



## 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.

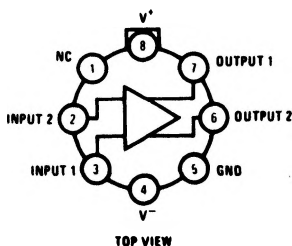
### Features

- Guaranteed high speed
- 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

20 ns max

### Connection Diagrams

**Metal Can Package**

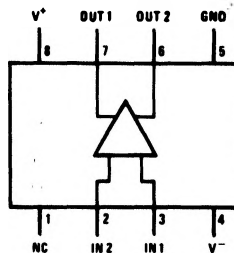


TOP VIEW

TL/H/5707-4

Order Number LM160H/883\* or LM360H  
See NS Package Number H08C

**Dual-In-Line Package**

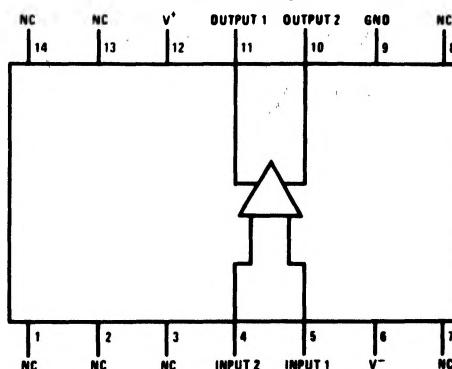


TOP VIEW

TL/H/5707-5

Order Number LM160J/883\*,  
LM360M or LM360N  
See NS Package Number J08A, M08A or N08E

**Dual-In-Package**



TOP VIEW

TL/H/5707-6

Order Number LM160J-14/883\*  
See NS Package Number J14A

\*Also available in SMD # 5962-8767401

**Absolute Maximum Ratings** (Note 5)

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

(Note 7)

|                            |                            |
|----------------------------|----------------------------|
| 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 8)     | 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** ( $T_{MIN} \leq T_A \leq T_{MAX}$ )

| Parameter                                                       | Conditions                                                 | Min  | Typ  | Max  | Units |
|-----------------------------------------------------------------|------------------------------------------------------------|------|------|------|-------|
| Operating Conditions                                            |                                                            |      |      |      |       |
| Supply Voltage $V_{CC}^+$                                       |                                                            | 4.5  | 5    | 6.5  | V     |
| Supply Voltage $V_{CC}^-$                                       |                                                            | -4.5 | -5   | -6.5 | V     |
| Input Offset Voltage                                            | $R_S \leq 200\Omega$                                       |      | 2    | 5    | mV    |
| Input Offset Current                                            |                                                            |      | 0.5  | 3    | μA    |
| Input Bias Current                                              |                                                            |      | 5    | 20   | μA    |
| Output Resistance (Either Output)                               | $V_{OUT} = V_{OH}$                                         |      | 100  |      | Ω     |
| Response Time                                                   | $T_A = 25^\circ\text{C}, V_S = \pm 5\text{V}$ (Notes 1, 6) |      | 13   | 25   | ns    |
|                                                                 | $T_A = 25^\circ\text{C}, V_S = \pm 5\text{V}$ (Notes 2, 6) |      | 12   | 20   | ns    |
|                                                                 | $T_A = 25^\circ\text{C}, V_S = \pm 5\text{V}$ (Notes 3, 6) |      | 14   |      | ns    |
| Response Time Difference between Outputs                        |                                                            |      |      |      |       |
| $(t_{pd} \text{ of } +V_{IN1}) - (t_{pd} \text{ of } -V_{IN2})$ | $T_A = 25^\circ\text{C}$ (Notes 1, 6)                      |      | 2    |      | ns    |
| $(t_{pd} \text{ of } +V_{IN2}) - (t_{pd} \text{ of } -V_{IN1})$ | $T_A = 25^\circ\text{C}$ (Notes 1, 6)                      |      | 2    |      | ns    |
| $(t_{pd} \text{ of } +V_{IN1}) - (t_{pd} \text{ of } +V_{IN2})$ | $T_A = 25^\circ\text{C}$ (Notes 1, 6)                      |      | 2    |      | ns    |
| $(t_{pd} \text{ of } -V_{IN1}) - (t_{pd} \text{ of } -V_{IN2})$ | $T_A = 25^\circ\text{C}$ (Notes 1, 6)                      |      | 2    |      | ns    |
| Input Resistance                                                | $f = 1 \text{ MHz}$                                        |      | 17   |      | kΩ    |
| Input Capacitance                                               | $f = 1 \text{ MHz}$                                        |      | 3    |      | pF    |
| Average Temperature Coefficient of Input Offset Voltage         | $R_S = 50\Omega$                                           |      | 8    |      | μV/°C |
| Average Temperature Coefficient of Input Offset Current         |                                                            |      | 7    |      | nA/°C |
| Common Mode Input Voltage Range                                 | $V_S = \pm 6.5\text{V}$                                    | ±4   | ±4.5 |      | V     |
| Differential Input Voltage Range                                |                                                            | ±5   |      |      | V     |
| Output High Voltage (Either Output)                             | $I_{OUT} = -320 \mu\text{A}, V_S = \pm 4.5\text{V}$        | 2.4  | 3    |      | V     |
| Output Low Voltage (Either Output)                              | $I_{SINK} = 6.4 \text{ mA}$                                |      | 0.25 | 0.4  | V     |
| Positive Supply Current                                         | $V_S = \pm 6.5\text{V}$                                    |      | 18   | 32   | mA    |
| Negative Supply Current                                         | $V_S = \pm 6.5\text{V}$                                    |      | -9   | -16  | mA    |

