

## LM161/LM361 High Speed Differential Comparators

 Check for Samples: [LM161](#), [LM361](#)

### FEATURES

- Independent strobes
- Ensured 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

### DESCRIPTION

The LM161/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.

### CONNECTION DIAGRAMS

#### SOIC or PDIP Package

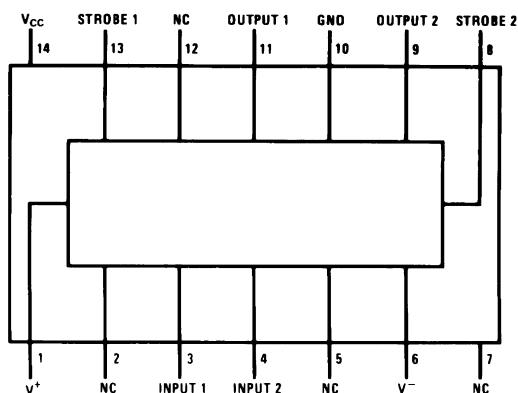


Figure 1. Top View  
Package Numbers D0014A, NFF0014A

#### TO-100 Package

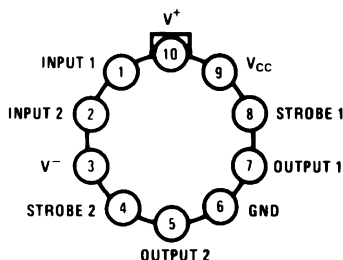


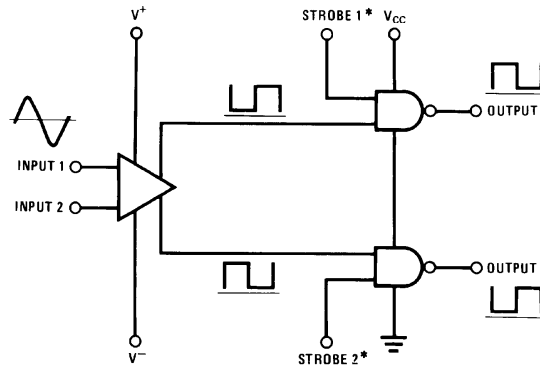
Figure 2. Package Number LME0010C



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**LOGIC DIAGRAM**



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



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

**Absolute Maximum Ratings <sup>(1)</sup>**

|  |   |
|--|---|
| Positive Supply Voltage, V <sup>+</sup>  | +16V  |
| Negative Supply Voltage, V <sup>-</sup>  | -16V  |
| Gate Supply Voltage, V <sub>CC</sub>     | +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              | <b>T<sub>MIN</sub></b> <b>T<sub>MAX</sub></b> |
| LM161                                    | -55°C to +125°C                               |
|  | -25°C to +85°C                                |
| LM361                                    | 0°C to +70°C                                  |
| Lead Temp. (Soldering, 10 seconds)       | 260°C   |
| For Any Device Lead Below V <sup>-</sup> | 0.3V  |

(1) The device may be damaged by use beyond the maximum ratings.

**Operating Conditions**

|                                      |              | Min                                   | Typ | Max   |
|--------------------------------------|--------------|---------------------------------------|-----|-------|
| Supply Voltage V <sup>+</sup>        | LM161        | 5V                                    |     | 15V   |
|                                      | LM361        | 5V                                    |     | 15V   |
| Supply Voltage V <sup>-</sup>        | LM161        | -6V                                   |     | -15V  |
|                                      | LM361        | -6V                                   |     | -15V  |
| Supply Voltage V <sub>CC</sub>       | LM161        | 4.5V                                  | 5V  | 5.5V  |
|                                      | LM361        | 4.75V                                 | 5V  | 5.25V |
| ESD Tolerance <sup>(1)</sup>         |              |                                       |     | 1600V |
| Soldering Information <sup>(2)</sup> | PDIP Package | Soldering (10 seconds) <sup>(2)</sup> |     | 260°C |
|                                      | SOIC Package | Vapor Phase (60 seconds)              |     | 215°C |
|                                      |              | Infrared (15 seconds)                 |     | 220°C |

(1) Human body model, 1.5 kΩ in series with 100 pF.

