OCTAL, HEX, AND QUAD D-TYPE FLIP-FLOPS WITH CLOCK ENABLE

SCLS202 – D2684, DECEMBER 1982 – REVISED JUNE 1989

- **'HC377 and 'HC378 Contain Eight and Six Flip-Flops, Respectively, with Single-Rail Outputs**
- **'HC379 Contains Four Flip-Flops with Double-Rail Outputs**
- **Clock Enable Latched to Avoid False Clocking**
- **Applications Include:**
  Buffer/Storage Registers
  Shift Registers
  Pattern Generators
- **Package Options Include Plastic "Small Outline" Packages, Ceramic Chip Carriers, and Standard Plastic and Ceramic 300-mil DIPs**
- **Dependable Texas Instruments Quality and Reliability**

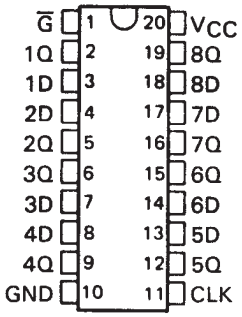
description

These circuits are positive-edge-triggered D-type flip-flops with an enable input. The 'HC377, 'HC378, and 'HC379 devices are similar to 'HC273, 'HC174, and 'HC175 respectively, but feature a latched clock enable ($\overline{G}$) instead of a common clear.

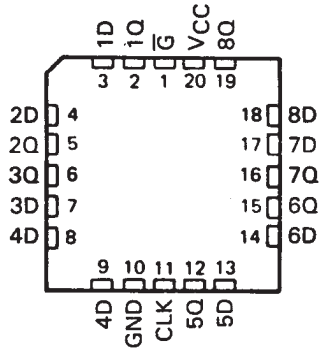
Information at the D inputs meeting the setup time requirements is transferred to the Q outputs on the positive-going edge of the clock pulse if $\overline{G}$ is low. Clock triggering occurs at a particular voltage level and is not directly related to the transition time of the positive-going pulse. When the clock input is at either the high or low level, the D input signal has no effect at the output. The circuits are designed to prevent false clocking by transitions at the $\overline{G}$ input.

The SN54HC377, SN54HC378, and SN54HC379 are characterized for operation over the full military temperature range of −55°C to 125°C. The SN74HC377, SN74HC378, and SN74HC379 are characterized for operation from −40°C to 85°C.

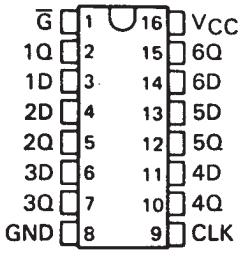
SN54HC377 . . . J PACKAGE
SN74HC377 . . . DW OR N PACKAGE
(TOP VIEW)



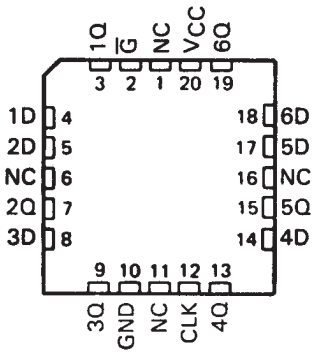
SN54HC377 . . . FK PACKAGE
(TOP VIEW)



SN54HC378 . . . J PACKAGE
SN74HC378 . . . D OR N PACKAGE
(TOP VIEW)

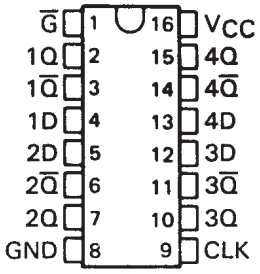


SN54HC378 . . . FK PACKAGE
(TOP VIEW)

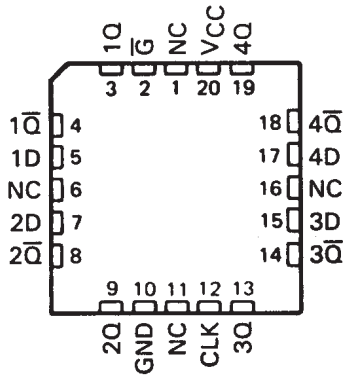


NC—No internal connection

SN54HC379 . . . J PACKAGE
SN74HC379 . . . D, J, OR N PACKAGE
(TOP VIEW)

