October 1989

LM715
High Speed Operational Amplifier

General Description

The LM715 is a high speed, high gain, monolithic operational amplifier intended for use in a wide range of applications where fast signal acquisition or wide bandwidth is required. The LM715 features fast settling time, high slew rate, low offsets, and high output swing for large signal applications. In addition, the device displays excellent temperature stability and will operate over a wide range of supply voltages.

Features

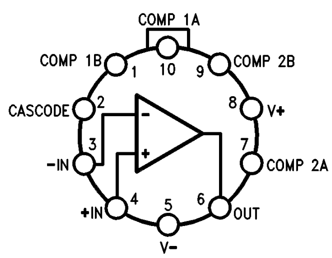
- High slew rate— 100 V/μs (Inverting, $A_V = 1$) typically
- Fast settling time— 800 ns typically
- Wide bandwidth— 65 MHz typically
- Wide operating supply range
- Wide input voltage ranges

Applications

- Video amplifiers
- Active filters
- High speed data conversion

Connection Diagrams

10-Lead Metal Package



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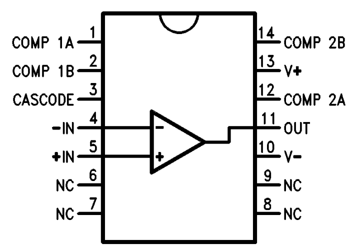
Top View

Lead 5 connected to case.

14-Lead DIP



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Top View

Ordering Information

Device Code	Package Code	Package Description
LM715MH	H10C	Metal
LM715CH	H10C	Metal
LM715MJ	J14A	Ceramic DIP
LM715CJ	J14A	Ceramic DIP

Absolute Maximum Ratings

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

Storage Temperature Range	$-65°C$ to $+175°C$
Operating Temperature Range	
Extended (LM715M)	$-55°C$ to $+125°C$
Commercial (LM715C)	0°C to $+70°C$
Lead Temperature	
Metal Can and Ceramic DIP	
(Soldering, 60 sec.)	300°C
Internal Power Dissipation (Notes 1, 2)	
10L-Metal Can	1.07W
14L-Ceramic DIP	1.36W
Supply Voltage	$\pm 18V$
Differential Input Voltage	$\pm 5V$
Input Voltage (Note 3)	$\pm 15V$

LM715M and LM715C
Electrical Characteristics

$T_A = 25°C$, $V_{CC} = \pm 15V$, unless otherwise specified

Symbol	Parameter		Conditions	LM715M			LM715C			Units
				Min	Typ	Max	Min	Typ	Max	
V_{IO}	Input Offset Voltage		$R_S \leq 10\ k\Omega$		2.0	5.0		2.0	7.5	mV
I_{IO}	Input Offset Current				70	250		70	250	nA
I_{IB}	Input Bias Current				400	750		400	1500	nA
Z_I	Input Impedance				1.0			1.0		MΩ
R_O	Output Resistance				75			75		Ω
I_{CC}	Supply Current				5.5	7.0		5.5	10	mA
P_c	Power Consumption				165	210		165	300	mW
V_{IR}	Input Voltage Range			± 10	± 12		± 10	± 12		V
A_{VS}	Large Signal Voltage Gain		$R_L \geq 2.0\ k\Omega$, $V_O = \pm 10V$	15	30		10	30		V/mV
V	Settling Time		$V_O = \pm 5.0V$, $A_V = 1.0$		800			800		ns
TR	Transient Response	Rise Time	$V_I = 400\ mV$, $A_V = 1.0$		30	60		30	75	ns
		Overshoot			25	40		25	50	%
SR	Slew Rate		$A_V = 100$		70			70		V/µs
			$A_V = 10$		38			38		
			$A_V = 1.0$ (Non-Inverting)	15	18		10	18		
			$A_V = 1.0$ (Inverting)		100			100		

The following specifications apply over the range of $-55°C \leq T_A \leq +125°C$ for the LM715M, and $0°C \leq T_A \leq +70°C$ for the LM715C

