

May 1999

# LM160/LM360 High Speed Differential Comparator

## General Description

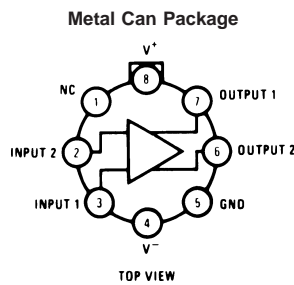
The LM160/LM360 is a very high speed differential input, complementary TTL output voltage comparator with improved characteristics over the  $\mu$ A760/ $\mu$ A760C, for which it is a pin-for-pin replacement. The device has been optimized for greater speed, input impedance and fan-out, and lower input offset voltage. Typically delay varies only 3 ns for overdrive variations of 5 mV to 400 mV.

Complementary outputs having minimum skew are provided. Applications involve high speed analog to digital convertors and zero-crossing detectors in disk file systems.

## Features

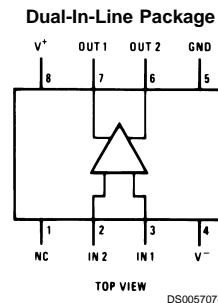
- Guaranteed high speed: 20 ns max
- Tight delay matching on both outputs
- Complementary TTL outputs
- High input impedance
- Low speed variation with overdrive variation
- Fan-out of 4
- Low input offset voltage
- Series 74 TTL compatible

## Connection Diagrams



Order Number LM160H/883 (Note 1) or LM360H  
See NS Package Number H08C

Note 1: Also available in SMD# 5962-8767401



Order Number LM360M or LM360N  
See NS Package Number M08A or N08E

LM160/LM360 High Speed Differential Comparator

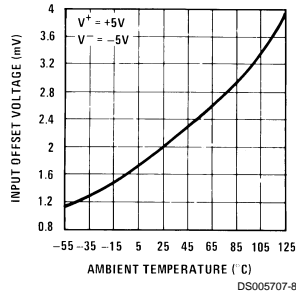
<b>Absolute Maximum Ratings</b> (Notes 6, 8)		Storage Temperature Range	-65°C to +150°C		
<b>If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.</b>		Lead Temperature			
Positive Supply Voltage	+8V	(Soldering, 10 sec.)	260°C		
Negative Supply Voltage	-8V	Soldering Information			
Peak Output Current	20 mA	Dual-In-Line Package			
Differential Input Voltage	±5V	Soldering (10 seconds)	260°C		
Input Voltage	$V^+ \geq V_{IN} \geq V^-$	Small Outline Package			
ESD Tolerance (Note 9)	1600V	Vapor Phase (60 seconds)	215°C		
Operating Temperature Range		Infrared (15 seconds)	220°C		
LM160	-55°C to +125°C	See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods of soldering surface mount devices.			
LM360	0°C to +70°C				
<b>Electrical Characteristics</b>					
(T <sub>MIN</sub> ≤ T <sub>A</sub> ≤ T <sub>MAX</sub> )					
Parameter	Conditions	Min	Typ	Max	Units
Operating Conditions					
Supply Voltage V <sub>CC</sub> <sup>+</sup>		4.5	5	6.5	V
Supply Voltage V <sub>CC</sub> <sup>-</sup>		-4.5	-5	-6.5	V
Input Offset Voltage	R <sub>S</sub> ≤ 200Ω		2	5	mV
Input Offset Current			0.5	3	μA
Input Bias Current			5	20	μA
Output Resistance (Either Output)	V <sub>OUT</sub> = V <sub>OH</sub>		100		Ω
Response Time					
	T <sub>A</sub> = 25°C, V <sub>S</sub> = ±5V (Notes 2, 7)		13	25	ns
	T <sub>A</sub> = 25°C, V <sub>S</sub> = ±5V (Notes 3, 7)		12	20	ns
	T <sub>A</sub> = 25°C, V <sub>S</sub> = ±5V (Notes 4, 7)		14		ns
Response Time Difference between Outputs					
(t <sub>pd</sub> of +V <sub>IN1</sub> ) - (t <sub>pd</sub> of -V <sub>IN2</sub> )	T <sub>A</sub> = 25°C (Notes 2, 7)		2		ns
(t <sub>pd</sub> of +V <sub>IN2</sub> ) - (t <sub>pd</sub> of -V <sub>IN1</sub> )	T <sub>A</sub> = 25°C (Notes 2, 7)		2		ns
(t <sub>pd</sub> of +V <sub>IN1</sub> ) - (t <sub>pd</sub> of +V <sub>IN2</sub> )	T <sub>A</sub> = 25°C (Notes 2, 7)		2		ns
(t <sub>pd</sub> of -V <sub>IN1</sub> ) - (t <sub>pd</sub> of -V <sub>IN2</sub> )	T <sub>A</sub> = 25°C (Notes 2, 7)		2		ns
Input Resistance	f = 1 MHz		17		kΩ
Input Capacitance	f = 1 MHz		3		pF
Average Temperature Coefficient of Input Offset Voltage	R <sub>S</sub> = 50Ω		8		μV/°C
Average Temperature Coefficient of Input Offset Current			7		nA/°C
Common Mode Input Voltage Range	V <sub>S</sub> = ±6.5V	±4	±4.5		V
Differential Input Voltage Range		±5			V
Output High Voltage (Either Output)	I <sub>OUT</sub> = -320 μA, V <sub>S</sub> = ±4.5V	2.4	3		V
Output Low Voltage (Either Output)	I <sub>SINK</sub> = 6.4 mA		0.25	0.4	V
Positive Supply Current	V <sub>S</sub> = ±6.5V		18	32	mA
Negative Supply Current	V <sub>S</sub> = ±6.5V		-9	-16	mA
<b>Note 2:</b> Response time measured from the 50% point of a 30 mVp-p 10 MHz sinusoidal input to the 50% point of the output.					
<b>Note 3:</b> Response time measured from the 50% point of a 2 Vp-p 10 MHz sinusoidal input to the 50% point of the output.					
<b>Note 4:</b> Response time measured from the start of a 100 mV input step with 5 mV overdrive to the time when the output crosses the logic threshold.					
<b>Note 5:</b> Typical thermal impedances are as follows:					
Cavity DIP (J):	θ <sub>JA</sub>	135°C/W	Header (H)	θ <sub>JA</sub>	165°C/W (Still Air)
Molded DIP (N):	θ <sub>JA</sub>	130°C/W			67°C/W (400 LF/min Air Flow)
				θ <sub>JC</sub>	25°C/W
<b>Note 6:</b> The device may be damaged if used beyond the maximum ratings.					
<b>Note 7:</b> Measurements are made in AC Test Circuit, Fanout = 1					
<b>Note 8:</b> Refer to RETS 160X for LM160H, LM160J-14 and LM160J military specifications.					

