

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: $\pm 15\text{V}$
- 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 ($\pm 15\text{V}$).

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

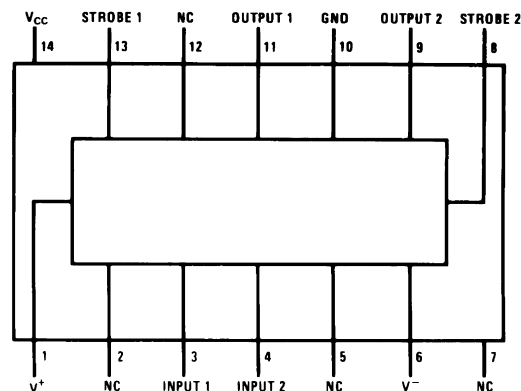


Figure 1. Top View
Package Numbers D0014A, NFF0014A

TO-100 Package

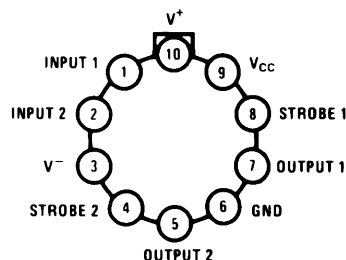


Figure 2. Package Number LME0010C



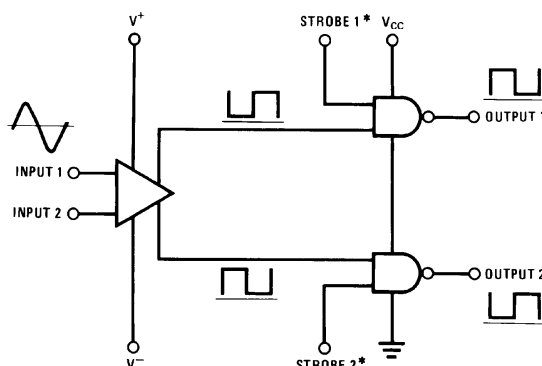
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LOGIC DIAGRAM



*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 ⁽¹⁾

| Absolute Maximum Ratings | | |
|------------------------------------|-----------------|-----------|
| Positive Supply Voltage, V^+ | +16V | |
| Negative Supply Voltage, V^- | -16V | |
| Gate Supply Voltage, V_{CC} | +7V | |
| Output Voltage | +7V | |
| Differential Input Voltage | $\pm 5V$ | |
| Input Common Mode Voltage | $\pm 6V$ | |
| 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 | |
| | -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 | |

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

Operating Conditions

| Operating Conditions | | | Min | Typ | Max |
|--------------------------------------|--------------|---------------------------------------|-------|-----|-------|
| Supply Voltage V ⁺ | LM161 | | 5V | | 15V |
| | LM361 | | 5V | | 15V |
| Supply Voltage V ⁻ | LM161 | | -6V | | -15V |
| | LM361 | | -6V | | -15V |
| Supply Voltage V _{CC} | LM161 | | 4.5V | 5V | 5.5V |
| | LM361 | | 4.75V | 5V | 5.25V |
| ESD Tolerance ⁽¹⁾ | | | | | 1600V |
| Soldering Information ⁽²⁾ | PDIP Package | Soldering (10 seconds) ⁽²⁾ | | | 260°C |
| | SOIC Package | Vapor Phase (60 seconds) | | | 215°C |
| | | Infrared (15 seconds) | | | 220°C |

(1) Human body model, $1.5\text{ k}\Omega$ 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⁽¹⁾⁽²⁾⁽¹⁾
 $(V^+ = +10V, V_{CC} = +5V, V^- = -10V, T_{MIN} \leq T_A \leq T_{MAX}, \text{ unless noted})$

