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: ±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 (±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

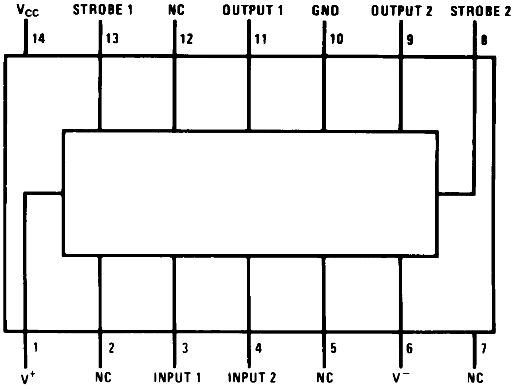


Figure 1. Top View
Package Numbers D0014A, NFF0014A

TO-100 Package

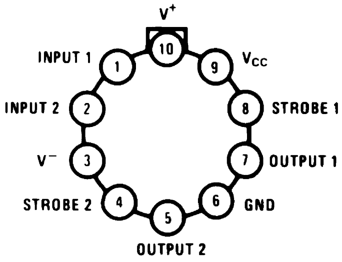
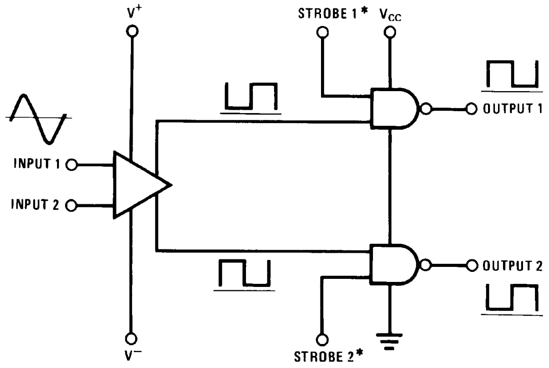


Figure 2. Package Number LME0010C

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]

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
	−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

			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

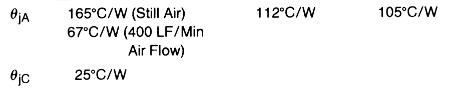
(1) Human body model, 1.5 kΩ in series with 100 pF.
(2) See AN-450 “Surface Mounting Methods and Their Effect on Product Reliability” for other methods of soldering surface mount devices.

Electrical Characteristics(1)(2)(1)

(V^+ = +10V, V_{CC} = +5V, V^- = −10V, $T_{MIN} \le T_A \le T_{MAX}$, 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			10		μA
				20			30	μA
Input Offset Current	T_A=25°C		2			2		μA
				3			5	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

Offset Voltage

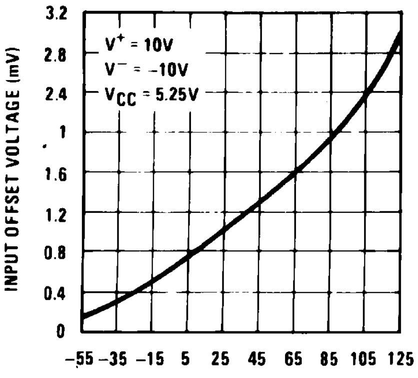


Figure 3.

Input Currents vs Ambient Temperature

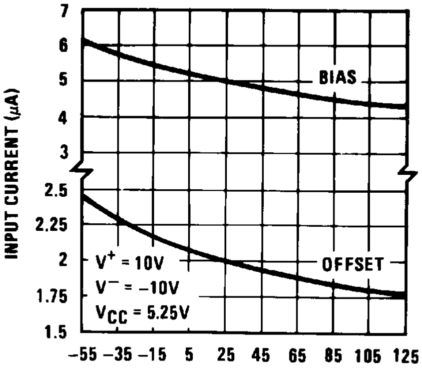


Figure 4.

Input Characteristics

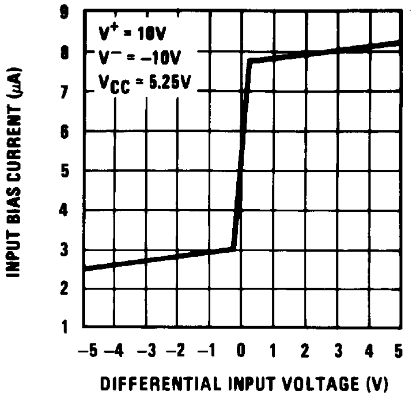


Figure 5.

