LM741 Operational Amplifier

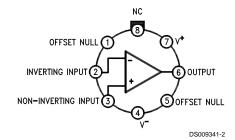
General Description

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.

Connection Diagrams

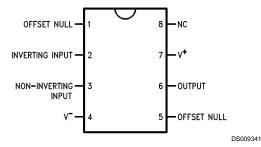
Metal Can Package



Note 1: LM741H is available per JM38510/10101

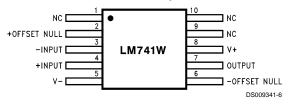
Order Number LM741H, LM741H/883 (Note 1), LM741AH/883 or LM741CH See NS Package Number H08C

Dual-In-Line or S.O. Package



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

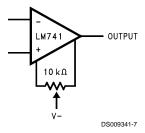
Ceramic Flatpak



Order Number LM741W/883 See NS Package Number W10A

Typical Application

Offset Nulling Circuit



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	Тур	Max	Min	Тур	Max	Min	Тур	Max	
Input Offset Voltage	T _A = 25°C										
	$R_S \le 10 \text{ k}\Omega$					1.0	5.0		2.0	6.0	mV
	$R_S \le 50\Omega$		0.8	3.0							mV
	$T_{AMIN} \le T_A \le T_{AMAX}$										
	$R_S \le 50\Omega$			4.0							mV
	$R_{S} \leq 10 \text{ k}\Omega$						6.0			7.5	mV
Average Input Offset				15							μV/°C
Voltage Drift											
Input Offset Voltage	$T_A = 25^{\circ}C, V_S = \pm 20V$	±10				±15			±15		mV
Adjustment Range											
Input Offset Current	$T_A = 25^{\circ}C$		3.0	30		20	200		20	200	nA
	$T_{AMIN} \le T_A \le T_{AMAX}$			70		85	500			300	nA
Average Input Offset				0.5							nA/°C
Current Drift											
Input Bias Current	$T_A = 25^{\circ}C$		30	80		80	500		80	500	nA
	$T_{AMIN} \le T_A \le T_{AMAX}$			0.210			1.5			0.8	μA
Input Resistance	$T_A = 25^{\circ}C, V_S = \pm 20V$	1.0	6.0		0.3	2.0		0.3	2.0		MΩ
	$T_{AMIN} \le T_A \le T_{AMAX}$	0.5									MΩ
	$V_S = \pm 20V$										
Input Voltage Range	T _A = 25°C							±12	±13		V
	$T_{AMIN} \le T_A \le T_{AMAX}$				±12	±13					V

www.national.com

Electrical Characteristics (Note 5) (Continued)

Parameter	Conditions	LM741A		LM741		LM741C		Units			
		Min	Тур	Max	Min	Тур	Max	Min	Тур	Max	
Large Signal Voltage Gain	$T_A = 25^{\circ}C, R_L \ge 2 \text{ k}\Omega$										
	$V_S = \pm 20V, V_O = \pm 15V$	50									V/mV
	$V_S = \pm 15V, V_O = \pm 10V$				50	200		20	200		V/mV
	$T_{AMIN} \le T_A \le T_{AMAX}$										
	$R_L \ge 2 k\Omega$,										
	$V_S = \pm 20V, V_O = \pm 15V$	32									V/mV
	$V_S = \pm 15V, V_O = \pm 10V$				25			15			V/mV
	$V_{S} = \pm 5V, V_{O} = \pm 2V$	10									V/mV
Output Voltage Swing	V _S = ±20V										
	$R_L \ge 10 \text{ k}\Omega$	±16									V
	$R_L \ge 2 k\Omega$	±15									V
	V _S = ±15V										
	$R_L \ge 10 \text{ k}\Omega$				±12	±14		±12	±14		V
	$R_L \ge 2 k\Omega$				±10	±13		±10	±13		V
Output Short Circuit	T _A = 25°C	10	25	35		25			25		mA
Current	$T_{AMIN} \le T_A \le T_{AMAX}$	10		40							mA
Common-Mode	$T_{AMIN} \le T_A \le T_{AMAX}$										
Rejection Ratio	$R_S \le 10 \text{ k}\Omega, V_{CM} = \pm 12V$				70	90		70	90		dB
	$R_S \le 50\Omega$, $V_{CM} = \pm 12V$	80	95								dB
Supply Voltage Rejection	$T_{AMIN} \le T_A \le T_{AMAX}$										
Ratio	$V_S = \pm 20V$ to $V_S = \pm 5V$										
	$R_S \le 50\Omega$	86	96								dB
	$R_S \le 10 \text{ k}\Omega$				77	96		77	96		dB
Transient Response	T _A = 25°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°C	0.437	1.5								MHz
Slew Rate	T _A = 25°C, Unity Gain	0.3	0.7			0.5			0.5		V/µs
Supply Current	$T_A = 25^{\circ}C$					1.7	2.8		1.7	2.8	mA
Power Consumption	T _A = 25°C										
	$V_S = \pm 20V$		80	150							mW
	$V_S = \pm 15V$					50	85		50	85	mW
LM741A	V _S = ±20V										
	$T_A = T_{AMIN}$			165							mW
	$T_A = T_{AMAX}$			135							mW
LM741	V _S = ±15V										
	$T_A = T_{AMIN}$					60	100				mW
	$T_A = T_{AMAX}$					45	75				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 ±15V, the absolute maximum input voltage is equal to the supply voltage.

