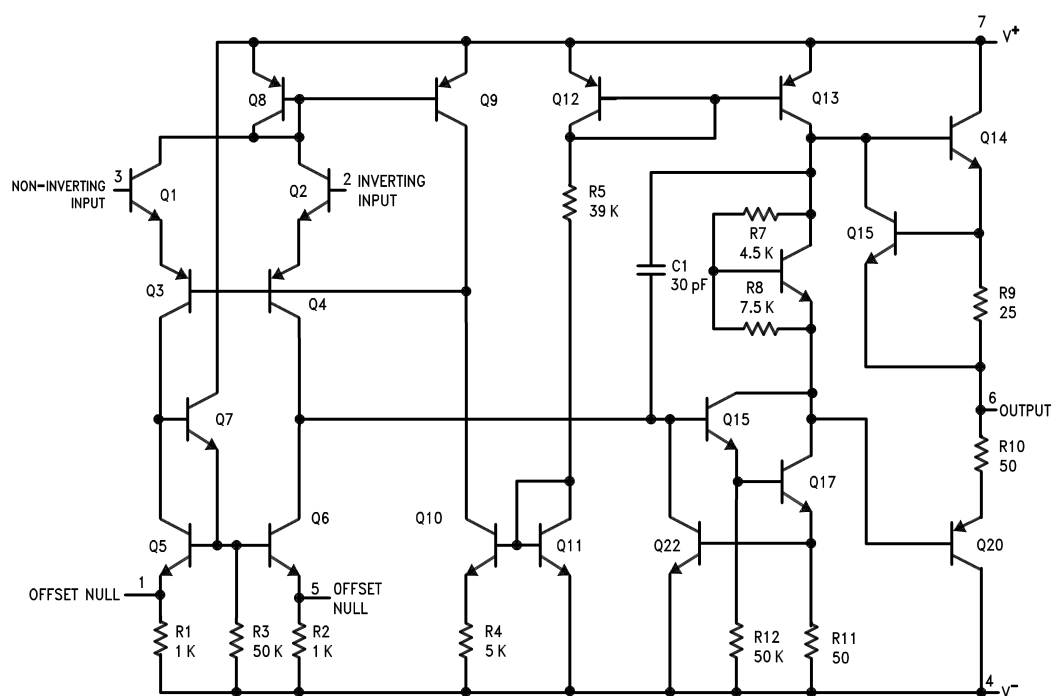
- (1) Unless otherwise specified, these specifications apply for $V_S = \pm 15\text{V}$, $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$ (LM741/LM741A). For the LM741C/LM741E, these specifications are limited to $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$.

Electrical Characteristics⁽¹⁾ (continued)

Parameter	Conditions	LM741A			LM741			LM741C			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Voltage Range	$T_A = 25^\circ\text{C}$							± 12	± 13		V
	$T_{\text{AMIN}} \leq T_A \leq T_{\text{AMAX}}$				± 12	± 13					V
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
	$T_{\text{AMIN}} \leq T_A \leq T_{\text{AMAX}}$, $R_L \geq 2\text{ k}\Omega$, $V_S = \pm 20\text{V}$, $V_O = \pm 15\text{V}$ $V_S = \pm 15\text{V}$, $V_O = \pm 10\text{V}$	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
	$T_{\text{AMIN}} \leq T_A \leq T_{\text{AMAX}}$	10		40							mA
Common-Mode Rejection Ratio	$T_{\text{AMIN}} \leq T_A \leq T_{\text{AMAX}}$ $R_S \leq 10\text{ k}\Omega$, $V_{\text{CM}} = \pm 12\text{V}$ $R_S \leq 50\Omega$, $V_{\text{CM}} = \pm 12\text{V}$	80	95		70	90		70	90		dB dB
Supply Voltage Rejection Ratio	$T_{\text{AMIN}} \leq T_A \leq T_{\text{AMAX}}$, $V_S = \pm 20\text{V}$ 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 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	$T_A = 25^\circ\text{C}$ $V_S = \pm 20\text{V}$ $V_S = \pm 15\text{V}$		80	150							mW mW
	$V_S = \pm 20\text{V}$										
	$T_A = T_{\text{AMIN}}$			165							mW
	$T_A = T_{\text{AMAX}}$			135							mW
	$V_S = \pm 15\text{V}$										
	$T_A = T_{\text{AMIN}}$ $T_A = T_{\text{AMAX}}$				60 45	100 75					mW mW

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

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

SCHEMATIC DIAGRAM

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	POST-PLATE	Level-1-NA-UNLIM	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	SNPB	Level-1-NA-UNLIM	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	POST-PLATE	Level-1-NA-UNLIM	-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	Level-1-NA-UNLIM	-55 to 125	LM741J	Samples
U5B7741312	ACTIVE	TO-99	LMC	8	500	TBD	POST-PLATE	Level-1-NA-UNLIM	-55 to 125	LM741H	Samples
U5B7741393	ACTIVE	TO-99	LMC	8	500	TBD	POST-PLATE	Level-1-NA-UNLIM	0 to 70	LM741CH	Samples
U9T7741393	ACTIVE	PDIP	P	8	40	TBD	SNPB	Level-1-NA-UNLIM	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)

