

## LM161/LM261/LM361 High Speed Differential Comparators

### General Description

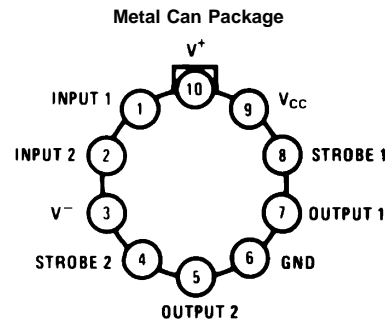
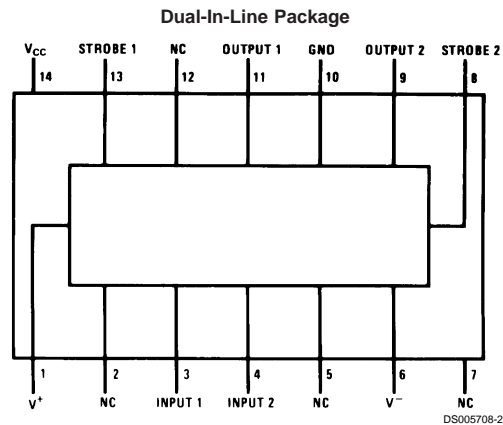
The LM161/LM261/LM361 is a very high speed differential input, complementary TTL output voltage comparator with improved characteristics over the SE529/NE529 for which it is a pin-for-pin replacement. The device has been optimized for greater speed performance and lower input offset voltage. Typically delay varies only 3 ns for over-drive variations of 5 mV to 500 mV. It may be operated from op amp supplies ( $\pm 15V$ ).

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

### Features

- Independent strobes
- Guaranteed high speed: 20 ns max
- Tight delay matching on both outputs
- Complementary TTL outputs
- Operates from op amp supplies:  $\pm 15V$
- Low speed variation with overdrive variation
- Low input offset voltage
- Versatile supply voltage range

### Connection Diagrams



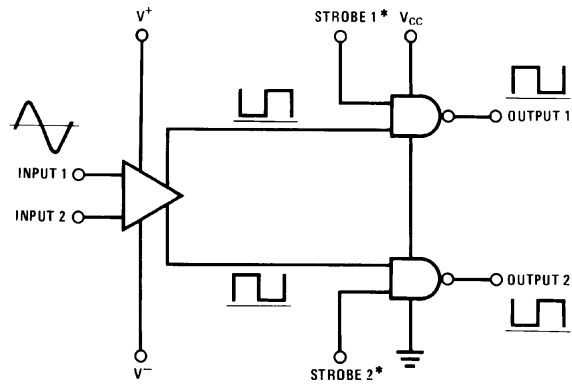
DS005708-3

Order Number LM161H/883 (Note 1), or LM361H  
See NS Package Number H10C

**Top View**  
Order Number LM161J  
LM361M or LM361N  
See NS Package Number M14A or N14A

**Note 1:** Also available per SMD #5962-8757203

## Logic Diagram



DS005708-4

\*Output is low when current is drawn from strobe pin.

## Absolute Maximum Ratings (Note 2)

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

|                                    |                     |
|------------------------------------|---------------------|
| Positive Supply Voltage, $V^+$     | +16V                |
| Negative Supply Voltage, $V^-$     | -16V                |
| Gate Supply Voltage, $V_{CC}$      | +7V                 |
| Output Voltage                     | +7V                 |
| Differential Input Voltage         | ±5V                 |
| Input Common Mode Voltage          | ±6V                 |
| Power Dissipation                  | 600 mW              |
| Storage Temperature Range          | -65°C to +150°C     |
| Operating Temperature Range        | $T_{MIN}$ $T_{MAX}$ |
| LM161                              | -55°C to +125°C     |
| LM261                              | -25°C to +85°C      |
| LM361                              | 0°C to +70°C        |
| Lead Temp. (Soldering, 10 seconds) | 260°C               |
| For Any Device Lead Below $V^-$    | 0.3V                |