(2) See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods of soldering surface mount devices.

**Electrical Characteristics**<sup>(1)(2)(1)</sup>
 $(V^+ = +10V, V_{CC} = +5V, V^- = -10V, T_{MIN} \leq T_A \leq T_{MAX}, \text{ unless noted})$ 

| Parameter                                     | Conditions   | Limits |     |      |       |     |      | Units |                                |
|---|--|--------|-----|------|-------|-----|------|-------|--------------------------------|
|   |  | LM161  |     |      | 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    | $\mu\text{A}$<br>$\mu\text{A}$ |
| Input Offset Current                          | $T_A=25^\circ\text{C}$   |        | 2   | 3    |       |     | 2    | 5     | $\mu\text{A}$<br>$\mu\text{A}$ |
| 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>$0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$    |        |     |      |       |     | 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                             |
| Supply Current $I^-$                          | $V^+=10V,$<br>$V^-=-10V, V_{CC}=5.25V,$<br>$0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$    |        |     |      |       |     | 10   |       | mA                             |
| Supply Current $I_{CC}$                       | $V^+=10V, V^-=-10V,$<br>$V_{CC}=5.25V,$<br>$-55^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$ |        |     | 18   |       |     |      |       | mA                             |
| Supply Current $I_{CC}$                       | $V^+=10V, V^-=-10V,$<br>$V_{CC}=5.25V,$<br>$0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$    |        |     |      |       |     | 20   |       | mA                             |
| Transient Response                            | $V_{IN} = 50\text{ mV overdrive}^{(3)}$  |        |     |      |       |     |      |       |                                |
| Propagation Delay Time ( $t_{pd(0)}$ )        | $T_A=25^\circ\text{C}$   |        | 14  | 20   |       |     | 14   | 20    | ns                             |
| Propagation Delay Time ( $t_{pd(1)}$ )        | $T_A=25^\circ\text{C}$   |        | 14  | 20   |       |     | 14   | 20    | ns                             |
| Delay Between Output A and B                  | $T_A=25^\circ\text{C}$   |        | 2   | 5    |       |     | 2    | 5     | ns                             |
| Strobe Delay Time ( $t_{pd(0)}$ )             | $T_A=25^\circ\text{C}$   |        | 8   |      |       |     | 8    |       | ns                             |
| Strobe Delay Time ( $t_{pd(1)}$ )             | $T_A=25^\circ\text{C}$   |        | 8   |      |       |     | 8    |       | ns                             |

(1) 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   |           |           |

(2) Refer to RETS161X for LM161H and LM161J military specifications.

(3) Measurements using AC Test circuit, Fanout = 1. The devices are faster at low supply voltages.

### Typical Performance Characteristics

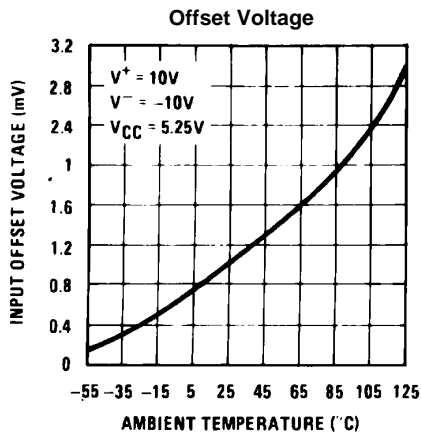


Figure 3.

