

# SN54LS590, SN54LS591, SN74LS590, SN74LS591 8-BIT BINARY COUNTERS WITH OUTPUT REGISTERS

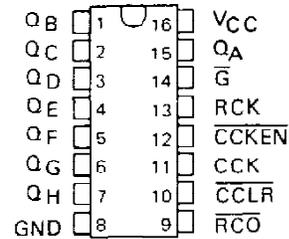
SDLS003

D2632, JANUARY 1981 — REVISED MARCH 1988

- 8-Bit Counter with Register
- Parallel Register Outputs
- Choice of 3-State ('LS590) or Open-Collector ('LS591) Register Outputs
- Guaranteed Counter Frequency: DC to 20 MHz

SN54LS590, SN54LS591 . . . J OR W PACKAGE  
SN74LS590, SN74LS591 . . . N PACKAGE

(TOP VIEW)



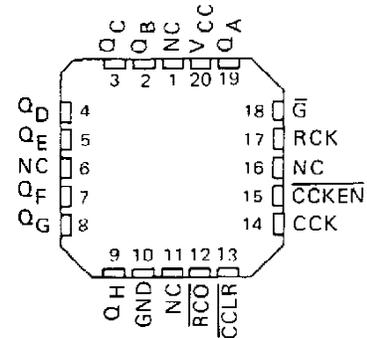
## description

These devices each contain an 8-bit binary counter that feeds an 8-bit storage register. The storage register has parallel outputs. Separate clocks are provided for both the binary counter and storage register. The binary counter features a direct clear input  $\overline{CCLR}$  and a count enable input  $\overline{CCKEN}$ . For cascading, a ripple carry output  $\overline{RCO}$  is provided. Expansion is easily accomplished for two stages by connecting  $\overline{RCO}$  of the first stage to  $\overline{CCKEN}$  of the second stage. Cascading for larger count chains can be accomplished by connecting  $\overline{RCO}$  of each stage to CCK of the following stage.

Both the counter and register clocks are positive-edge triggered. If the user wishes to connect both clocks together, the counter state will always be one count ahead of the register. Internal circuitry prevents clocking from the clock enable.

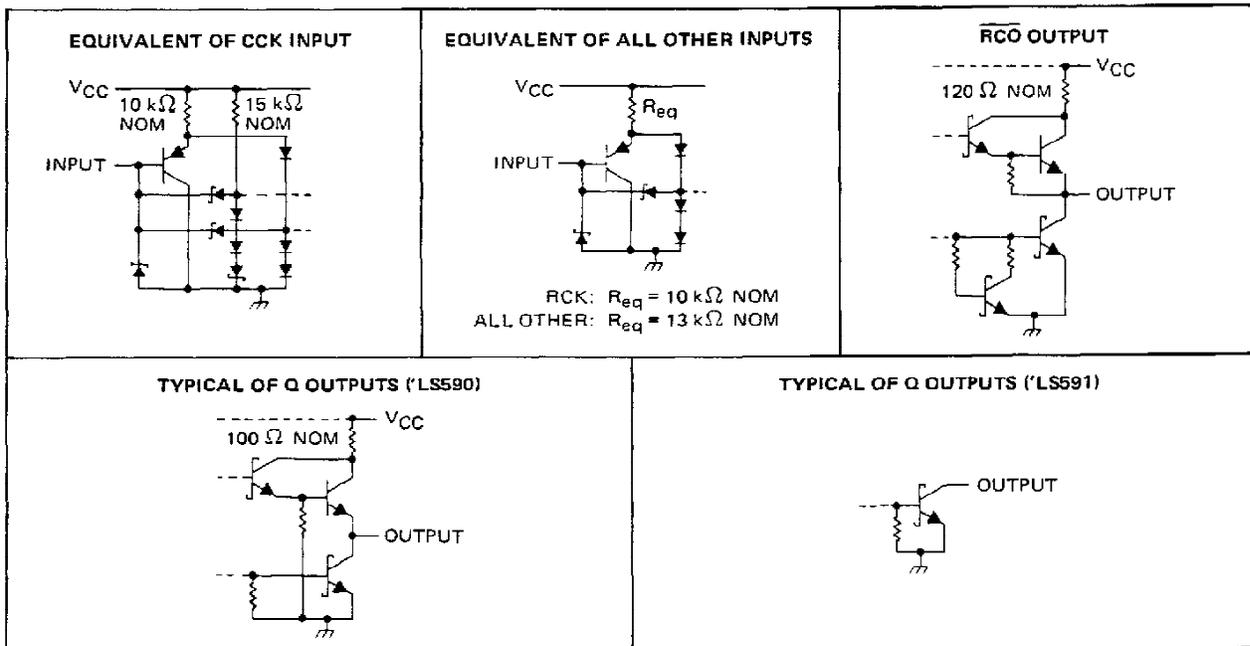
SN54LS590, SN54LS591 . . . FK PACKAGE

(TOP VIEW)