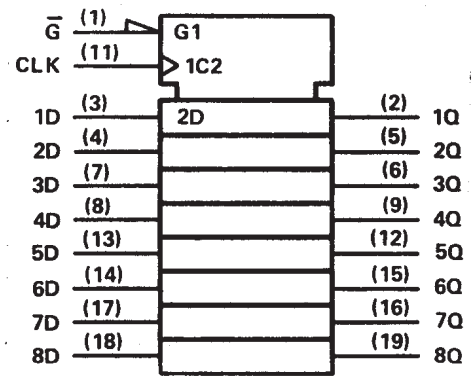


SN54HC379 . . . FK PACKAGE
(TOP VIEW)



NC—No internal connection

'HC377 logic symbol†



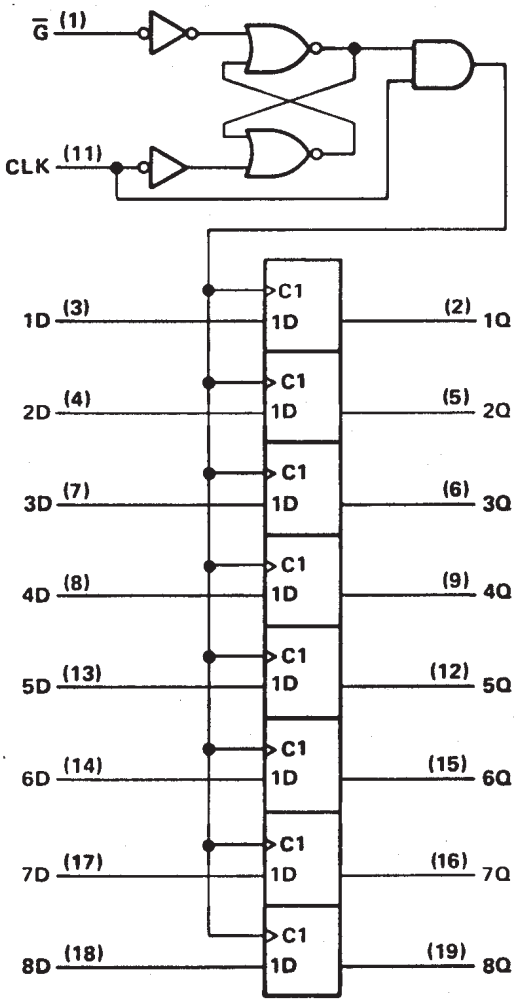
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for DW, J, and N packages.

FUNCTION TABLE
(EACH FLIP-FLOP)

INPUTS			OUTPUT
$\overline{G}$	CLOCK	DATA	Q
H	X	X	Q_0
L	↑	H	H
L	↑	L	L
X	L	X	Q_0

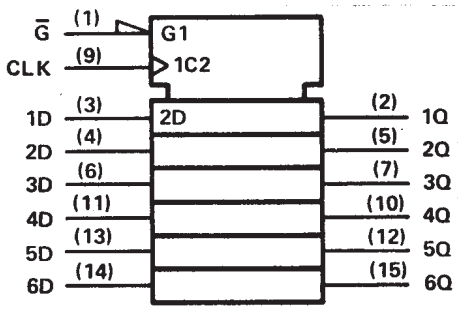
H = high level, L = low level, X = irrelevant

'HC377 logic diagram (positive logic)



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

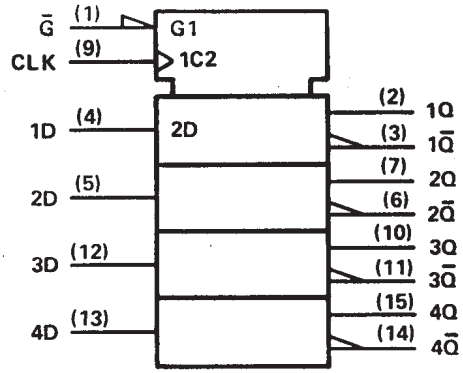
'HC378 logic symbol†



FUNCTION TABLE
(EACH FLIP-FLOP)