Supply Current vs Ambient Temperature

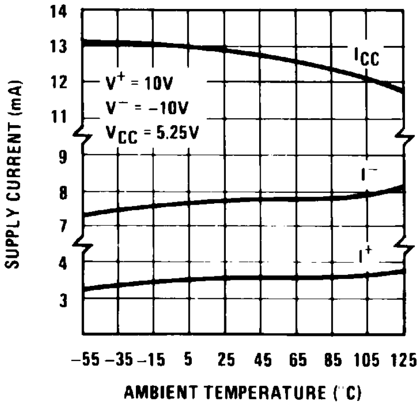


Figure 6.

Supply Current vs Supply Voltage

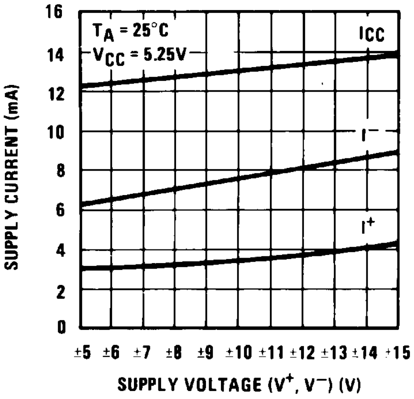


Figure 7.

Propagation Delay vs Ambient Temperature

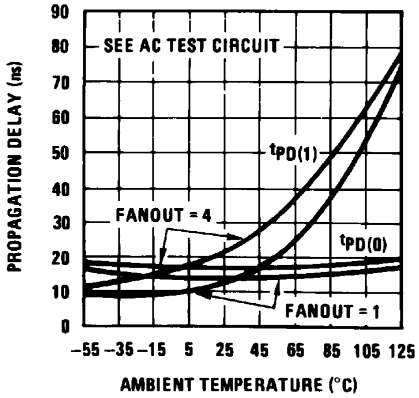


Figure 8.

Typical Performance Characteristics (continued)

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

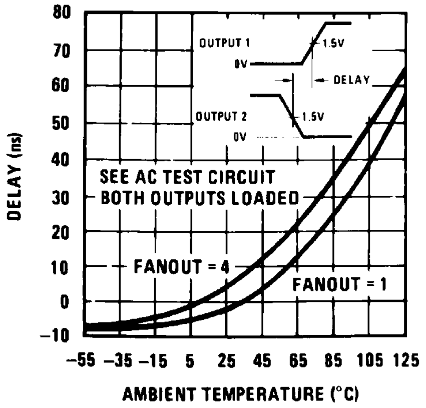


Figure 9.

Strobe Delay vs Ambient Temperature

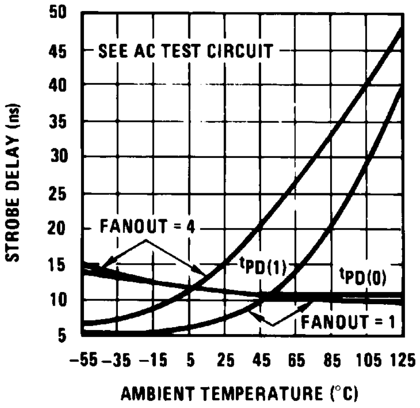


Figure 10.

Common-Mode Pulse Response

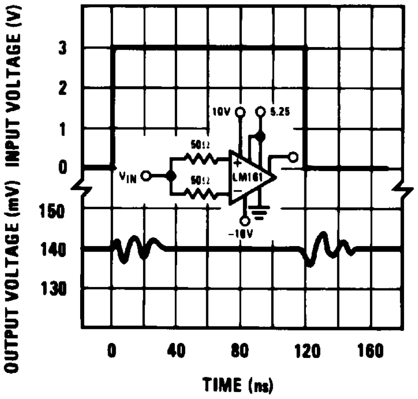


Figure 11.

