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

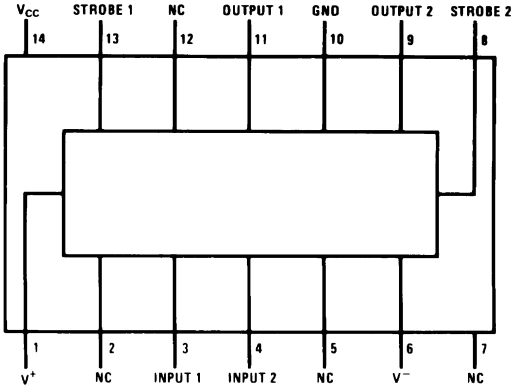


Figure 1. Top View
Package Numbers D0014A, NFF0014A

TO-100 Package

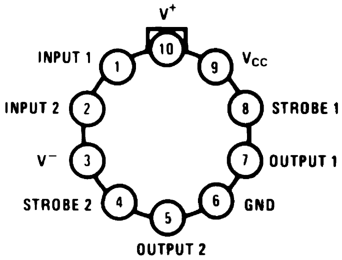
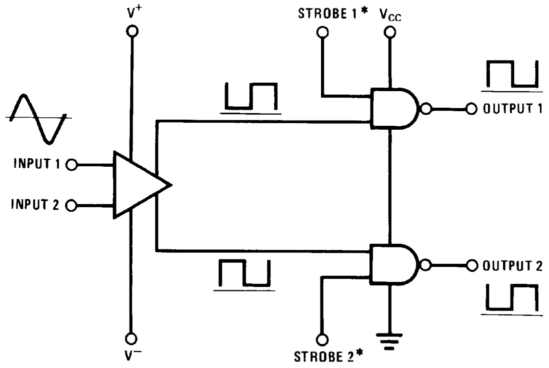


Figure 2. Package Number LME0010C

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

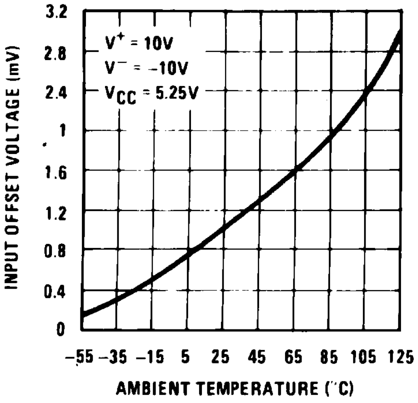


Figure 3.

Input Currents vs Ambient Temperature

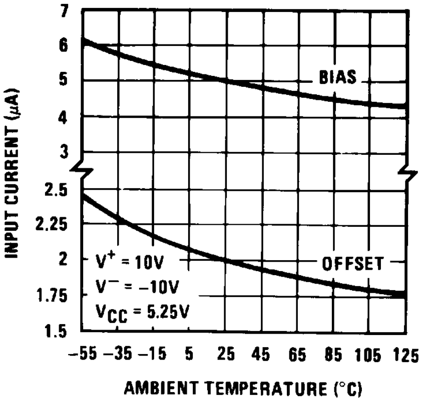


Figure 4.

Input Characteristics

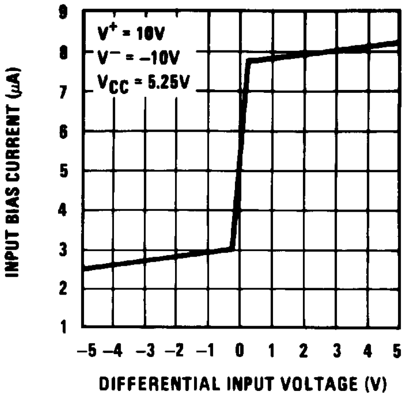


Figure 5.

Supply Current vs Ambient Temperature

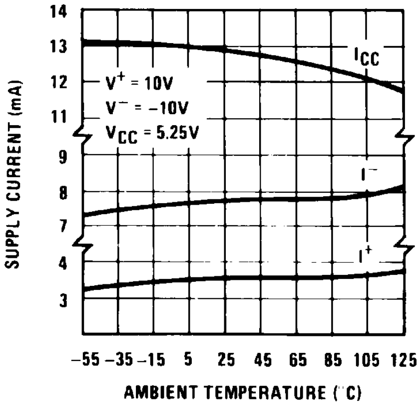


Figure 6.

Supply Current vs Supply Voltage

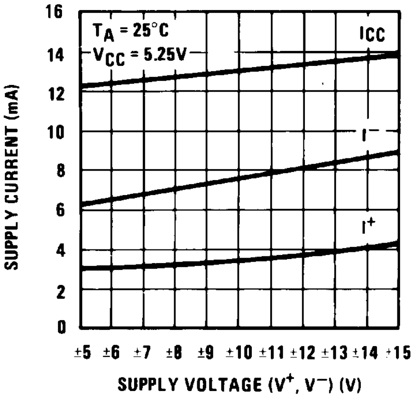


Figure 7.