## Operating Conditions

|                          | Min   | Typ | Max   |
|--------------------------|-------|-----|-------|
| Supply Voltage $V^+$     |       |     |       |
| LM161/LM261              | 5V    |     | 15V   |
| LM361                    | 5V    |     | 15V   |
| Supply Voltage $V^-$     |       |     |       |
| LM161/LM261              | -6V   |     | -15V  |
| LM361                    | -6V   |     | -15V  |
| Supply Voltage $V_{CC}$  |       |     |       |
| LM161/LM261              | 4.5V  | 5V  | 5.5V  |
| LM361                    | 4.75V | 5V  | 5.25V |
| ESD Tolerance (Note 6)   |       |     | 1600V |
| 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

( $V^+ = +10V$ ,  $V_{CC} = +5V$ ,  $V^- = -10V$ ,  $T_{MIN} \leq T_A \leq T_{MAX}$ , unless noted)

| Parameter                                     | Conditions  | Limits      |     |      |       |     |      | Units         |
|---|---|-------------|-----|------|-------|-----|------|---------------|
|   |   | LM161/LM261 |     |      | LM361 |     |      |               |
|   |   | Min         | Typ | Max  | Min   | Typ | Max  |               |
| Input Offset Voltage                          |   |             | 1   | 3    |       | 1   | 5    | mV            |
| Input Bias Current                            | $T_A = 25^\circ\text{C}$  |             | 5   | 20   |       | 10  | 30   | $\mu\text{A}$ |
| Input Offset Current                          | $T_A = 25^\circ\text{C}$  |             | 2   | 3    |       | 2   | 5    | $\mu\text{A}$ |
| Voltage Gain                                  | $T_A = 25^\circ\text{C}$  |             | 3   |      |       | 3   |      | V/mV          |
| Input Resistance                              | $T_A = 25^\circ\text{C}$ , $f = 1\text{ kHz}$   |             | 20  |      |       | 20  |      | k $\Omega$    |
| Logical "1" Output Voltage                    | $V_{CC} = 4.75V$ ,<br>$I_{SOURCE} = -0.5\text{ mA}$   | 2.4         | 3.3 |      | 2.4   | 3.3 |      | V             |
| Logical "0" Output Voltage                    | $V_{CC} = 4.75V$ ,<br>$I_{SINK} = 6.4\text{ mA}$  |             |     | 0.4  |       |     | 0.4  | V             |
| Strobe Input "1" Current<br>(Output Enabled)  | $V_{CC} = 5.25V$ ,<br>$V_{STROBE} = 2.4V$   |             |     | 200  |       |     | 200  | $\mu\text{A}$ |
| Strobe Input "0" Current<br>(Output Disabled) | $V_{CC} = 5.25V$ ,<br>$V_{STROBE} = 0.4V$   |             |     | -1.6 |       |     | -1.6 | mA            |
| Strobe Input "0" Voltage                      | $V_{CC} = 4.75V$  |             |     | 0.8  |       |     | 0.8  | V             |
| Strobe Input "1" Voltage                      | $V_{CC} = 4.75V$  | 2           |     |      | 2     |     |      | V             |
| Output Short Circuit Current                  | $V_{CC} = 5.25V$ , $V_{OUT} = 0V$   | -18         |     | -55  | -18   |     | -55  | mA            |
| Supply Current $I^+$                          | $V^+ = 10V$ , $V^- = -10V$ ,<br>$V_{CC} = 5.25V$ ,<br>$-55^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ |             |     | 4.5  |       |     |      | mA            |
| Supply Current $I^+$                          | $V^+ = 10V$ , $V^- = -10V$ ,<br>$V_{CC} = 5.25V$ ,<br>$0^\circ\text{C} \leq T_A < 70^\circ\text{C}$       |             |     |      |       | 5   |      | mA            |
| Supply Current $I^-$                          | $V^+ = 10V$ , $V^- = -10V$ ,<br>$V_{CC} = 5.25V$ ,<br>$-55^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ |             |     | 10   |       |     |      | mA            |

