

LM741 Operational Amplifier

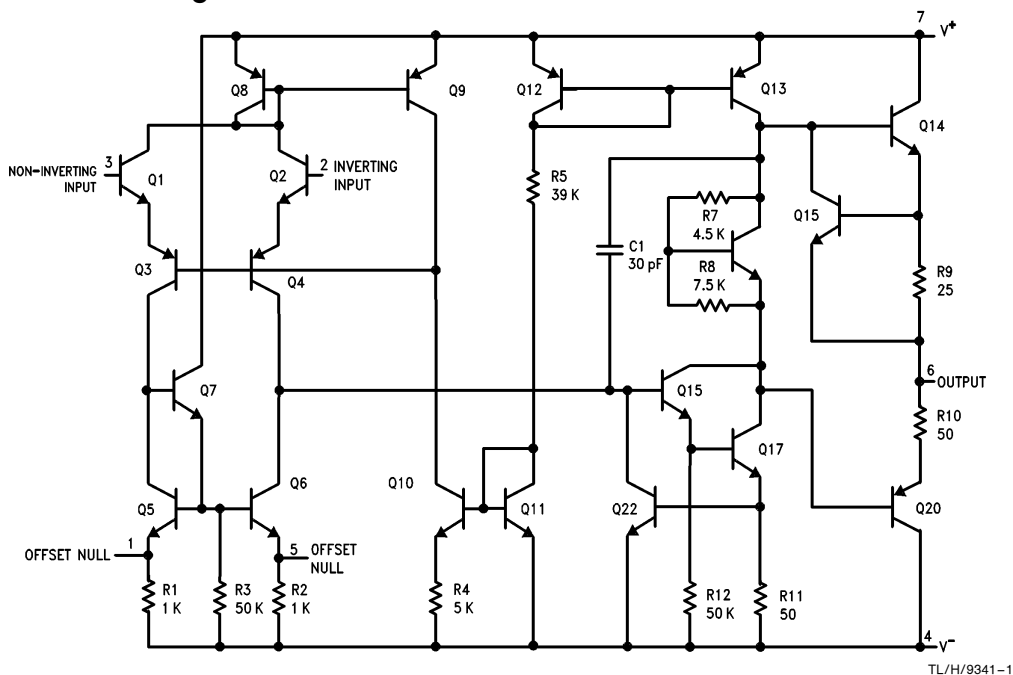
General Description

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

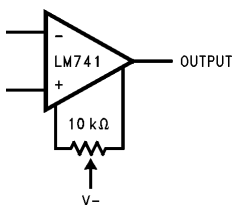
output, no latch-up when the common mode range is exceeded, as well as freedom from oscillations.

The LM741C/LM741E are identical to the LM741/LM741A except that the LM741C/LM741E have their performance guaranteed over a 0°C to +70°C temperature range, instead of -55°C to +125°C.

Schematic Diagram



Offset Nulling Circuit



Absolute Maximum Ratings

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

(Note 5)

	LM741A	LM741E	LM741	LM741C
Supply Voltage	$\pm 22\text{V}$	$\pm 22\text{V}$	$\pm 22\text{V}$	$\pm 18\text{V}$
Power Dissipation (Note 1)	500 mW	500 mW	500 mW	500 mW
Differential Input Voltage	$\pm 30\text{V}$	$\pm 30\text{V}$	$\pm 30\text{V}$	$\pm 30\text{V}$
Input Voltage (Note 2)	$\pm 15\text{V}$	$\pm 15\text{V}$	$\pm 15\text{V}$	$\pm 15\text{V}$
Output Short Circuit Duration	Continuous	Continuous	Continuous	Continuous
Operating Temperature Range	-55°C to $+125^{\circ}\text{C}$	0°C to $+70^{\circ}\text{C}$	-55°C to $+125^{\circ}\text{C}$	0°C to $+70^{\circ}\text{C}$
Storage Temperature Range	-65°C to $+150^{\circ}\text{C}$	-65°C to $+150^{\circ}\text{C}$	-65°C to $+150^{\circ}\text{C}$	-65°C to $+150^{\circ}\text{C}$
Junction Temperature	150°C	100°C	150°C	100°C
Soldering Information				
N-Package (10 seconds)	260°C	260°C	260°C	260°C
J- or H-Package (10 seconds)	300°C	300°C	300°C	300°C
M-Package				
Vapor Phase (60 seconds)	215°C	215°C	215°C	215°C
Infrared (15 seconds)	215°C	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 6)	400V	400V	400V	400V
------------------------	------	------	------	------

Electrical Characteristics (Note 3)