Propagation Delay vs Ambient Temperature

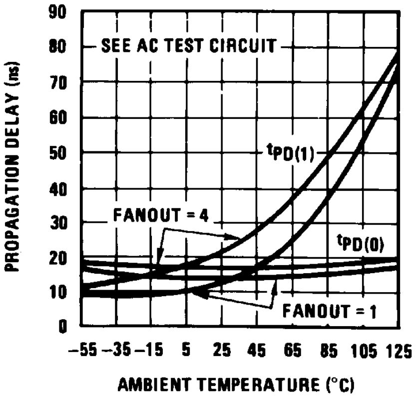


Figure 8.

Typical Performance Characteristics (continued)

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

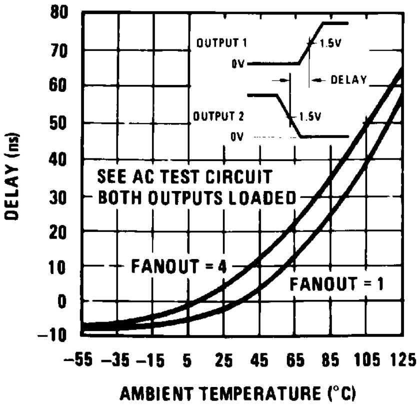


Figure 9.

Strobe Delay vs Ambient Temperature

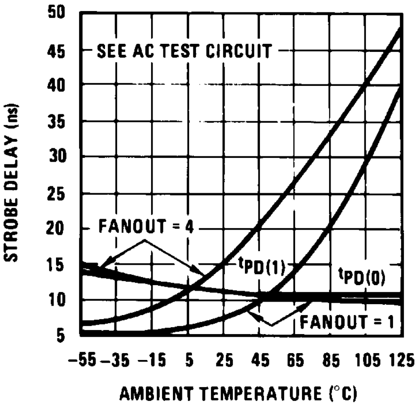


Figure 10.

Common-Mode Pulse Response

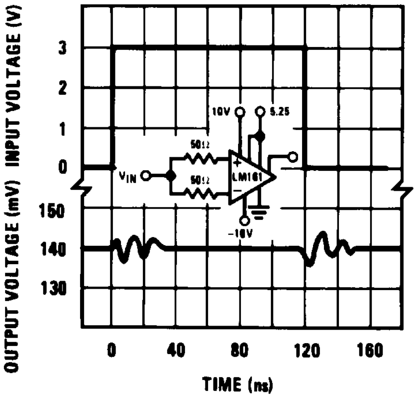


Figure 11.

Propagation Delay vs Supply Voltage

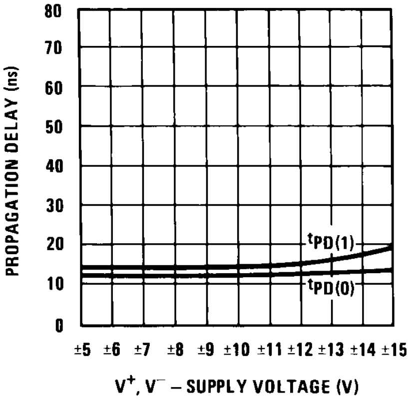
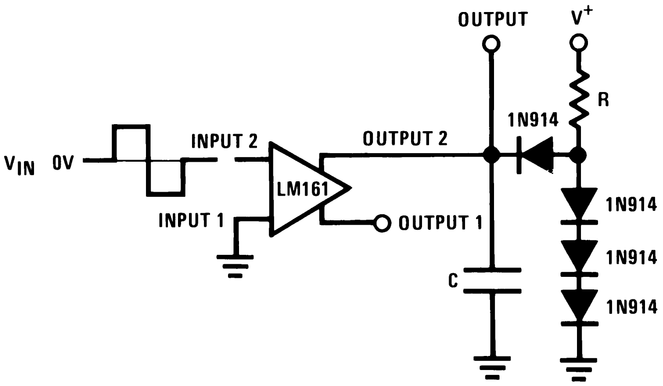


Figure 12.