## Electrical Characteristics (Continued)

( $V^+ = +10V$ ,  $V_{CC} = +5V$ ,  $V^- = -10V$ ,  $T_{MIN} \leq T_A \leq T_{MAX}$ , unless noted)

| Parameter                              | Conditions  | Limits      |     |     |       |     |     | Units |
|--|---|-------------|-----|-----|-------|-----|-----|-------|
|  |   | LM161/LM261 |     |     | LM361 |     |     |       |
|  |   | Min         | Typ | Max | Min   | Typ | Max |       |
| Supply Current $I^-$                   | $V^+ = 10V$ ,<br>$V^- = -10V$ , $V_{CC} = 5.25V$ ,<br>$0^\circ C \leq T_A \leq 70^\circ C$    |             |     |     |       |     | 10  | mA    |
| Supply Current $I_{CC}$                | $V^+ = 10V$ , $V^- = -10V$ ,<br>$V_{CC} = 5.25V$ ,<br>$-55^\circ C \leq T_A \leq 125^\circ C$ |             |     | 18  |       |     |     | mA    |
| Supply Current $I_{CC}$                | $V^+ = 10V$ , $V^- = -10V$ ,<br>$V_{CC} = 5.25V$ ,<br>$0^\circ C \leq T_A \leq 70^\circ C$    |             |     |     |       |     | 20  | mA    |
| Transient Response                     | $V_{IN} = 50$ mV overdrive<br>(Note 4)  |             |     |     |       |     |     |       |
| Propagation Delay Time ( $t_{pd(0)}$ ) | $T_A = 25^\circ C$  |             | 14  | 20  |       | 14  | 20  | ns    |
| Propagation Delay Time ( $t_{pd(1)}$ ) | $T_A = 25^\circ C$  |             | 14  | 20  |       | 14  | 20  | ns    |
| Delay Between Output A and B           | $T_A = 25^\circ C$  |             | 2   | 5   |       | 2   | 5   | ns    |
| Strobe Delay Time ( $t_{pd(0)}$ )      | $T_A = 25^\circ C$  |             | 8   |     |       | 8   |     | ns    |
| Strobe Delay Time ( $t_{pd(1)}$ )      | $T_A = 25^\circ C$  |             | 8   |     |       | 8   |     | ns    |

**Note 2:** The device may be damaged by use beyond the maximum ratings.

**Note 3:** Typical thermal impedances are as follows:

|               | H Package  | J Package | N Package |
|---------------|--|-----------|-----------|
| $\theta_{JA}$ | 165°C/W (Still Air)<br>67°C/W (400 LF/Min<br>Air Flow) | 112°C/W   | 105°C/W   |
| $\theta_{JC}$ | 25°C/W   |           |           |

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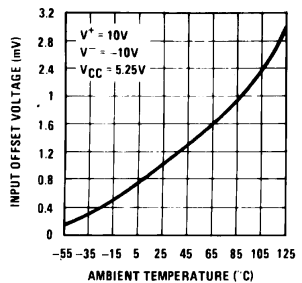
**Note 4:** Measurements using AC Test circuit, Fanout = 1. The devices are faster at low supply voltages.

**Note 5:** Refer to RETS161X for LM161H and LM161J military specifications.

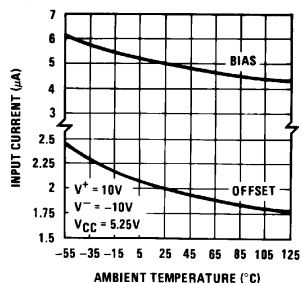
**Note 6:** Human body model, 1.5 k $\Omega$  in series with 100 pF.

