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## LM741 Operational Amplifier

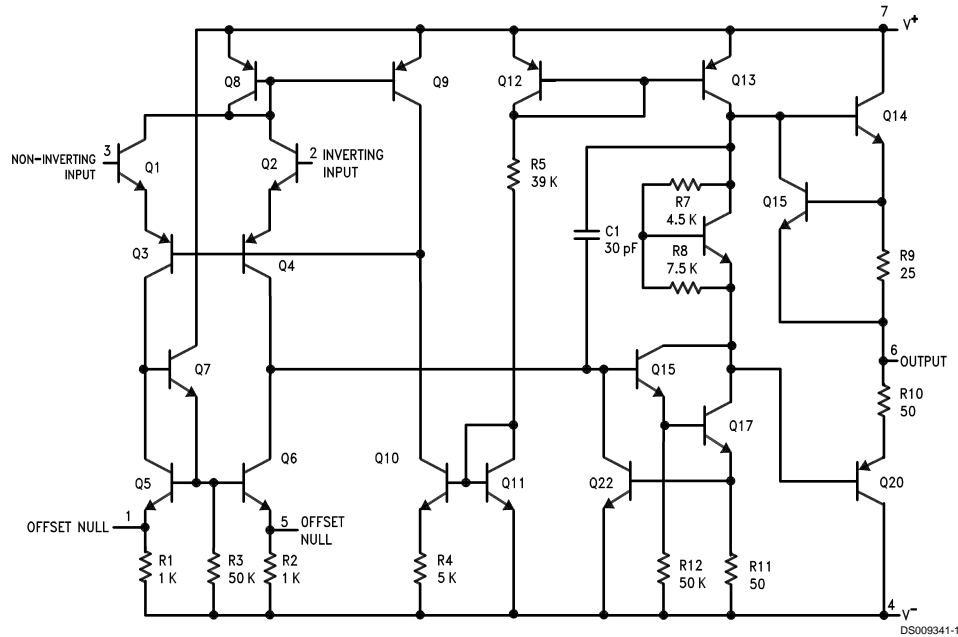
### General Description

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.

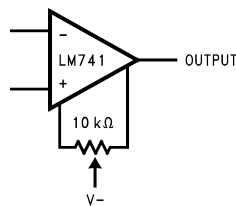
The amplifiers offer many features which make their application nearly foolproof: overload protection on the input and output, no latch-up when the common mode range is exceeded, as well as freedom from oscillations.

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



DS009341-7

## Absolute Maximum Ratings (Note 1)

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

(Note 6)

	LM741A	LM741E	LM741	LM741C
Supply Voltage	±22V	±22V	±22V	±18V
Power Dissipation (Note 2)	500 mW	500 mW	500 mW	500 mW
Differential Input Voltage	±30V	±30V	±30V	±30V
Input Voltage (Note 3)	±15V	±15V	±15V	±15V
Output Short Circuit Duration	Continuous	Continuous	Continuous	Continuous
Operating Temperature Range	-55°C to +125°C	0°C to +70°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	-65°C to +150°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 7)	400V	400V	400V	400V

## Electrical Characteristics (Note 4)

Parameter	Conditions	LM741A/LM741E			LM741			LM741C			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	$T_A = 25^\circ\text{C}$										
	$R_S \leq 10\text{ k}\Omega$		0.8	3.0		1.0	5.0		2.0	6.0	mV
	$R_S \leq 50\Omega$										mV
Average Input Offset Voltage Drift	$T_{AMIN} \leq T_A \leq T_{AMAX}$			4.0							mV
	$R_S \leq 50\Omega$						6.0			7.5	mV
	$R_S \leq 10\text{ k}\Omega$										$\mu\text{V}/^\circ\text{C}$
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
	$T_{AMIN} \leq T_A \leq T_{AMAX}$			70		85	500			300	nA
Average Input Offset Current Drift				0.5							$\text{nA}/^\circ\text{C}$
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	$\mu\text{A}$
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		$\text{M}\Omega$
	$T_{AMIN} \leq T_A \leq T_{AMAX}, V_S = \pm 20\text{V}$	0.5									$\text{M}\Omega$
Input Voltage Range	$T_A = 25^\circ\text{C}$							±12	±13		V
	$T_{AMIN} \leq T_A \leq T_{AMAX}$				±12	±13					V