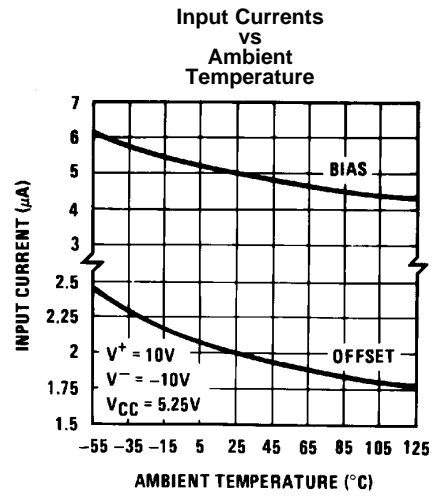


Figure 4.

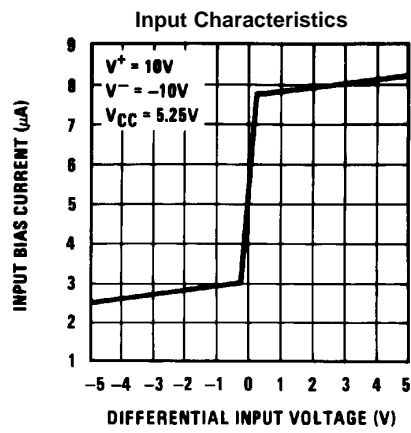


Figure 5.

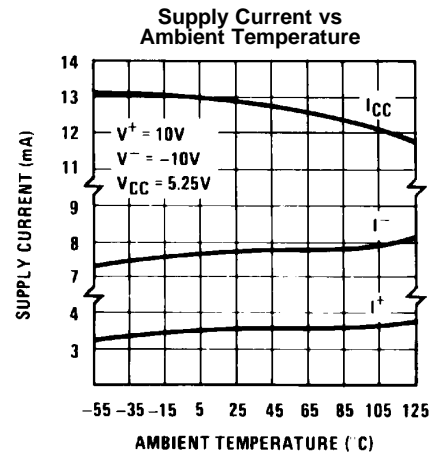


Figure 6.

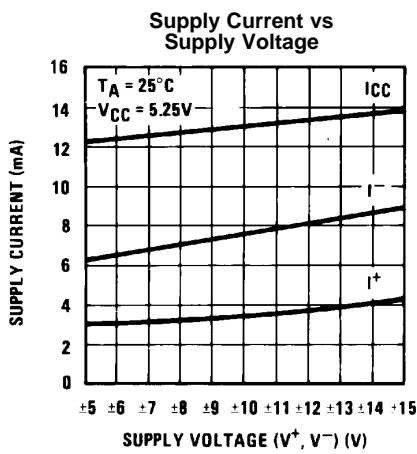


Figure 7.

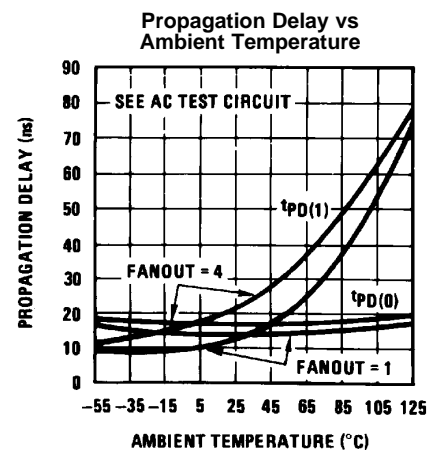


Figure 8.

Typical Performance Characteristics (continued)

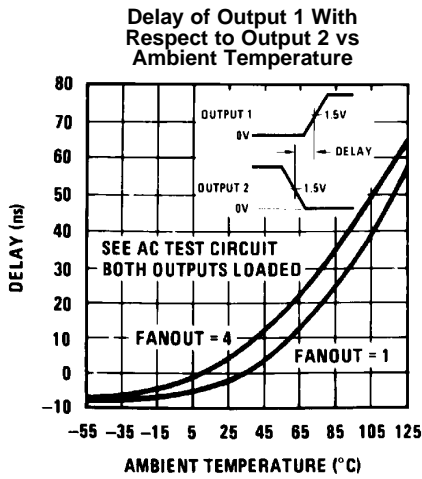


Figure 9.