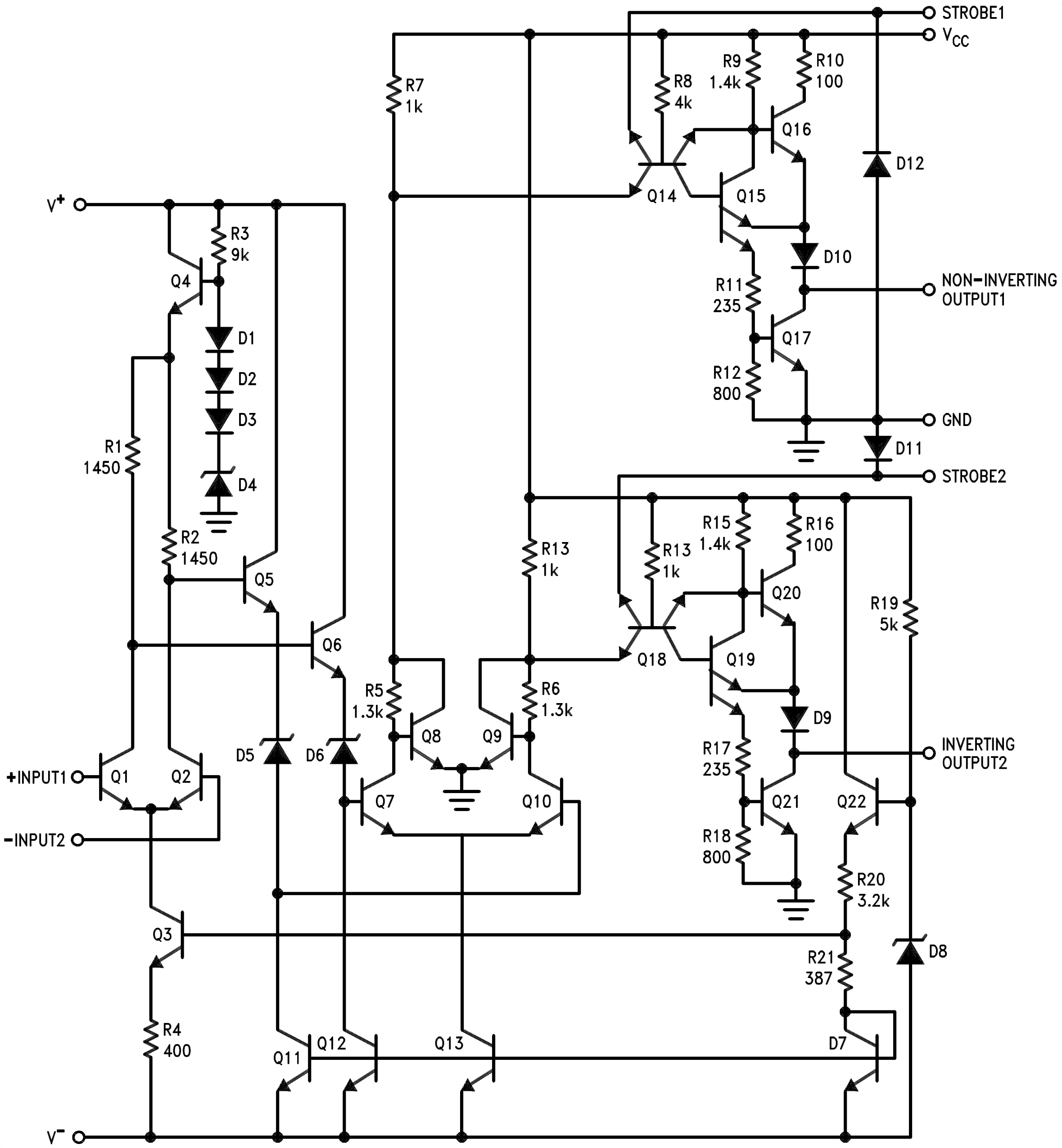
AC TEST CIRCUIT



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 part number	Status (1)	Material type (2)	Package | Pins	Package qty | Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
LM361H/NOPB	Active	Production	TO-100 (LME) | 10	500 | TUBE	Yes	Call TI	Level-1-NA-UNLIM	0 to 70	(LM361H, LM361H)
LM361H/NOPB.B	Active	Production	TO-100 (LME) | 10	500 | TUBE	Yes	Call TI	Level-1-NA-UNLIM	0 to 70	(LM361H, LM361H)
LM361M	Obsolete	Production	SOIC (D) | 14	-	-	Call TI	Call TI	0 to 70	LM361M
LM361M/NOPB	Active	Production	SOIC (D) | 14	55 | TUBE	Yes	SN	Level-1-260C-UNLIM	0 to 70	LM361M
LM361M/NOPB.B	Active	Production	SOIC (D) | 14	55 | TUBE	Yes	SN	Level-1-260C-UNLIM	0 to 70	LM361M
LM361MX/NOPB	Active	Production	SOIC (D) | 14	2500 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	0 to 70	LM361M
LM361MX/NOPB.B	Active	Production	SOIC (D) | 14	2500 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	0 to 70	LM361M
LM361N/NOPB	Active	Production	PDIP (N) | 14	25 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	0 to 70	LM361N
LM361N/NOPB.B	Active	Production	PDIP (N) | 14	25 | TUBE	Yes	NIPDAU	Level-1-NA-UNLIM	0 to 70	LM361N

