
May 1998

LM741 Operational Amplifier

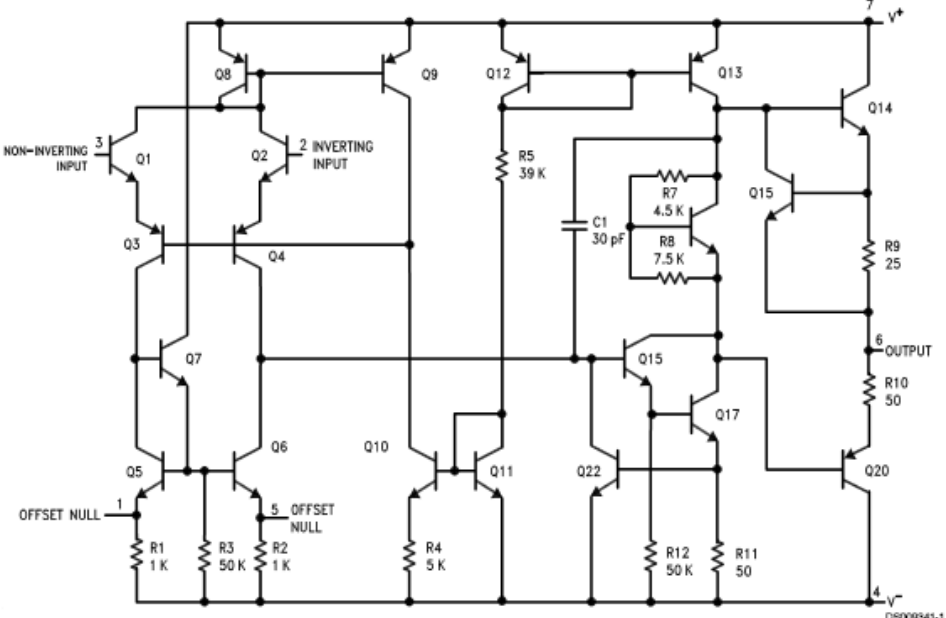
General Description

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.

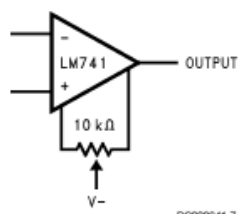
The LM741C/LM741E are identical to the LM741/LM741A except that the LM741C/LM741E have their performance guaranteed over a 0°C to +70°C temperature range, instead of -55°C to +125°C.

Schematic Diagram



DS000341-1

Offset Nulling Circuit



DS000341-7

LM741 Operational Amplifier

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	$T_A = 25^\circ\text{C}$					1.0	5.0		2.0	6.0	mV
	$R_B \leq 10\text{ k}\Omega$		0.8	3.0							mV
	$T_{AMIN} \leq T_A \leq T_{AMAX}$			4.0			6.0			7.5	mV
Average Input Offset Voltage Drift	$R_B \leq 50\Omega$										$\mu\text{V}/^\circ\text{C}$
	$R_B \leq 10\text{ k}\Omega$			15							$\mu\text{V}/^\circ\text{C}$
Input Offset Voltage Adjustment Range	$T_A = 25^\circ\text{C}, V_B = \pm 20\text{V}$	±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	μA
Input Resistance	$T_A = 25^\circ\text{C}, V_B = \pm 20\text{V}$	1.0	6.0		0.3	2.0		0.3	2.0		M Ω
	$T_{AMIN} \leq T_A \leq T_{AMAX}, V_B = \pm 20\text{V}$	0.5									M Ω
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
	$T_{AMIN} \leq T_A \leq T_{AMAX}$, $R_L \geq 2\text{ k}\Omega$, $V_S = \pm 20\text{V}$, $V_O = \pm 15\text{V}$ $V_S = \pm 15\text{V}$, $V_O = \pm 10\text{V}$ $V_S = \pm 5\text{V}$, $V_O = \pm 2\text{V}$	32			25			15			V/mV V/mV V/mV
		10									
Output Voltage Swing	$V_S = \pm 20\text{V}$ $R_L \geq 10\text{ k}\Omega$ $R_L \geq 2\text{ k}\Omega$	± 16									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 mA
	$T_{AMIN} \leq T_A \leq T_{AMAX}$	10		40							
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
Supply Voltage Rejection Ratio	$T_{AMIN} \leq T_A \leq T_{AMAX}$ $V_S = \pm 20\text{V}$ 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 Rise Time Overshoot	$T_A = 25^\circ\text{C}$, Unity Gain		0.25	0.8		0.3			0.3		μs %
			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/ 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
	LM741A $V_S = \pm 20\text{V}$ $T_A = T_{AMIN}$ $T_A = T_{AMAX}$			165 135			50 85		50 85		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)
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 3: For supply voltages less than $\pm 15V$, the absolute maximum input voltage is equal to the supply voltage.