| 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°C | | 5 | 20 | | 10 | 30 | μA μA |
| Input Offset Current | T _A =25°C | | 2 | 3 | | 2 | 5 | μA μA |
| Voltage Gain | T _A =25°C | | 3 | | | 3 | | V/mV |
| Input Resistance | T _A =25°C, f=1 kHz | | 20 | | | 20 | | kΩ |
| Logical “1” Output Voltage | V _{CC} =4.75V, I _{SOURCE} =−0.5 mA | 2.4 | 3.3 | | 2.4 | 3.3 | | V |
| Logical “0” Output Voltage | V _{CC} =4.75V, I _{SINK} =6.4 mA | | | 0.4 | | | 0.4 | V |
| Strobe Input “1” Current (Output Enabled) | V _{CC} =5.25V, V _{STROBE} =2.4V | | | 200 | | | 200 | μA |
| Strobe Input “0” Current (Output Disabled) | V _{CC} =5.25V, 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, V _{CC} =5.25V, −55°C≤T _A ≤125°C | | | 4.5 | | | | mA |
| Supply Current I ⁺ | V ⁺ =10V, V [−] =−10V, V _{CC} =5.25V, 0°C≤T _A ≤70°C | | | | | | 5 | mA |
| Supply Current I [−] | V ⁺ =10V, V [−] =−10V, V _{CC} =5.25V, −55°C≤T _A ≤125°C | | | 10 | | | | mA |
| Supply Current I [−] | V ⁺ =10V, V [−] =−10V, V _{CC} =5.25V, 0°C≤T _A ≤70°C | | | | | | 10 | mA |
| Supply Current I _{CC} | V ⁺ =10V, V [−] =−10V, V _{CC} =5.25V, −55°C≤T _A ≤125°C | | | 18 | | | | mA |
| Supply Current I _{CC} | V ⁺ =10V, V [−] =−10V, V _{CC} =5.25V, 0°C≤T _A ≤70°C | | | | | | 20 | mA |
| Transient Response | V _{IN} = 50 mV overdrive ⁽³⁾ | | | | | | | |
| Propagation Delay Time (t _{pd(0)}) | T _A =25°C | | 14 | 20 | | 14 | 20 | ns |
| Propagation Delay Time (t _{pd(1)}) | T _A =25°C | | 14 | 20 | | 14 | 20 | ns |
| Delay Between Output A and B | T _A =25°C | | 2 | 5 | | 2 | 5 | ns |
| Strobe Delay Time (t _{pd(0)}) | T _A =25°C | | 8 | | | 8 | | ns |
| Strobe Delay Time (t _{pd(1)}) | T _A =25°C | | 8 | | | 8 | | ns |