Propagation Delay vs Supply Voltage

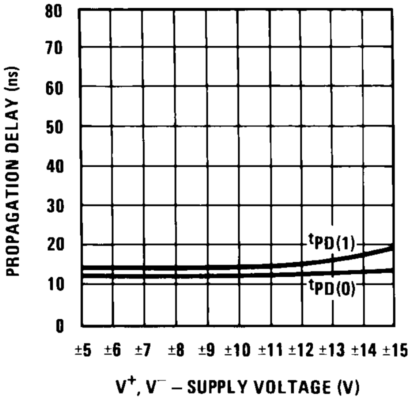
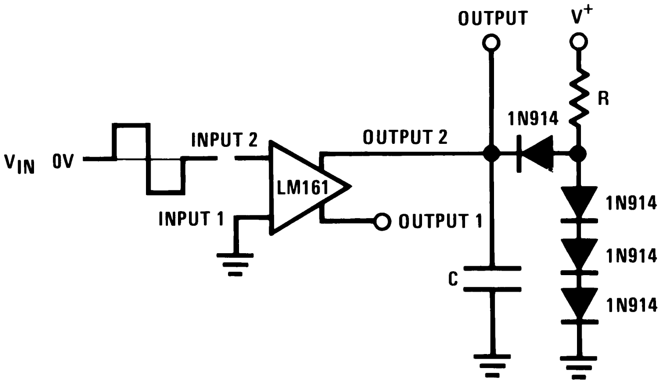


Figure 12.