## Electrical Characteristics (Continued)

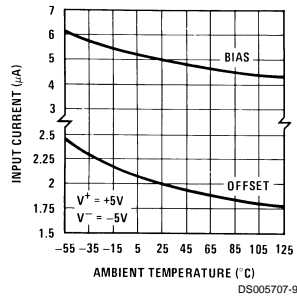
Note 9: Human body model, 1.5 kΩ in series with 100 pF.

### Typical Performance Characteristics

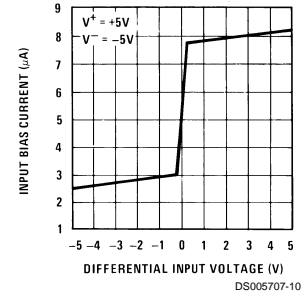
Offset Voltage



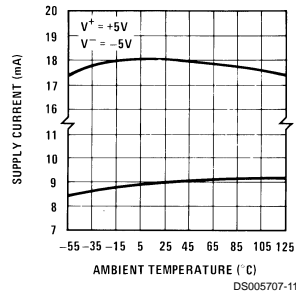
Input Current vs Ambient Temperature



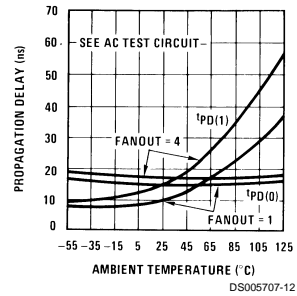
Input Characteristics



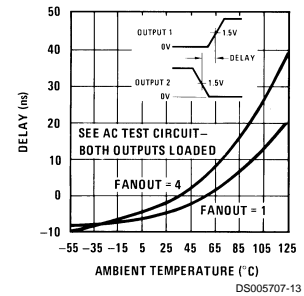
Supply Current vs Ambient Temperature



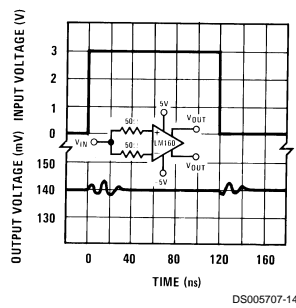
Propagation Delay vs Ambient Temperature