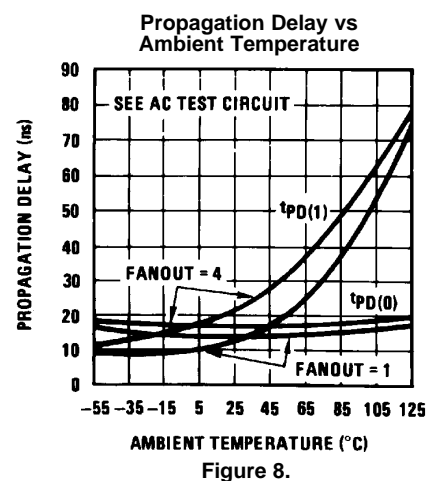
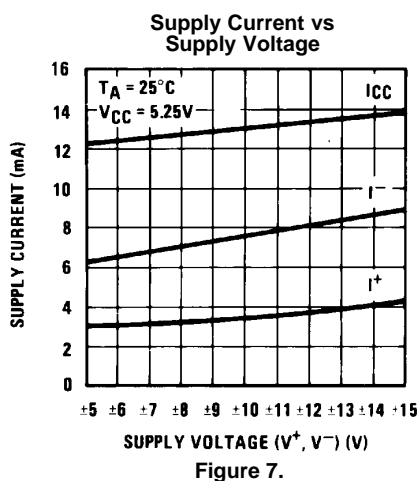
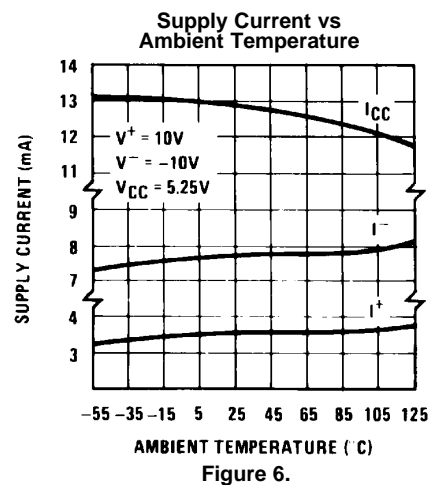
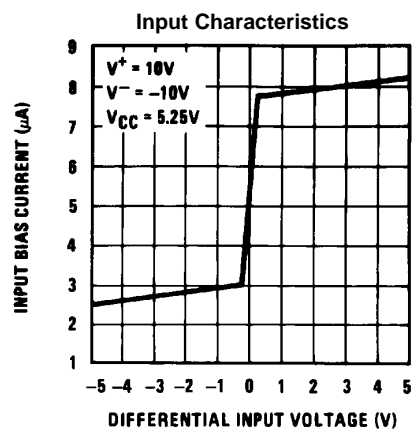
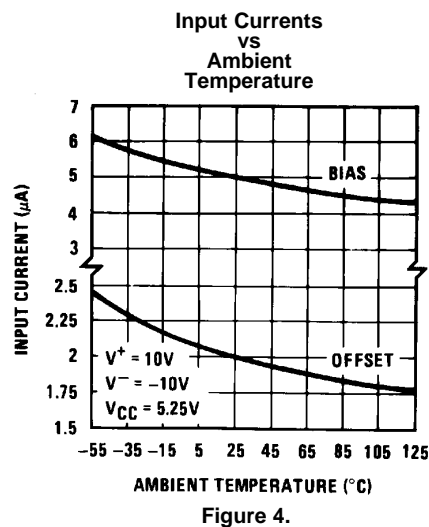
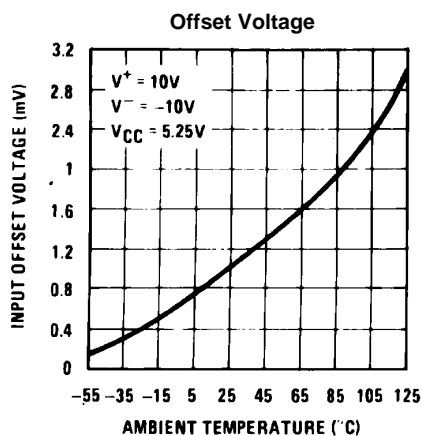
(1) Typical thermal impedances are as follows:

| | H Package | J Package | N Package |
|---------------|---|-----------|-----------|
| θ_{JA} | 165°C/W (Still Air) 67°C/W (400 LF/Min Air Flow) | 112°C/W | 105°C/W |
| θ_{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



Typical Performance Characteristics (continued)

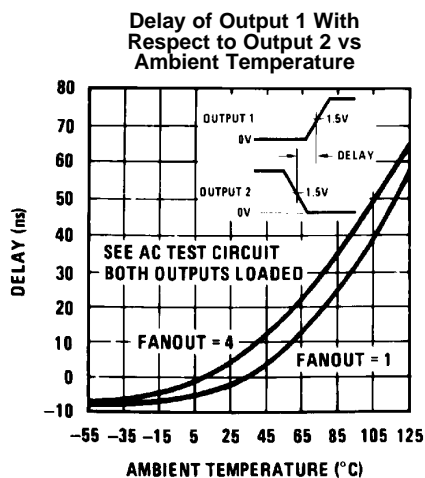


Figure 9.

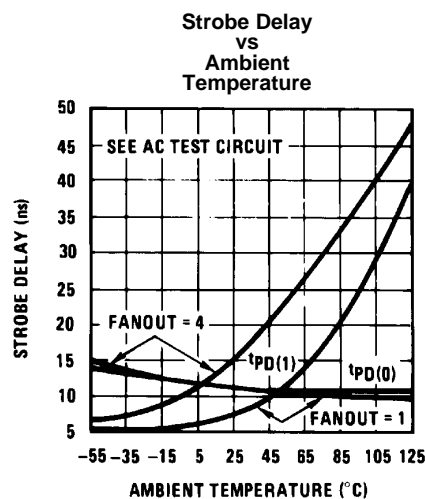


Figure 10.