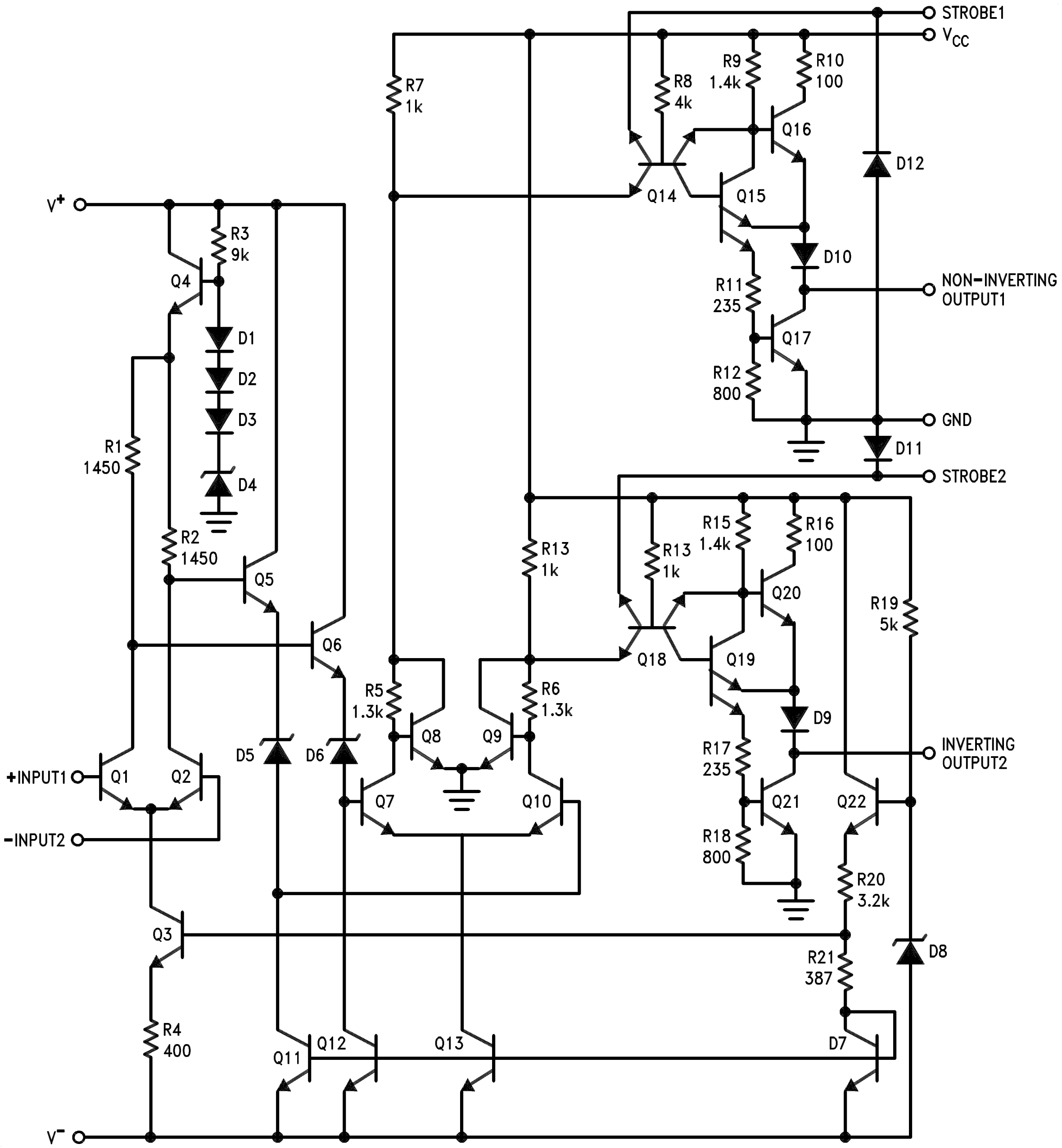
AC TEST CIRCUIT



V_{IN} = ±50 mV	FANOUT = 1	FANOUT = 4	V^- = −10V	C=15 pF	C = 30 pF
V^+ = +10V	R = 2.4k	R = 680Ω	V_{CC} = 5.25V		

SCHEMATIC DIAGRAM

LM161



R10, R16: 85
R11, R17: 205

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)	Top-Side Markings (4)	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	ACTIVE	SOIC	D	14	2500	TBD	Call TI	Call TI	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)	Call TI	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.

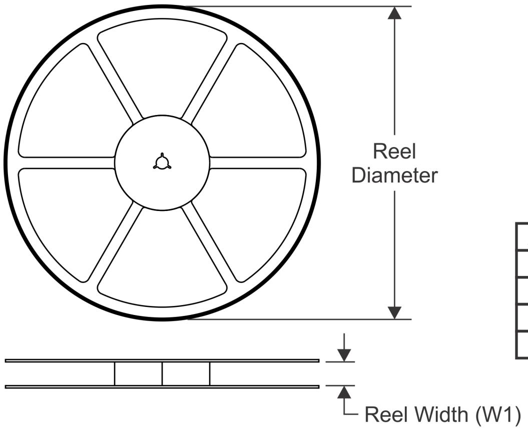
(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side Marking for that device.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

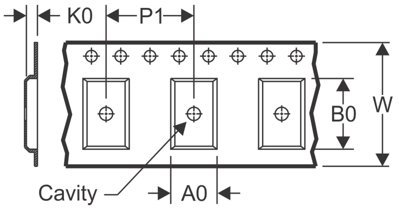
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

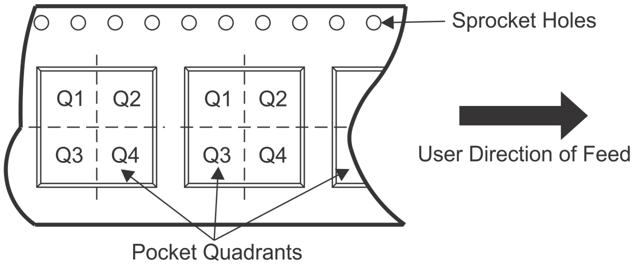


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

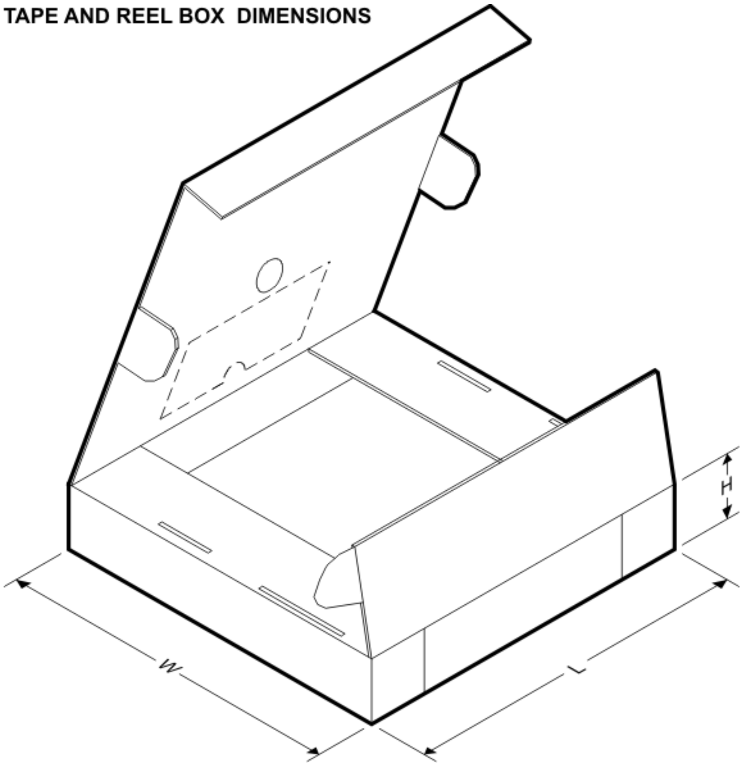
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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