Parameter	Conditions	LM741A/LM741E			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 mV
	$T_{\text{AMIN}} \leq T_A \leq T_{\text{AMAX}}$ $R_S \leq 50\Omega$ $R_S \leq 10\text{ k}\Omega$			4.0			6.0			7.5	mV 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
	$T_{\text{AMIN}} \leq T_A \leq T_{\text{AMAX}}$			70		85	500			300	nA
Average Input Offset Current Drift				0.5							nA/ $^{\circ}\text{C}$
Input Bias Current	$T_A = 25^{\circ}\text{C}$		30	80		80	500		80	500	nA
	$T_{\text{AMIN}} \leq T_A \leq T_{\text{AMAX}}$			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
	$T_{\text{AMIN}} \leq T_A \leq T_{\text{AMAX}}$, $V_S = \pm 20\text{V}$	0.5									M Ω
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

Electrical Characteristics (Note 3) (Continued)

Parameter	Conditions	LM741A/LM741E			LM741			LM741C			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Output Voltage Swing	$V_S = \pm 20V$ $R_L \geq 10\text{ k}\Omega$ $R_L \geq 2\text{ k}\Omega$	± 16 ± 15									V V
	$V_S = \pm 15V$ $R_L \geq 10\text{ k}\Omega$ $R_L \geq 2\text{ k}\Omega$				± 12 ± 10	± 14 ± 13		± 12 ± 10	± 14 ± 13		V V
Output Short Circuit Current	$T_A = 25^\circ\text{C}$ $T_{\text{AMIN}} \leq T_A \leq T_{\text{AMAX}}$	10 10	25	35 40		25			25		mA mA
Common-Mode Rejection Ratio	$T_{\text{AMIN}} \leq T_A \leq T_{\text{AMAX}}$ $R_S \leq 10\text{ k}\Omega$, $V_{\text{CM}} = \pm 12V$ $R_S \leq 50\Omega$, $V_{\text{CM}} = \pm 12V$	80	95		70	90		70	90		dB dB
Supply Voltage Rejection Ratio	$T_{\text{AMIN}} \leq T_A \leq T_{\text{AMAX}}$, $V_S = \pm 20V$ to $V_S = \pm 5V$ $R_S \leq 50\Omega$ $R_S \leq 10\text{ k}\Omega$	86	96		77	96		77	96		dB dB
Transient Response Rise Time Overshoot	$T_A = 25^\circ\text{C}$, Unity Gain		0.25 6.0	0.8 20		0.3 5			0.3 5		μs %
Bandwidth (Note 4)	$T_A = 25^\circ\text{C}$	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	$T_A = 25^\circ\text{C}$ $V_S = \pm 20V$ $V_S = \pm 15V$		80	150		50	85		50	85	mW mW
LM741A	$V_S = \pm 20V$ $T_A = T_{\text{AMIN}}$ $T_A = T_{\text{AMAX}}$			165 135							mW mW
LM741E	$V_S = \pm 20V$ $T_A = T_{\text{AMIN}}$ $T_A = T_{\text{AMAX}}$			150 150							mW mW
LM741	$V_S = \pm 15V$ $T_A = T_{\text{AMIN}}$ $T_A = T_{\text{AMAX}}$					60 45	100 75				mW mW

Note 1: 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 2: For supply voltages less than $\pm 15V$, the absolute maximum input voltage is equal to the supply voltage.

Note 3: Unless otherwise specified, these specifications apply for $V_S = \pm 15V$, $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$ (LM741/LM741A). For the LM741C/LM741E, these specifications are limited to $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$.

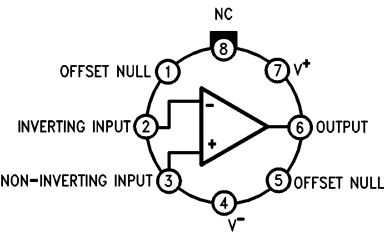
Note 4: Calculated value from: BW (MHz) = 0.35/Rise Time(μs).

Note 5: For military specifications see RETS741X for LM741 and RETS741AX for LM741A.

Note 6: Human body model, 1.5 k Ω in series with 100 pF.

Connection Diagrams

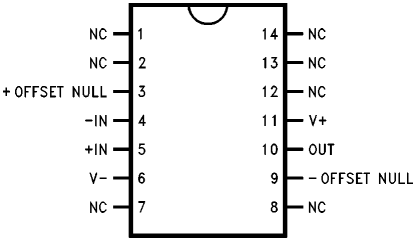
Metal Can Package



TL/H/9341-2

Order Number LM741H, LM741H/883*,
LM741AH/883 or LM741CH
See NS Package Number H08C

