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# 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.

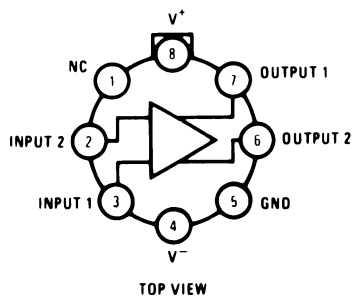
Complementary outputs having minimum skew are provided. Applications involve high speed analog to digital converters and zero-crossing detectors in disk file systems.

## 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

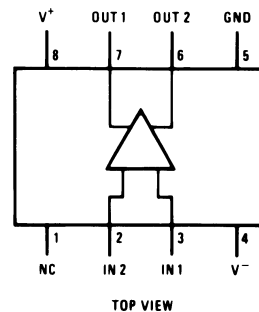
**Metal Can Package**



00570704

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

**Dual-In-Line Package**



00570705

Order Number LM360M, LM360MX or LM360N  
See NS Package Number M08A or N08E

**Note 1:** Also available in SMD# 5962-8767401

**Absolute Maximum Ratings** (Notes 6, 8)

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

Positive Supply Voltage	+8V
Negative Supply Voltage	-8V
Peak Output Current	20 mA
Differential Input Voltage	±5V
Input Voltage	$V^+ \geq V_{IN} \geq V^-$
ESD Tolerance (Note 9)	1600V
Operating Temperature Range	
LM160	-55°C to +125°C
LM360	0°C to +70°C

Storage Temperature Range	-65°C to +150°C
Lead Temperature	
(Soldering, 10 sec.)	260°C
Soldering Information	
Dual-In-Line Package	
Soldering (10 seconds)	260°C
Small Outline Package	
Vapor Phase (60 seconds)	215°C
Infrared (15 seconds)	220°C
See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods of soldering surface mount devices.	

**Electrical Characteristics**(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

**Note 2:** Response time measured from the 50% point of a 30 mVp-p 10 MHz sinusoidal input to the 50% point of the output.

**Note 3:** Response time measured from the 50% point of a 2 Vp-p 10 MHz sinusoidal input to the 50% point of the output.

## Electrical Characteristics (Continued)

**Note 4:** 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.

**Note 5:** Typical thermal impedances are as follows:

Cavity DIP (J):	$\theta_{jA}$	135°C/W	Header (H)	$\theta_{jA}$	165°C/W	(Still Air)
Molded DIP (N):	$\theta_{jA}$	130°C/W			67°C/W	(400 LF/min Air Flow)
				$\theta_{jC}$	25°C/W	

**Note 6:** The device may be damaged if used beyond the maximum ratings.

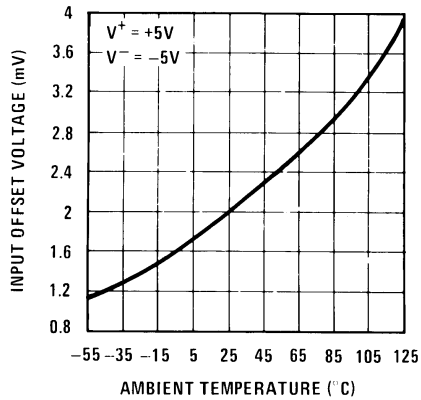
**Note 7:** Measurements are made in AC Test Circuit, Fanout = 1

**Note 8:** Refer to RETS 160X for LM160H, LM160J-14 and LM160J military specifications.

**Note 9:** Human body model, 1.5 k $\Omega$  in series with 100 pF.

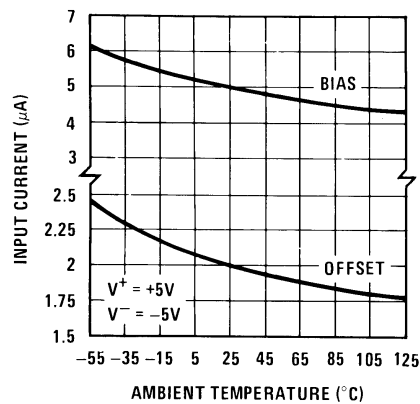
## Typical Performance Characteristics

Offset Voltage



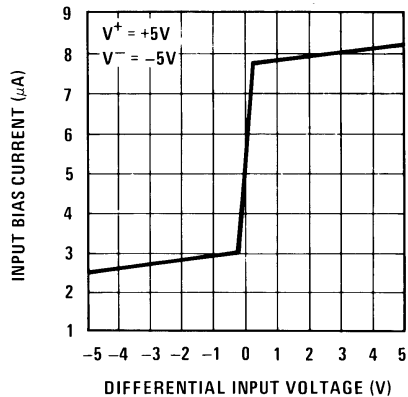
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Input Current vs Ambient Temperature