NC - No internal connection

## schematics of inputs and outputs



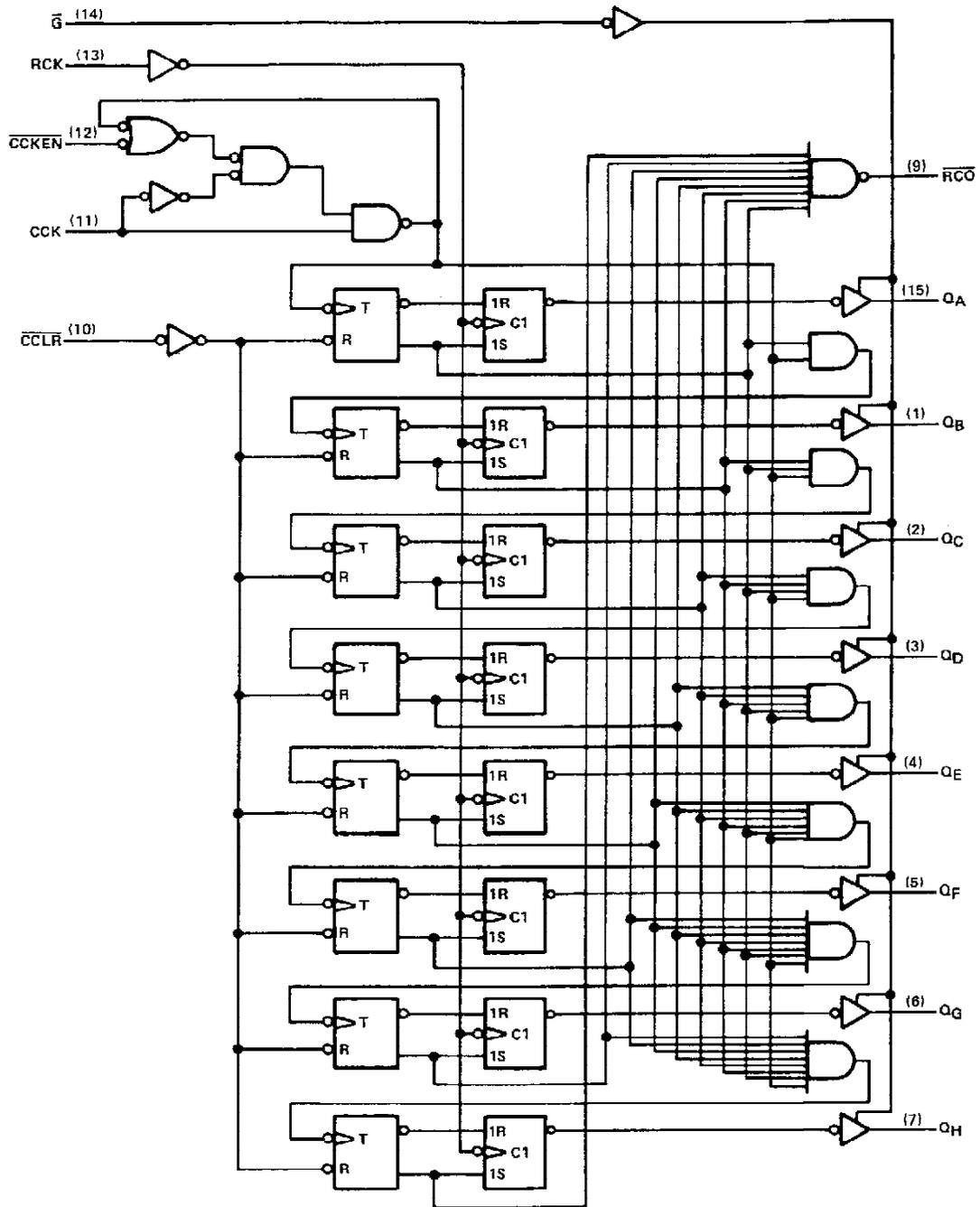
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**SN54LS590, SN54LS591, SN74LS590, SN74LS591**  
**8-BIT BINARY COUNTERS WITH OUTPUT REGISTERS**

logic diagram (positive logic)



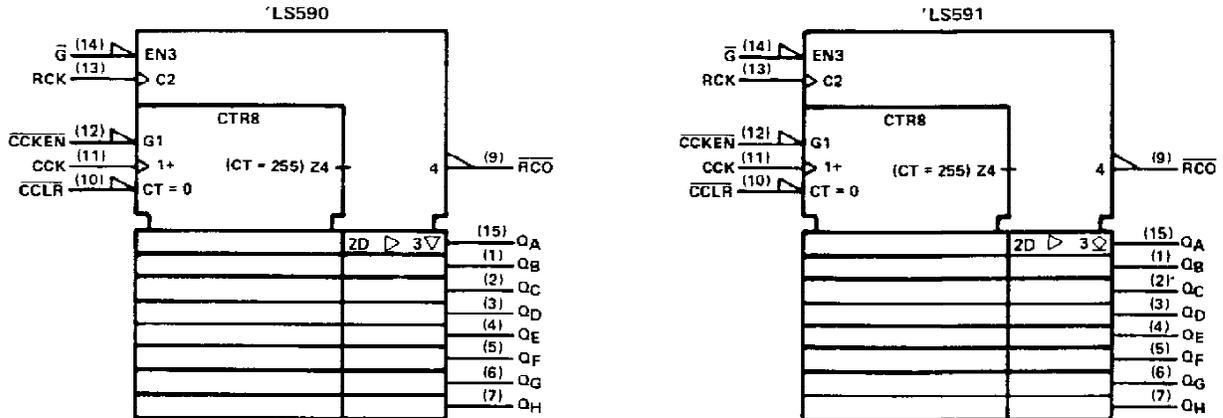
Pin numbers shown are for J, N and W packages.

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# SN54LS590, SN54LS591, SN74LS590, SN74LS591 8-BIT BINARY COUNTERS WITH OUTPUT REGISTERS

logic symbols †



†These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12. Pin numbers shown are for J, N, and W packages.

## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, $V_{CC}$ (see Note 1)	7 V
Input voltage	7 V
Off-state output voltage	5.5 V
Operating free-air temperature range: SN54LS590, SN54LS591	$-55^{\circ}\text{C}$ to $125^{\circ}\text{C}$
SN74LS590, SN74LS591	$0^{\circ}\text{C}$ to $70^{\circ}\text{C}$
Storage temperature range	$-65^{\circ}\text{C}$ to $150^{\circ}\text{C}$

NOTE 1: Voltage values are with respect to the network ground terminal.