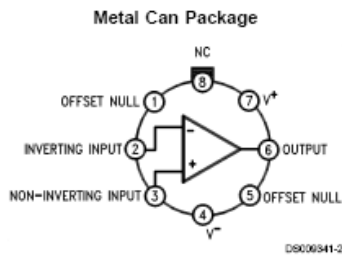
Note 4: Unless otherwise specified, these specifications apply for $V_B = \pm 15V$, $-55^\circ C \leq T_A \leq +125^\circ C$ (LM741/LM741A). For the LM741C/LM741E, these specifications are limited to $0^\circ C \leq T_A \leq +70^\circ C$.

Note 5: Calculated value from: BW (MHz) = 0.35/Rise Time(μs).

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

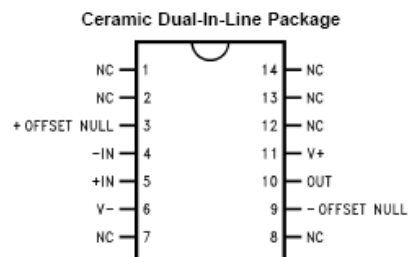
Note 7: Human body model, 1.5 k Ω in series with 100 pF.

Connection Diagram



Note 8: LM741H is available per JM38510/10101

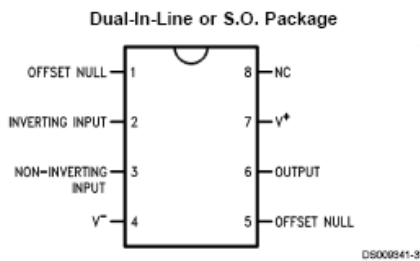
Order Number LM741H, LM741H/883 (Note 8),
LM741AH/883 or LM741CH
See NS Package Number H08C



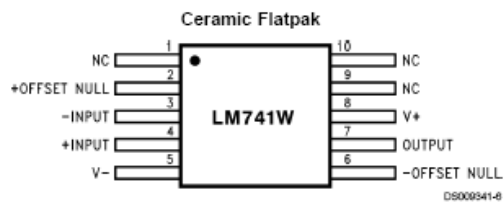
Note 9: also available per JM38510/10101

