

## 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

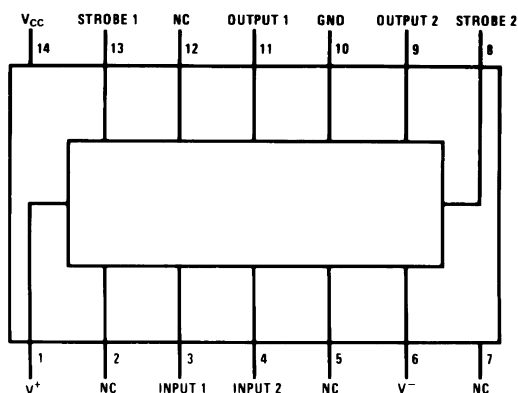


Figure 1. Top View  
Package Numbers D0014A, NFF0014A

#### TO-100 Package

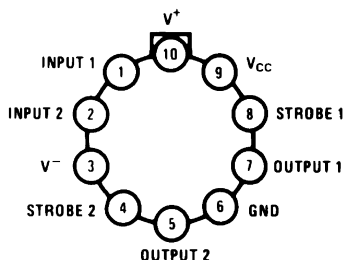


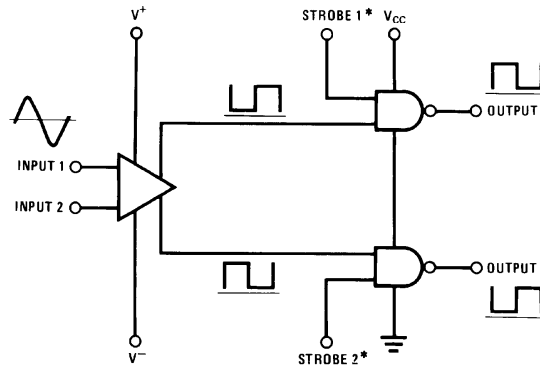
Figure 2. Package Number LME0010C



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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	$\mu\text{A}$ $\mu\text{A}$
Input Offset Current	$T_A=25^\circ\text{C}$		2	3		2	5	$\mu\text{A}$ $\mu\text{A}$
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	$V_{CC}=4.75V,$ $I_{SOURCE}=-0.5\text{ mA}$	2.4	3.3		2.4	3.3		V
Logical "0" Output Voltage	$V_{CC}=4.75V,$ $I_{SINK}=6.4\text{ mA}$			0.4			0.4	V
Strobe Input "1" Current (Output Enabled)	$V_{CC}=5.25V,$ $V_{STROBE}=2.4V$			200			200	$\mu\text{A}$
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 $I^+$	$V^+=10V, V^-=-10V,$ $V_{CC}=5.25V,$ $-55^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$			4.5				mA
Supply Current $I^+$	$V^+=10V, V^-=-10V,$ $V_{CC}=5.25V,$ $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$						5	mA
Supply Current $I^-$	$V^+=10V, V^-=-10V,$ $V_{CC}=5.25V,$ $-55^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$			10				mA
Supply Current $I^-$	$V^+=10V,$ $V^-=-10V, V_{CC}=5.25V,$ $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$						10	mA
Supply Current $I_{CC}$	$V^+=10V, V^-=-10V,$ $V_{CC}=5.25V,$ $-55^\circ\text{C} \leq T_A \leq 125^\circ\text{C}$			18				mA
Supply Current $I_{CC}$	$V^+=10V, V^-=-10V,$ $V_{CC}=5.25V,$ $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$						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) 67°C/W (400 LF/Min 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

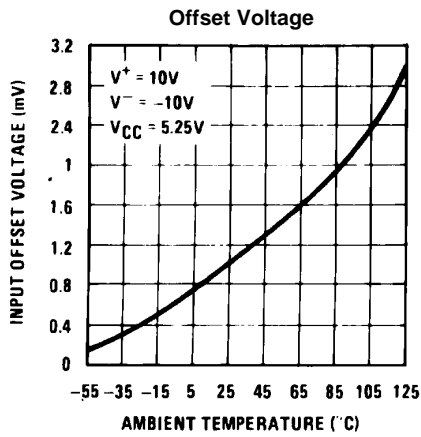


Figure 3.