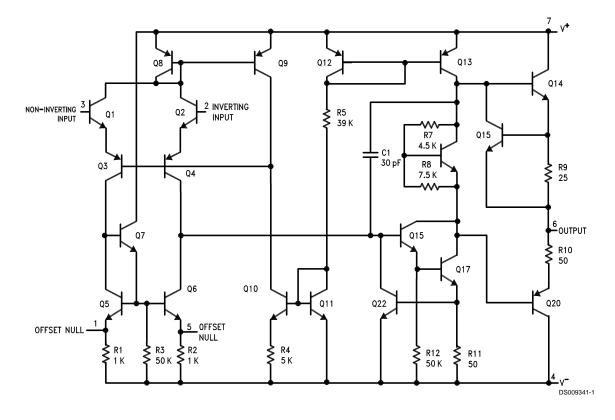
Note 5: Unless otherwise specified, these specifications apply for $V_S = \pm 15V$, $-55^{\circ}C \le T_A \le +125^{\circ}C$ (LM741/LM741A). For the LM741C/LM741E, these specifications are limited to $0^{\circ}C \le T_A \le +70^{\circ}C$.

Note 6: Calculated value from: BW (MHz) = 0.35/Rise Time(µs).

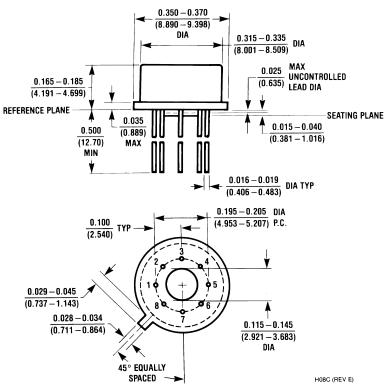
Note 7: For military specifications see RETS741X for LM741 and RETS741AX for LM741A.

Note 8: Human body model, 1.5 k Ω in series with 100 pF.

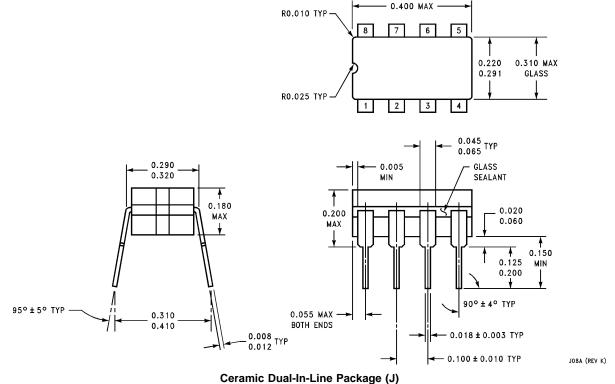
Schematic Diagram



Physical Dimensions inches (millimeters) unless otherwise noted

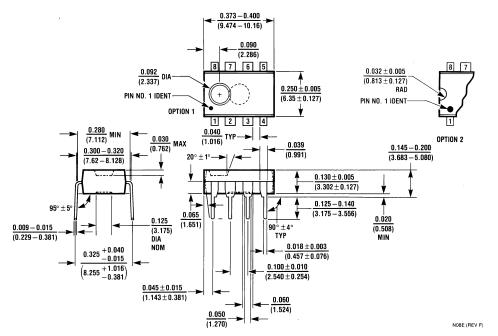


Metal Can Package (H)
Order Number LM741H, LM741H/883, LM741AH/883, LM741AH-MIL or LM741CH
NS Package Number H08C

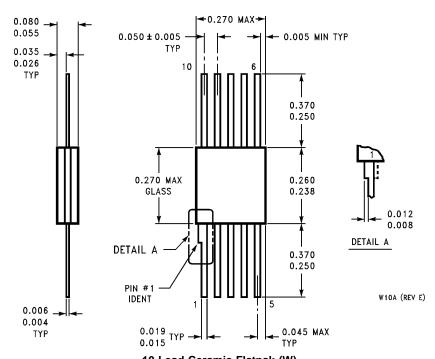


Order Number LM741J/883 NS Package Number J08A

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



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



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

www.national.com

Notes

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 AND GENERAL COUNSEL 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

Americas Tel: 1-800-272-9959 Fax: 1-800-737-7018 Email: support@nsc.com

www.national.com

National Semiconductor Europe

Fax: +49 (0) 180-530 85 86 Email: europe.support@nsc.com Deutsch Tel: +49 (0) 69 9508 6208 English Tel: +44 (0) 870 24 0 2171

Français Tel: +33 (0) 1 41 91 8790

National Semiconductor Asia Pacific Customer Response Group Tel: 65-2544466

Fax: 65-2504466 Email: ap.support@nsc.com **National Semiconductor** Tel: 81-3-5639-7560

Fax: 81-3-5639-7507