## Electrical Characteristics (Note 4) (Continued)

Parameter	Conditions	LM741A/LM741E			LM741			LM741C			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
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
	$T_{AMIN} \leq T_A \leq T_{AMAX}$ , $R_L \geq 2\text{ k}\Omega$ , $V_S = \pm 20\text{V}$ , $V_O = \pm 15\text{V}$ $V_S = \pm 15\text{V}$ , $V_O = \pm 10\text{V}$	32			25			15			V/mV V/mV
	$V_S = \pm 5\text{V}$ , $V_O = \pm 2\text{V}$	10									V/mV
Output Voltage Swing	$V_S = \pm 20\text{V}$ $R_L \geq 10\text{ k}\Omega$ $R_L \geq 2\text{ k}\Omega$	$\pm 16$ $\pm 15$									V V
	$V_S = \pm 15\text{V}$ $R_L \geq 10\text{ k}\Omega$ $R_L \geq 2\text{ k}\Omega$				$\pm 12$ $\pm 10$	$\pm 14$ $\pm 13$		$\pm 12$ $\pm 10$	$\pm 14$ $\pm 13$		V V
Output Short Circuit Current	$T_A = 25^\circ\text{C}$	10	25	35		25			25		mA
	$T_{AMIN} \leq T_A \leq T_{AMAX}$	10		40							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 dB
	$T_{AMIN} \leq T_A \leq T_{AMAX}$ , $V_S = \pm 20\text{V}$ 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 dB
Transient Response	$T_A = 25^\circ\text{C}$ , Unity Gain	Rise Time		0.25	0.8		0.3		0.3		$\mu\text{s}$
		Overshoot		6.0	20		5		5		%
Bandwidth (Note 5)	$T_A = 25^\circ\text{C}$	0.437	1.5								MHz
Slew Rate	$T_A = 25^\circ\text{C}$ , Unity Gain	0.3	0.7			0.5			0.5		V/ $\mu\text{s}$
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
	LM741A $V_S = \pm 20\text{V}$ $T_A = T_{AMIN}$ $T_A = T_{AMAX}$			165 135							mW mW
LM741E	$V_S = \pm 20\text{V}$ $T_A = T_{AMIN}$ $T_A = T_{AMAX}$			150 150							mW mW
	LM741 $V_S = \pm 15\text{V}$ $T_A = T_{AMIN}$ $T_A = T_{AMAX}$					60 45	100 75				mW mW

**Note 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.

## Electrical Characteristics (Note 4) (Continued)

**Note 2:** 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)
$\theta_{JA}$ (Junction to Ambient)	100°C/W	100°C/W	170°C/W	195°C/W
$\theta_{JC}$ (Junction to Case)	N/A	N/A	25°C/W	N/A

**Note 3:** For supply voltages less than  $\pm 15V$ , the absolute maximum input voltage is equal to the supply voltage.

**Note 4:** Unless otherwise specified, these specifications apply for  $V_S = \pm 15V$ ,  $-55^\circ C \leq T_A \leq +125^\circ C$  (LM741/LM741A). For the LM741C/LM741E, these specifications are limited to  $0^\circ C \leq T_A \leq +70^\circ C$ .

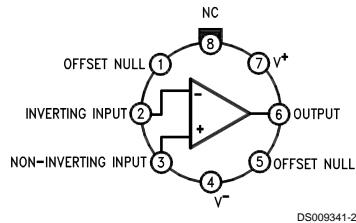
**Note 5:** Calculated value from:  $BW$  (MHz) =  $0.35/\text{Rise Time}(\mu s)$ .