INPUTS			OUTPUT
$\overline{G}$	CLOCK	DATA	Q
H	X	X	Q_0
L	↑	H	H
L	↑	L	L
X	L	X	Q_0

'HC379 logic symbol†



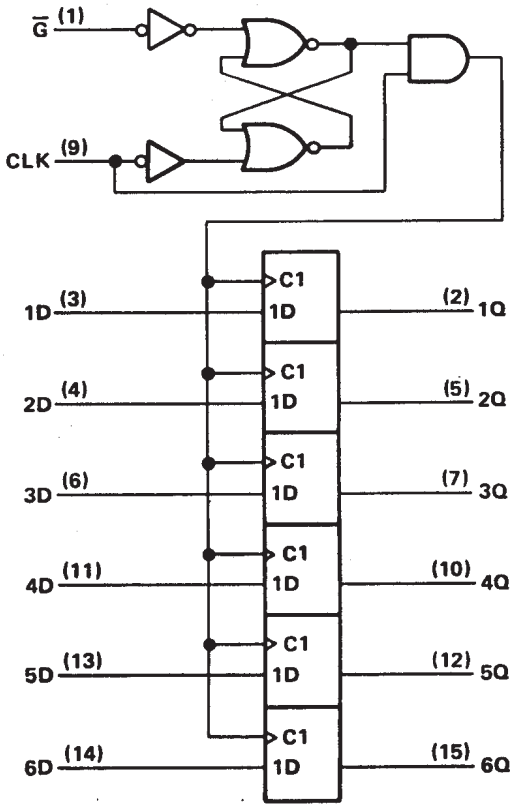
FUNCTION TABLE
(EACH FLIP-FLOP)

INPUTS			OUTPUTS	
$\overline{G}$	CLOCK	DATA	Q	$\overline{Q}$
H	X	X	Q_0	$\overline{Q}_0$
L	↑	H	H	L
L	↑	L	L	H
X	L	X	Q_0	$\overline{Q}_0$

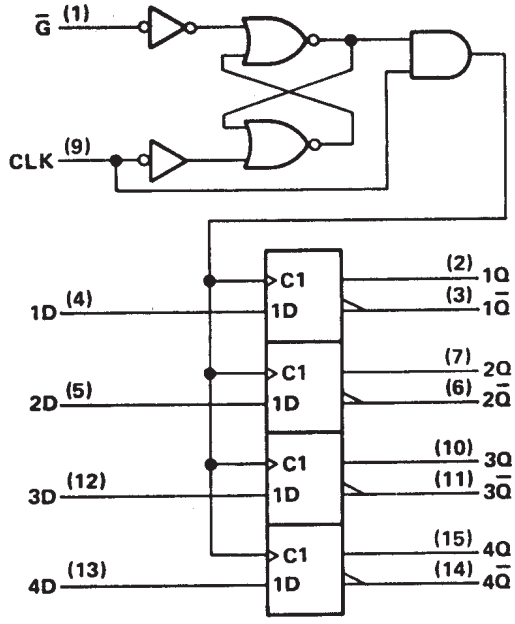
†These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

Pin numbers are for D, J, and N packages.

'HC378 logic diagram (positive logic)



'HC379 logic diagram (positive logic)



absolute maximum ratings over operating free-air temperature range†

Supply voltage, V_{CC} . . . . . −0.5 V to 7 V
Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{CC}$) . . . . . ±20 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$ . . . . . ±20 mA
Continuous output current, I_O (V_O = 0 to V_{CC}) . . . . . ±25 mA
Continuous current through V_{CC} or GND pins . . . . . ±50 mA
Lead temperature 1,6 mm (1/16 in) from case for 60 s: FK or J package . . . . . 300°C
Lead temperature 1,6 mm (1/16 in) from case for 10 s: D, DW, or N package . . . . . 260°C
Storage temperature range . . . . . −65°C to 150°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