## recommended operating conditions

		SN54LS*			SN74LS*			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$	Supply voltage	4.5	5	5.5	4.75	5	5.25	V
$V_{IH}$	High-level input voltage	2			2			V
$V_{IL}$	Low-level input voltage	0.7			0.8			V
$V_{OH}$	High-level output voltage	Q, 'LS591 only		5.5	5.5		V	
$I_{OH}$	High-level output current	RCO		-1	-1		mA	
		Q, 'LS590 only		-1	-2.6			
$I_{OL}$	Low-level output current	RCO		8	16		mA	
		Q		12	24			
$f_{CCK}$	Counter clock frequency	0	20	0	20	MHz		
$f_{RCK}$	Register clock frequency	0	25	0	25	MHz		
$t_w(CCK)$	Duration of counter clock pulse	25			25			ns
$t_w(\overline{CCLR})$	Duration of counter clear pulse	20			20			ns
$t_w(RCK)$	Duration of register clock pulse	20			20			ns
$t_{su}$	Setup time	CCKEN low before CCK ↑		20	20		ns	
		CCLR inactive before CCK ↑		20	20			
		CCK before RCK ↑ (see Note 2)		40	40			
$t_h$	Hold time	CCKEN low after CCK ↑		0	0		ns	
$T_A$	Operating free-air temperature	-55	125	0	70	$^{\circ}\text{C}$		

NOTE 2: This setup time ensures the register will see stable data from the counter outputs. The clocks may be tied together in which case the register state will be one clock pulse behind the counter.

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# SN54LS590, SN54LS591, SN74LS590, SN74LS591

## 8-BIT BINARY COUNTERS WITH OUTPUT REGISTERS

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS†			SN54LS*			SN74LS*			UNIT	
				MIN	TYP‡	MAX	MIN	TYP‡	MAX		
V <sub>IK</sub>	V <sub>CC</sub> = MIN, I <sub>I</sub> = -18 mA			-1.5			-1.5			V	
V <sub>OH</sub>	'LS590 Q	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2V, V <sub>IL</sub> = MAX	I <sub>OH</sub> = -1 mA	2.4	3.2				V		
	RCO		I <sub>OH</sub> = -2.6 mA				2.4	3.1			
I <sub>OH</sub>	'LS591 Q	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2V, V <sub>IL</sub> = MAX	V <sub>OH</sub> = 5.5V	0.1			0.1			mA	
	Q	V <sub>CC</sub> = MIN, V <sub>IH</sub> = 2V, V <sub>IL</sub> = MAX	I <sub>OL</sub> = 12 mA	0.25		0.4	0.25		0.4	V	
V <sub>OL</sub>	RCO		I <sub>OL</sub> = 24 mA				0.35		0.5		
		I <sub>OL</sub> = 8 mA	0.25		0.4	0.25		0.4			
I <sub>OL</sub>		I <sub>OL</sub> = 16 mA				0.35		0.5			
I <sub>OZH</sub>	'LS590 Q	V <sub>CC</sub> = MAX, V <sub>O</sub> = 2.7V	V <sub>IH</sub> = 2V, V <sub>IL</sub> = MAX	20			20			μA	
I <sub>OZL</sub>	'LS590 Q	V <sub>CC</sub> = MAX, V <sub>O</sub> = 0.4V	V <sub>IH</sub> = 2V, V <sub>IL</sub> = MAX	-20			-20			μA	
I <sub>I</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 7V			0.1			0.1			mA	
I <sub>IH</sub>	V <sub>CC</sub> = MAX, V <sub>I</sub> = 2.7V			20			20			μA	
I <sub>IL</sub>	CCK	V <sub>CC</sub> = MAX, V <sub>I</sub> = 0.4V			-0.8			-0.8			mA
	All others				-0.2			-0.2			
I <sub>OS</sub> §	'LS590 Q	V <sub>CC</sub> = MAX, V <sub>O</sub> = 0V			-30			-130			mA
	RCO				-20			-100			
I <sub>CC</sub>	'LS590	V <sub>CC</sub> = MAX, All possible inputs grounded, All outputs open	I <sub>CCH</sub>	33		55	33		55	mA	
			I <sub>CCL</sub>	44		65	44		65		
			I <sub>CCZ</sub>	46		65	46		65		
	'LS591		I <sub>CCH</sub>	35		55	35		55		
			I <sub>CCL</sub>	42		65	42		65		

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at V<sub>CC</sub> = 5V, T<sub>A</sub> = 25°C

§ Not more than one output should be shorted at a time and the duration of the short-circuit should not exceed one second.

switching characteristics, V<sub>CC</sub> = 5V, T<sub>A</sub> = 25°C (see note 3)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	'LS590			'LS591			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
f <sub>max</sub>	RCK	Q	R <sub>L</sub> = 667 Ω, C <sub>L</sub> = 45 pF	20	35		20	35	MHz	
t <sub>PLH</sub>	CCK↑	RCO	R <sub>L</sub> = 1 kΩ, C <sub>L</sub> = 30 pF	14 22			16 24			ns
t <sub>PHL</sub>	CCK↑	RCO		20 30			25 38			ns
t <sub>PLH</sub>	CCLR↓	RCO	R <sub>L</sub> = 667 Ω, C <sub>L</sub> = 45 pF	30 45			32 48			ns
t <sub>PLH</sub>	RCK↑	Q		12 18			25 38			ns
t <sub>PHL</sub>	RCK↑	Q		22 33			28 42			ns
t <sub>PZH</sub>	G↓	Q		25 38						ns
t <sub>PZL</sub>	G↓	Q		30 45						ns
t <sub>PHZ</sub>	G↑	Q		20 30						ns
t <sub>PLZ</sub>	G↑	Q	R <sub>L</sub> = 667 Ω, C <sub>L</sub> = 5 pF	25 38						ns
t <sub>PLH</sub>	G↑	Q	R <sub>L</sub> = 667 Ω, C <sub>L</sub> = 45 pF				34 50			ns
t <sub>PHL</sub>	G↓	Q					32 48			ns