## Typical Performance Characteristics

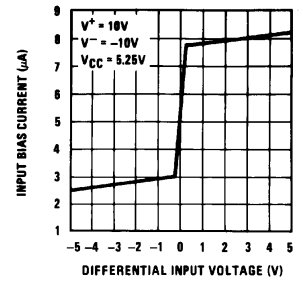
Offset Voltage



Input Currents vs Ambient Temperature

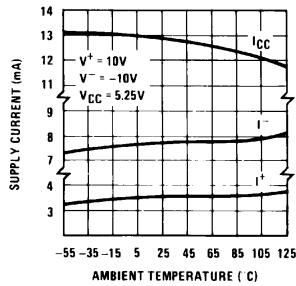


Input Characteristics

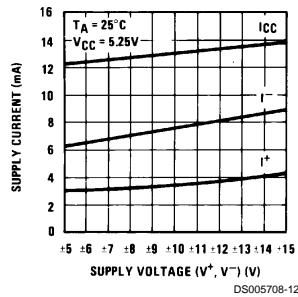


## Typical Performance Characteristics (Continued)

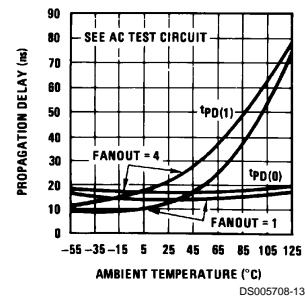
Supply Current vs Ambient Temperature



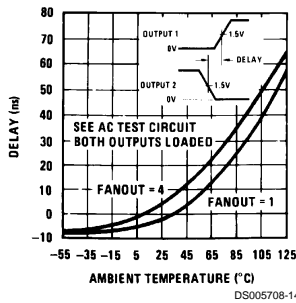
Supply Current vs Supply Voltage



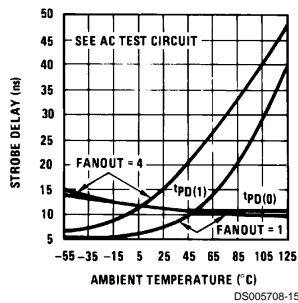
Propagation Delay vs Ambient Temperature



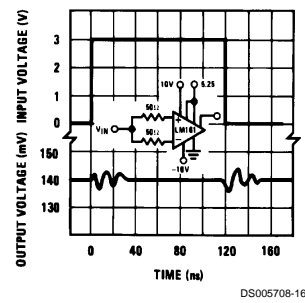
Delay of Output 1 With Respect to Output 2 vs Ambient Temperature