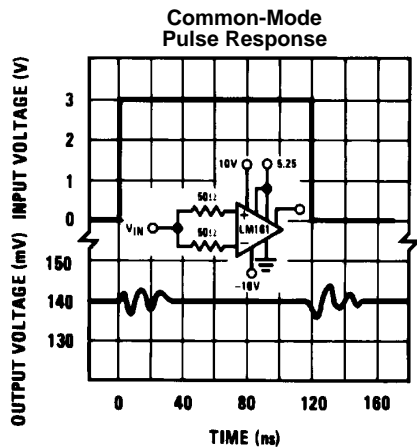


Figure 11.

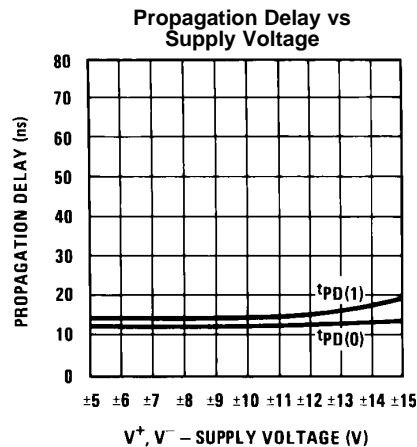
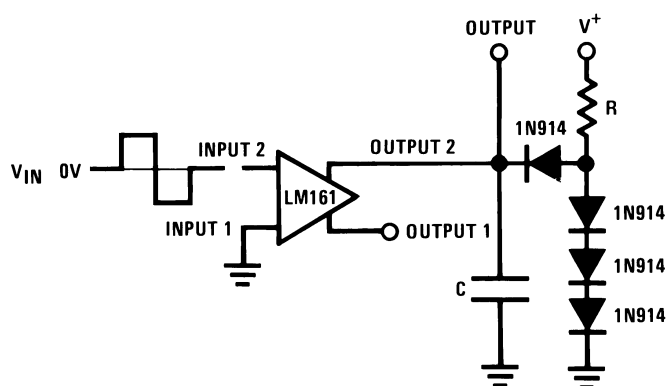


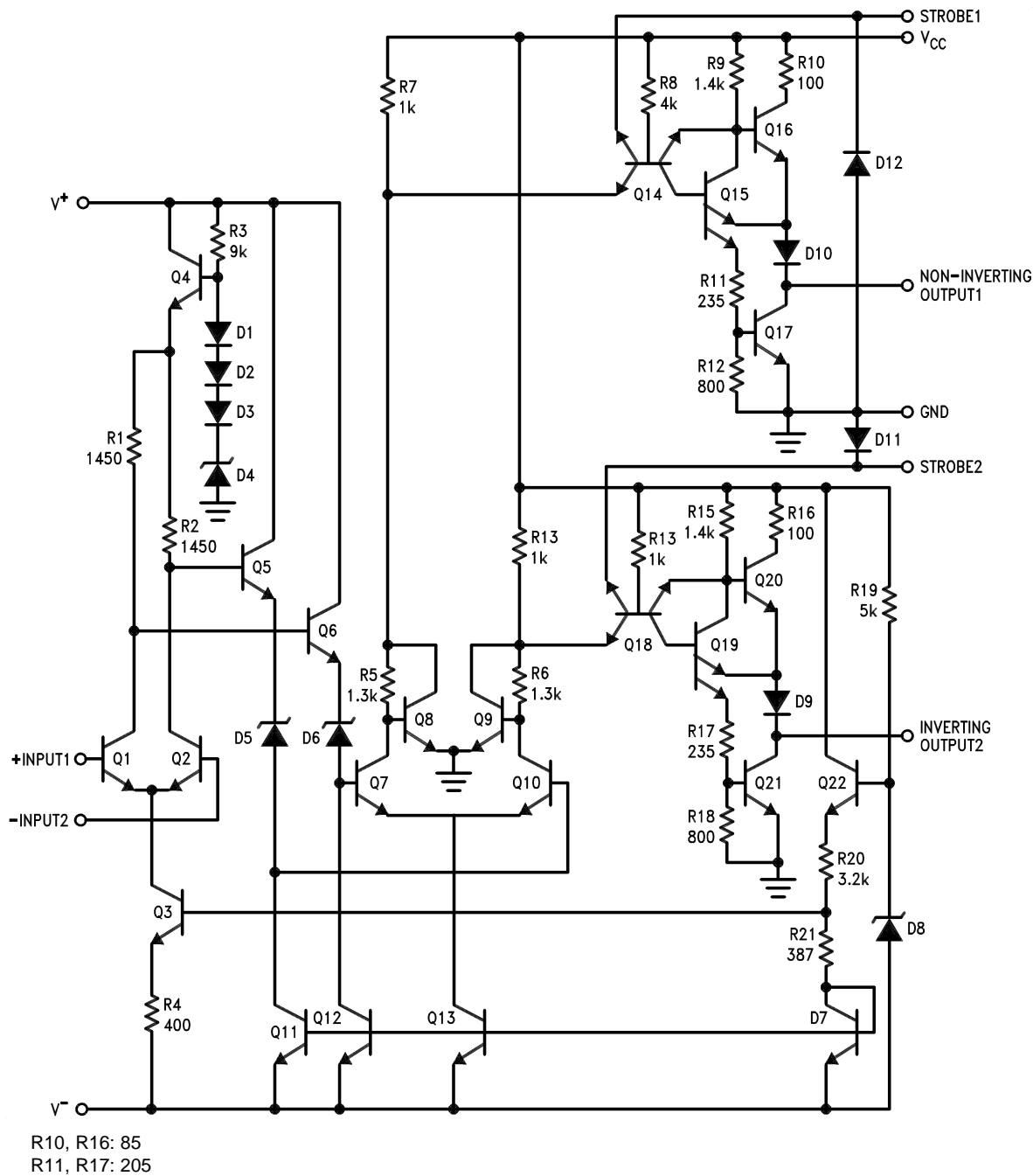
Figure 12.