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

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

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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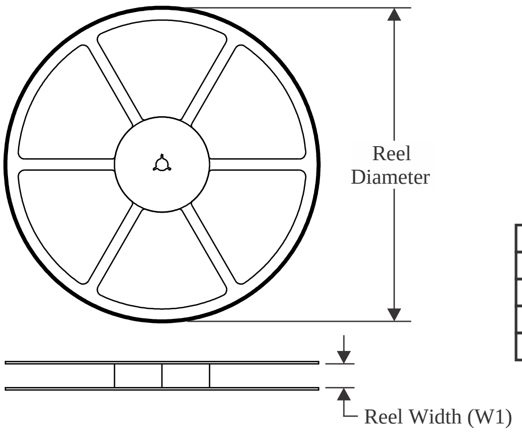
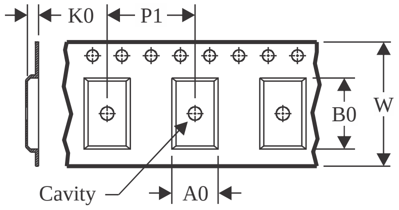
TAPE AND REEL INFORMATION

REEL DIMENSIONS

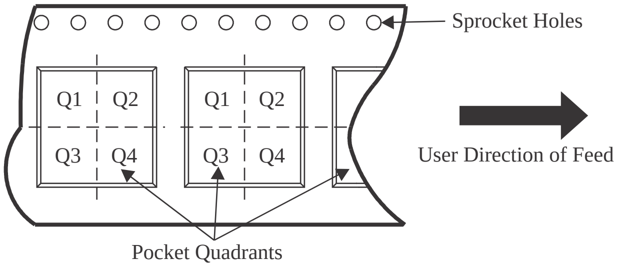


TAPE DIMENSIONS



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

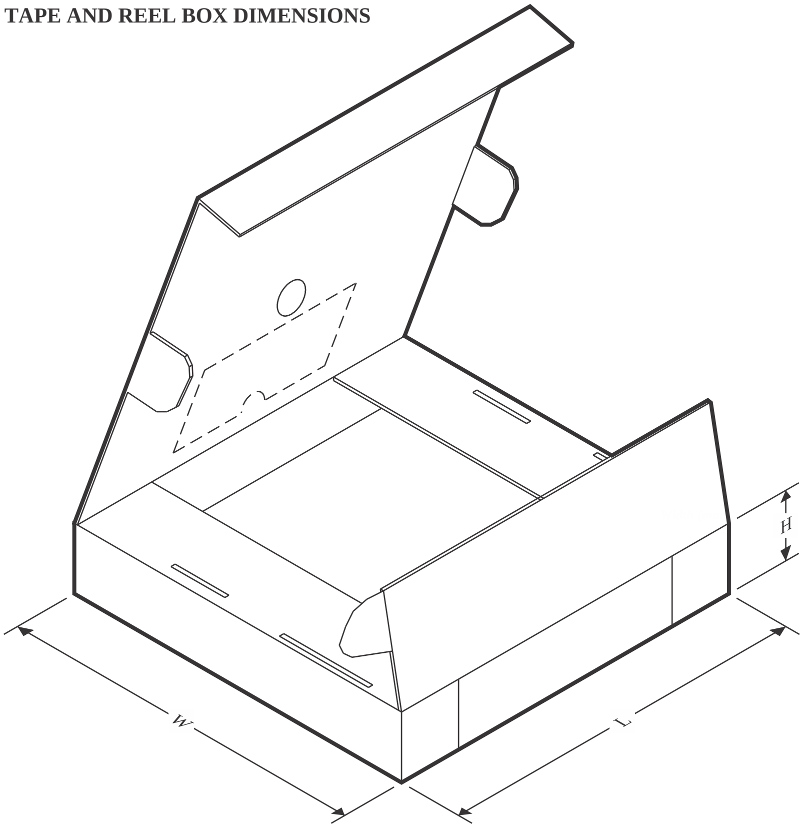
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



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

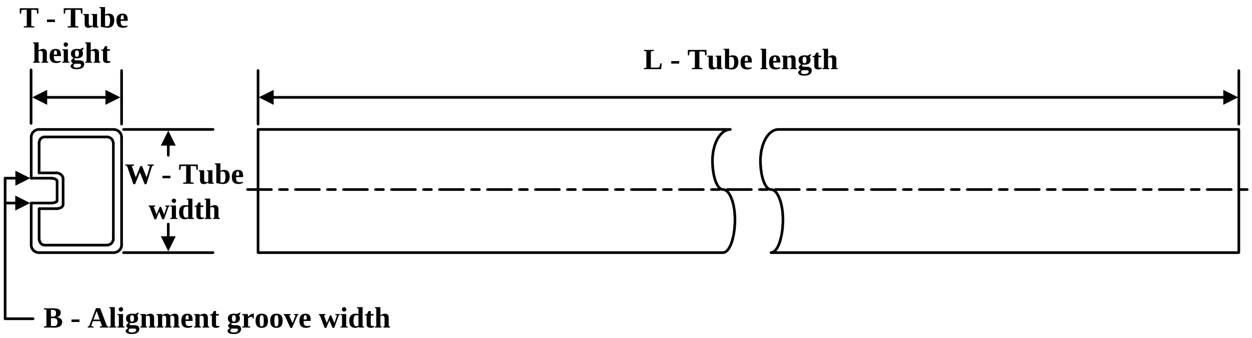
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