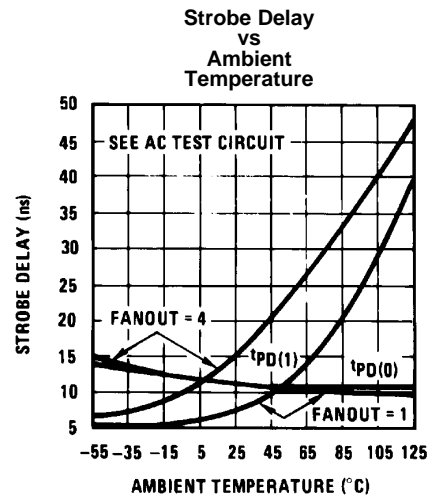


Figure 10.

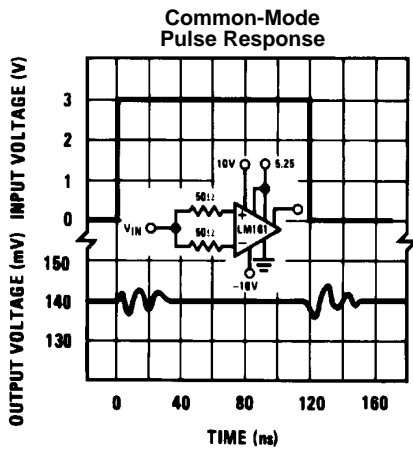


Figure 11.

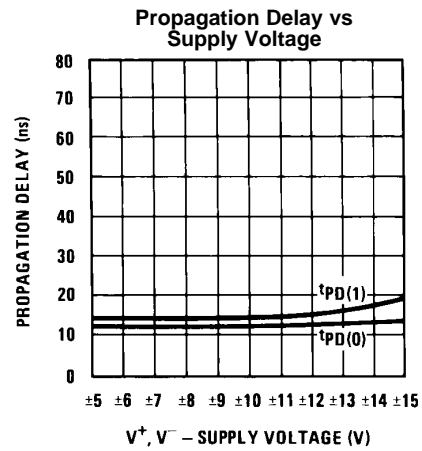
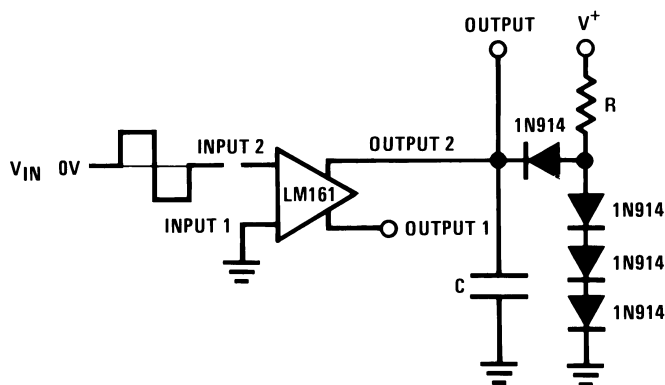


Figure 12.

