

LM741/LM741A/LM741C/LM741E Operational Amplifier

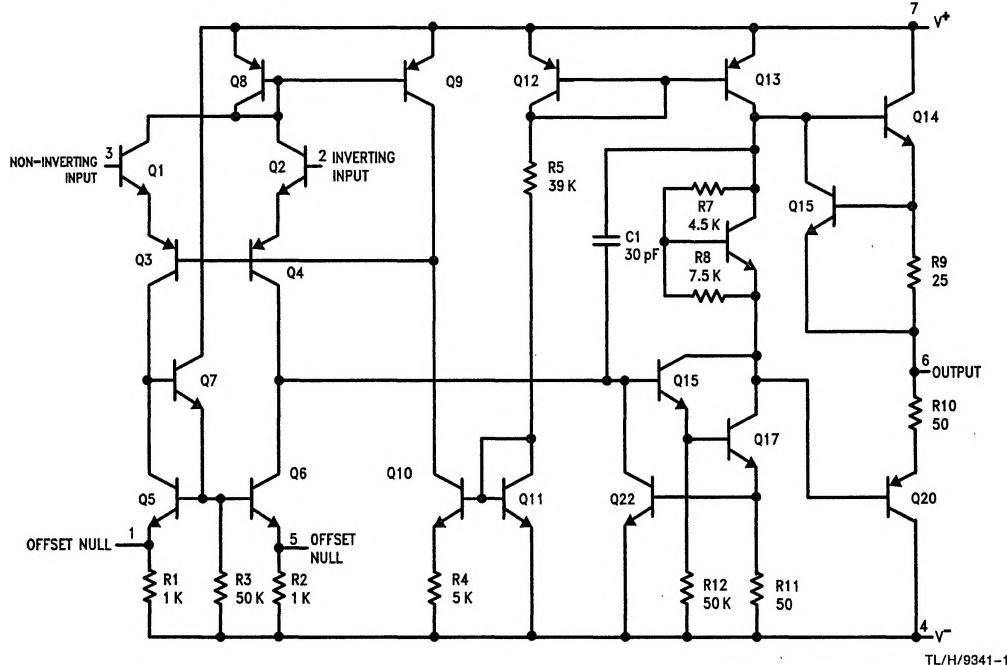
General Description

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

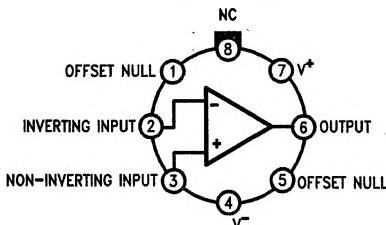
output, no latch-up when the common mode range is exceeded, as well as freedom from oscillations.

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 and Connection Diagrams (Top Views)

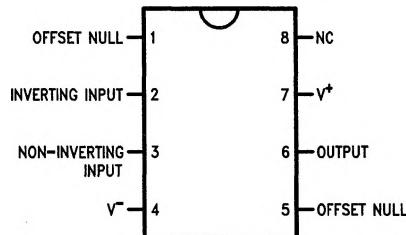


Metal Can Package



Order Number LM741H, LM741AH,
LM741CH or LM741EH
See NS Package Number H08C

Dual-In-Line or S.O. Package



Order Number LM741J, LM741AJ, LM741CJ,
LM741CM, LM741CN or LM741EN
See NS Package Number J08A, M08A or N08E

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

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	$T_A = 25^{\circ}C$ $R_S \leq 10\text{ k}\Omega$ $R_S \leq 50\Omega$		0.8	3.0		1.0	5.0		2.0	6.0	mV mV
	$T_{AMIN} \leq T_A \leq T_{AMAX}$ $R_S \leq 50\Omega$ $R_S \leq 10\text{ k}\Omega$			4.0			6.0			7.5	mV mV
Average Input Offset Voltage Drift				15							$\mu V/^{\circ}C$
Input Offset Voltage Adjustment Range	$T_A = 25^{\circ}C, V_S = \pm 20V$	± 10			± 15			± 15			mV
Input Offset Current	$T_A = 25^{\circ}C$		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							$nA/^{\circ}C$
Input Bias Current	$T_A = 25^{\circ}C$		30	80		80	500		80	500	nA
	$T_{AMIN} \leq T_A \leq T_{AMAX}$			0.210			1.5			0.8	μA
Input Resistance	$T_A = 25^{\circ}C, V_S = \pm 20V$	1.0	6.0		0.3	2.0		0.3	2.0		$M\Omega$
	$T_{AMIN} \leq T_A \leq T_{AMAX}, V_S = \pm 20V$	0.5									$M\Omega$
Input Voltage Range	$T_A = 25^{\circ}C$							± 12	± 13		V
	$T_{AMIN} \leq T_A \leq T_{AMAX}$				± 12	± 13					V
Large Signal Voltage Gain	$T_A = 25^{\circ}C, R_L \geq 2\text{ k}\Omega$ $V_S = \pm 20V, V_O = \pm 15V$ $V_S = \pm 15V, V_O = \pm 10V$	50			50	200		20	200		V/mV V/mV
	$T_{AMIN} \leq T_A \leq T_{AMAX}, R_L \geq 2\text{ k}\Omega$ $V_S = \pm 20V, V_O = \pm 15V$ $V_S = \pm 15V, V_O = \pm 10V$ $V_S = \pm 5V, V_O = \pm 2V$	32			25			15			V/mV V/mV V/mV
		10									

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 = ±20V R _L ≥ 10 kΩ R _L ≥ 2 kΩ	±16 ±15									V V
	V _S = ±15V R _L ≥ 10 kΩ R _L ≥ 2 kΩ				±12 ±10	±14 ±13		±12 ±10	±14 ±13		V V
Output Short Circuit Current	T _A = 25°C T _{AMIN} ≤ T _A ≤ T _{AMAX}	10 10	25	35 40		25			25		mA mA
Common-Mode Rejection Ratio	T _{AMIN} ≤ T _A ≤ T _{AMAX} R _S ≤ 10 kΩ, V _{CM} = ±12V R _S ≤ 50Ω, V _{CM} = ±12V				70	90		70	90		dB dB
Supply Voltage Rejection Ratio	T _{AMIN} ≤ T _A ≤ T _{AMAX} , V _S = ±20V to V _S = ±5V R _S ≤ 50Ω R _S ≤ 10 kΩ		86	96		77	96		77	96	dB dB
Transient Response Rise Time Overshoot	T _A = 25°C, Unity Gain			0.25 6.0	0.8 20		0.3 5		0.3 5		μs %
Bandwidth (Note 4)	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°C					1.7	2.8		1.7	2.8	mA
Power Consumption	T _A = 25°C V _S = ±20V V _S = ±15V		80	150		50	85		50	85	mW mW
LM741A	V _S = ±20V T _A = T _{AMIN} T _A = T _{AMAX}			165 135							mW mW
LM741E	V _S = ±20V T _A = T _{AMIN} T _A = T _{AMAX}			150 150							mW mW
LM741	V _S = ±15V T _A = T _{AMIN} T _A = T _{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 + (θ_{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 ±15V, the absolute maximum input voltage is equal to the supply voltage.

Note 3: Unless otherwise specified, these specifications apply for V_S = ±15V, -55°C ≤ T_A ≤ +125°C (LM741/LM741A). For the LM741C/LM741E, these specifications are limited to 0°C ≤ T_A ≤ +70°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 kΩ in series with 100 pF.