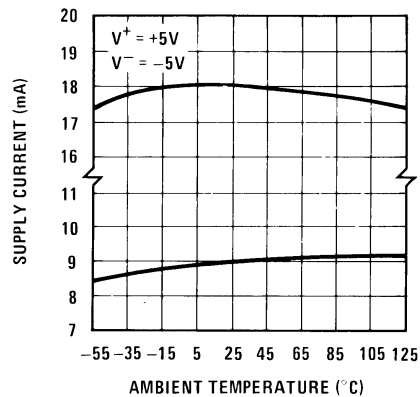
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Input Characteristics



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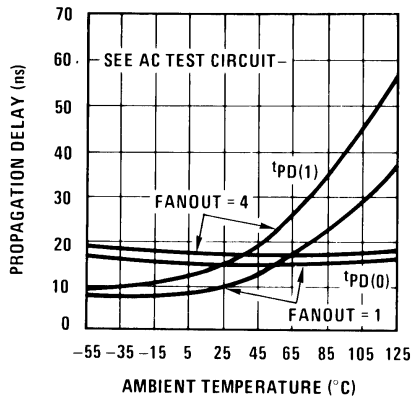
Supply Current vs Ambient Temperature



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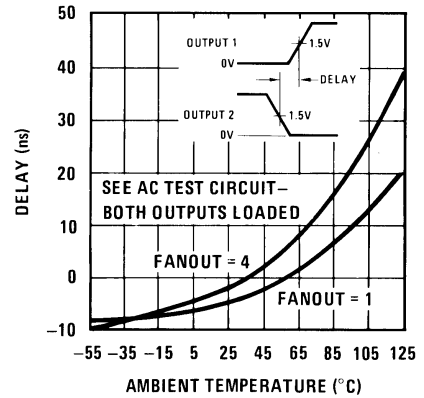
# Typical Performance Characteristics (Continued)

**Propagation Delay vs Ambient Temperature**



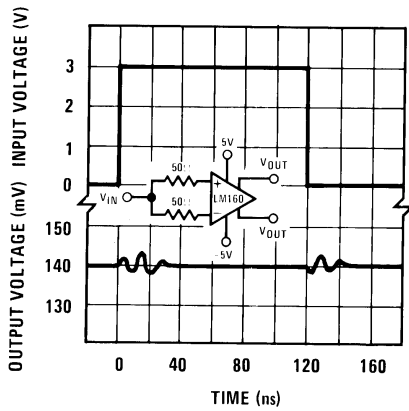
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**Delay of Output 1 With Respect to Output 2 vs Ambient Temperature**



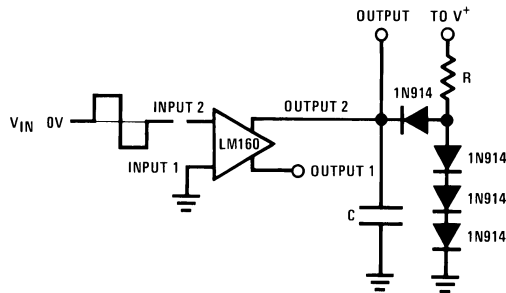
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**Common-Mode Pulse Response**