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

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**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
5962-87517012A	ACTIVE	LCCC	FK	20	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	5962- 87517012A SNJ54LS 590FK	<a href="#">Samples</a>
5962-8751701EA	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	5962-8751701EA SNJ54LS590J	<a href="#">Samples</a>
5962-8751701EA	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	5962-8751701EA SNJ54LS590J	<a href="#">Samples</a>
SN54LS590J	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	SN54LS590J	<a href="#">Samples</a>
SN54LS590J	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	SN54LS590J	<a href="#">Samples</a>
SN74LS590D	ACTIVE	SOIC	D	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LS590	<a href="#">Samples</a>
SN74LS590D	ACTIVE	SOIC	D	16	40	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	LS590	<a href="#">Samples</a>
SN74LS590N	ACTIVE	PDIP	N	16	25	RoHS & Green	NIPDAU	N / A for Pkg Type	0 to 70	SN74LS590N	<a href="#">Samples</a>
SN74LS590N	ACTIVE	PDIP	N	16	25	RoHS & Green	NIPDAU	N / A for Pkg Type	0 to 70	SN74LS590N	<a href="#">Samples</a>
SN74LS590NSR	ACTIVE	SO	NS	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	74LS590	<a href="#">Samples</a>
SN74LS590NSR	ACTIVE	SO	NS	16	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	0 to 70	74LS590	<a href="#">Samples</a>
SNJ54LS590FK	ACTIVE	LCCC	FK	20	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	5962- 87517012A SNJ54LS 590FK	<a href="#">Samples</a>
SNJ54LS590FK	ACTIVE	LCCC	FK	20	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	5962- 87517012A SNJ54LS 590FK	<a href="#">Samples</a>
SNJ54LS590J	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	5962-8751701EA SNJ54LS590J	<a href="#">Samples</a>
SNJ54LS590J	ACTIVE	CDIP	J	16	1	Non-RoHS & Green	SNPB	N / A for Pkg Type	-55 to 125	5962-8751701EA SNJ54LS590J	<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  $\leq 1000$ ppm threshold. Antimony trioxide based flame retardants must also meet the  $\leq 1000$ ppm 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 finish/Ball material - Orderable Devices 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.

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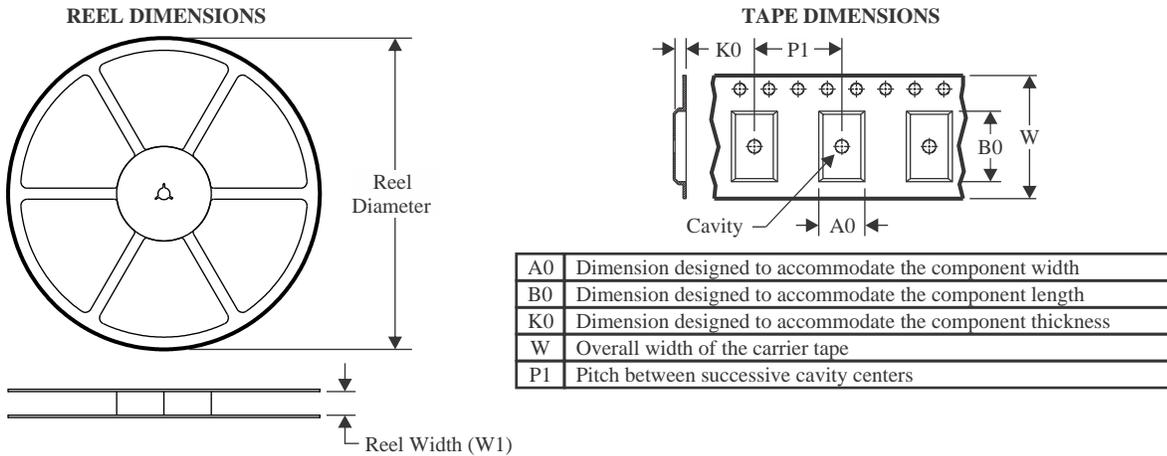
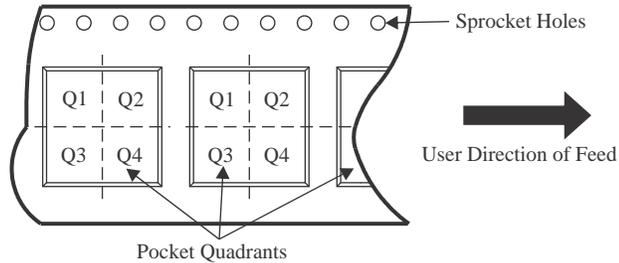
**OTHER QUALIFIED VERSIONS OF SN54LS590, SN74LS590 :**

● Catalog : [SN74LS590](#)

● Military : [SN54LS590](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

**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
SN74LS590NSR	SO	NS	16	2000	330.0	16.4	8.2	10.5	2.5	12.0	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)
SN74LS590NSR	SO	NS	16	2000	356.0	356.0	35.0