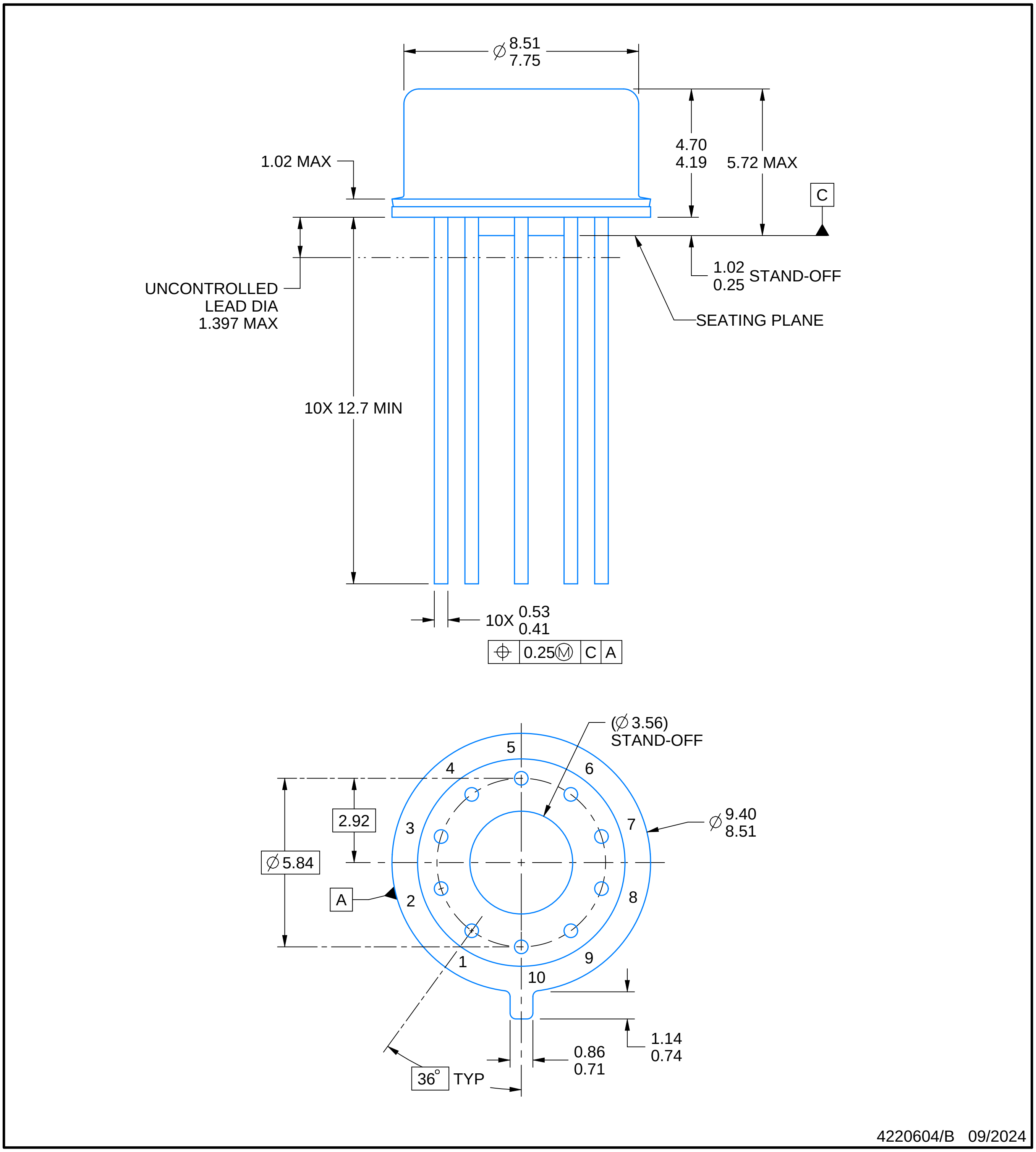
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
LM361MX/NOPB	SOIC	D	14	2500	367.0	367.0	35.0