Symbol	Parameter	Conditions	LM715M			LM715C			Units
			Min	Typ	Max	Min	Typ	Max	
V_{IO}	Input Offset Voltage	$R_S \leq 10\ k\Omega$			7.5			10	mV
I_{IO}	Input Offset Current	$T_A = T_{A\ Max}$			250			250	nA
		$T_A = T_{A\ Min}$			800			750	
I_{IB}	Input Bias Current	$T_A = T_{A\ Max}$			0.75			1.5	µA
		$T_A = T_{A\ Min}$			4.0			7.5	
CMR	Common Mode Rejection	$R_S \leq 10\ k\Omega$	74	92		74 (Note 4)	92 (Note 4)		dB
PSRR	Power Supply Rejection Ratio	$R_S \leq 10\ k\Omega$		45	300		45 (Note 4)	400 (Note 4)	µV/V
A_{VS}	Large Signal Voltage Gain	$R_L \geq 2.0\ k\Omega$, $V_O = \pm 10V$	10			8			V/mV
V_{OP}	Output Voltage Swing	$R_L = 2.0\ k\Omega$	± 10	± 13		± 10	± 13		V

Note 1: $T_{J\ Max} = 175°C$.

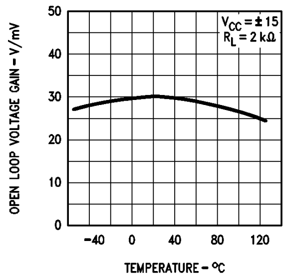
Note 2: Ratings apply to ambient temperature at 25°C. Above this temperature, derate the 10L-Metal Can at 7.1 mW/°C, and the 14L-Ceramic DIP at 9.1 mW/°C.

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

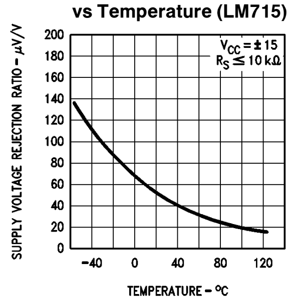
Note 4: $T_A = 25°C$ only.

Typical Performance Characteristics for LM715M and LM715C

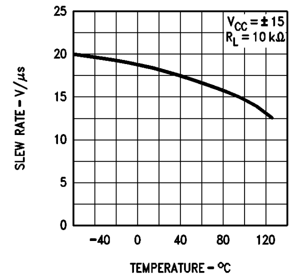
Voltage Gain vs Temperature (LM715)



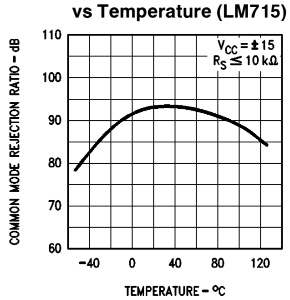
Supply Voltage Rejection Ratio vs Temperature (LM715)



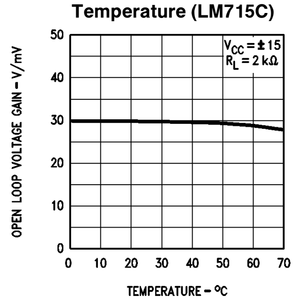
Slew Rate vs Temperature (LM715)



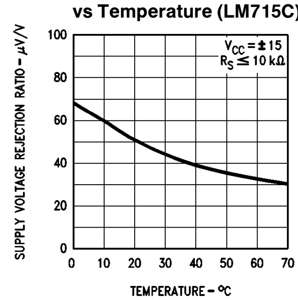
Common Mode Rejection Ratio vs Temperature (LM715)



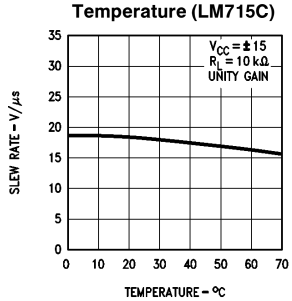
Voltage Gain vs Temperature (LM715C)



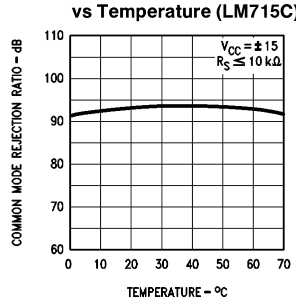
Supply Voltage Rejection Ratio vs Temperature (LM715C)