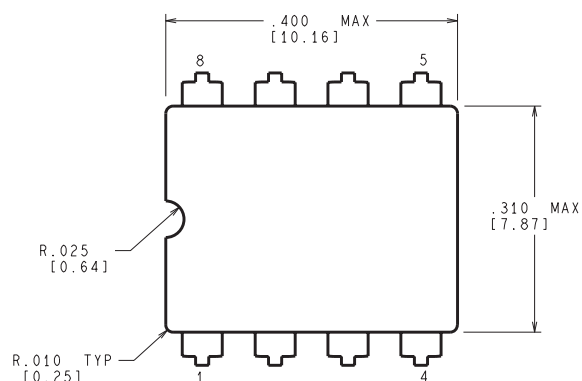
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

⁽⁴⁾ Only one of markings shown within the brackets will appear on the physical device.

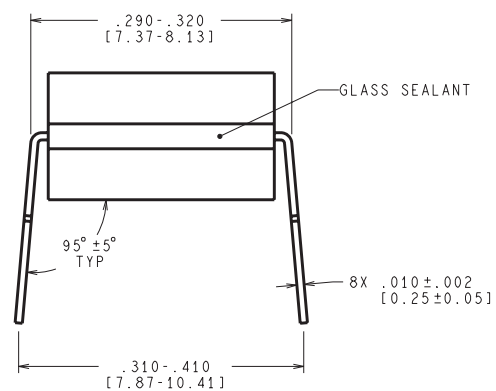
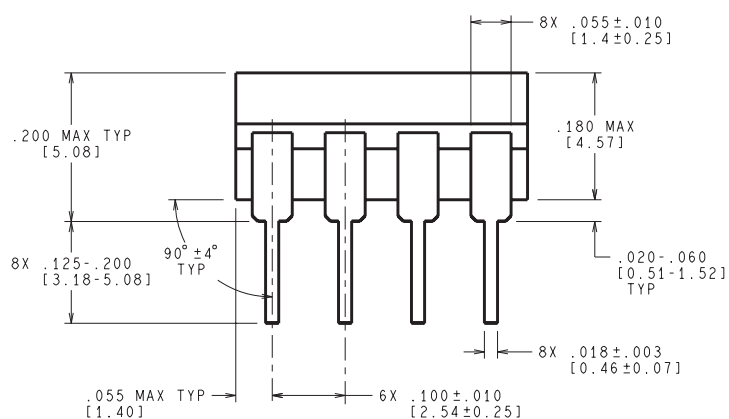
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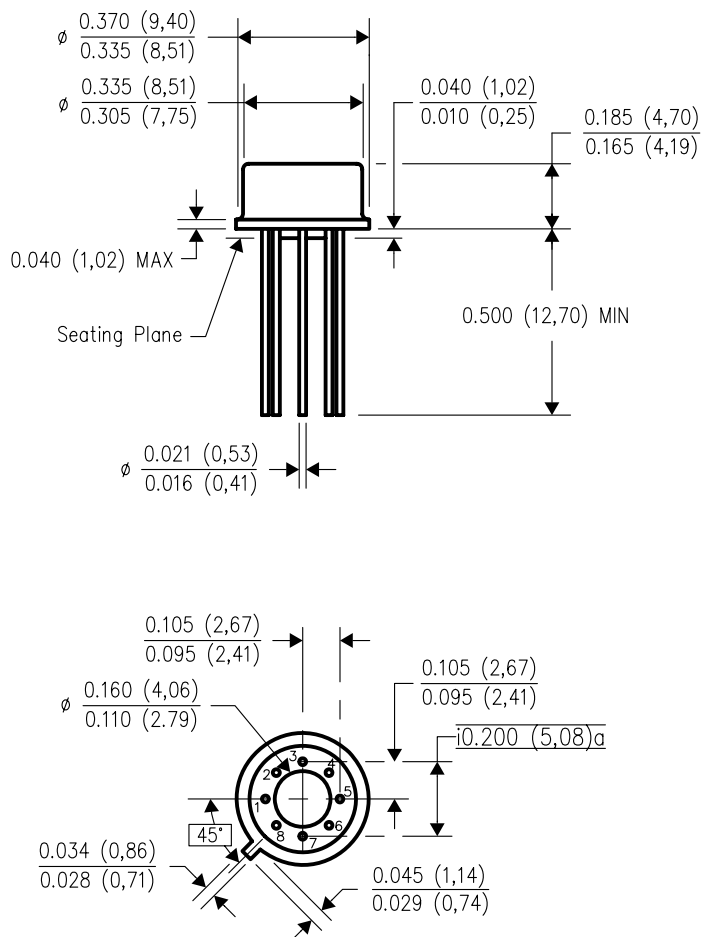
CONTROLLING DIMENSION IS INCH
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J08A (Rev M)

LMC (O-MBCY-W8)

METAL CYLINDRICAL PACKAGE



4202483/B 09/07

- NOTES:
- All linear dimensions are in inches (millimeters).
 - This drawing is subject to change without notice.
 - Leads in true position within 0.010 (0,25) R @ MMC at seating plane.
 - Pin numbers shown for reference only. Numbers may not be marked on package.
 - Falls within JEDEC MO-002/T0-99.

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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