recommended operating conditions

			SN54HC377 SN54HC378 SN54HC379			SN74HC377 SN74HC378 SN74HC379			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage		2	5	6	2	5	6	V
V_{IH}	High-level input voltage	V_{CC} = 2 V	1.5			1.5			V
		V_{CC} = 4.5 V	3.15			3.15			
		V_{CC} = 6 V	4.2			4.2			
V_{IL}	Low-level input voltage	V_{CC} = 2 V	0		0.3	0		0.3	V
		V_{CC} = 4.5 V	0		0.9	0		0.9	
		V_{CC} = 6 V	0		1.2	0		1.2	
V_I	Input voltage		0		V_{CC}	0		V_{CC}	V
V_O	Output voltage		0		V_{CC}	0		V_{CC}	V
t_t	Input transition (rise and fall) times	V_{CC} = 2 V	0		1000	0		1000	ns
		V_{CC} = 4.5 V	0		500	0		500	
		V_{CC} = 6 V	0		400	0		400	
T_A	Operating free-air temperature		−55		125	−40		85	°C

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

PARAMETER	TEST CONDITIONS	V_{CC}	T_A = 25°C			SN54HC377 SN54HC378 SN54HC379		SN74HC377 SN74HC378 SN74HC379		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V_{OH}	V_I = V_{IH} or V_{IL}, I_{OH} = −20 μA	2 V	1.9	1.998		1.9		1.9		V
		4.5 V	4.4	4.499		4.4		4.4		
		6 V	5.9	5.999		5.9		5.9		
	V_I = V_{IH} or V_{IL}, I_{OH} = −4 mA	4.5 V	3.98	4.30		3.7		3.84		
	V_I = V_{IH} or V_{IL}, I_{OH} = −5.2 mA	6 V	5.48	5.80		5.2		5.34		
V_{OL}	V_I = V_{IH} or V_{IL}, I_{OL} = 20 μA	2 V		0.002	0.1		0.1		0.1	V
		4.5 V		0.001	0.1		0.1		0.1	
		6 V		0.001	0.1		0.1		0.1	
	V_I = V_{IH} or V_{IL}, I_{OL} = 4 mA	4.5 V		0.17	0.26		0.4		0.33	
	V_I = V_{IH} or V_{IL}, I_{OL} = 5.2 mA	6 V		0.15	0.26		0.4		0.33	
I_I	V_I = V_{CC} or 0	6 V		±0.1	±100		±1000		±1000	nA
I_{CC}	V_I = V_{CC} or 0, I_O = 0	6 V			8		160		80	μA
C_i		2 to 6 V		3	10		10		10	pF

timing requirements over recommended operating free-air temperature range (unless otherwise noted)

			V_{CC}	T_A = 25°C		SN54HC377 SN54HC378 SN54HC379		SN74HC377 SN74HC378 SN74HC379		UNIT
				MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency		2 V	0	5	0	3	0	4	MHz
			4.5 V	0	25	0	16	0	20	
			6 V	0	29	0	19	0	23	
t_w	Pulse duration, CLK high or low		2 V	100		150		125		ns
			4.5 V	20		30		25		
			6 V	17		25		21		
t_{su}	Set up time before CLK↑	D	2 V	100		150		125		ns
			4.5 V	20		30		25		
			6 V	17		25		21		
		$\overline{G}$ high or low	2 V	100		150		125		ns
			4.5 V	20		30		25		
			6 V	17		25		21		
t_h	Hold time after CLK↑	$\overline{G}$ inactive or active, data	2 V	5		5		5		ns
			4.5 V	5		5		5		
			6 V	5		5		5		

switching characteristics over recommended operating free-air temperature range (unless otherwise noted), C_L = 50 pF (see Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	T_A = 25°C			SN54HC377 SN54HC378 SN54HC379		SN74HC377 SN74HC378 SN74HC379		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			2 V	5	11		3		4		MHz
			4.5 V	25	54		16		20		
			6 V	29	64		19		23		
t_{pd}	CLK	Any	2 V		56	160		240		200	ns
			4.5 V		15	32		48		40	
			6 V		12	27		41		34	
t_t		Any	2 V		38	75		110		95	ns
			4.5 V		8	15		22		19	
			6 V		6	13		19		16	