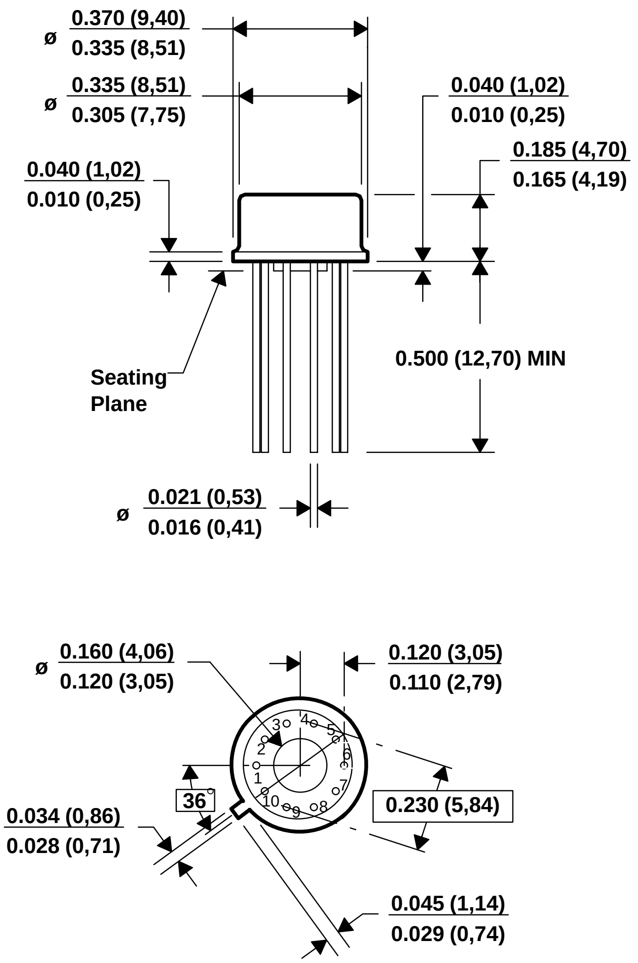
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM361MX	SOIC	D	14	2500	349.0	337.0	45.0
LM361MX/NOPB	SOIC	D	14	2500	349.0	337.0	45.0

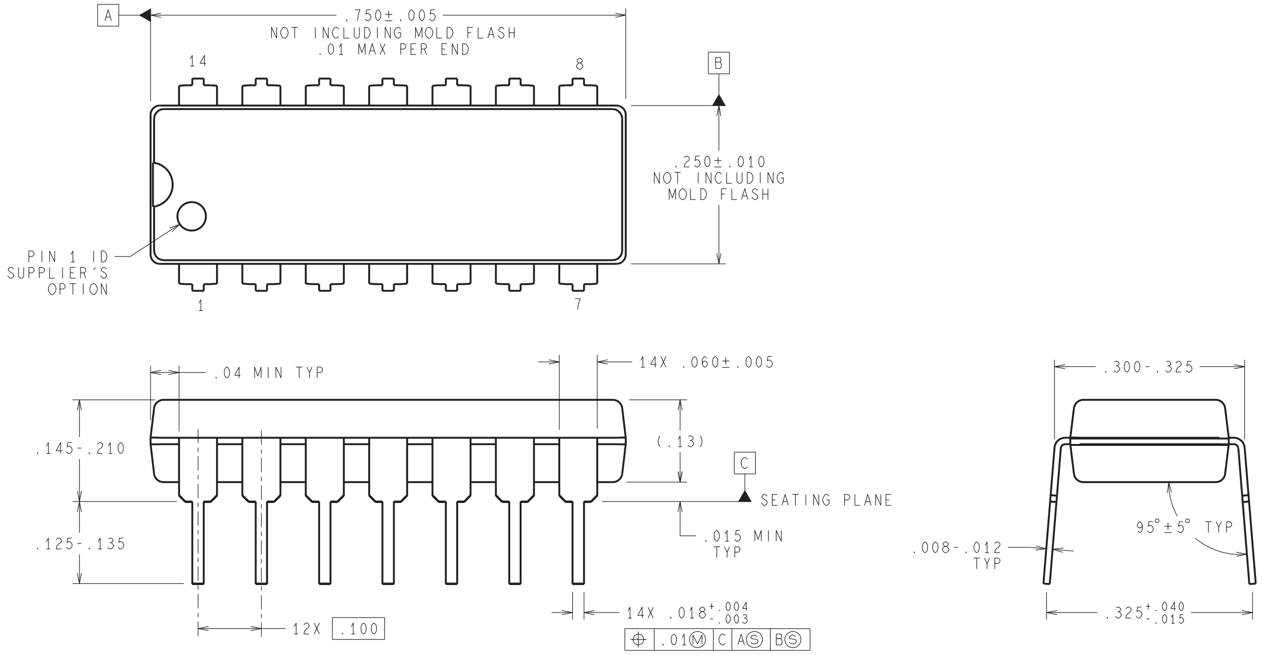
LME (O–MBCY–W10) **METAL CYLINDRICAL PACKAGE**