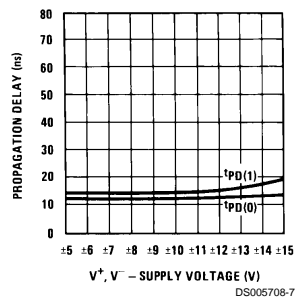
Strobe Delay vs Ambient Temperature



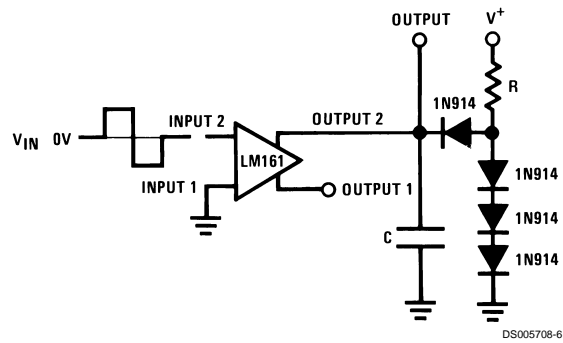
Common-Mode Pulse Response



Propagation Delay vs Supply Voltage

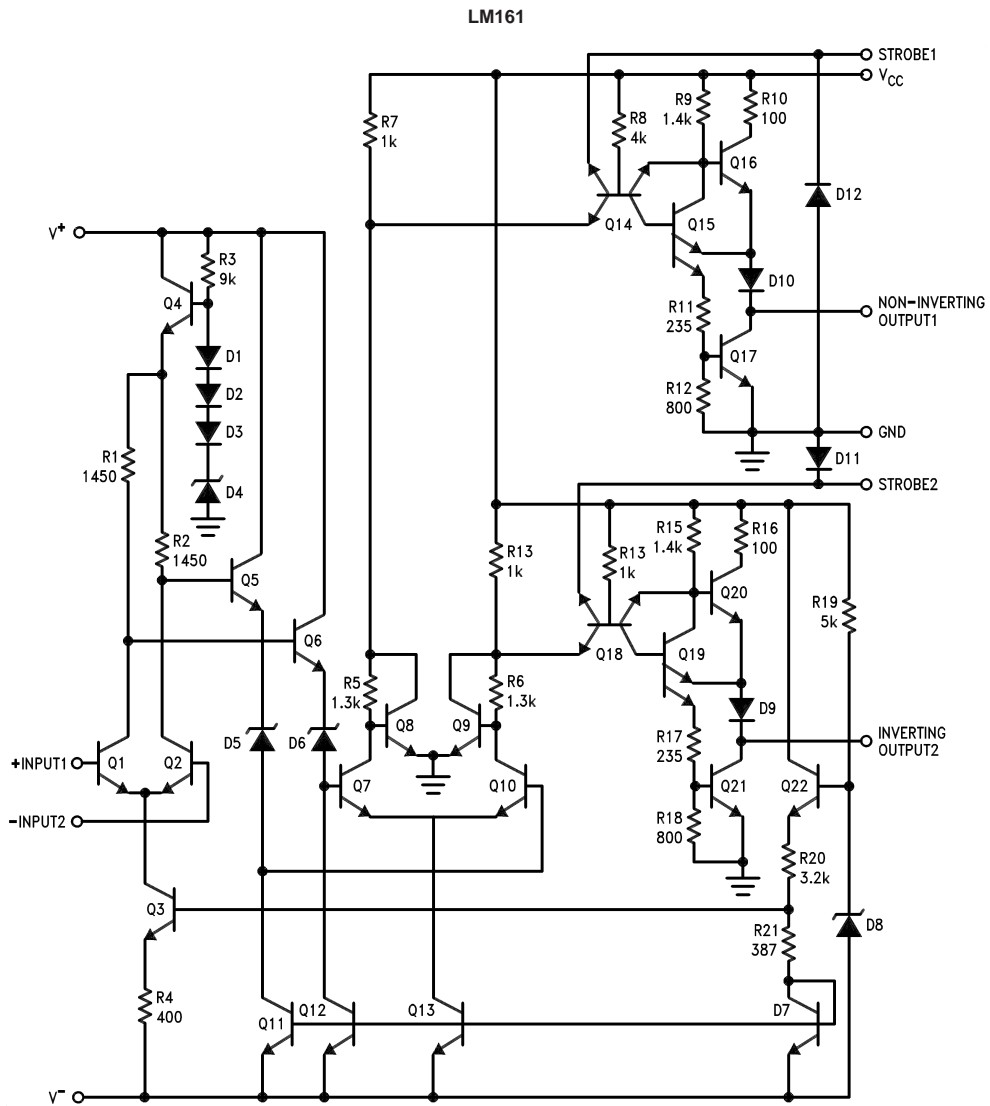


## AC Test Circuit



|                              |                     |                     |
|------------------------------|---------------------|---------------------|
| $V_{IN} = \pm 50 \text{ mV}$ | FANOUT = 1          | FANOUT = 4          |
| $V^+ = +10\text{V}$          | $R = 2.4\text{k}$   | $R = 680\Omega$     |
| $V^- = -10\text{V}$          | $C = 15 \text{ pF}$ | $C = 30 \text{ pF}$ |
| $V_{CC} = 5.25\text{V}$      |                     |                     |