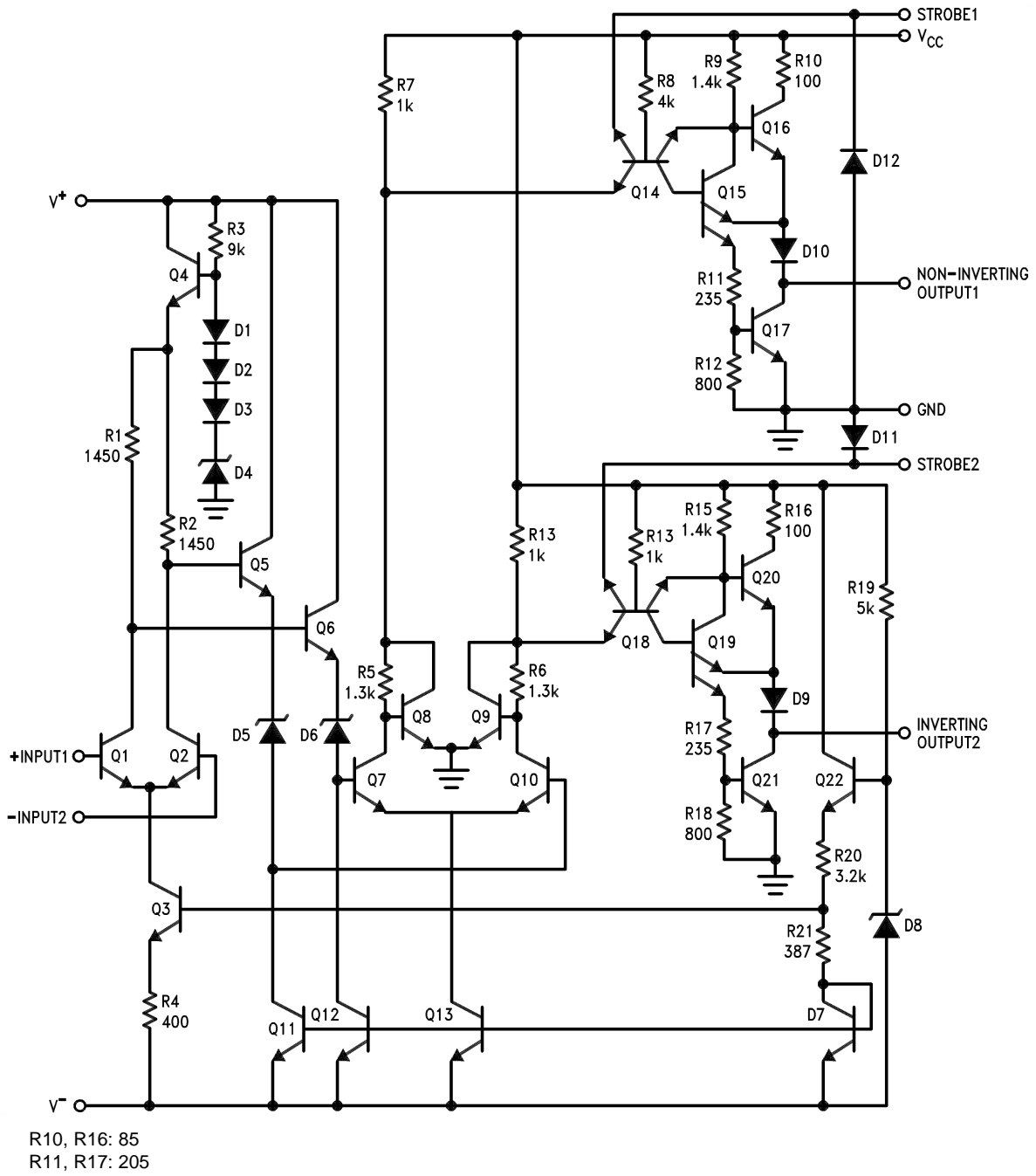
AC TEST CIRCUIT



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

SCHMATIC DIAGRAM

LM161



## REVISION HISTORY

| Changes from Revision B (March 2013) to Revision C         | Page              |
|--|-------------------|
| • Changed layout of National Data Sheet to TI format ..... | <a href="#">7</a> |



**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2)         | Lead/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|-----------------|------|-------------|-------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| LM361H/NOPB      | ACTIVE        | TO-100       | LME             | 10   | 500         | Green (RoHS & no Sb/Br) | Call TI                 | Level-1-NA-UNLIM     | 0 to 70      | ( LM361H, LM361H)       | <a href="#">Samples</a> |
| LM361M           | NRND          | SOIC         | D               | 14   | 55          | TBD                     | Call TI                 | Call TI              | 0 to 70      | LM361M                  |                         |
| LM361M/NOPB      | ACTIVE        | SOIC         | D               | 14   | 55          | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | 0 to 70      | LM361M                  | <a href="#">Samples</a> |
| LM361MX/NOPB     | ACTIVE        | SOIC         | D               | 14   | 2500        | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-260C-UNLIM   | 0 to 70      | LM361M                  | <a href="#">Samples</a> |
| LM361N/NOPB      | ACTIVE        | PDIP         | NFF             | 14   | 25          | Green (RoHS & no Sb/Br) | CU SN                   | Level-1-NA-UNLIM     | 0 to 70      | LM361N                  | <a href="#">Samples</a> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBsolete:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