C_{pd}	Power dissipation capacitance	No load, T_A = 25°C	30 pF typ

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

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
5962-87807012A	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
5962-8780701RA	ACTIVE	CDIP	J	20	1	TBD	A42 SNPB	N / A for Pkg Type
SN54HC377J	ACTIVE	CDIP	J	20	1	TBD	A42 SNPB	N / A for Pkg Type
SN74HC377DW	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC377DWE4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC377DWG4	ACTIVE	SOIC	DW	20	25	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC377DWR	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC377DWRE4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC377DWRG4	ACTIVE	SOIC	DW	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC377N	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74HC377NE4	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74HC377NSR	ACTIVE	SO	NS	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC377NSRE4	ACTIVE	SO	NS	20	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74HC378D	OBSOLETE	SOIC	D	16		TBD	Call TI	Call TI
SN74HC378N	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74HC378N3	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SN74HC379N	OBSOLETE	PDIP	N	16		TBD	Call TI	Call TI
SNJ54HC377FK	ACTIVE	LCCC	FK	20	1	TBD	POST-PLATE	N / A for Pkg Type
SNJ54HC377J	ACTIVE	CDIP	J	20	1	TBD	A42 SNPB	N / A for Pkg Type

[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.

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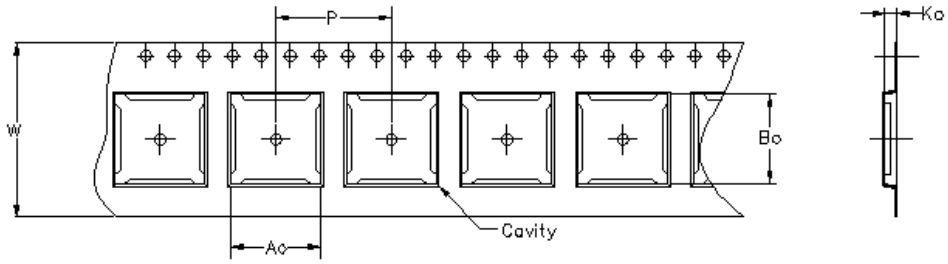
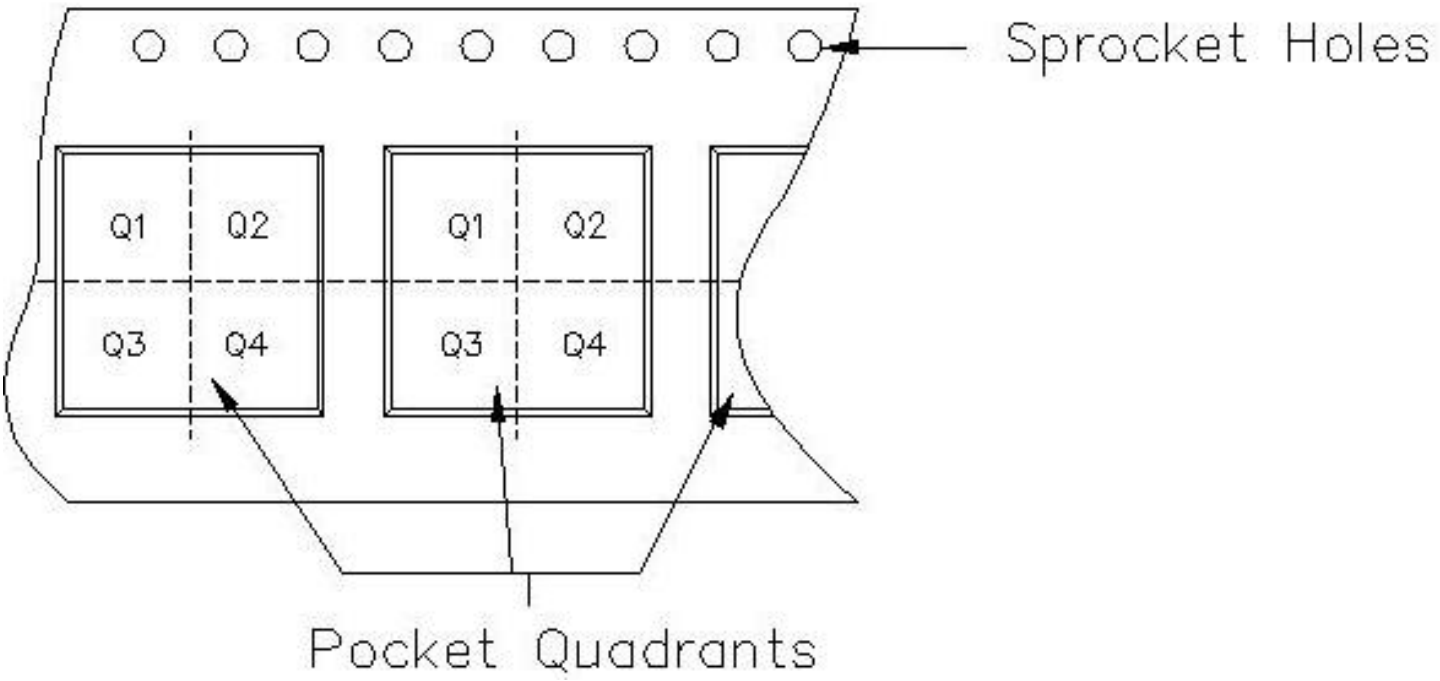