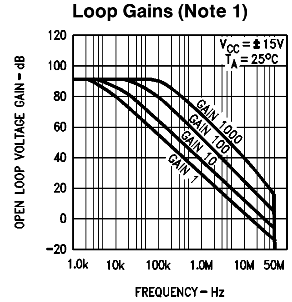
Slew Rate vs Temperature (LM715C)



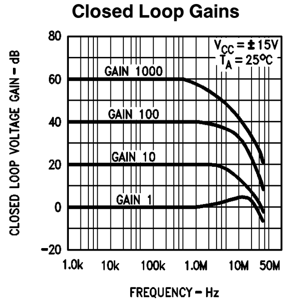
Common Mode Rejection Ratio vs Temperature (LM715C)



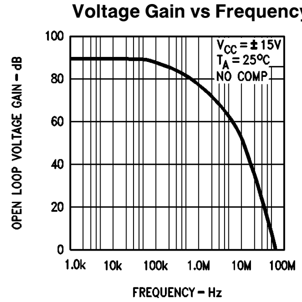
Frequency Response for Open Loop Gains (Note 1)



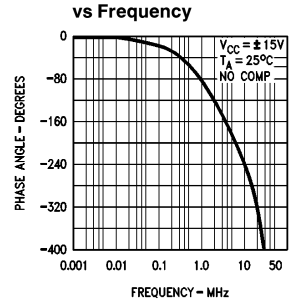
Frequency Response for Closed Loop Gains



Voltage Gain vs Frequency



Open Loop Phase vs Frequency



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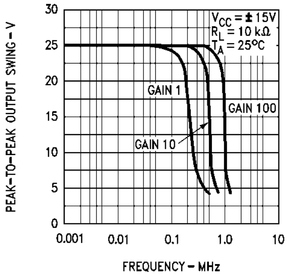
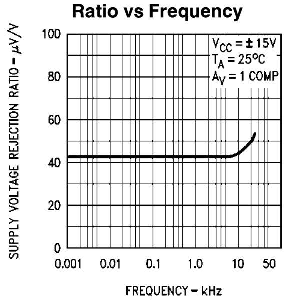
Note 1: See "Non-Inverting Compensation Components Value Table" for Closed Loop Gain values.

Typical Performance Characteristics for LM715M and LM715C (Continued)

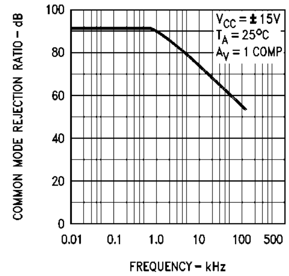
Output Swing vs Frequency for Closed Loop Gains



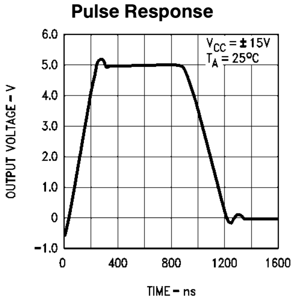
Supply Voltage Rejection Ratio vs Frequency



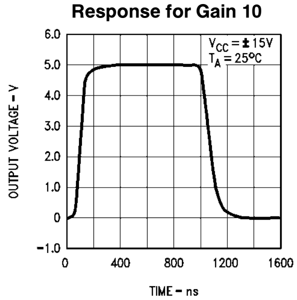
Common Mode Rejection Ratio vs Frequency



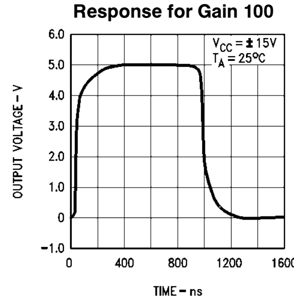
Unity Gain Large Signal Pulse Response



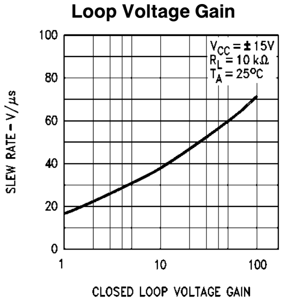
Large Signal Pulse Response for Gain 10



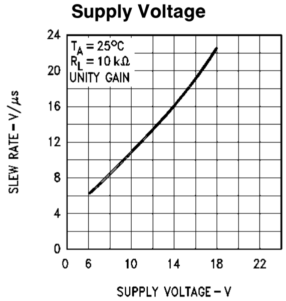
Large Signal Pulse Response for Gain 100



