

Absolute Maximum Ratings (Note 10)

Distributors for availability and specifications.

If Military/Aerospace specified devices are required,
please contact the National Semiconductor Sales Office/

	LM139/LM239/LM339			LM3302		
	LM139A/LM239A/LM339A	LM2901		LM139A/LM239A/LM339A	LM2901	LM3302
Supply Voltage, V^+	36 V_{DC} or $\pm 18 V_{DC}$			28 V_{DC} or $\pm 14 V_{DC}$		
Differential Input Voltage (Note 8)	36 V_{DC}			28 V_{DC}		
Input Voltage	$-0.3 V_{DC}$ to $+36 V_{DC}$			$-0.3 V_{DC}$ to $+28 V_{DC}$		
Input Current ($V_{IN} < -0.3 V_{DC}$), (Note 3)	50 mA			50 mA		
Power Dissipation (Note 1)						
Molded DIP	1050 mW			1050 mW		
Cavity DIP	1190 mW					
Small Outline Package	760 mW					
Output Short-Circuit to GND, (Note 2)	Continuous			Continuous		
Storage Temperature Range	-65°C to $+150^\circ\text{C}$			-65°C to $+150^\circ\text{C}$		
Lead Temperature (Soldering, 10 seconds)	260°C			260°C		
Operating Temperature Range				-40°C to $+85^\circ\text{C}$		
LM339/LM339A	0°C to $+70^\circ\text{C}$					
LM239/LM239A	-25°C to $+85^\circ\text{C}$					
LM2901	-40°C to $+85^\circ\text{C}$					
LM139/LM139A	-55°C to $+125^\circ\text{C}$					
Soldering Information						
Dual-In-Line Package						
Soldering (10 seconds)	260°C			260°C		
Small Outline Package						
Vapor Phase (60 seconds)	215°C			215°C		
Infrared (15 seconds)	220°C			220°C		
See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods of soldering surface mount devices.						
ESD rating (1.5 k Ω in series with 100 pF)	600V			600V		

Electrical Characteristics $(V^+ = 5 V_{DC}, T_A = 25^\circ\text{C}$, unless otherwise stated)

Parameter	Conditions	LM139A			LM239A, LM339A			LM139			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	(Note 9)	1.0	2.0		1.0	2.0		2.0	5.0		mV_{DC}
Input Bias Current	$I_{IN(+)}$ or $I_{IN(-)}$ with Output in Linear Range, (Note 5), $V_{CM} = 0V$	25	100		25	250		25	100		nA_{DC}
Input Offset Current	$I_{IN(+)} - I_{IN(-)}$, $V_{CM} = 0V$	3.0	25		5.0	50		3.0	25		nA_{DC}
Input Common-Mode Voltage Range	$V^+ = 30 V_{DC}$ (LM3302, $V^+ = 28 V_{DC}$) (Note 6)	0	$V^+ - 1.5$		0	$V^+ - 1.5$		0	$V^+ - 1.5$		V_{DC}
Supply Current	$R_L = \infty$ on all Comparators, $R_L = \infty$, $V^+ = 36V$, (LM3302, $V^+ = 28 V_{DC}$)	0.8	2.0		0.8	2.0		0.8	2.0		mA_{DC}
					1.0	2.5		1.0	2.5		mA_{DC}
Voltage Gain	$R_L \geq 15 k\Omega$, $V^+ = 15 V_{DC}$ $V_O = 1 V_{DC}$ to $11 V_{DC}$	50	200		50	200		50	200		V/mV
Large Signal Response Time	$V_{IN} = \text{TTL Logic Swing}$, $V_{REF} = 1.4 V_{DC}$, $V_{RL} = 5 V_{DC}$	300			300			300			ns

Electrical Characteristics (Continued) $(V^+ = 5 V_{DC}, T_A = 25^\circ\text{C}, \text{ unless otherwise stated})$