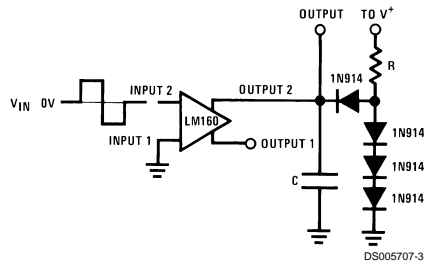
Delay of Output 1 With Respect to Output 2 vs Ambient Temperature



Common-Mode Pulse Response

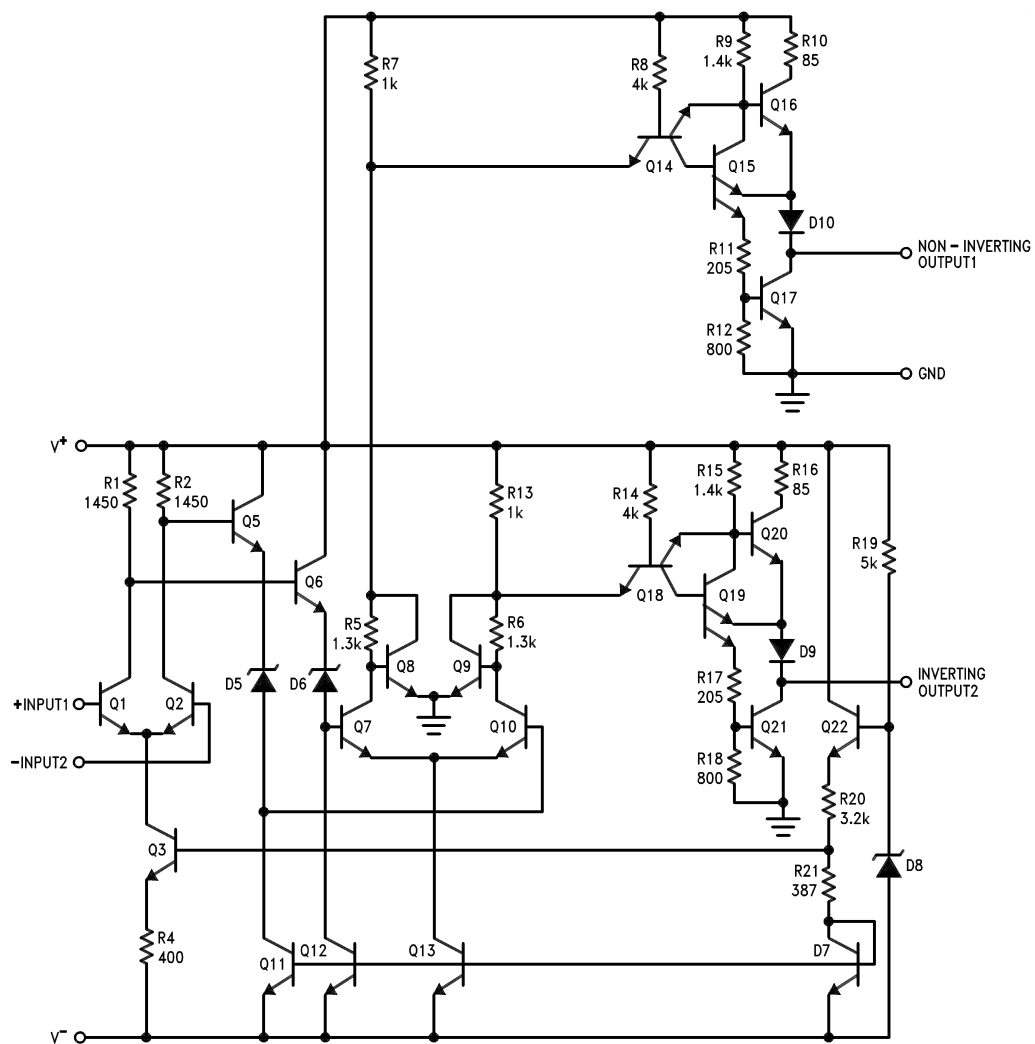


### AC Test Circuit



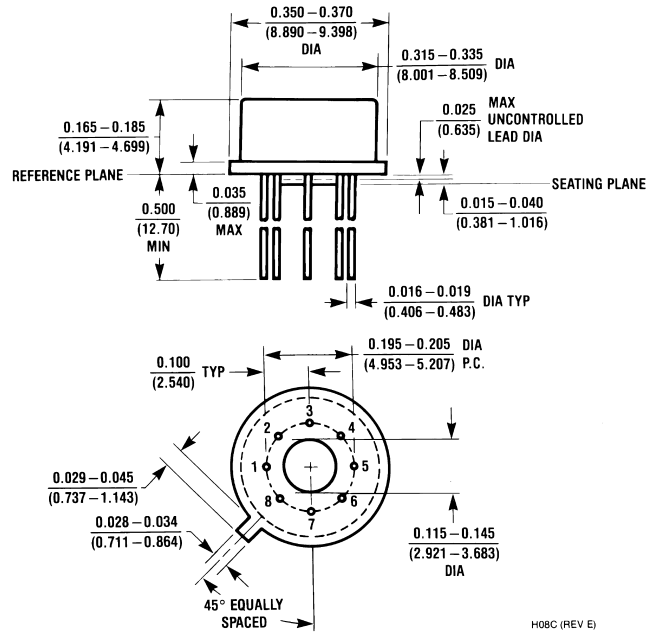
$V_{IN} = \pm 50 \text{ mV}$      $FANOUT=1$      $FANOUT=4$   
 $V^+ = +5V$          $R=2.4k$          $R=630\Omega$   
 $V^- = -5V$          $C=15 \text{ pF}$       $C=30 \text{ pF}$

### Schematic Diagram

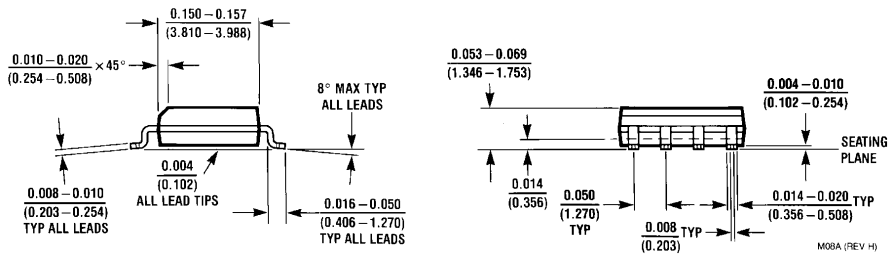
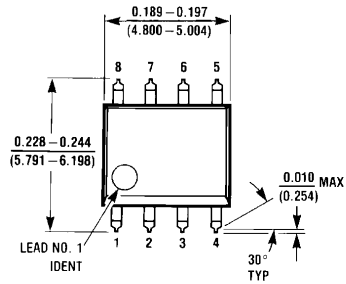