| Device       | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| LM361MX/NOPB | SOIC         | D               | 14   | 2500 | 330.0              | 16.4               | 6.5     | 9.35    | 2.3     | 8.0     | 16.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**



\*All dimensions are nominal

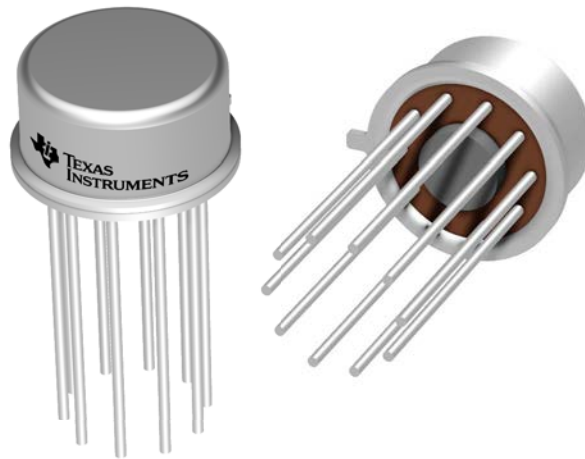
| Device       | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM361MX/NOPB | SOIC         | D               | 14   | 2500 | 367.0       | 367.0      | 35.0        |

## GENERIC PACKAGE VIEW

**LME 10**

**TO-CAN - 5.72 mm max height**

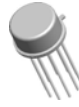
METAL CYLINDRICAL PACKAGE



Images above are just a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.

4202488/B

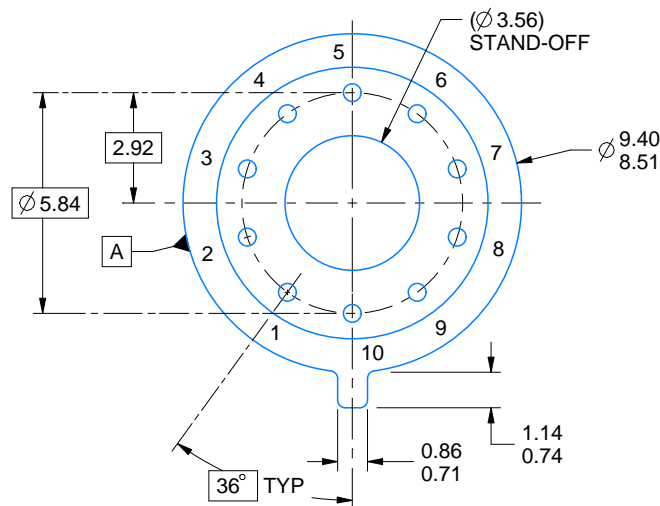
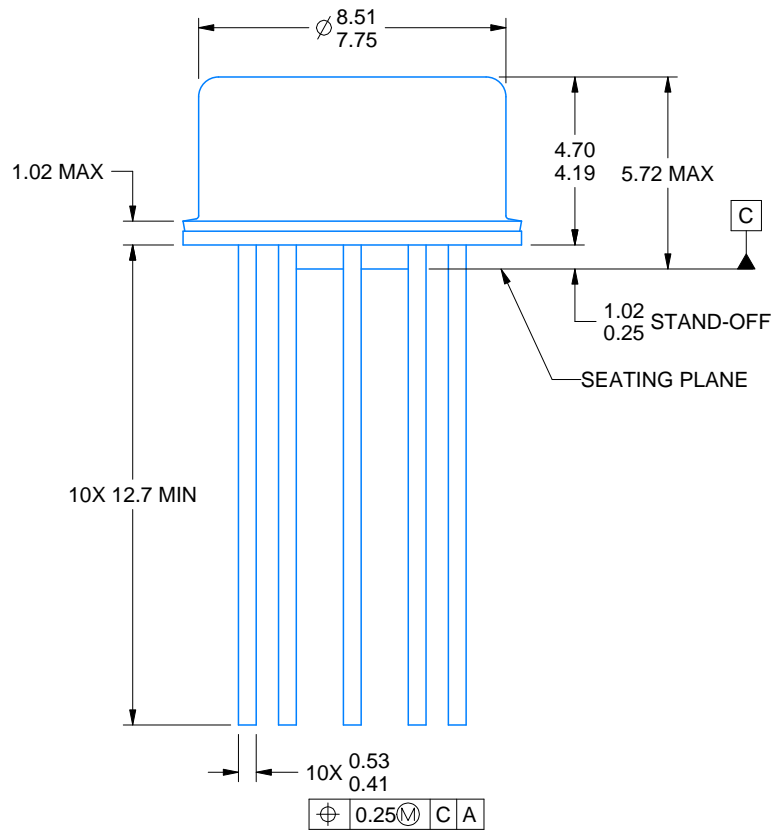
# LME0010A