Note 1: Response time measured from the 50% point of a 30 mVp-p 10 MHz sinusoidal input to the 50% point of the output.

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

Note 3: 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 4: 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  |                       |

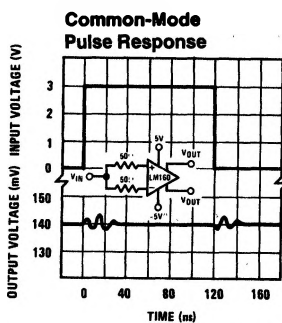
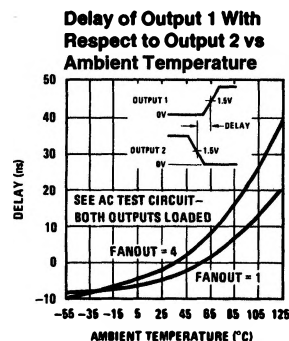
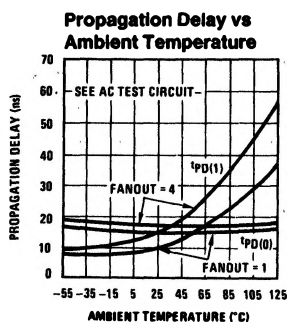
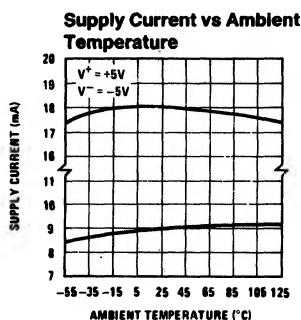
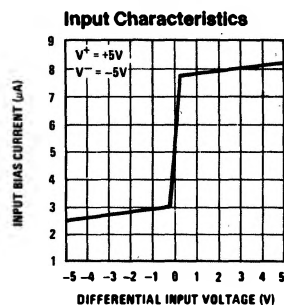
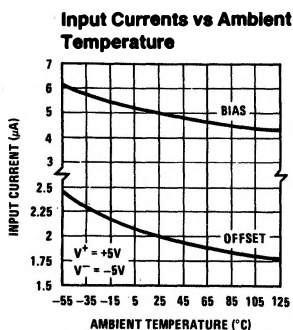
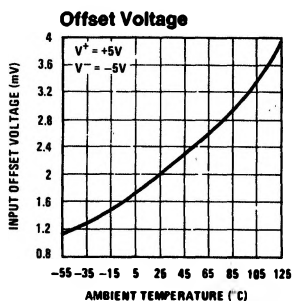
Note 5: The device may be damaged if used beyond the maximum ratings.