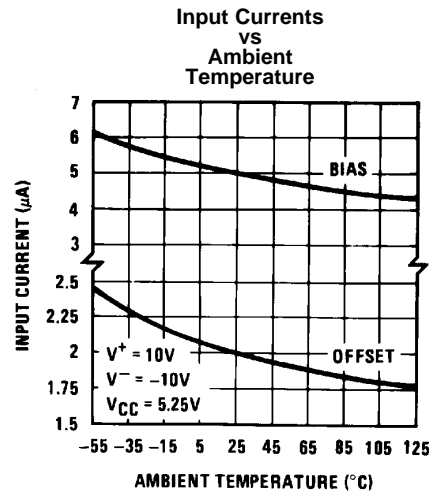


Figure 4.

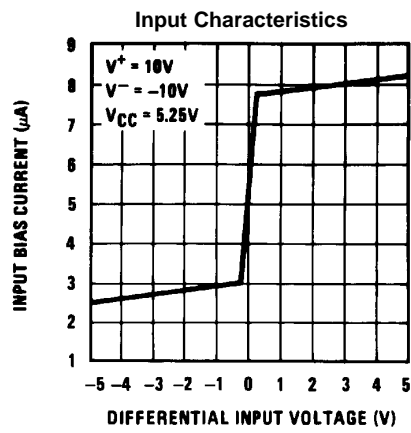


Figure 5.

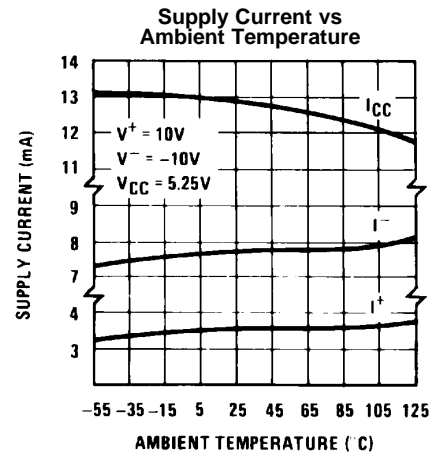


Figure 6.

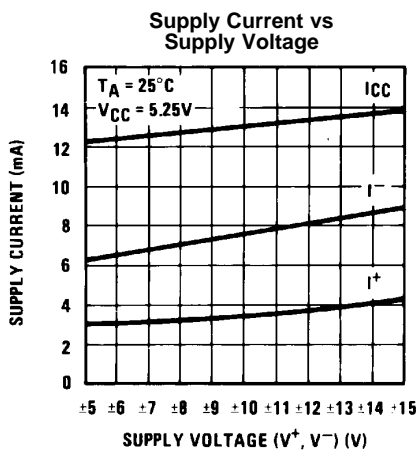


Figure 7.

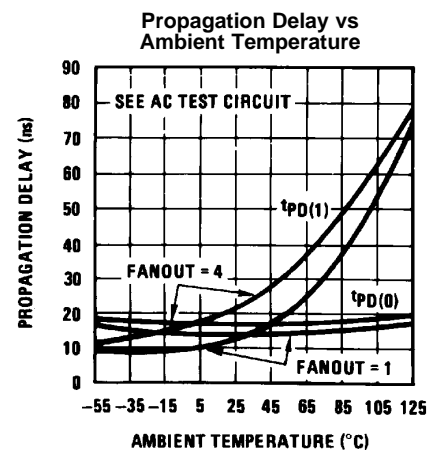


Figure 8.

Typical Performance Characteristics (continued)

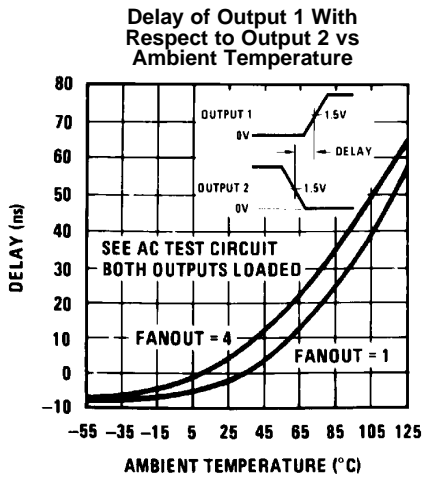


Figure 9.