**Note 6:** For military specifications see RETS741X for LM741 and RETS741AX for LM741A.

**Note 7:** Human body model, 1.5 k $\Omega$  in series with 100 pF.

## Connection Diagram

**Metal Can Package**

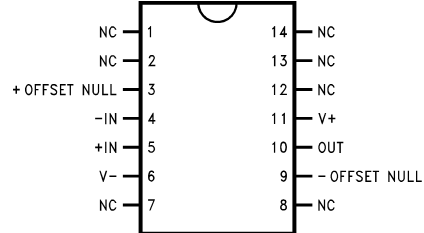


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**Note 8:** LM741H is available per JM38510/10101

**Order Number LM741H, LM741H/883 (Note 8),  
LM741AH/883 or LM741CH  
See NS Package Number H08C**

**Ceramic Dual-In-Line Package**



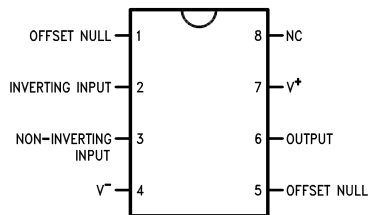
DS009341-5

**Note 9:** also available per JM38510/10101

**Note 10:** also available per JM38510/10102

**Order Number LM741J-14/883 (Note 9),  
LM741AJ-14/883 (Note 10)  