Parameter	Conditions	LM139A			LM239A, LM339A			LM139			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
	$R_L = 5.1 \text{ k}\Omega$										
Response Time	$V_{RL} = 5 V_{DC}, R_L = 5.1 \text{ k}\Omega,$ (Note 7)		1.3			1.3			1.3		μs
Output Sink Current	$V_{IN(-)} = 1 V_{DC}, V_{IN(+)} = 0,$ $V_O \leq 1.5 V_{DC}$	6.0	16		6.0	16		6.0	16		mA_{DC}
Saturation Voltage	$V_{IN(-)} = 1 V_{DC}, V_{IN(+)} = 0,$ $I_{SINK} \leq 4 \text{ mA}$		250	400		250	400		250	400	mV_{DC}
Output Leakage Current	$V_{IN(+)} = 1 V_{DC}, V_{IN(-)} = 0,$ $V_O = 5 V_{DC}$		0.1			0.1			0.1		nA_{DC}

Electrical Characteristics $(V^+ = 5 V_{DC}, T_A = 25^\circ\text{C}, \text{ unless otherwise stated})$

Parameter	Conditions	LM239, LM339			LM2901			LM3302			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	(Note 9)		2.0	5.0		2.0	7.0		3	20	mV_{DC}
Input Bias Current	$I_{IN(+)}$ or $I_{IN(-)}$ with Output in Linear Range, (Note 5), $V_{CM} = 0V$		25	250		25	250		25	500	nA_{DC}
Input Offset Current	$I_{IN(+)} - I_{IN(-)}, V_{CM} = 0V$		5.0	50		5	50		3	100	nA_{DC}
Input Common-Mode Voltage Range	$V^+ = 30 V_{DC}$ (LM3302, $V^+ = 28 V_{DC}$) (Note 6)	0		$V^+ - 1.5$	0		$V^+ - 1.5$	0		$V^+ - 1.5$	V_{DC}
Supply Current	$R_L = \infty$ on all Comparators, $R_L = \infty, V^+ = 36V,$ (LM3302, $V^+ = 28 V_{DC}$)		0.8	2.0		0.8	2.0		0.8	2.0	mA_{DC}
			1.0	2.5		1.0	2.5		1.0	2.5	mA_{DC}
Voltage Gain	$R_L \geq 15 \text{ k}\Omega, V^+ = 15 V_{DC}$ $V_O = 1 V_{DC}$ to $11 V_{DC}$	50	200		25	100		2	30		V/mV
Large Signal Response Time	$V_{IN} = \text{TTL Logic Swing}, V_{REF} =$ $1.4 V_{DC}, V_{RL} = 5 V_{DC},$ $R_L = 5.1 \text{ k}\Omega,$		300			300			300		ns
Response Time	$V_{RL} = 5 V_{DC}, R_L = 5.1 \text{ k}\Omega,$ (Note 7)		1.3			1.3			1.3		μs
Output Sink Current	$V_{IN(-)} = 1 V_{DC}, V_{IN(+)} = 0,$ $V_O \leq 1.5 V_{DC}$	6.0	16		6.0	16		6.0	16		mA_{DC}
Saturation Voltage	$V_{IN(-)} = 1 V_{DC}, V_{IN(+)} = 0,$ $I_{SINK} \leq 4 \text{ mA}$		250	400		250	400		250	500	mV_{DC}
Output Leakage Current	$V_{IN(+)} = 1 V_{DC}, V_{IN(-)} = 0,$ $V_O = 5 V_{DC}$		0.1			0.1			0.1		nA_{DC}

Electrical Characteristics $(V^+ = 5.0 V_{DC}, \text{ (Note 4)})$

Parameter	Conditions	LM139A			LM239A, LM339A			LM139			Units
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
Input Offset Voltage	(Note 9)			4.0			4.0			9.0	mV_{DC}
Input Offset Current	$I_{IN(+)} - I_{IN(-)}, V_{CM} = 0V$			100			150			100	nA_{DC}
Input Bias Current	$I_{IN(+)}$ or $I_{IN(-)}$ with Output in Linear Range, $V_{CM} = 0V$ (Note 5)			300			400			300	nA_{DC}
Input Common-Mode Voltage Range	$V^+ = 30 V_{DC}$ (LM3302, $V^+ = 28 V_{DC}$) (Note 6)	0		$V^+ - 2.0$	0		$V^+ - 2.0$	0		$V^+ - 2.0$	V_{DC}