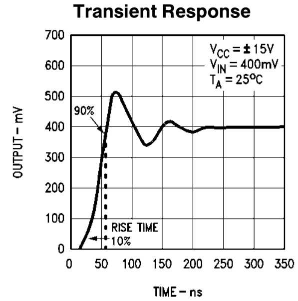
Slew Rate vs Closed Loop Voltage Gain



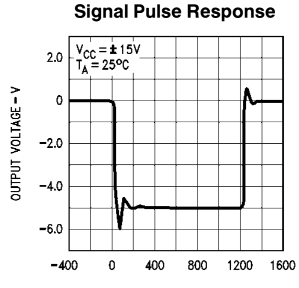
Slew Rate vs Supply Voltage



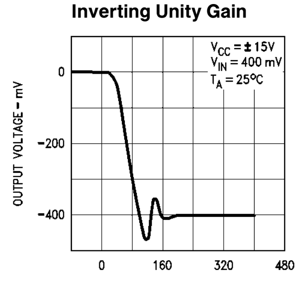
Voltage Follower Transient Response



Inverting Unity Gain Large Signal Pulse Response



Small Signal Pulse Response Inverting Unity Gain



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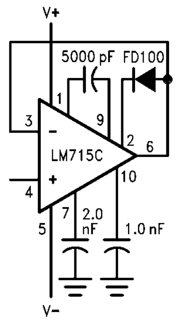
Typical Performance Characteristics for LM715M and LM715C (Continued)

Voltage Follower (Note 2)



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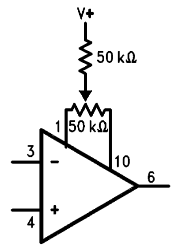
Voltage Offset Null Circuit (Note 2)



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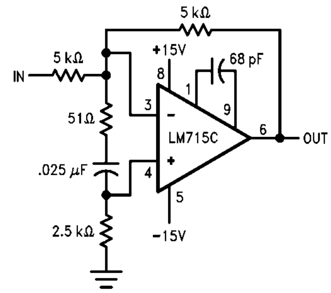
High Slew Rate Circuit (Note 2)



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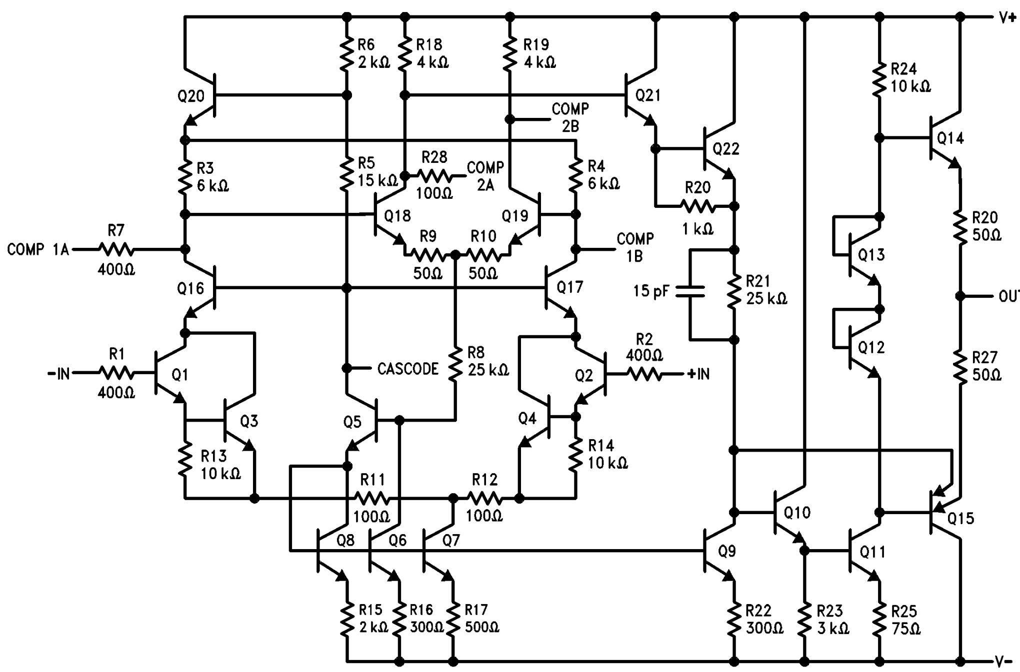
Note 2: Lead numbers apply to metal package.