**TUBE**


\*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
5962-87517012A	FK	LCCC	20	1	506.98	12.06	2030	NA
SN74LS590D	D	SOIC	16	40	507	8	3940	4.32
SN74LS590N	N	PDIP	16	25	506	13.97	11230	4.32
SN74LS590N	N	PDIP	16	25	506	13.97	11230	4.32
SNJ54LS590FK	FK	LCCC	20	1	506.98	12.06	2030	NA

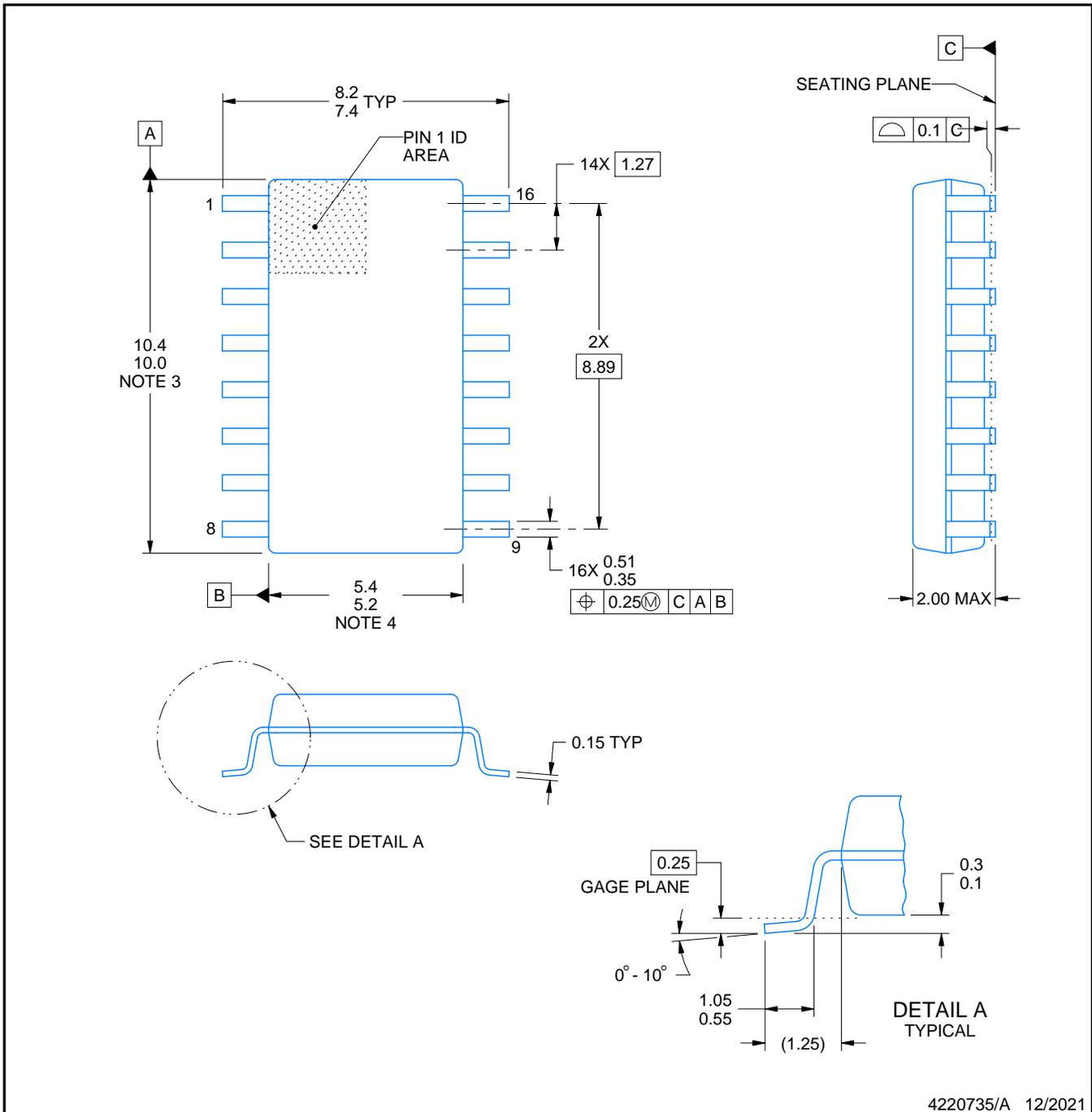


# PACKAGE OUTLINE

## NS0016A

### SOP - 2.00 mm max height

SOP



#### NOTES:

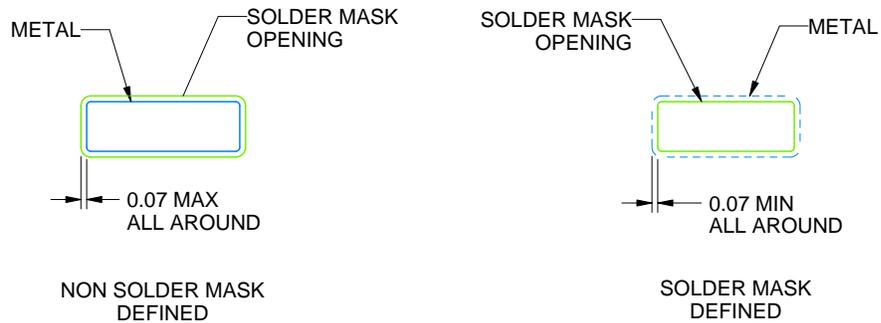