AC TEST CIRCUIT

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

SCHEMATIC DIAGRAM

LM161



REVISION HISTORY

Changes from Revision B (March 2013) to Revision C

Page

- Changed layout of National Data Sheet to TI format [7](#)

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Device Marking (4/5) | Samples |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|------------------|----------------------|--------------|-------------------------|-------------------------|
| LM361H | ACTIVE | TO-100 | LME | 10 | 500 | TBD | Call TI | Call TI | 0 to 70 | LM361H | Samples |
| LM361H/NOPB | ACTIVE | TO-100 | LME | 10 | 500 | Green (RoHS & no Sb/Br) | POST-PLATE | Level-1-NA-UNLIM | 0 to 70 | LM361H | Samples |
| LM361M | ACTIVE | SOIC | D | 14 | 55 | TBD | Call TI | Call TI | 0 to 70 | LM361M | Samples |
| LM361M/NOPB | ACTIVE | SOIC | D | 14 | 55 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | 0 to 70 | LM361M | Samples |
| LM361MX/NOPB | ACTIVE | SOIC | D | 14 | 2500 | Green (RoHS & no Sb/Br) | CU SN | Level-1-260C-UNLIM | 0 to 70 | LM361M | Samples |
| LM361N | ACTIVE | PDIP | NFF | 14 | 25 | TBD | Call TI | Call TI | 0 to 70 | LM361N | Samples |
| LM361N/NOPB | ACTIVE | PDIP | NFF | 14 | 25 | Green (RoHS & no Sb/Br) | CU SN | Level-1-NA-UNLIM | 0 to 70 | LM361N | Samples |
| LM529CH | ACTIVE | TO-100 | LME | 10 | 500 | TBD | Call TI | Call TI | 0 to 70 | LM361H | Samples |
| LM529CN | ACTIVE | PDIP | NFF | 14 | 25 | TBD | Call TI | Call TI | 0 to 70 | LM361N | Samples |
| NE529A | ACTIVE | PDIP | NFF | 14 | 25 | TBD | Call TI | Call TI | 0 to 70 | LM361N | Samples |
| NE529K | ACTIVE | TO-100 | LME | 10 | 500 | TBD | Call TI | Call TI | 0 to 70 | LM361H | Samples |
| SE529K | ACTIVE | TO-100 | LME | 10 | 500 | TBD | Call TI | Call TI | 0 to 70 | LM361H | Samples |