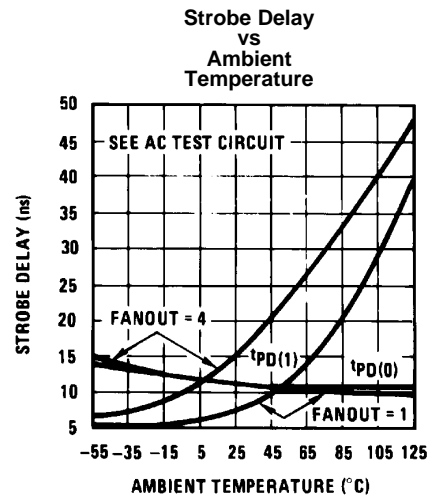


Figure 10.

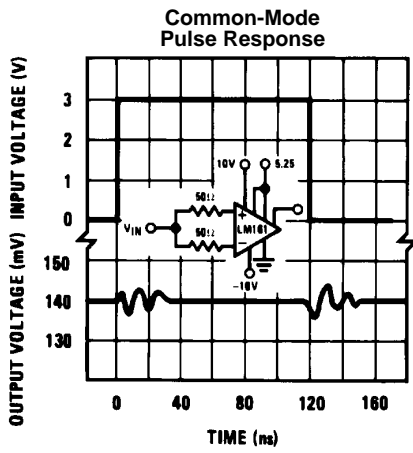


Figure 11.

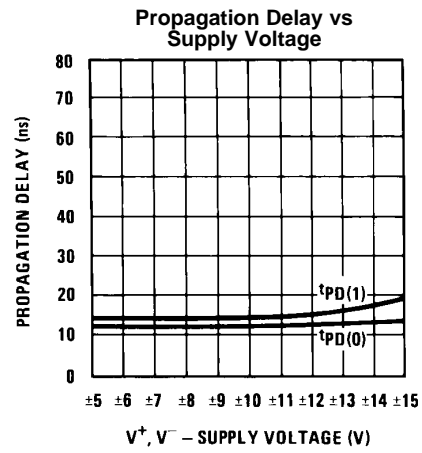
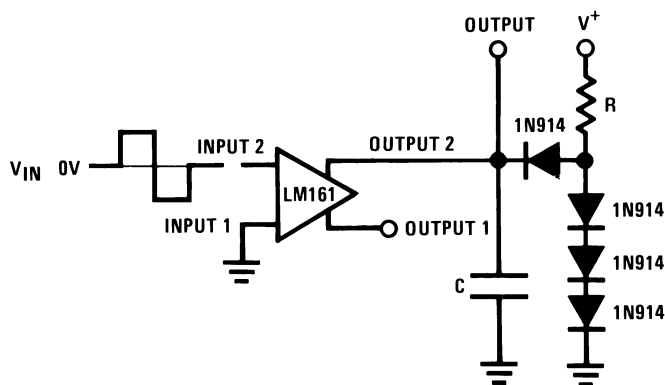


Figure 12.