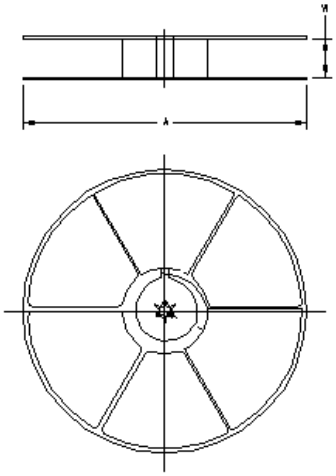
Carrier tape design is defined largely by the component lentgh, width, and thickness.

Ao = Dimension designed to accommodate the component width.
Bo = Dimension designed to accommodate the component length.
Ko = Dimension designed to accommodate the component thickness.
W = Overall width of the carrier tape.
P = Pitch between successive cavity centers.



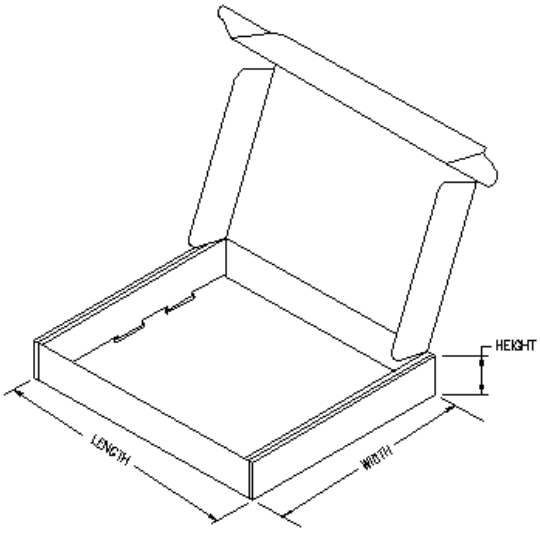
TAPE AND REEL INFORMATION

Device	Package	Pins	Site	Reel Diameter (mm)	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74HC377DWR	DW	20	MLA	330	24	10.8	13.0	2.7	12	24	Q1
SN74HC377NSR	NS	20	MLA	330	24	8.2	13.0	2.5	12	24	Q1