(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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

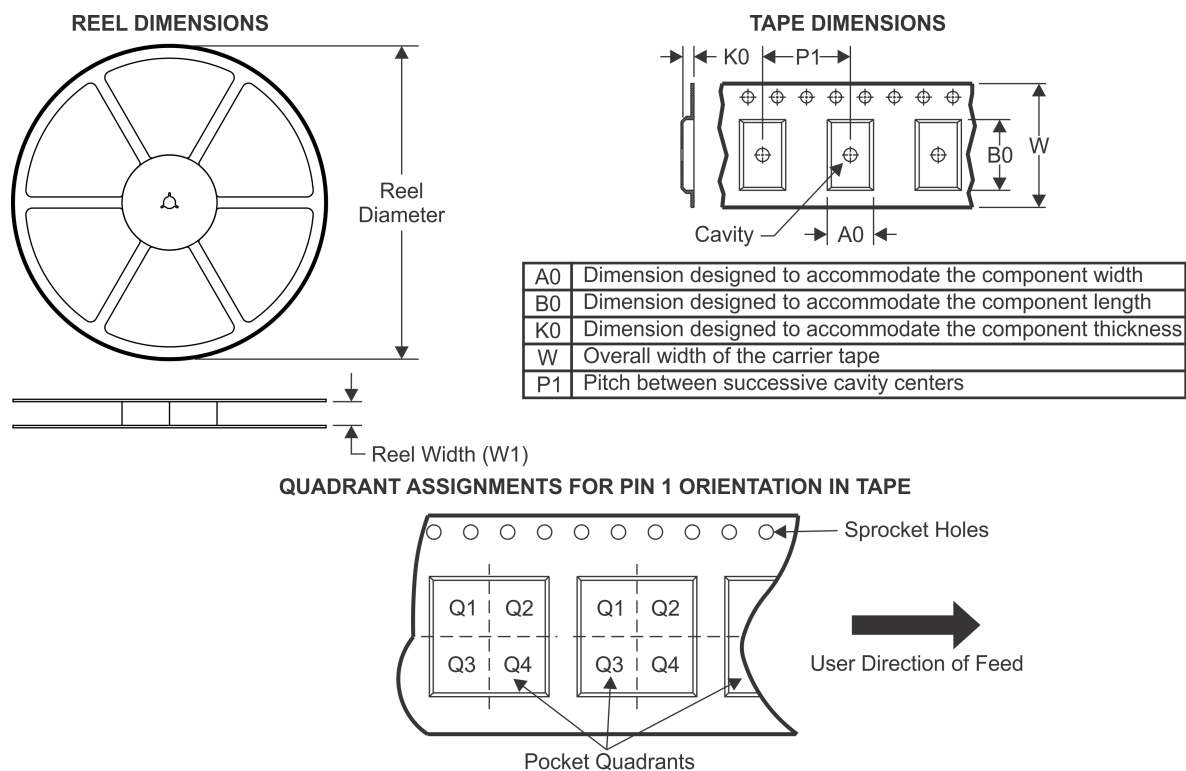
⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

⁽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.