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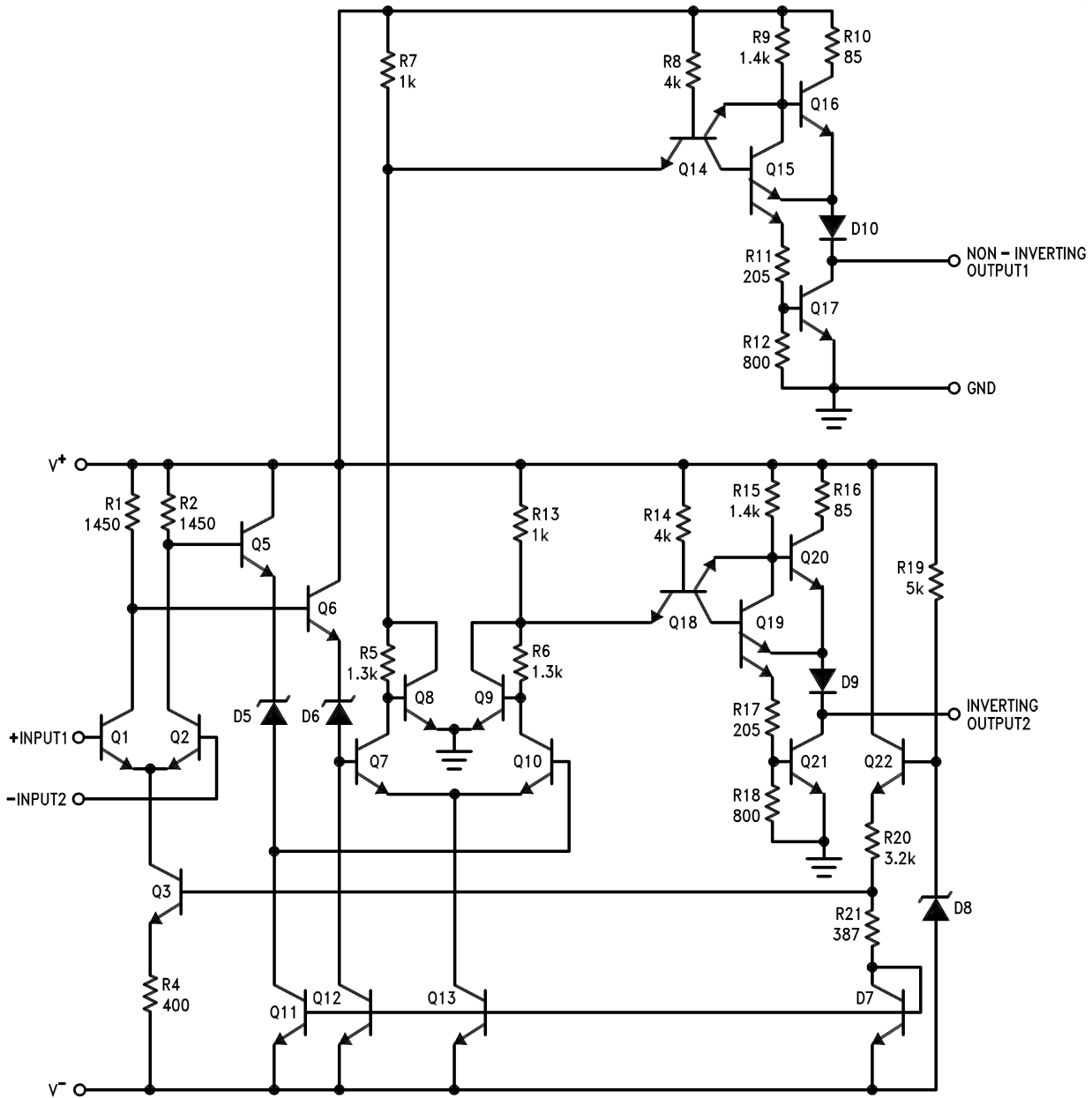
## AC Test Circuit



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

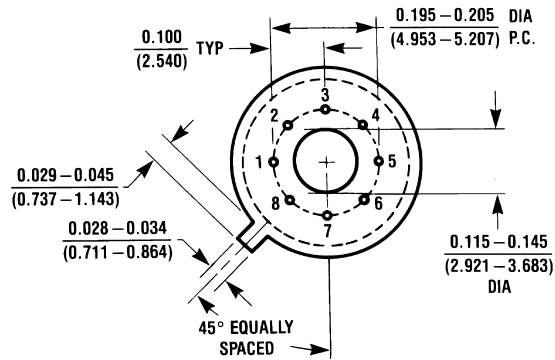
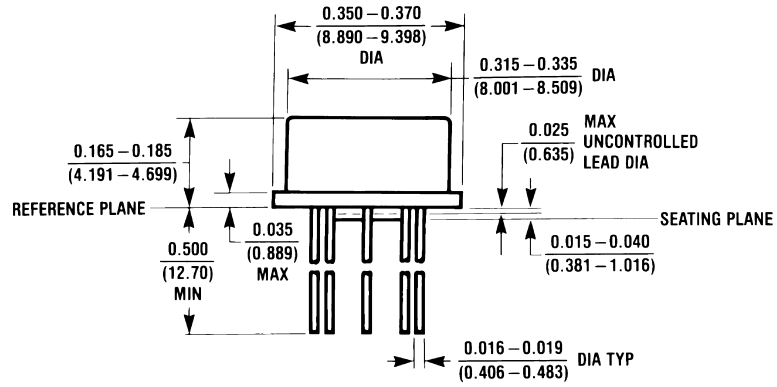
# Schematic Diagram