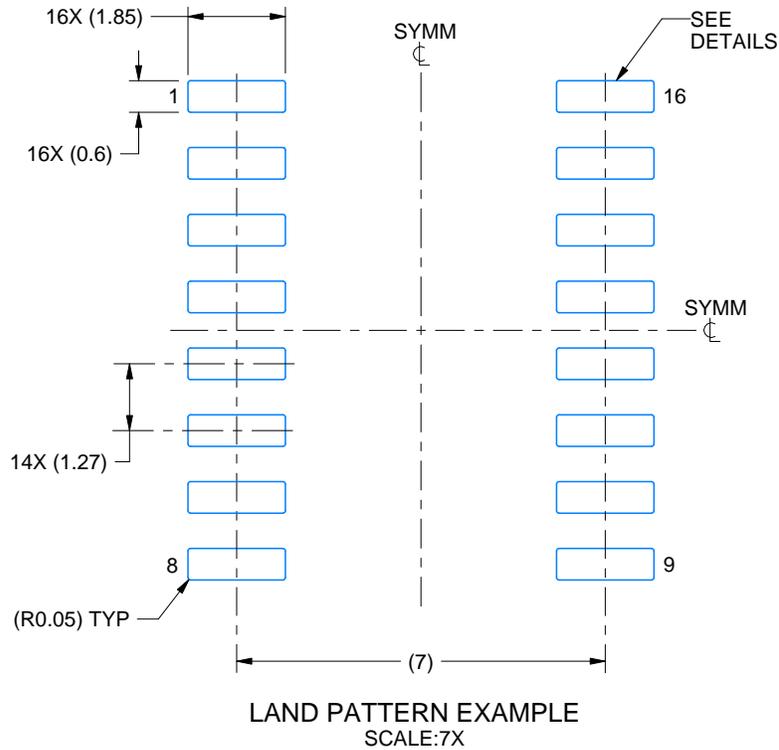
1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm, per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm, per side.

# EXAMPLE BOARD LAYOUT

NS0016A

SOP - 2.00 mm max height

SOP



4220735/A 12/2021

NOTES: (continued)

5. Publication IPC-7351 may have alternate designs.

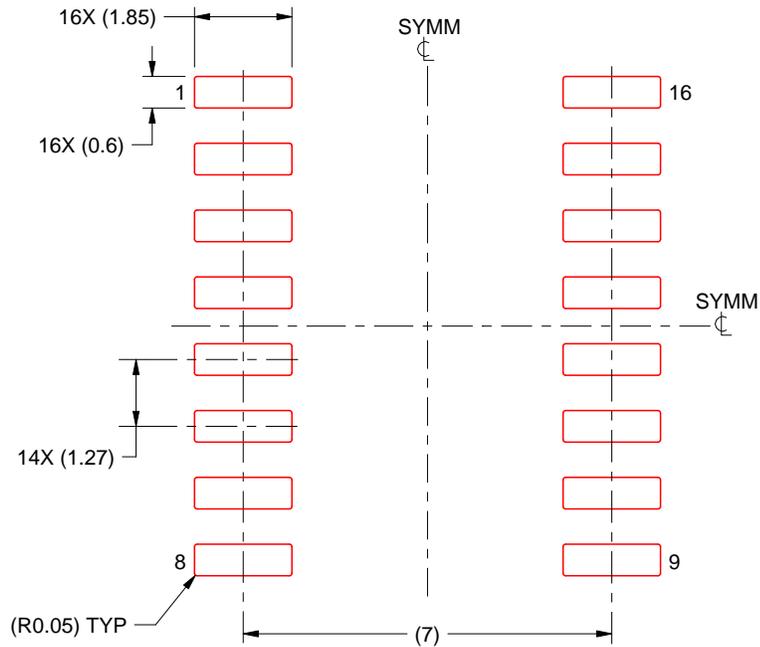
6. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