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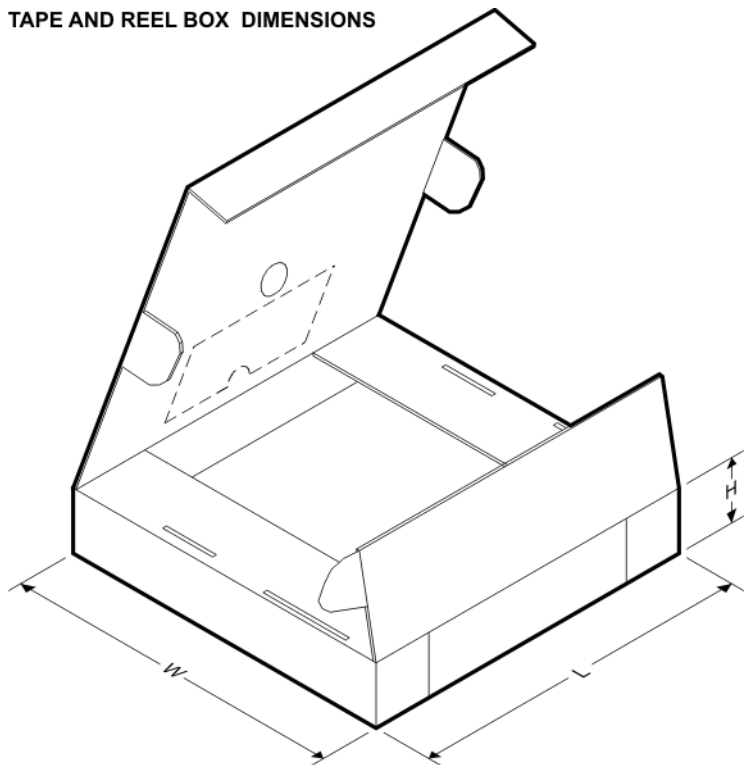
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TAPE AND REEL INFORMATION


*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 |

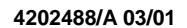
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

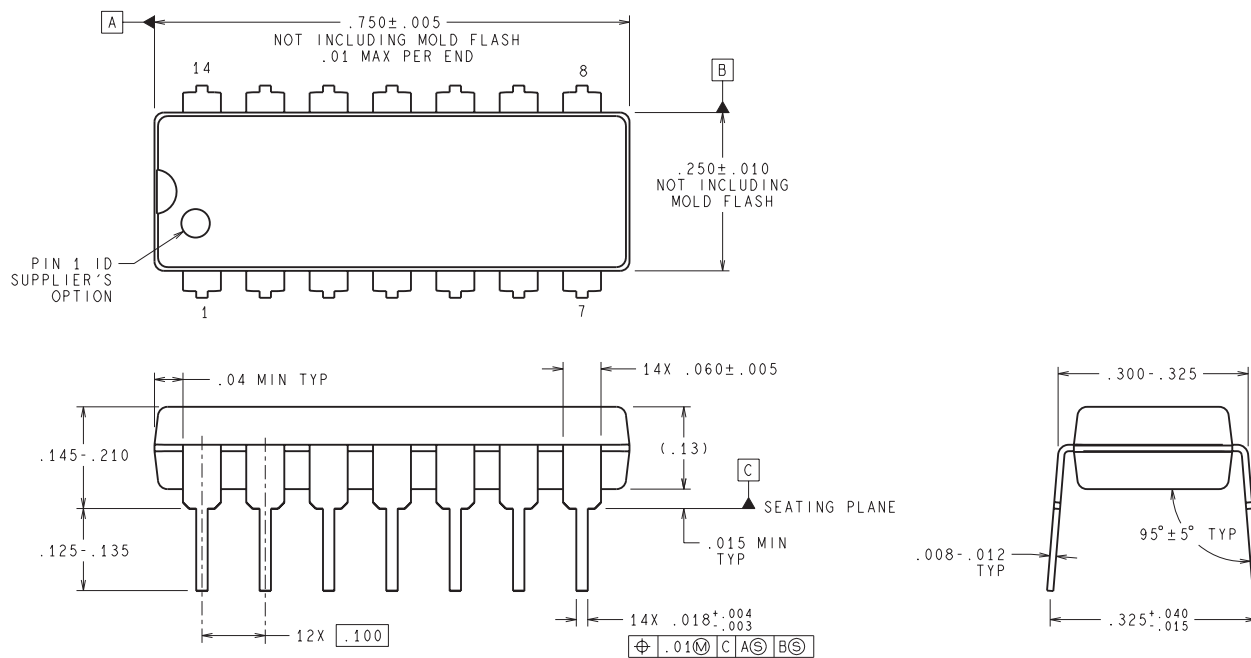
| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|--------------|--------------|-----------------|------|------|-------------|------------|-------------|
| LM361MX/NOPB | SOIC | D | 14 | 2500 | 367.0 | 367.0 | 35.0 |