Equivalent Circuit



TL/H/10059–3

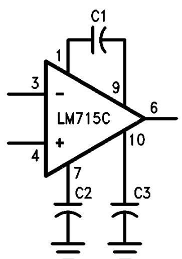
Applications Information

Non-Inverting Compensation Components Values

Closed Loop Gain	C1	C2	C3
1000	10 pF		
100	50 pF		250 pF
10 (Note)	100 pF	500 pF	1000 pF
1	500 pF	2000 pF	1000 pF

Note: For gain 10, compensation may be simplified by removing C2, C3 and adding a 200 pF capacitor (C4) between Lead 7 and 10.

Frequency Compensation Circuit



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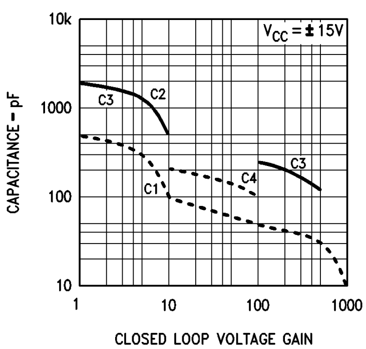
Suggested Values of Compensation Capacitors vs Closed Loop Voltage Gain



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Layout Instructions

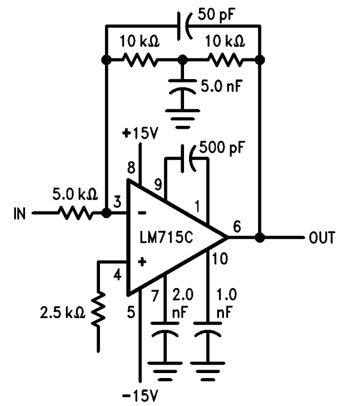
Layout—The layout should be such that stray capacitance is minimal.

Supplies—The supplies should be adequately bypassed. Used of 0.1 μF high quality ceramic capacitors is recommended.

Ringing—Excessive ringing (long acquisition time) may occur with large capacitive loads. This may be reduced by isolating the capacitive load with a resistance of 100Ω. Large source resistances may also give rise to the same problem and this may be decreased by the addition of a capacitance across the feedback resistance. A value of around 50 pF for unity gain configuration and around 3.0 pF for gain 10 should be adequate.

Latch Up—This may occur when the amplifier is used as a voltage follower. The inclusion of a diode between leads 6 and 2 with the cathode toward lead 2 is the recommended preventive measure.

Typical Applications



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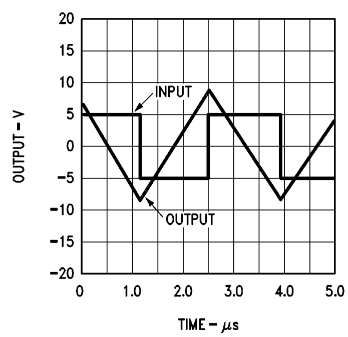
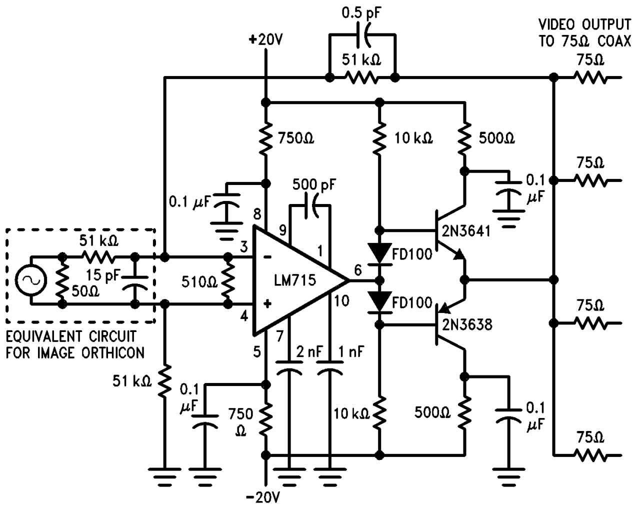
High Speed Integrator



TL/H/10059–13

Note: All lead numbers on this page apply to metal package.