Electrical Characteristics (Continued) $(V^+ = 5.0 V_{DC}, \text{ (Note 4)})$

Parameter	Conditions	LM139A		LM239A, LM339A			LM139		Units	
		Min	Typ	Max	Min	Typ	Max	Min		Typ
Saturation Voltage	$V_{IN(-)} = 1 V_{DC}, V_{IN(+)} = 0,$ $I_{SINK} \leq 4 \text{ mA}$			700			700			mV_{DC}
Output Leakage Current	$V_{IN(+)} = 1 V_{DC}, V_{IN(-)} = 0,$ $V_O = 30 V_{DC}, \text{ (LM3302,}$ $V_O = 28 V_{DC})$			1.0			1.0			μA_{DC}
Differential Input Voltage	Keep all V_{IN} 's $\geq 0 V_{DC}$ (or V^- , if used), (Note 8)			36			36			V_{DC}

Electrical Characteristics $(V^+ = 5.0 V_{DC}, \text{ (Note 4)})$

Parameter	Conditions	LM239, LM339			LM2901		LM3302		Units	
		Min	Typ	Max	Min	Typ	Max	Min		Typ
Input Offset Voltage	(Note 9)			9.0	9	15		40		mV_{DC}
Input Offset Current	$I_{IN(+)} - I_{IN(-)}, V_{CM} = 0V$			150	50	200		300		nA_{DC}
Input Bias Current	$I_{IN(+)}$ or $I_{IN(-)}$ with Output in Linear Range, $V_{CM} = 0V$ (Note 5)			400	200	500		1000		nA_{DC}
Input Common-Mode Voltage Range	$V^+ = 30 V_{DC}$ (LM3302, $V^+ = 28 V_{DC}$) (Note 6)			$V^+ - 2.0$	0	$V^+ - 2.0$	0	$V^+ - 2.0$		V_{DC}
Saturation Voltage	$V_{IN(-)} = 1 V_{DC}, V_{IN(+)} = 0,$ $I_{SINK} \leq 4 \text{ mA}$			700	400	700		700		mV_{DC}
Output Leakage Current	$V_{IN(+)} = 1 V_{DC}, V_{IN(-)} = 0,$ $V_O = 30 V_{DC}, \text{ (LM3302, } V_O = 28 V_{DC})$			1.0		1.0		1.0		μA_{DC}
Differential Input Voltage	Keep all V_{IN} 's $\geq 0 V_{DC}$ (or V^- , if used), (Note 8)			36		36		28		V_{DC}

Note 1: For operating at high temperatures, the LM339/LM339A, LM2901, LM3302 must be derated based on a 125°C maximum junction temperature and a thermal resistance of 95°C/W which applies for the device soldered in a printed circuit board, operating in a still air ambient. The LM239 and LM139 must be derated based on a 150°C maximum junction temperature. The low bias dissipation and the "ON-OFF" characteristic of the outputs keeps the chip dissipation very small ($P_D \leq 100 \text{ mW}$), provided the output transistors are allowed to saturate.

Note 2: Short circuits from the output to V^+ can cause excessive heating and eventual destruction. When considering short circuits to ground, the maximum output current is approximately 20 mA independent of the magnitude of V^+ .

Note 3: This input current will only exist when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistors becoming forward biased and thereby acting as input diode clamps. In addition to this diode action, there is also lateral NPN parasitic transistor action on the IC chip. This transistor action can cause the output voltages of the comparators to go to the V^+ voltage level (or to ground for a large overdrive) for the time duration that an input is driven negative. This is not destructive and normal output states will re-establish when the input voltage, which was negative, again returns to a value greater than $-0.3 V_{DC}$ (at 25°C).

Note 4: These specifications are limited to $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$, for the LM139/LM139A. With the LM239/LM239A, all temperature specifications are limited to $-25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$, the LM339/LM339A temperature specifications are limited to $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$, and the LM2901, LM3302 temperature range is $-40^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$.

Note 5: The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output so no loading change exists on the reference or input lines.

Note 6: The input common-mode voltage or either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is $V^+ - 1.5V$ at 25°C, but either or both inputs can go to $+30 V_{DC}$ without damage (25V for LM3302), independent of the magnitude of V^+ .

Note 7: The response time specified is a 100 mV input step with 5 mV overdrive. For larger overdrive signals 300 ns can be obtained, see typical performance characteristics section.