See NS Package Number J14A**

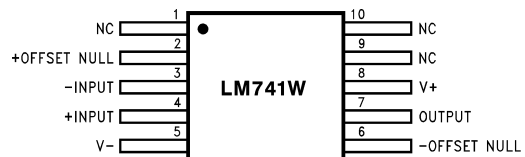
**Dual-In-Line or S.O. Package**



DS009341-3

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

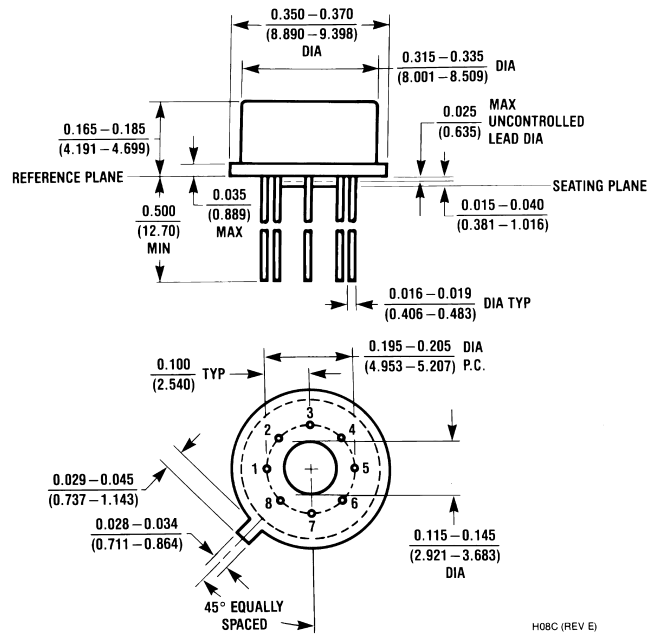
**Ceramic Flatpak**



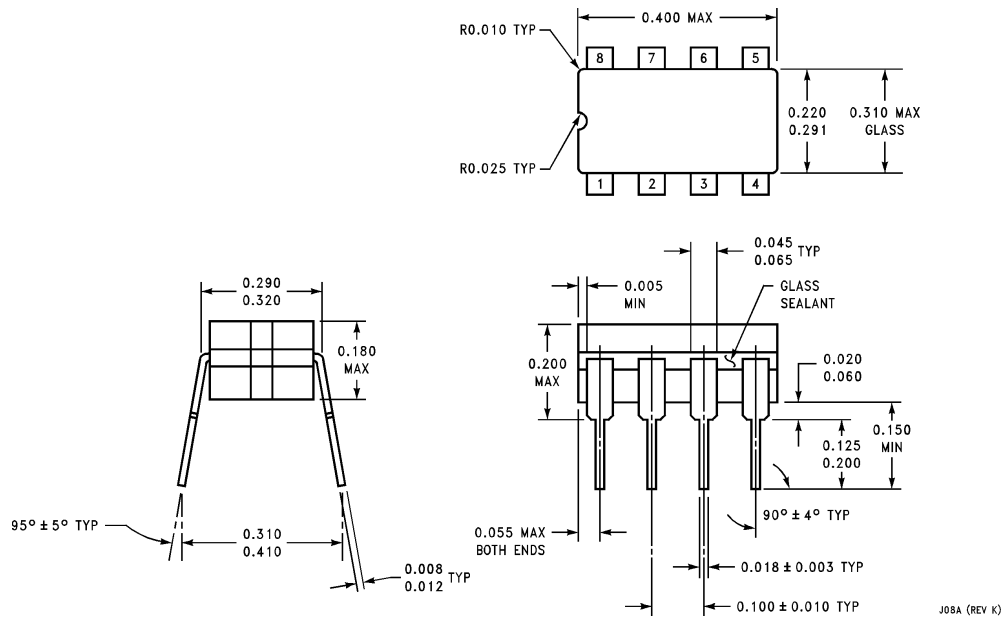
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**Order Number LM741W/883  
See NS Package Number W10A**

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

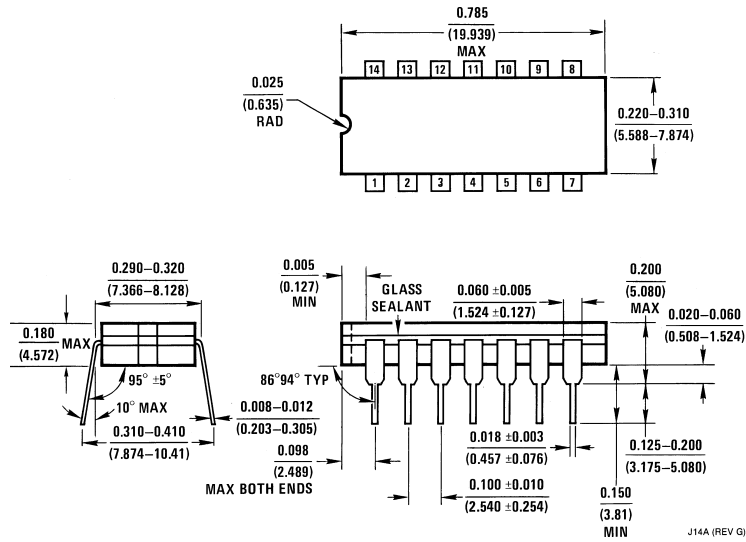


**Metal Can Package (H)**  
 Order Number LM741H, LM741H/883, LM741AH/883, LM741CH or LM741EH  
 NS Package Number H08C

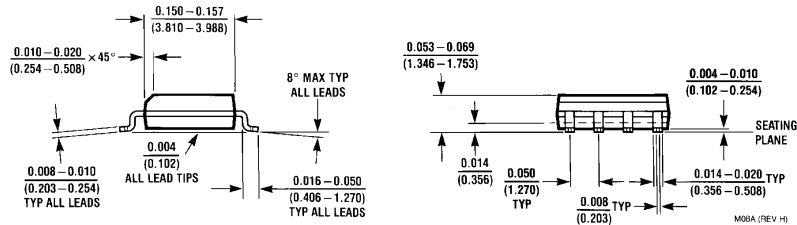
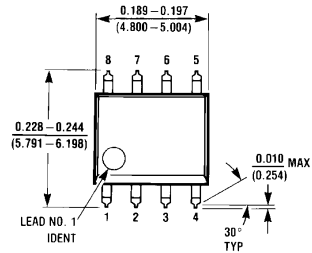