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**Physical Dimensions** inches (millimeters)

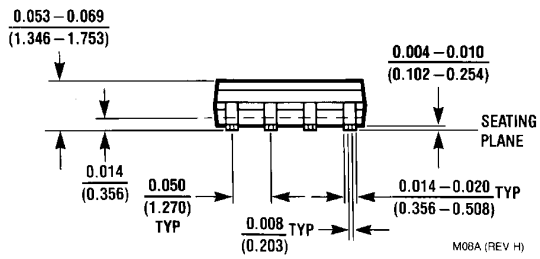
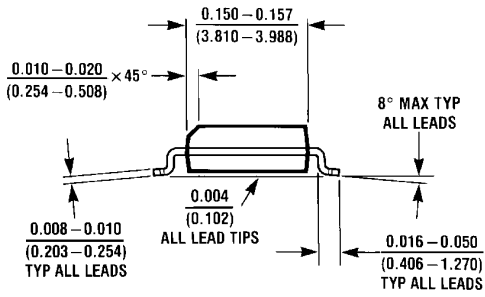
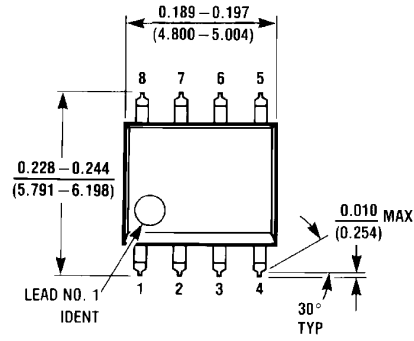
unless otherwise noted



H08C (REV E)

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

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

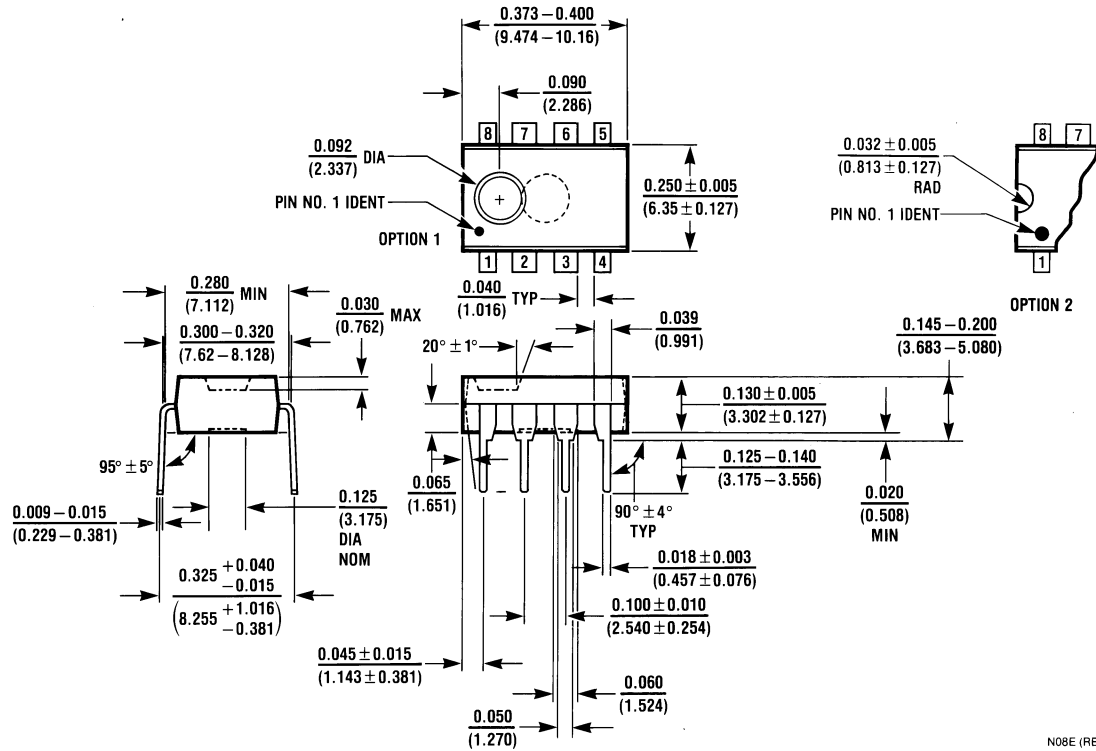


**Molded Dual-In-Line Package (M)**  
**Order Number LM360M or LM360MX**  
**NS Package Number M08A**

M08A (REV H)



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



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

N08E (REV F)

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