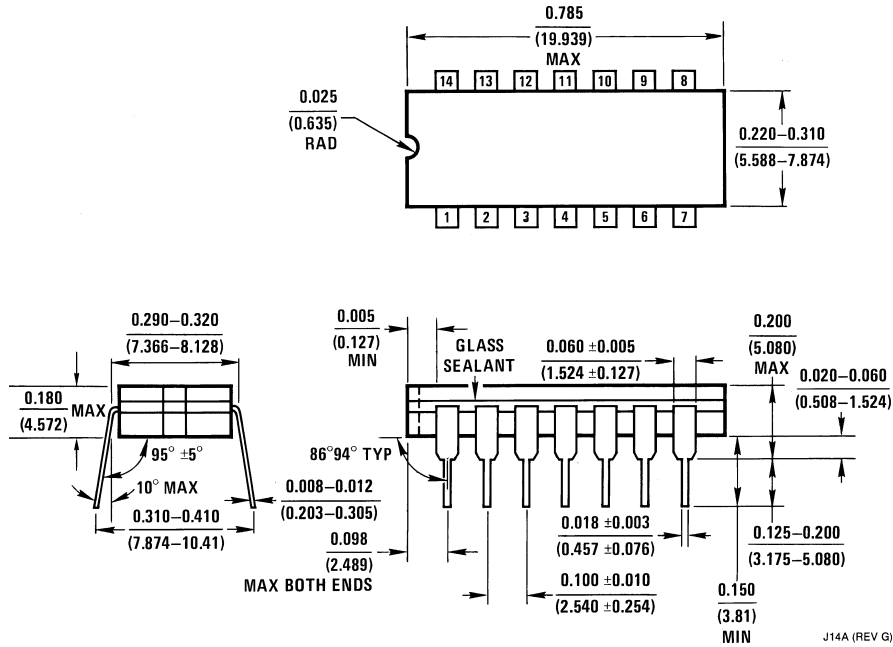
Note 8: Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator will provide a proper output state. The low input voltage state must not be less than $-0.3 V_{DC}$ (or $0.3 V_{DC}$ below the magnitude of the negative power supply, if used) (at 25°C).

Note 9: At output switch point, $V_O \approx 1.4 V_{DC}$, $R_S = 0\Omega$ with V^+ from 5 V_{DC} to 30 V_{DC} ; and over the full input common-mode range (0 V_{DC} to $V^+ - 1.5 V_{DC}$), at 25°C. For LM3302, V^+ from 5 V_{DC} to 28 V_{DC} .

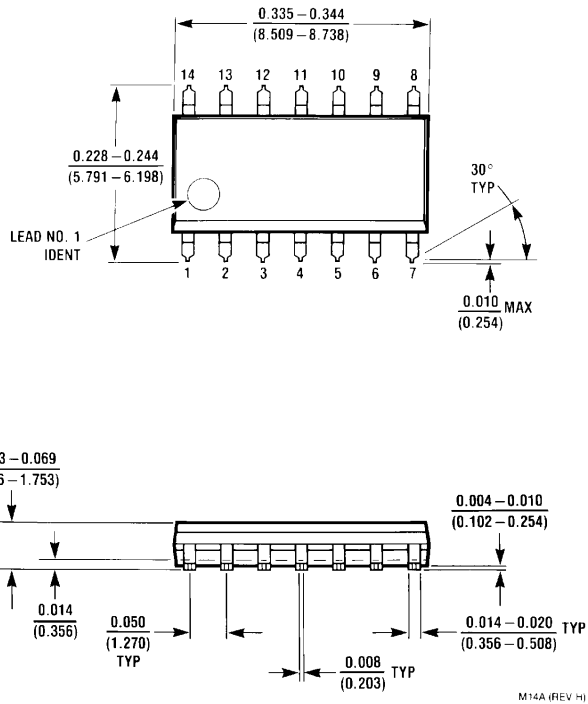
Note 10: Refer to RETS139AX for LM139A military specifications and to RETS139X for LM139 military specifications.