Note 6: Measurements are made in AC Test Circuit, Fanout = 1

Note 7: Refer to RETS 180X for LM160H, LM160J-14 and LM160J military specifications.

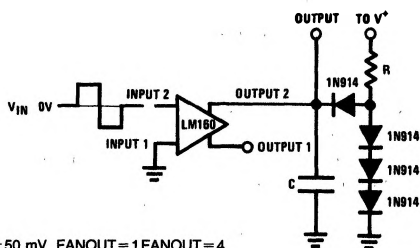
Note 8: Human body model, 1.5 kΩ in series with 100 pF.

# Typical Performance Characteristics



TL/H/5707-2

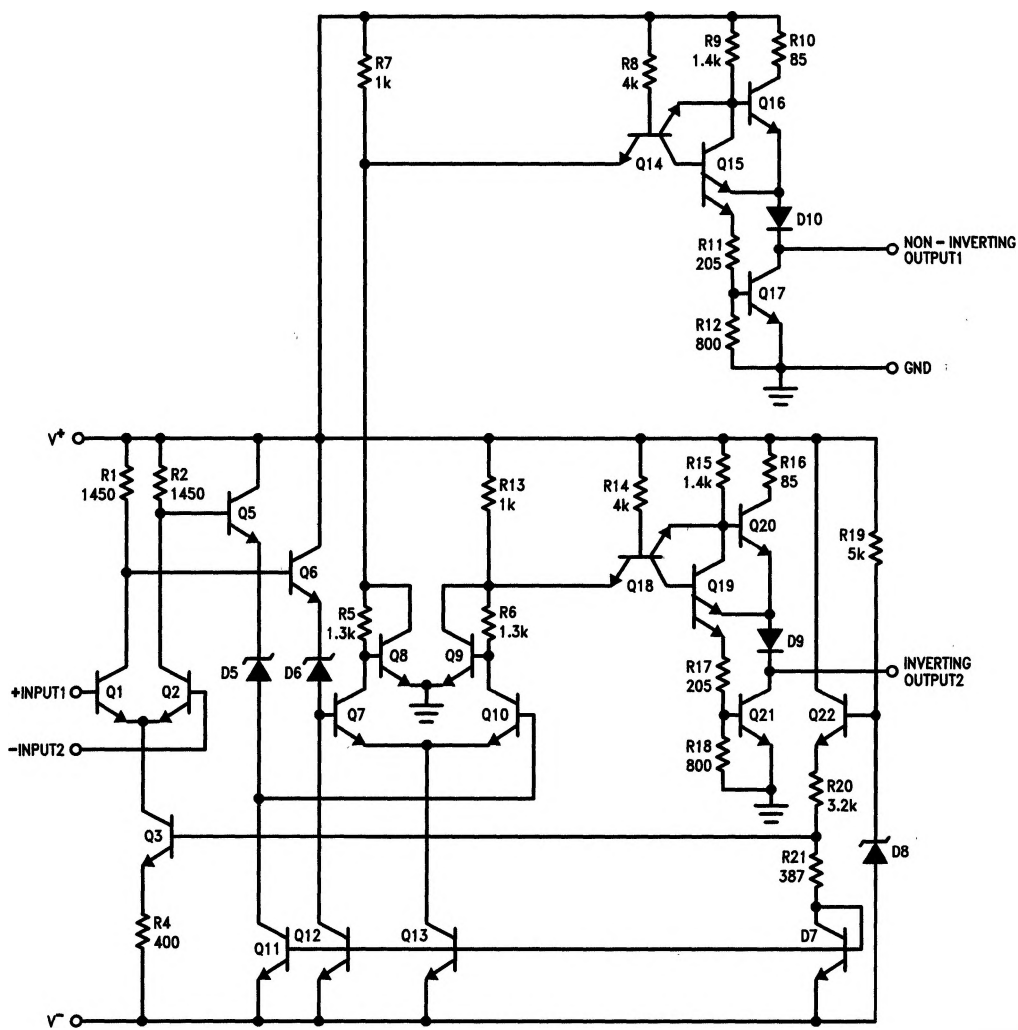
## AC Test Circuit



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

TL/H/5707-3

## Schematic Diagram



TL/H/5707-1