TUBE



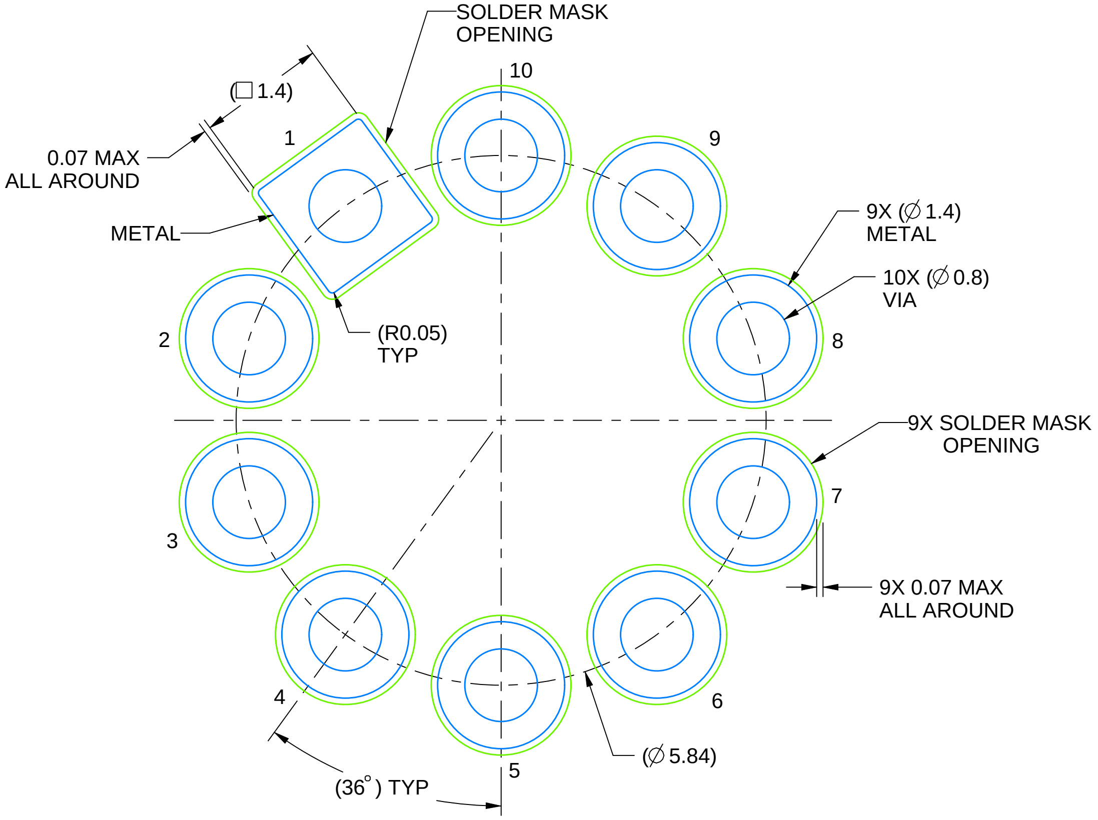
*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (µm)	B (mm)
LM361M/NOPB	D	SOIC	14	55	495	8	4064	3.05
LM361M/NOPB.B	D	SOIC	14	55	495	8	4064	3.05
LM361N/NOPB	N	PDIP	14	25	502	14	11938	4.32
LM361N/NOPB.B	N	PDIP	14	25	502	14	11938	4.32

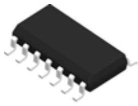


NOTES:

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.