Typical Applications (Continued)



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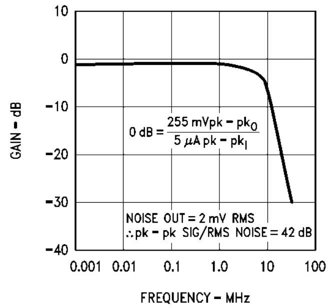
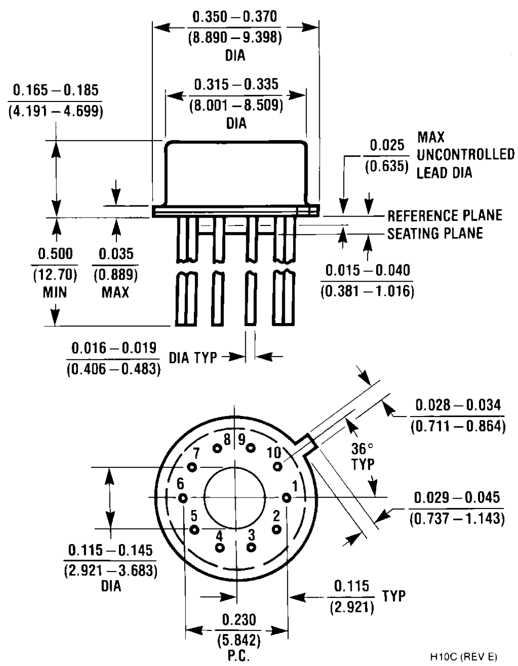
Wide Band Video Amplifier Drive Capability with 75Ω Coax Cable



TL/H/10059–11

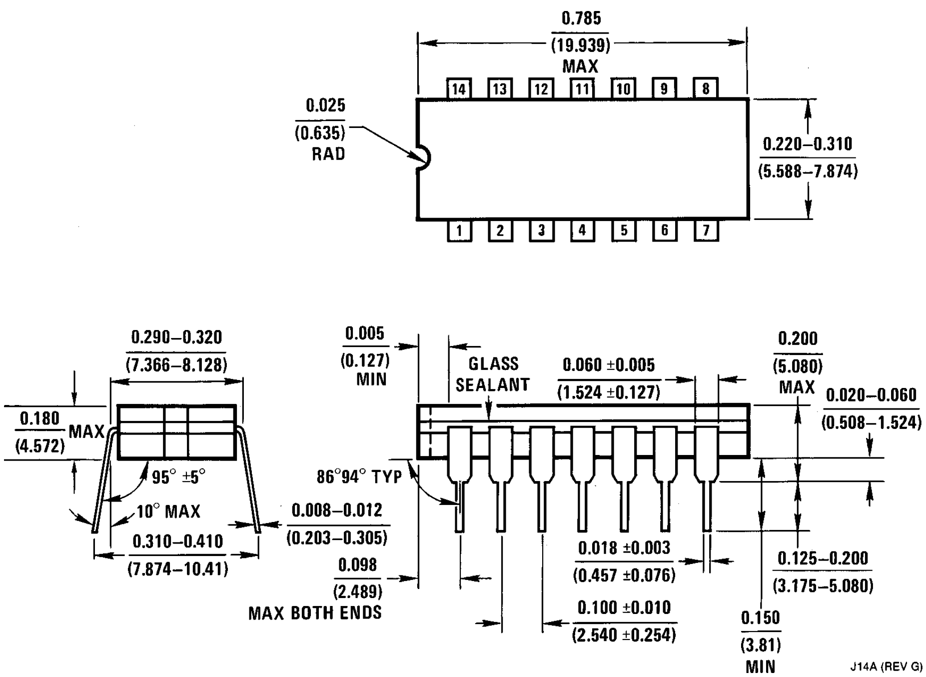
Note: All lead numbers shown refer to metal package.

Physical Dimensions inches (millimeters)



10-Lead Metal Can Package (H)
Order Number LM715CH or LM715MH
NS Package Number H10C

Physical Dimensions inches (millimeters) (Continued)



14-Lead Ceramic Dual-In-Line Package (J)
Order Number LM715CJ or LM715MJ
NS Package Number J14A

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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