TAPE AND REEL BOX INFORMATION

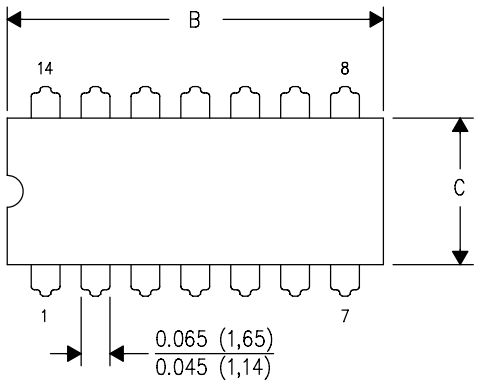
Device	Package	Pins	Site	Length (mm)	Width (mm)	Height (mm)
SN74HC377DWR	DW	20	MLA	333.2	333.2	31.75
SN74HC377NSR	NS	20	MLA	333.2	333.2	31.75



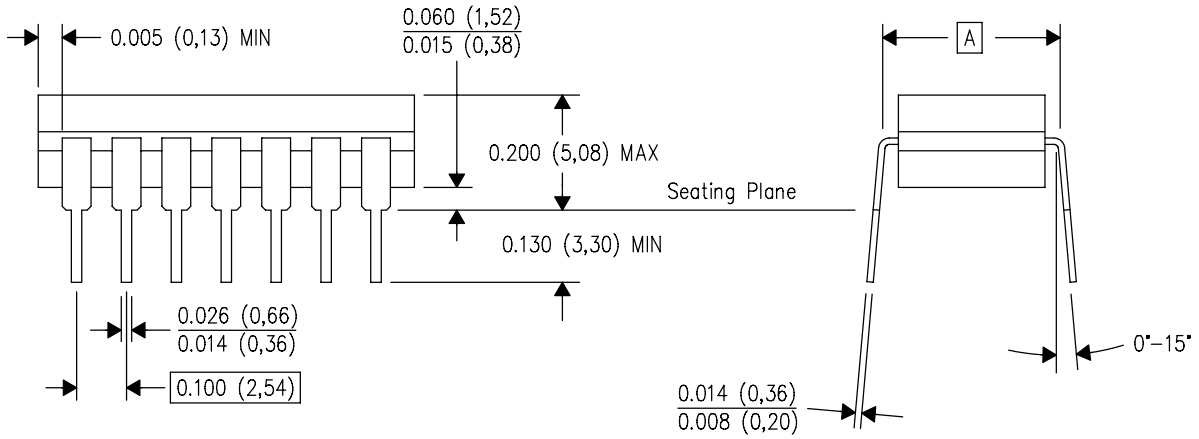
J (R–GDIP–T**)

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)