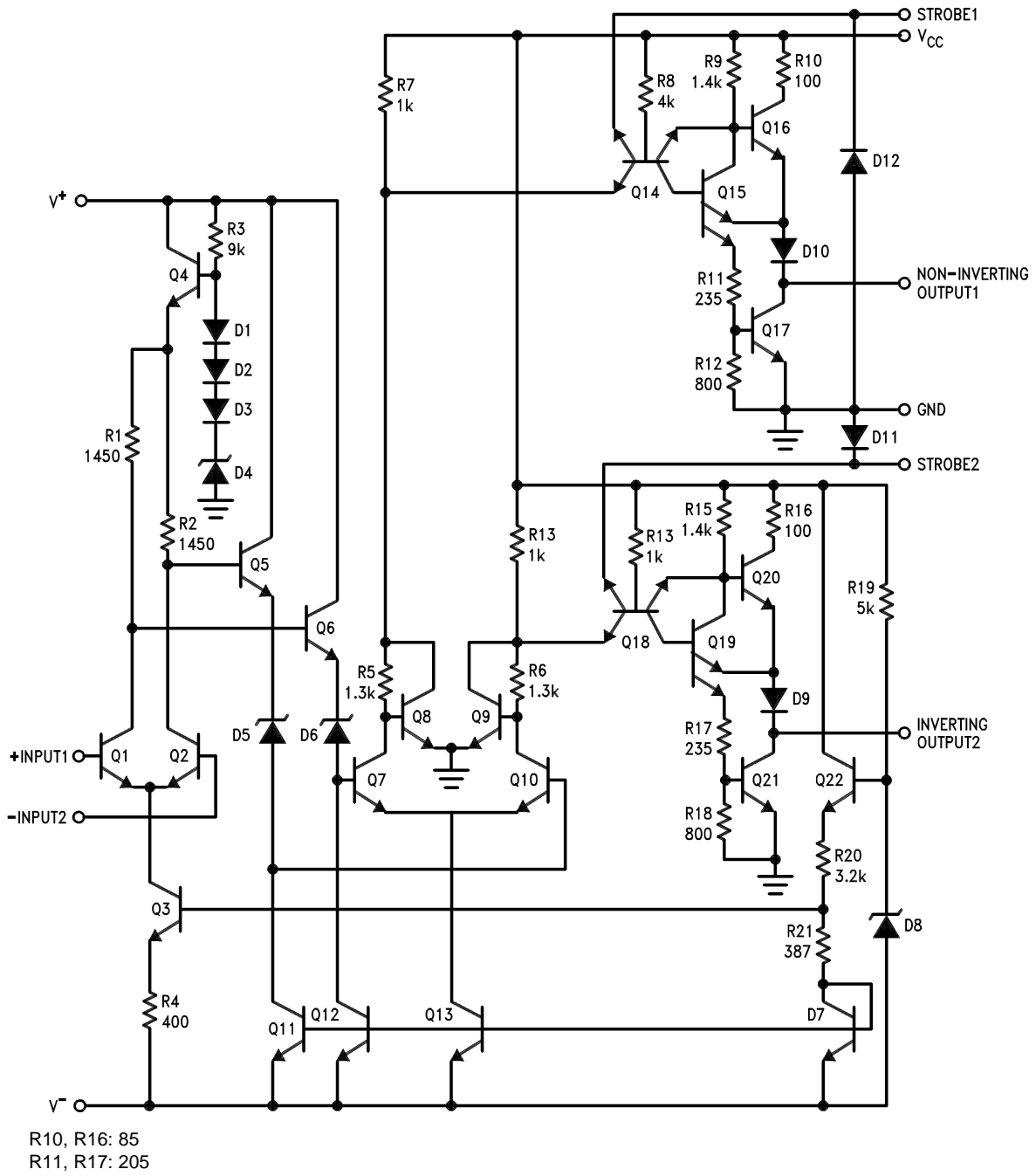
AC TEST CIRCUIT



$V_{IN} = \pm 50 \text{ mV}$	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 (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
LM361H	ACTIVE	TO-100	LME	10	500	TBD	Call TI	Call TI	0 to 70	LM361H	<a href="#">Samples</a>
LM361H/NOPB	ACTIVE	TO-100	LME	10	500	Green (RoHS & no Sb/Br)	POST-PLATE	Level-1-NA-UNLIM	0 to 70	LM361H	<a href="#">Samples</a>
LM361M	ACTIVE	SOIC	D	14	55	TBD	Call TI	Call TI	0 to 70	LM361M	<a href="#">Samples</a>
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	ACTIVE	SOIC	D	14	2500	TBD	Call TI	Call TI	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	ACTIVE	PDIP	NFF	14	25	TBD	Call TI	Call TI	0 to 70	LM361N	<a href="#">Samples</a>
LM361N/NOPB	ACTIVE	PDIP	NFF	14	25	Green (RoHS & no Sb/Br)	Call TI	Level-1-NA-UNLIM	0 to 70	LM361N	<a href="#">Samples</a>
LM529CH	ACTIVE	TO-100	LME	10	500	TBD	Call TI	Call TI	0 to 70	LM361H	<a href="#">Samples</a>
LM529CN	ACTIVE	PDIP	NFF	14	25	TBD	Call TI	Call TI	0 to 70	LM361N	<a href="#">Samples</a>
NE529A	ACTIVE	PDIP	NFF	14	25	TBD	Call TI	Call TI	0 to 70	LM361N	<a href="#">Samples</a>
NE529K	ACTIVE	TO-100	LME	10	500	TBD	Call TI	Call TI	0 to 70	LM361H	<a href="#">Samples</a>
SE529K	ACTIVE	TO-100	LME	10	500	TBD	Call TI	Call TI	0 to 70	LM361H	<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.