Note 10: also available per JM38510/10102

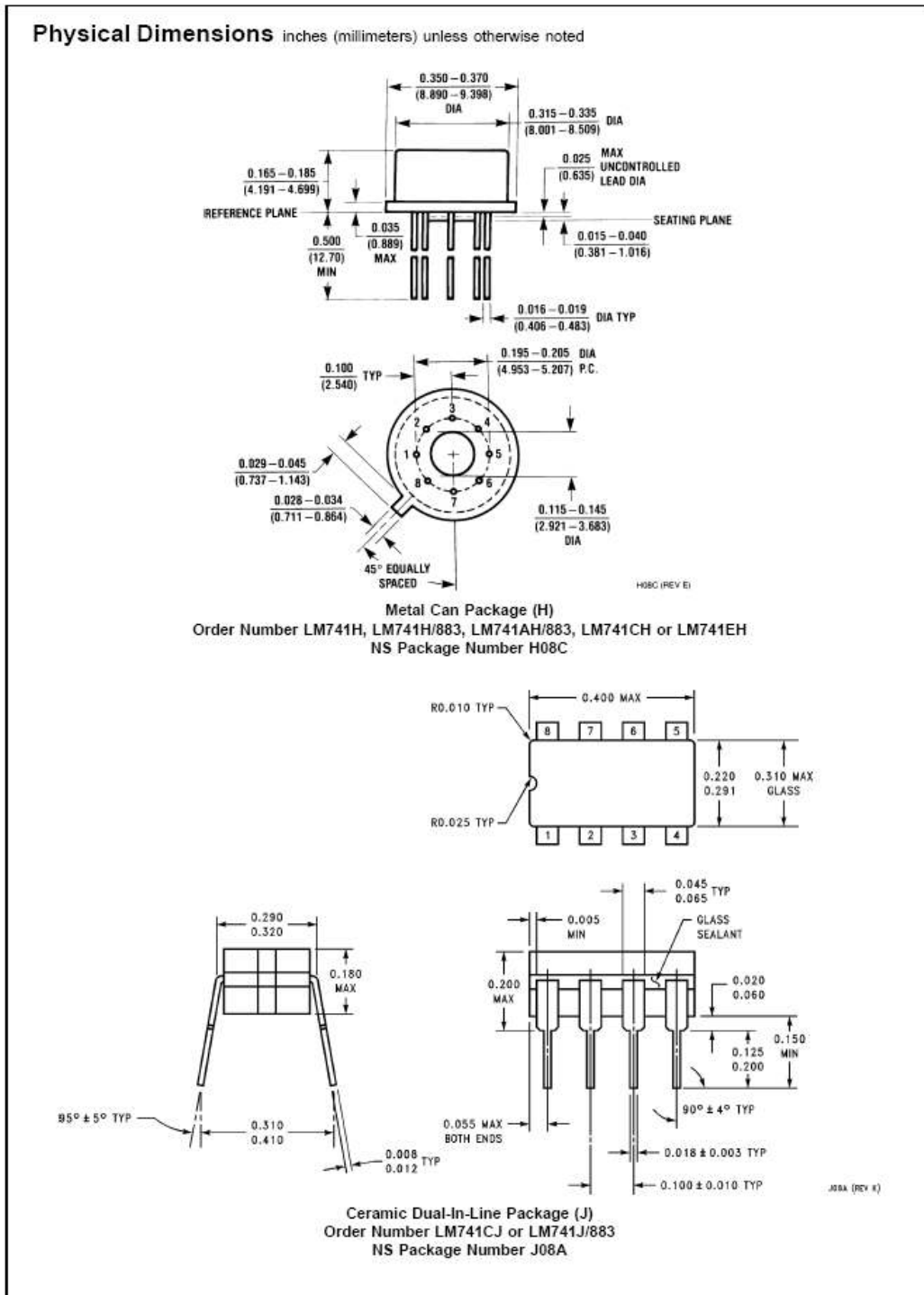
Order Number LM741J-14/883 (Note 9),
LM741AJ-14/883 (Note 10)
See NS Package Number J14A



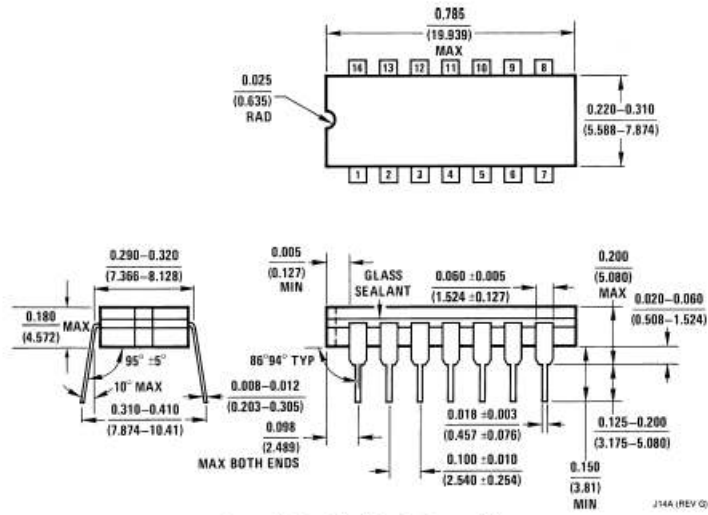
Order Number LM741J, LM741J/883,
LM741CM, LM741CN or LM741EN
See NS Package Number J08A, M08A or N08E



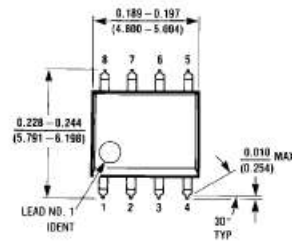
Order Number LM741W/883
See NS Package Number W10A



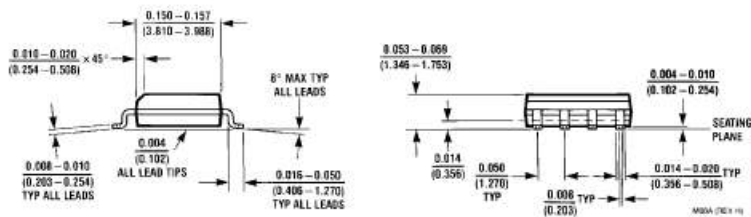
Physical Dimensions inches (millimeters) unless otherwise noted (Continued)