**Ceramic Dual-In-Line Package (J)**  
 Order Number LM741CJ or LM741J/883  
 NS Package Number J08A

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

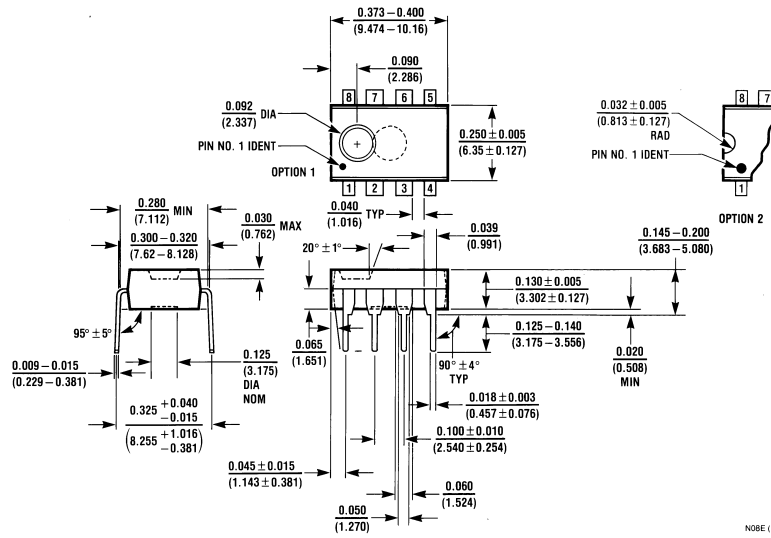


**Ceramic Dual-In-Line Package (J)**  
**Order Number LM741J-14/883 or LM741AJ-14/883**  
**NS Package Number J14A**



**Small Outline Package (M)**  
**Order Number LM741CM**  
**NS Package Number M08A**

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

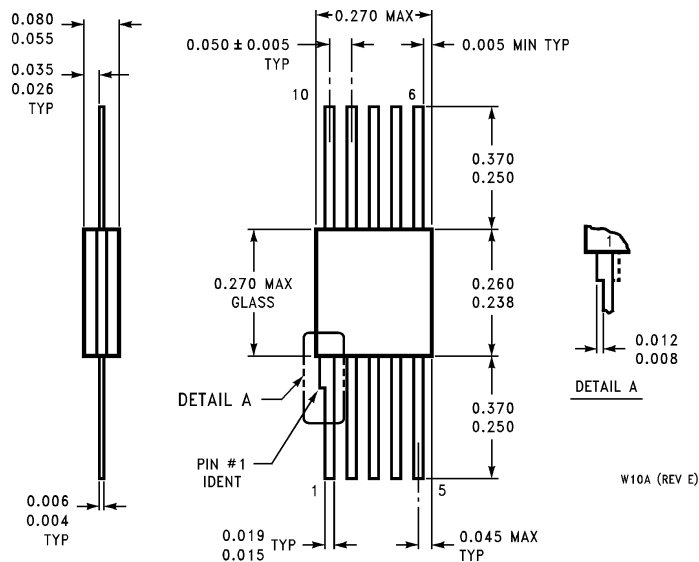


**Dual-In-Line Package (N)**  
**Order Number LM741CN or LM741EN**  
**NS Package Number N08E**

N08E (REV F)



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



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

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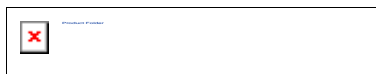
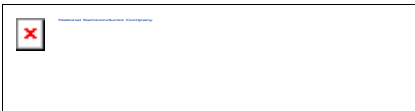
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## LM741 Operational Amplifier

See Also: [LM107](#) - less noise & better accuracy

Generic P/N 741

### Contents

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- [Package Availability, Models, Samples & Pricing](#)
- [Design Tools](#)
- [Application Notes](#)

Parametric Table	
Channels (Channels)	1
Input Output Type	Not Rail to Rail
Bandwidth, typ (MHz)	1
Slew Rate, typ (Volts/usec)	.50
Supply Current per Channel, typ (mA)	1.70
Minimum Supply Voltage (Volt)	10
Maximum Supply Voltage (Volt)	36,44
Offset Voltage, Max (mV)	6,5,3
Input Bias Current, Temp Max (nA)	800,1500,210
Output Current, typ (mA)	25
Voltage Noise, typ (nV/Hz)	30
Shut down	No
Special Features	Vos Adj