NS0016A

SOP - 2.00 mm max height

SOP



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:7X

4220735/A 12/2021

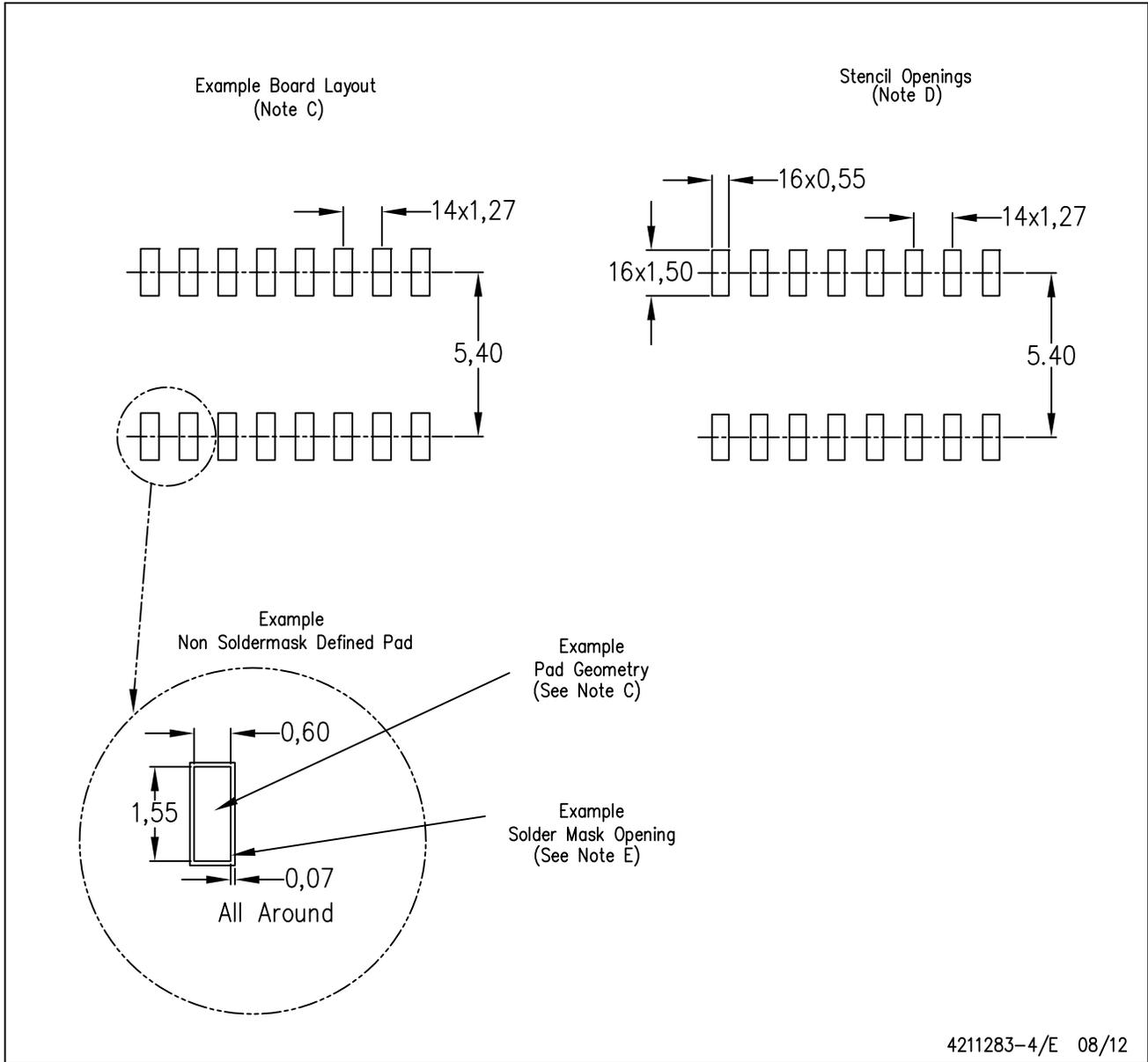
NOTES: (continued)

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



D (R-PDSO-G16)

PLASTIC SMALL OUTLINE



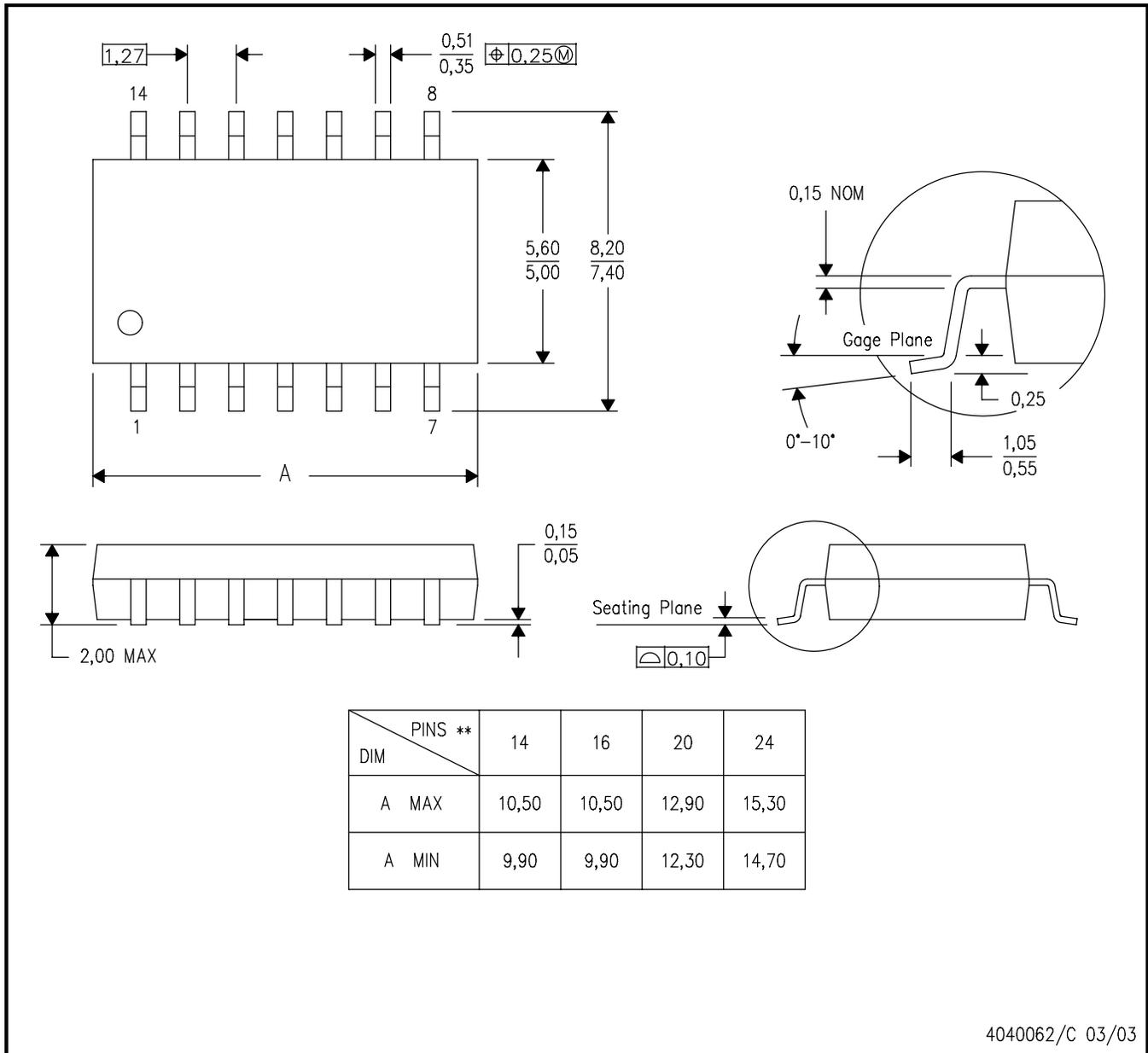
- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers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