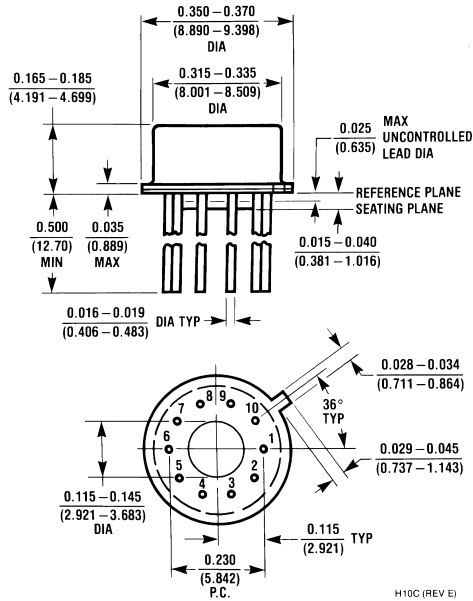
# Schematic Diagram



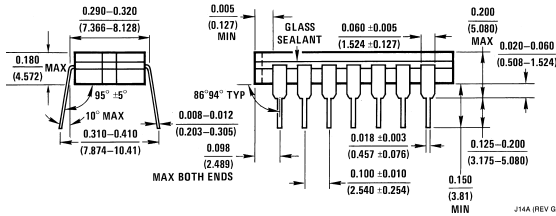
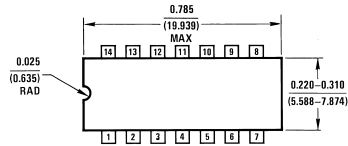
R10, R16: 85  
R11, R17: 205

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



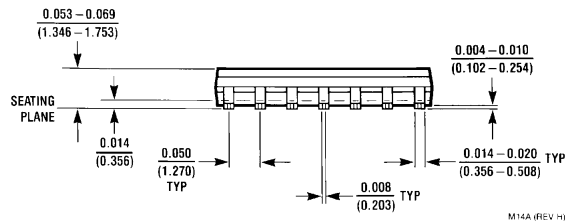
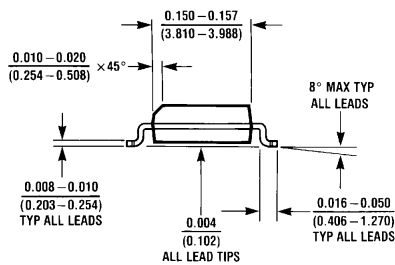
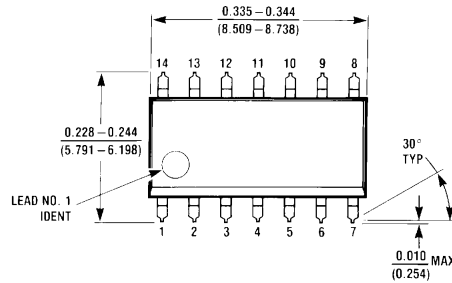
**Metal Can Package (H)**  
Order Number LM161H/883, or LM361H  
NS Package Number H10C



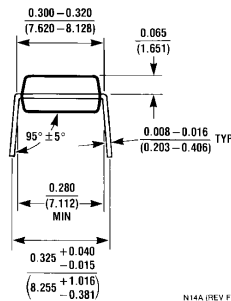
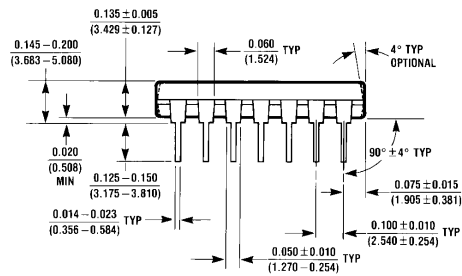
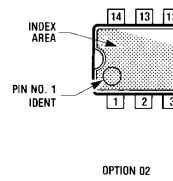
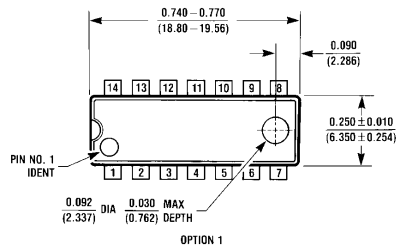
**Ceramic Dual-In-Line Package (J)**  
Order Number LM161J  
NS Package Number J14A



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



Order Number LM361M  
NS Package Number M14A



Molded Dual-In-Line Package (N)  
Order Number LM361N  
NS Package Number N14A

## Notes

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