Ceramic Dual-In-Line Package



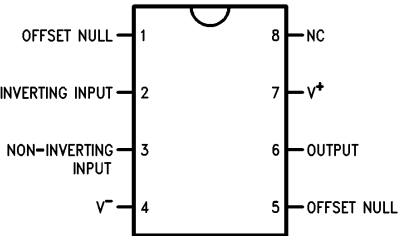
TL/H/9341-5

Order Number LM741J-14/883*, LM741AJ-14/883**
See NS Package Number J14A

*also available per JM38510/10101

**also available per JM38510/10102

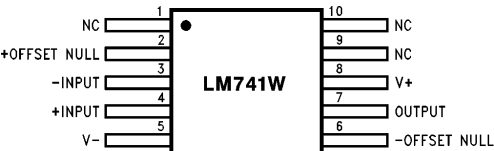
Dual-In-Line or S.O. Package



TL/H/9341-3

Order Number LM741J, LM741J/883,
LM741CM, LM741CN or LM741EN
See NS Package Number J08A, M08A or N08E

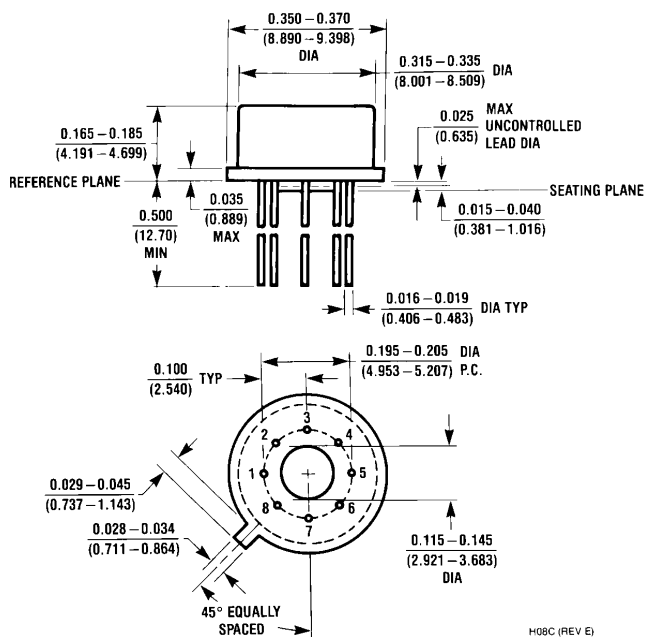
Ceramic Flatpak



TL/H/9341-6

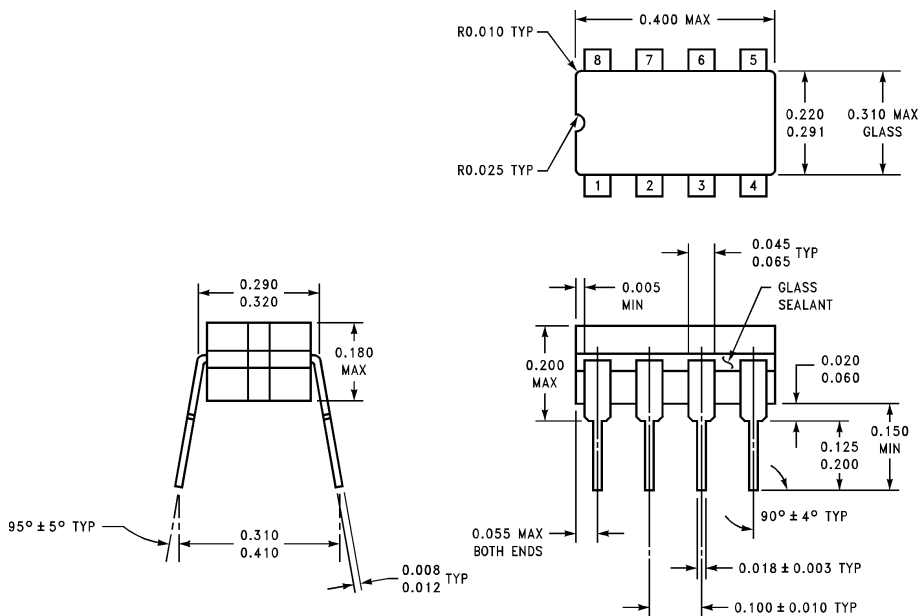
Order Number LM741W/883
See NS Package Number W10A