# MECHANICAL DATA

NS (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

## GENERIC PACKAGE VIEW

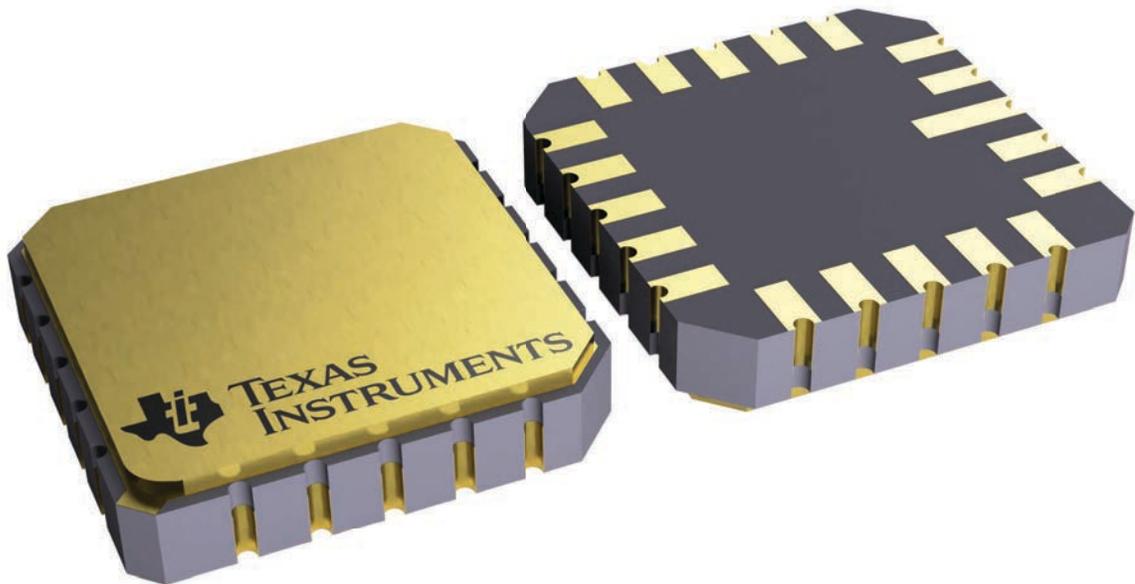
**FK 20**

**LCCC - 2.03 mm max height**

8.89 x 8.89, 1.27 mm pitch

LEADLESS CERAMIC CHIP CARRIER

This image is a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.

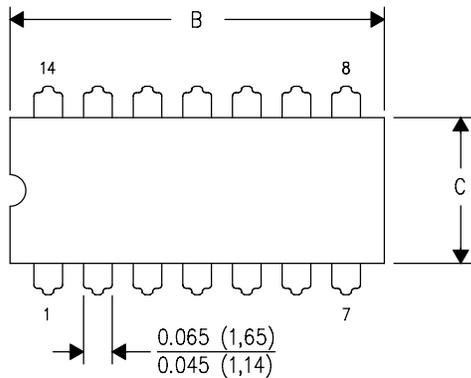


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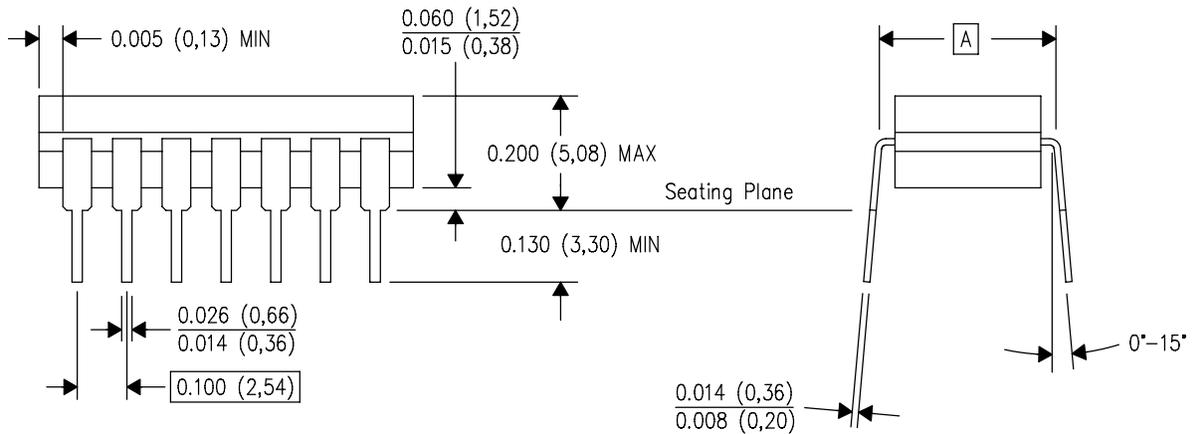
J (R-GDIP-T\*\*)

14 LEADS SHOWN

CERAMIC DUAL IN-LINE PACKAGE



DIM \ PINS **	14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	—	—	—	—
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)



4040083/F 03/03

- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - This package is hermetically sealed with a ceramic lid using glass frit.
  - Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
  - Falls within MIL STD 1835 GDIP1-T14, GDIP1-T16, GDIP1-T18 and GDIP1-T20.

N (R-PDIP-T\*\*)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



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

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