# PACKAGE OUTLINE

## TO-CAN - 5.72 mm max height

METAL CYLINDRICAL PACKAGE



4220604/A 05/2017

### NOTES:

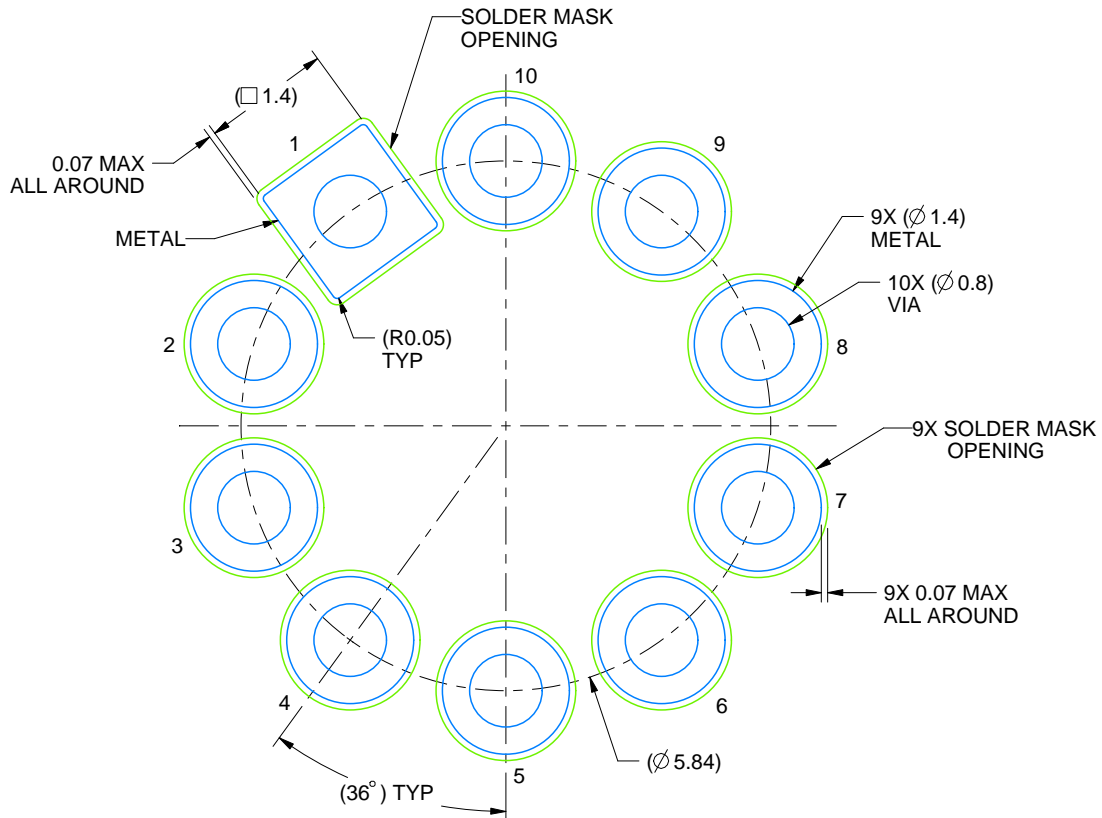
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. Reference JEDEC registration MO-006/TO-100.