**OBSELETE:** 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.

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**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)

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

<sup>(4)</sup> Multiple Top-Side Markings will be inside parentheses. Only one Top-Side 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 Top-Side Marking for that device.

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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	SOIC	D	14	2500	330.0	16.4	6.5	9.35	2.3	8.0	16.0	Q1
LM361MX/NOPB	SOIC	D	14	2500	330.0	16.4	6.5	9.35	2.3	8.0	16.0	Q1

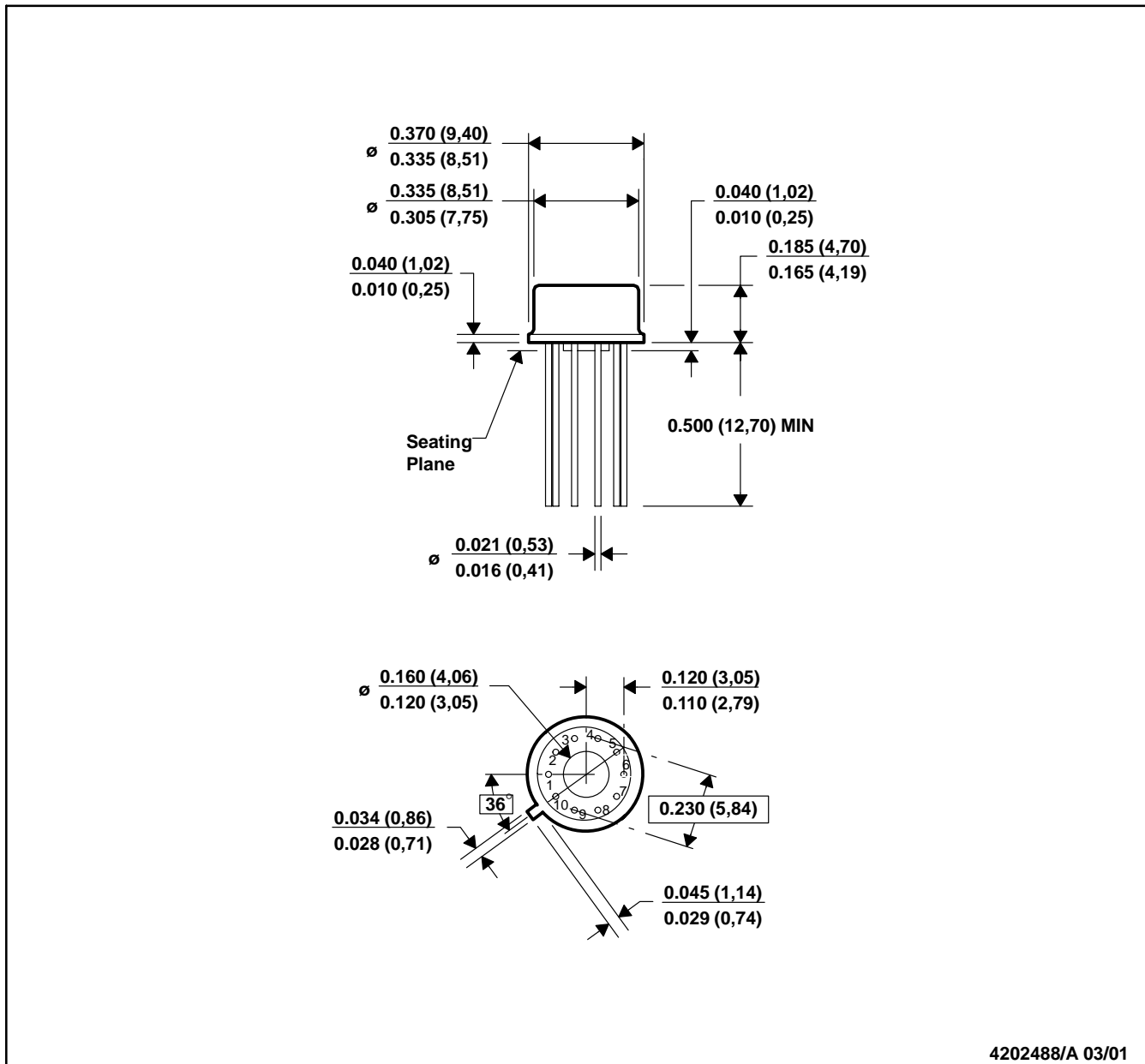
**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