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

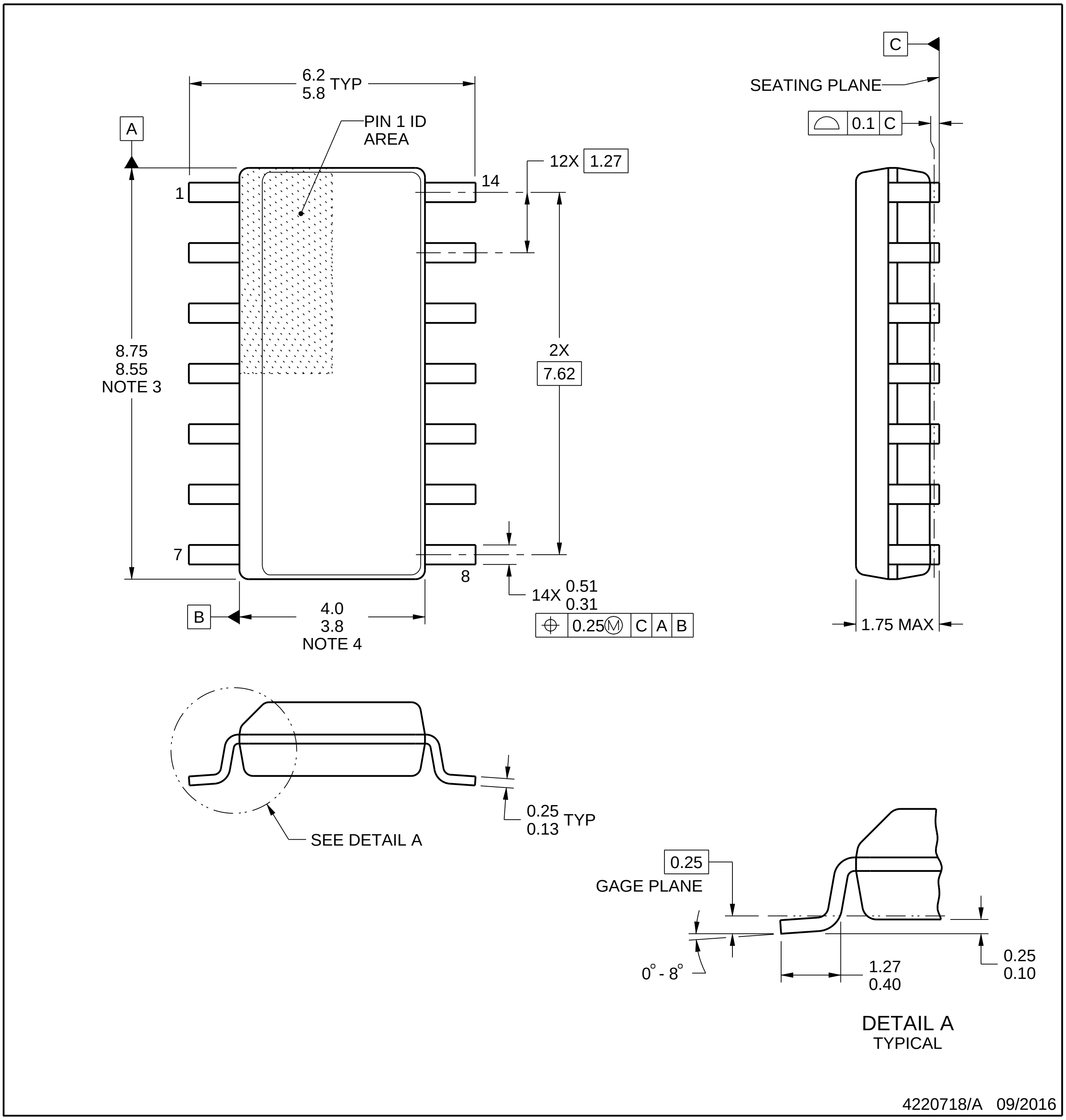


PACKAGE OUTLINE

D0014A

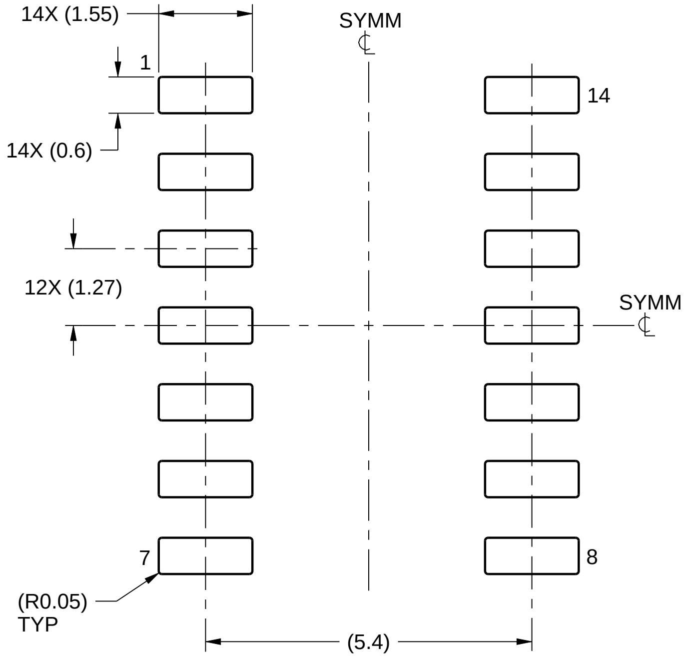
SOIC - 1.75 mm max height

SMALL OUTLINE INTEGRATED CIRCUIT

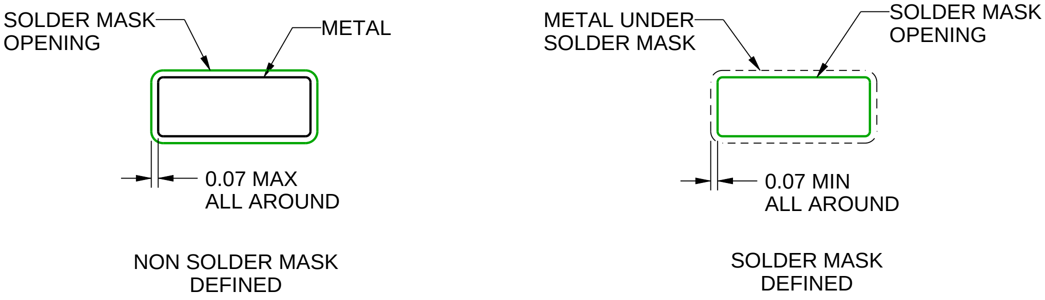


NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.43 mm, per side.
5. Reference JEDEC registration MS-012, variation AB.