# EXAMPLE BOARD LAYOUT

LME0010A

TO-CAN - 5.72 mm max height

METAL CYLINDRICAL PACKAGE



LAND PATTERN EXAMPLE  
NON-SOLDER MASK DEFINED  
SCALE: 12X

4220604/A 05/2017

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  -  Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
  -  Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
  - E. Reference JEDEC MS-012 variation AB.



D (R-PDSO-G14)

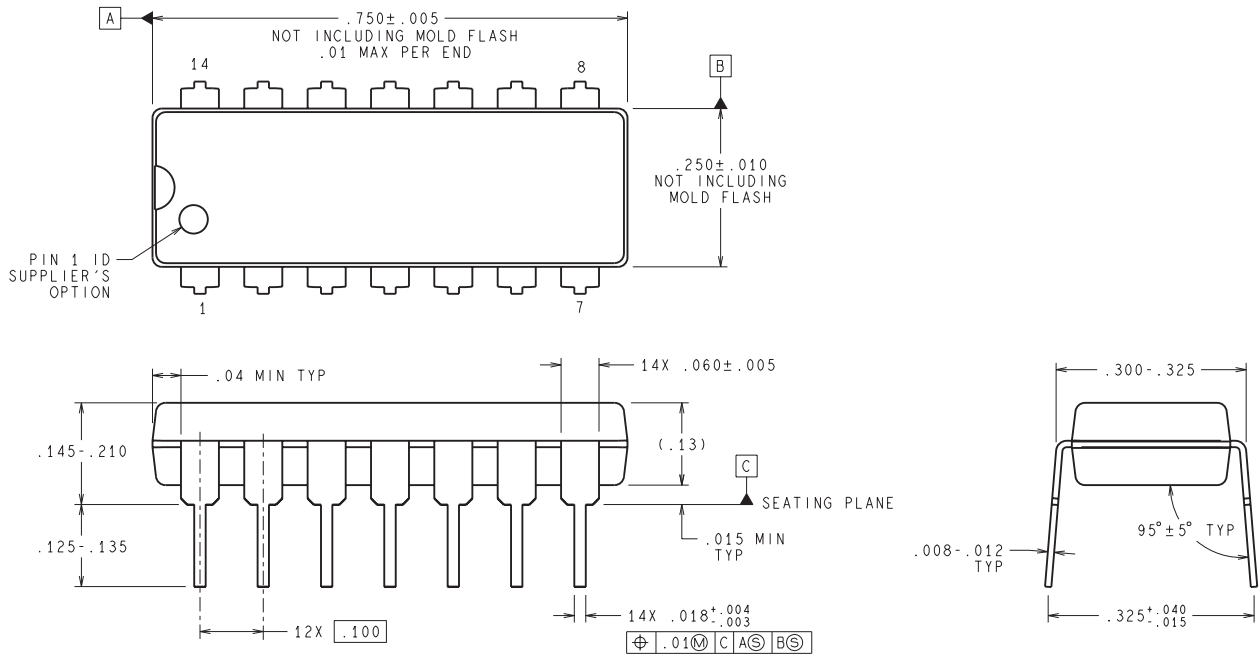
PLASTIC SMALL OUTLINE



4211283-3/E 08/12

- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

NFF0014A



**DIMENSIONS ARE IN INCHES**  
 DIMENSIONS IN ( ) FOR REFERENCE ONLY

N14A (Rev G)

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