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

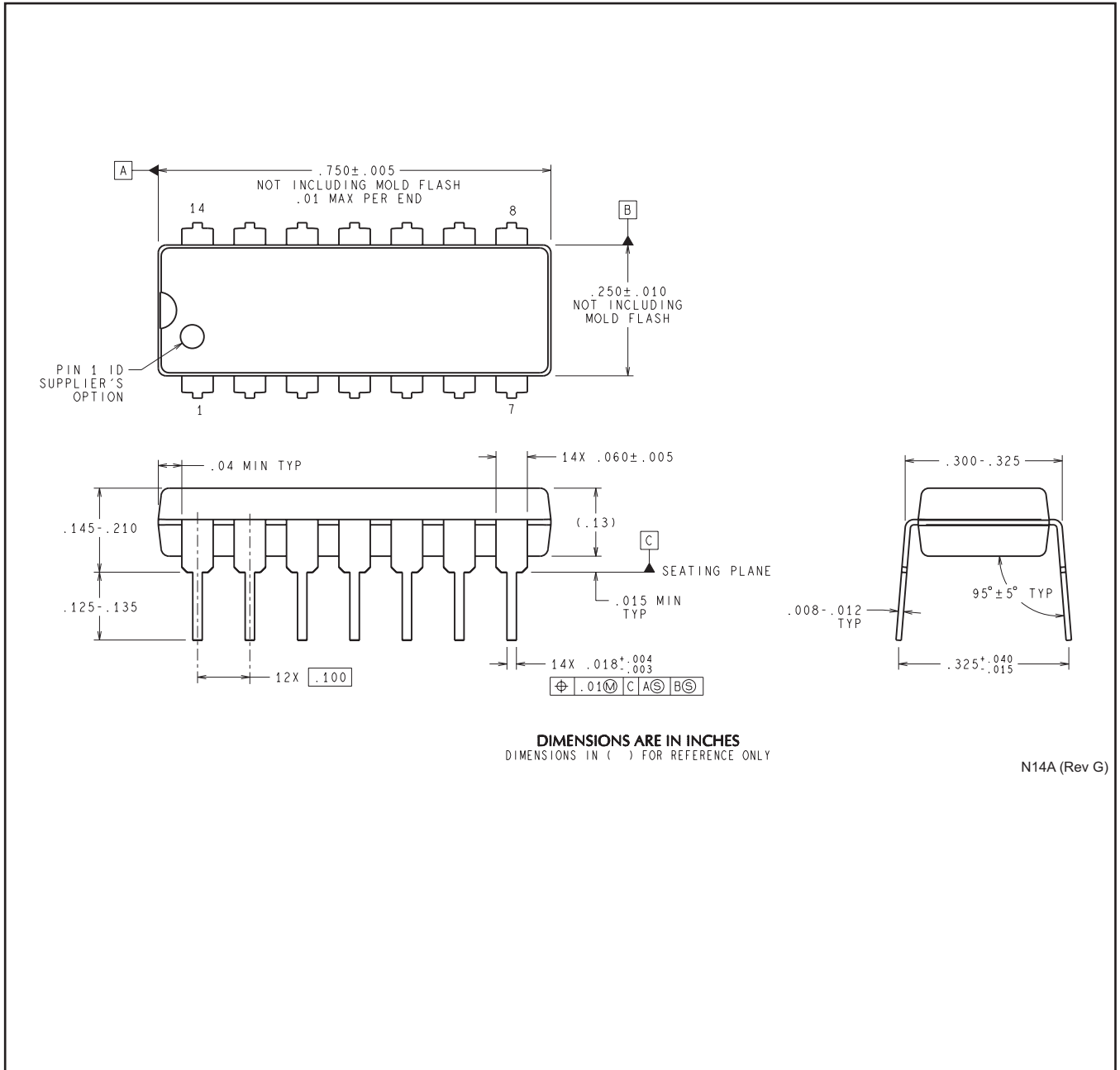
LME (O-MBCY-W10)

METAL CYLINDRICAL PACKAGE



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Leads in true position within 0.010 (0,25) R @ MMC at seating plane.  
 D. Pin numbers shown for reference only. Numbers may not be marked on package.  
 E. Falls within JEDEC MO-006/TO-100.

NFF0014A



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

N14A (Rev G)

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.

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### Applications

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Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
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