LAND PATTERN EXAMPLE
SCALE:8X



NON SOLDER MASK
DEFINED

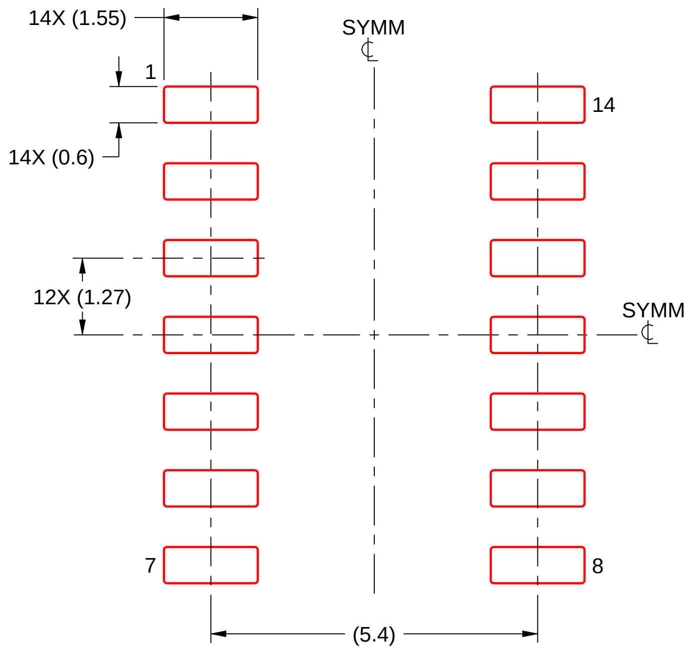
SOLDER MASK
DEFINED

SOLDER MASK DETAILS

4220718/A 09/2016

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE:8X

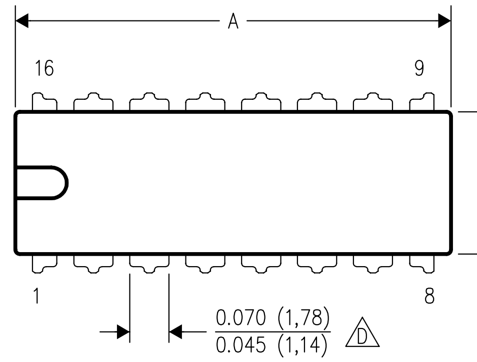
4220718/A 09/2016

NOTES: (continued)

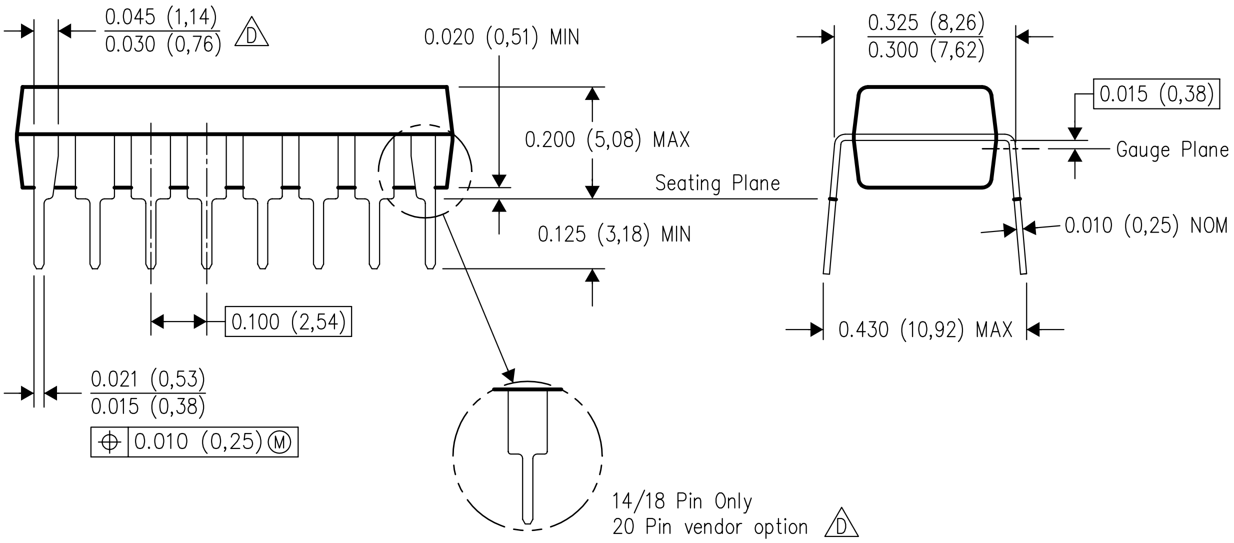
8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

N (R–PDIP–T**) PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



PINS ** DIM	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
△C MS–001 VARIATION	AA	BB	AC	AD



4040049/E 12/2002

NOTES:
- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- △C Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
- △D The 20 pin end lead shoulder width is a vendor option, either half or full width.

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