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## Datasheet

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LM741 Operational Amplifier	213 Kbytes	24-Jun-99	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
LM741 Mil-Aero Datasheet MNLM741-X	320 Kbytes		<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
LM741 Mil-Aero Datasheet MNLM741A-X	20 Kbytes		<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>

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## Package Availability, Models, Samples & Pricing

Part Number	Package		Status	Models		Samples & Electronic Orders	Budgetary Pricing	
	Type	# pins		SPICE	IBIS		Quantity	\$US ea
LM741CN	<a href="#">MDIP</a>	8	Full production	<a href="#">LM741.MOD</a>	N/A		2500+	\$0.232
LM741CH	TO-5	8	Full production	<a href="#">LM741.MOD</a>	N/A		1K+	\$0.934
LM741H	TO-5	8	Full production	<a href="#">LM741.MOD</a>	N/A		250+	\$1.450
LM741AH-MIL	TO-5	8	Preliminary	<a href="#">LM741.MOD</a>	N/A	.		
LM741AH/883	TO-5	8	Full production	<a href="#">LM741.MOD</a>	N/A		50+	\$5.100

LM741H/883	TO-5	8	Full production	<a href="#">LM741.MOD</a>	N/A		50+	\$2.050
LM741J/883	Cerdip	8	Full production	<a href="#">LM741.MOD</a>	N/A		50+	\$1.450
LM741W/883	Cerpack	10	Full production	<a href="#">LM741.MOD</a>	N/A		50+	\$9.600
LM741WG/883	Ceramic SOIC	10	Full production	<a href="#">LM741.MOD</a>	N/A		50+	\$9.100
LM741WG-MPR	Ceramic SOIC	10	Preliminary	<a href="#">LM741.MOD</a>	N/A	.		
JM38510/10101BG	TO-5	8	Full production	N/A	N/A	.	50+	\$5.100
JM38510/10101BP	Cerdip	8	Full production	N/A	N/A	.	50+	\$5.100
JM38510/10101BC	Cerdip	14	Full production	N/A	N/A	.	50+	\$5.200
JM38510/10101BH	Cerpack	10	Full production	N/A	N/A	.	50+	\$23.000
JM38510/10101SG	TO-5	8	Full production	N/A	N/A	.	50+	\$163.00
JM38510/10101SP	Cerdip	8	Full production	N/A	N/A	.	50+	\$195.00
LM741C MDC	die		Full production	<a href="#">LM741.MOD</a>	N/A	.		







LM741C MWC	wafer	Full production	<a href="#">LM741.MOD</a>	N/A	.		
LM741 MDS	die	Full production	<a href="#">LM741.MOD</a>	N/A	.		
LM741 MW8	wafer	Full production	<a href="#">LM741.MOD</a>	N/A	.		

## Design Tools

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Amplifiers Selection Guide software for Windows	8 Kbytes	26-May-2000		<a href="#">View</a>	

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## Application Notes

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<b>AN-127:</b> LM 143 Monolithic High Voltage Operational Amplifier Applications	248 Kbytes	4-Nov-95	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
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<b>LB-19:</b> Predicting OP Amp Slew Rate Limited Response	89 Kbytes	28-Jun-96	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
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References for A/D Converters ( <b>JAPANESE</b> )	124 Kbytes				

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<b>AN-711:</b> Application Note 711 LM78S40 Switching Voltage Regulator Applications	346 Kbytes	2-Mar-99	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
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<b>LB-17:</b> LM118 Op Amp Slews 70V/microsecond	83 Kbytes	28-Jun-96	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>
<b>LB-42:</b> Get Fast Stable Response From Improved Unity-Gain Followers	83 Kbytes	28-Jun-96	<a href="#">View Online</a>	<a href="#">Download</a>	<a href="#">Receive via Email</a>

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*[Information as of 18-Jul-2000]*

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