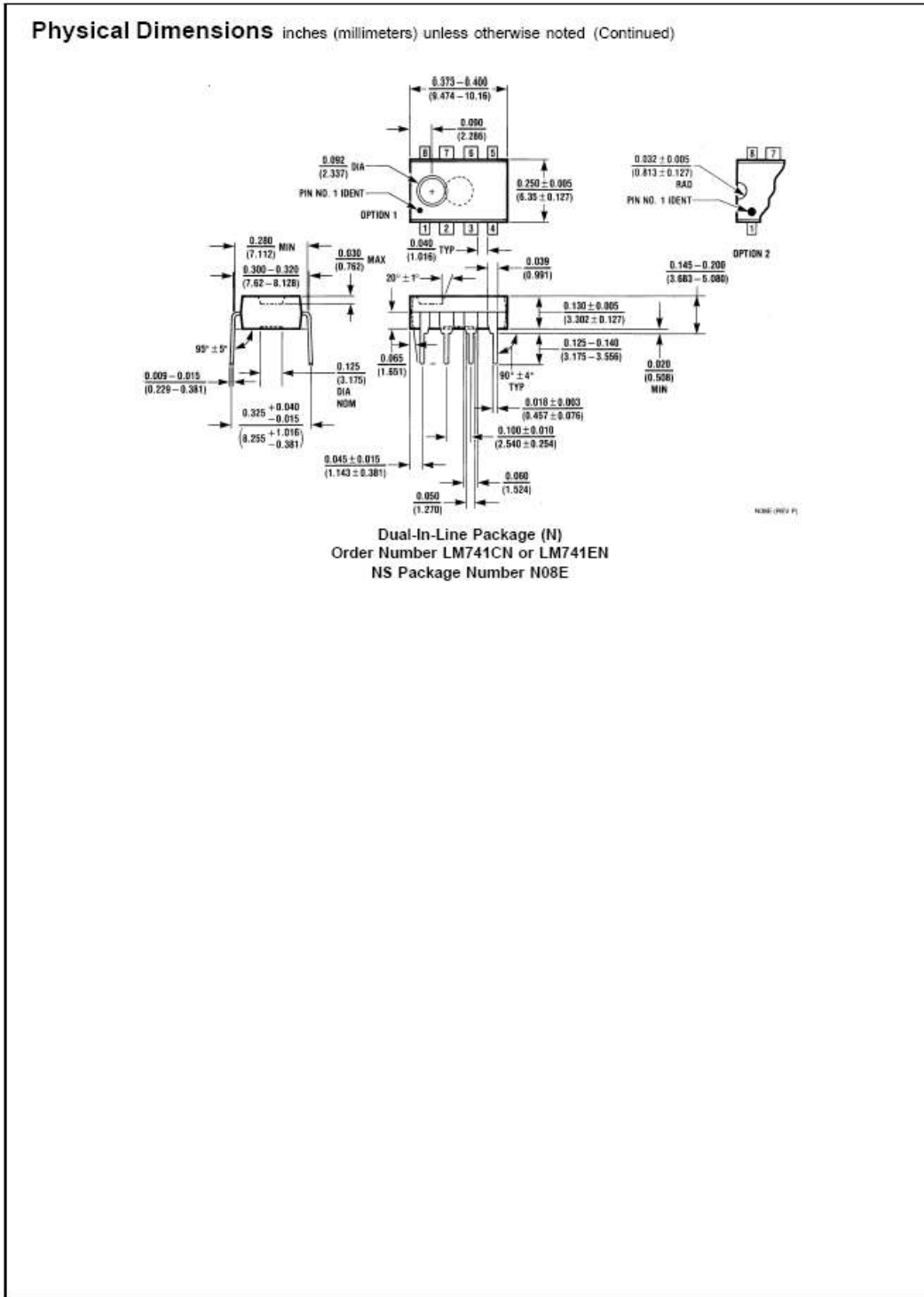


Ceramic Dual-In-Line Package (J)
 Order Number LM741J-14/883 or LM741AJ-14/883
 NS Package Number J14A



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






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

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

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