METAL CYLINDRICAL PACKAGE



- 

NFF0014A

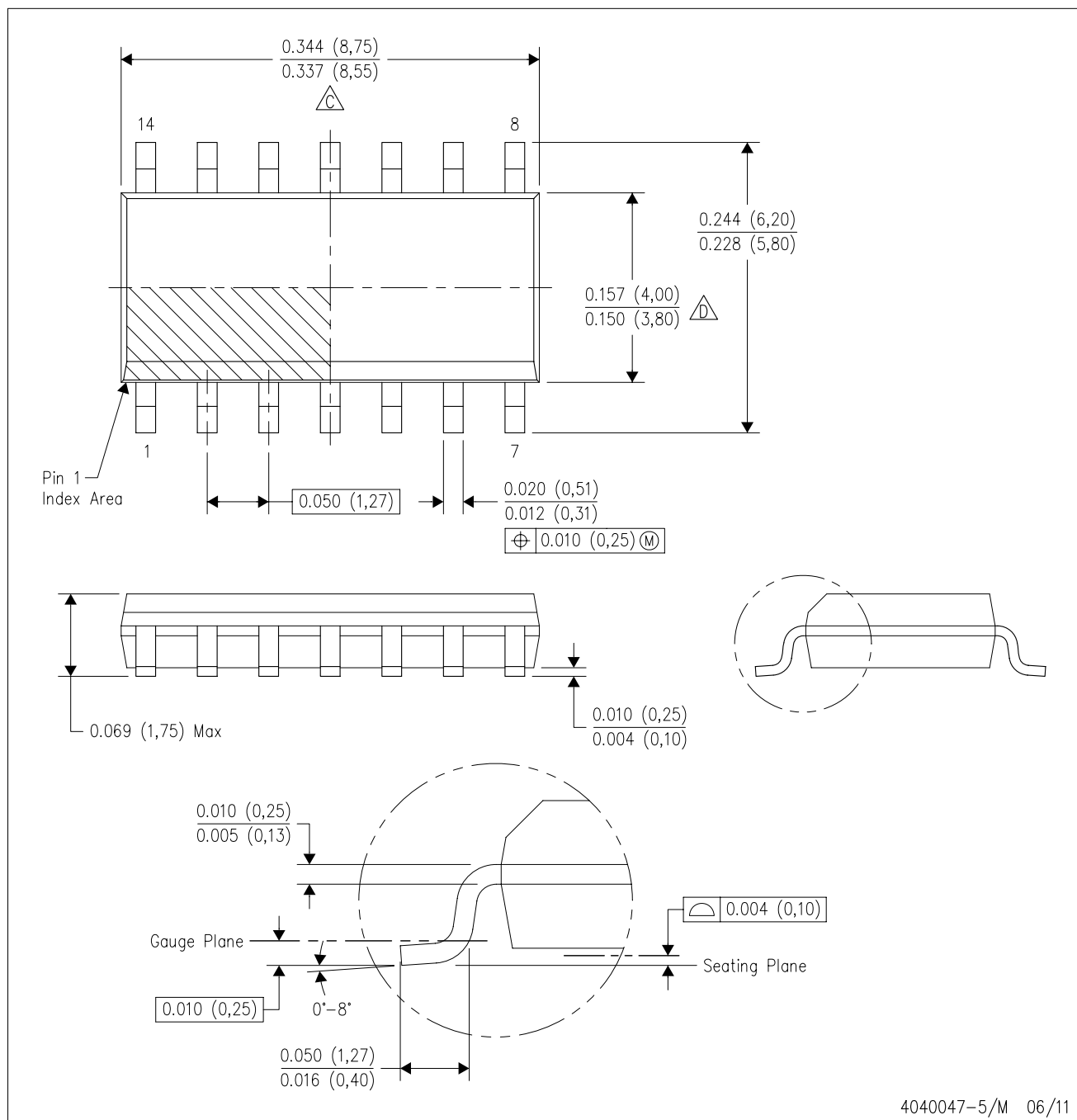


DIMENSIONS ARE IN INCHES
DIMENSIONS IN () FOR REFERENCE ONLY

N14A (Rev G)

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



4040047-5/M 06/11

NOTES:

- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- C. 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.
- D. 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.

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