*LM741H is available per JM38510/10101



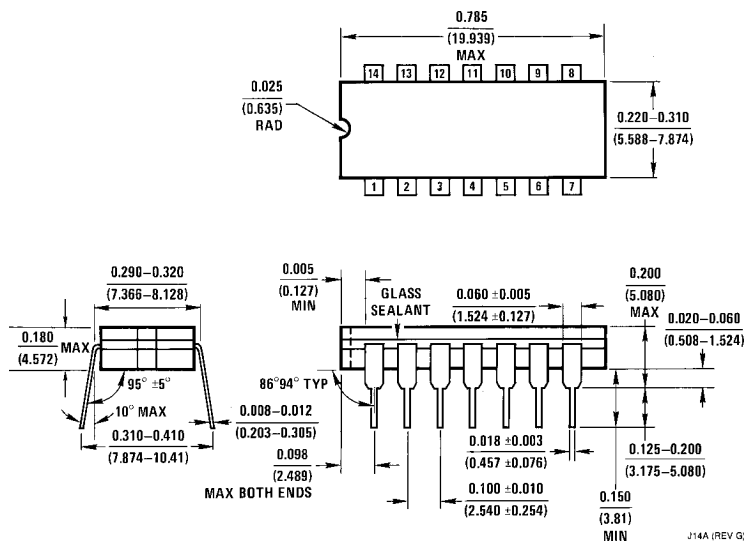
Metal Can Package (H)
Order Number LM741H, LM741H/883, LM741AH/883, LM741CH or LM741EH
NS Package Number H08C

Physical Dimensions inches (millimeters) (Continued)



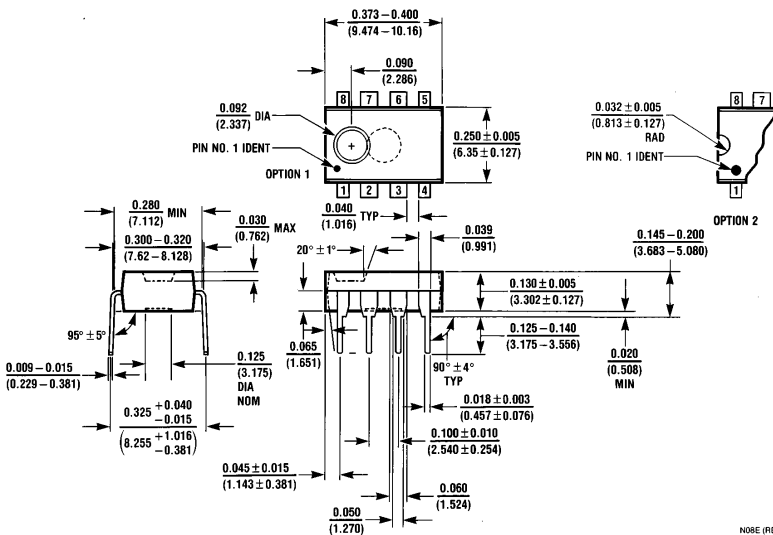
J08A (REV K)

Ceramic Dual-In-Line Package (J)
Order Number LM741CJ or LM741J/883
NS Package Number J08A



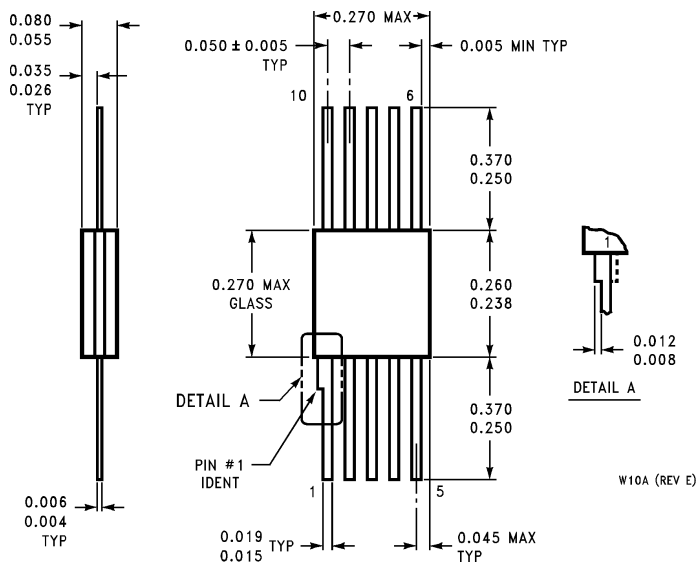
J14A (REV G)

Ceramic Dual-In-Line Package (J)
Order Number LM741J-14/883 or LM741AJ-14/883
NS Package Number J14A



7

Physical Dimensions inches (millimeters) (Continued)



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

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



National Semiconductor Corporation
 1111 West Bardin Road
 Arlington, TX 76017
 Tel: 1(800) 272-9959
 Fax: 1(800) 737-7018

National Semiconductor Europe

Fax: (+49) 0-180-530 85 86
 Email: cnjwge@tevm2.nsc.com
 Deutsch Tel: (+49) 0-180-530 85 85
 English Tel: (+49) 0-180-532 78 32
 Français Tel: (+49) 0-180-532 93 58
 Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.

13th Floor, Straight Block,
 Ocean Centre, 5 Canton Rd.
 Tsimshatsui, Kowloon
 Hong Kong
 Tel: (852) 2737-1600
 Fax: (852) 2736-9960

National Semiconductor Japan Ltd.

Tel: 81-043-299-2309
 Fax: 81-043-299-2408