4202488/A 03/01

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

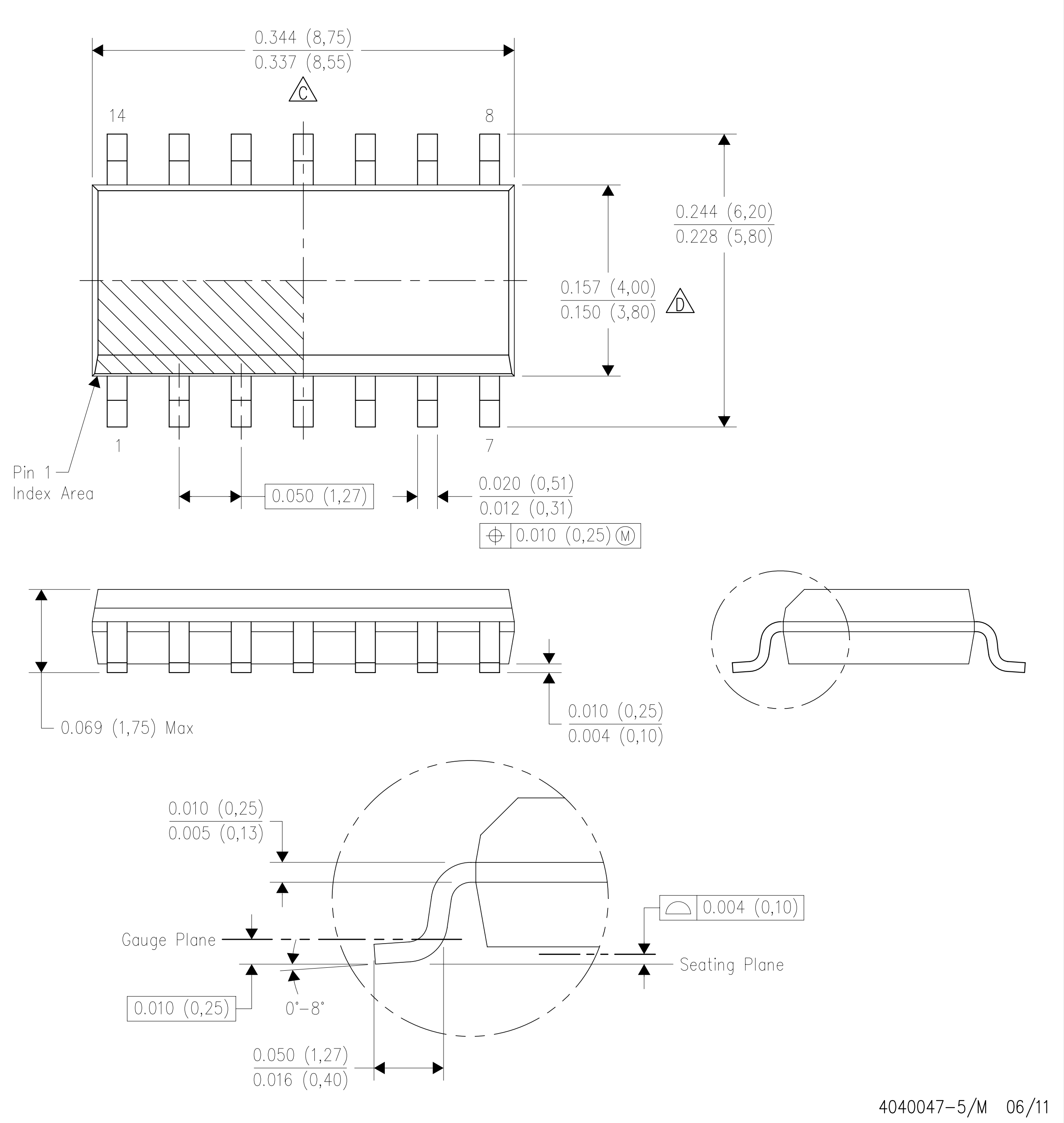


DIMENSIONS ARE IN INCHES

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.
- 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.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265