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**Physical Dimensions** inches (millimeters) unless otherwise noted

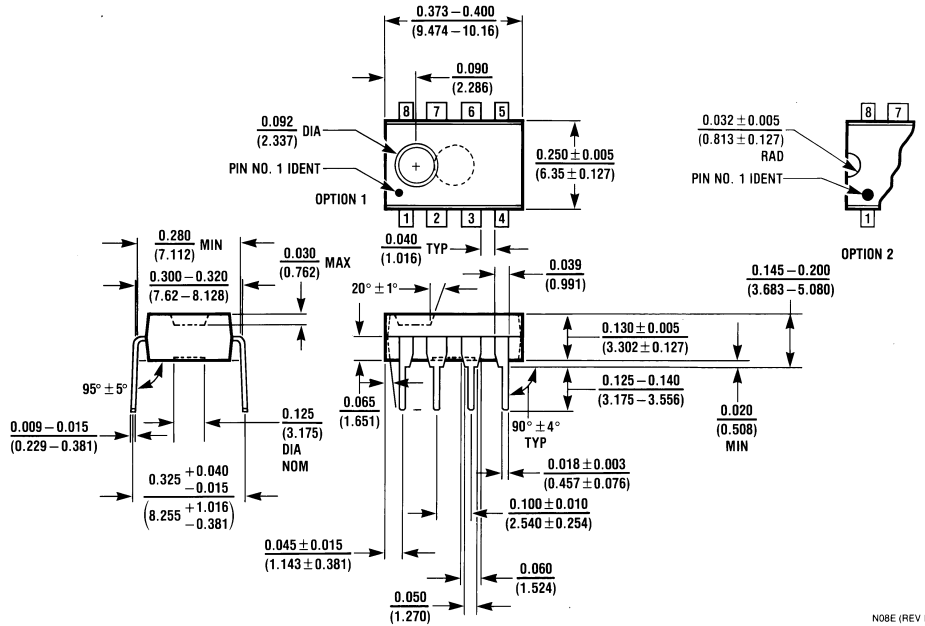


**Metal Can Package (H)**  
Order Number LM160H/883 or LM360H  
NS Package Number H08C



**Molded Dual-In-Line Package (M)**  
Order Number LM360M  
NS Package Number M08A

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



**Molded Dual-In-Line Package (N)**  
**Order Number LM360N**  
**NS Package Number N08E**

NO8E (REV F)

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