Physical Dimensions inches (millimeters)

unless otherwise noted

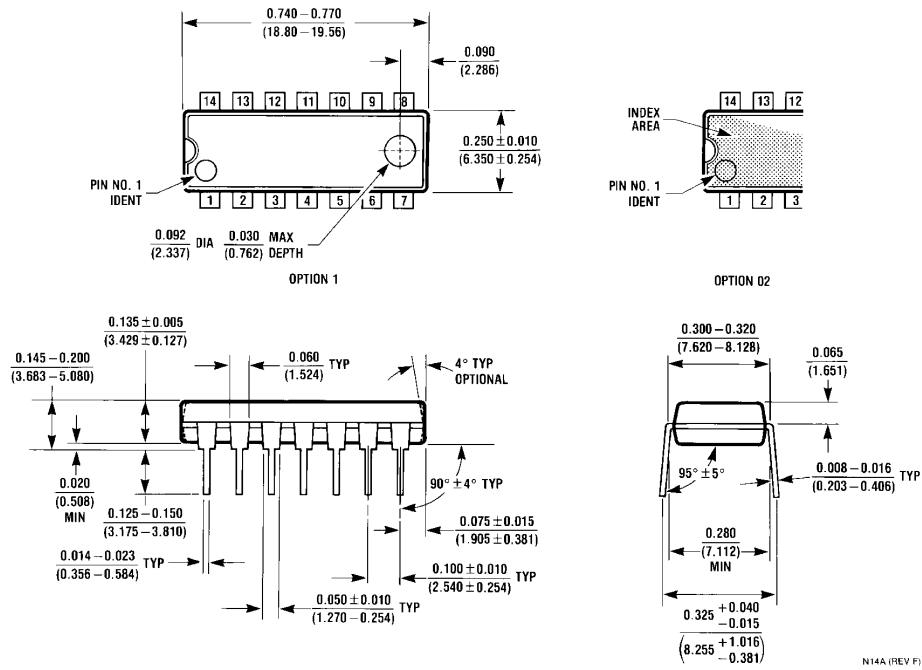


Ceramic Dual-In-Line Package (J)
Order Number LM139J, LM139J/883, LM139AJ,
LM139AJ/883, LM239J, LM239AJ, LM339J
NS Package Number J14A

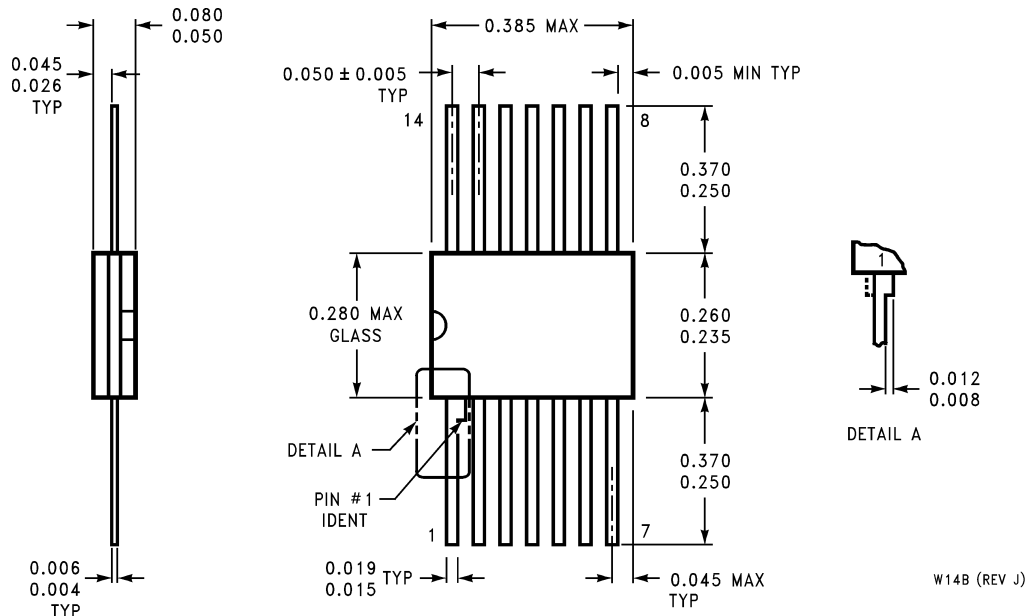


S.O. Package (M)
Order Number LM339AM, LM339AMX, LM339M, LM339MX, LM2901M or LM2901MX
NS Package Number M14A

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



Molded Dual-In-Line Package (N)
Order Number LM339N, LM339AN, LM2901N or LM3302N
NS Package Number N14A



Order Number LM139AW/883, LM139W/883
NS Package Number W14B