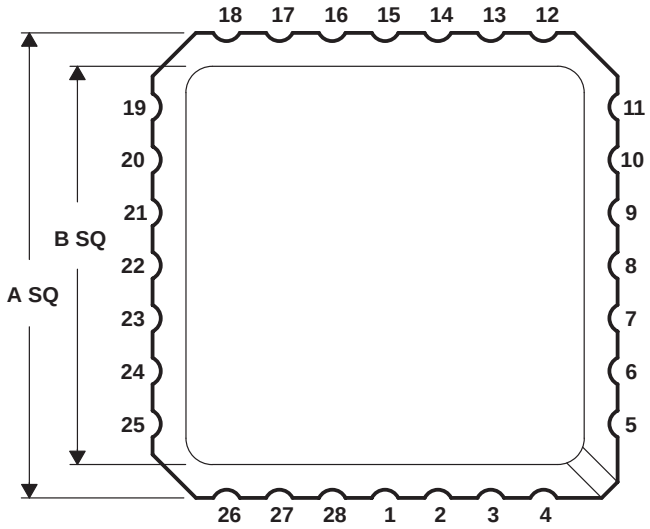


4040083/F 03/03

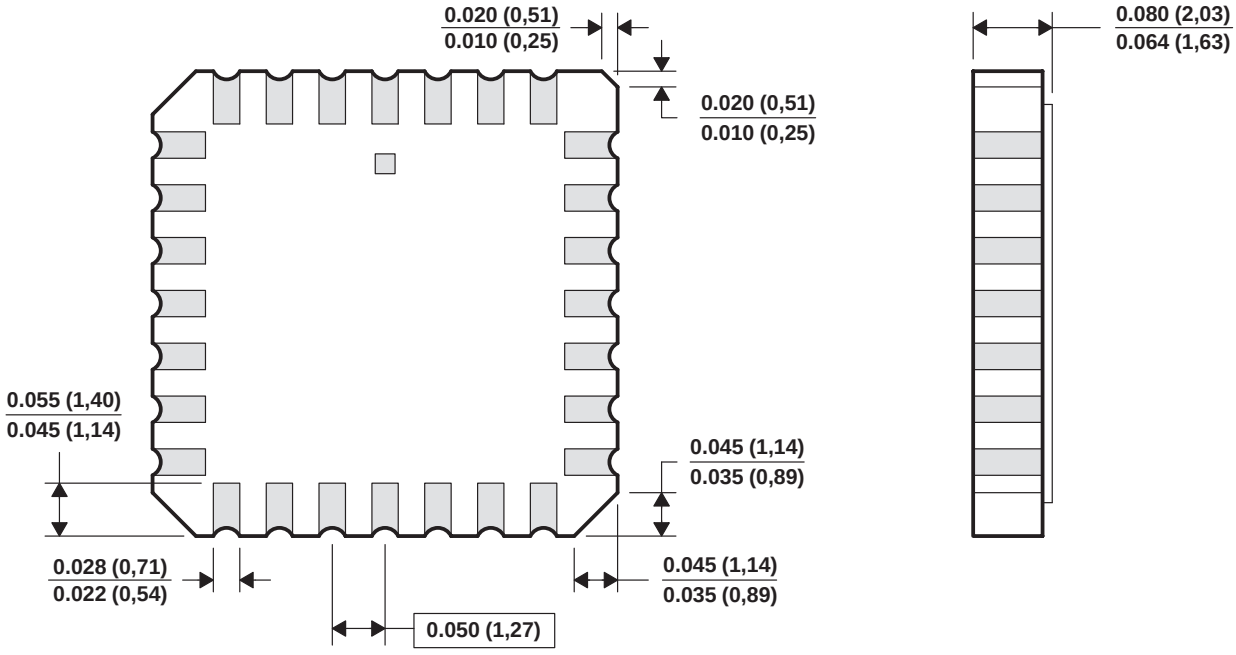
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package is hermetically sealed with a ceramic lid using glass frit.
D. Index point is provided on cap for terminal identification only on press ceramic glass frit seal only.
E. Falls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

FK (S-CQCC-N)** **LEADLESS CERAMIC CHIP CARRIER**

28 TERMINAL SHOWN



NO. OF TERMINALS **	A		B	
	MIN	MAX	MIN	MAX
20	0.342 (8,69)	0.358 (9,09)	0.307 (7,80)	0.358 (9,09)
28	0.442 (11,23)	0.458 (11,63)	0.406 (10,31)	0.458 (11,63)
44	0.640 (16,26)	0.660 (16,76)	0.495 (12,58)	0.560 (14,22)
52	0.739 (18,78)	0.761 (19,32)	0.495 (12,58)	0.560 (14,22)
68	0.938 (23,83)	0.962 (24,43)	0.850 (21,6)	0.858 (21,8)
84	1.141 (28,99)	1.165 (29,59)	1.047 (26,6)	1.063 (27,0)



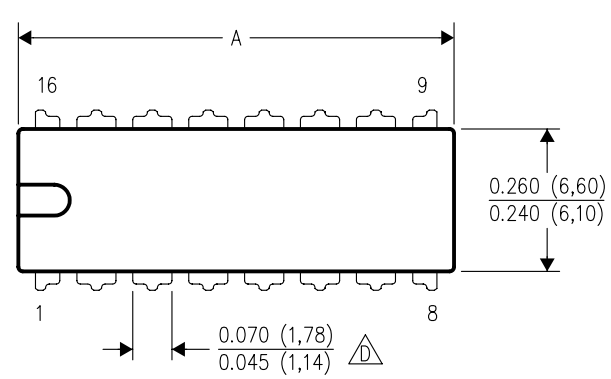
4040140/D 10/96

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. This package can be hermetically sealed with a metal lid.
D. The terminals are gold plated.
E. Falls within JEDEC MS-004

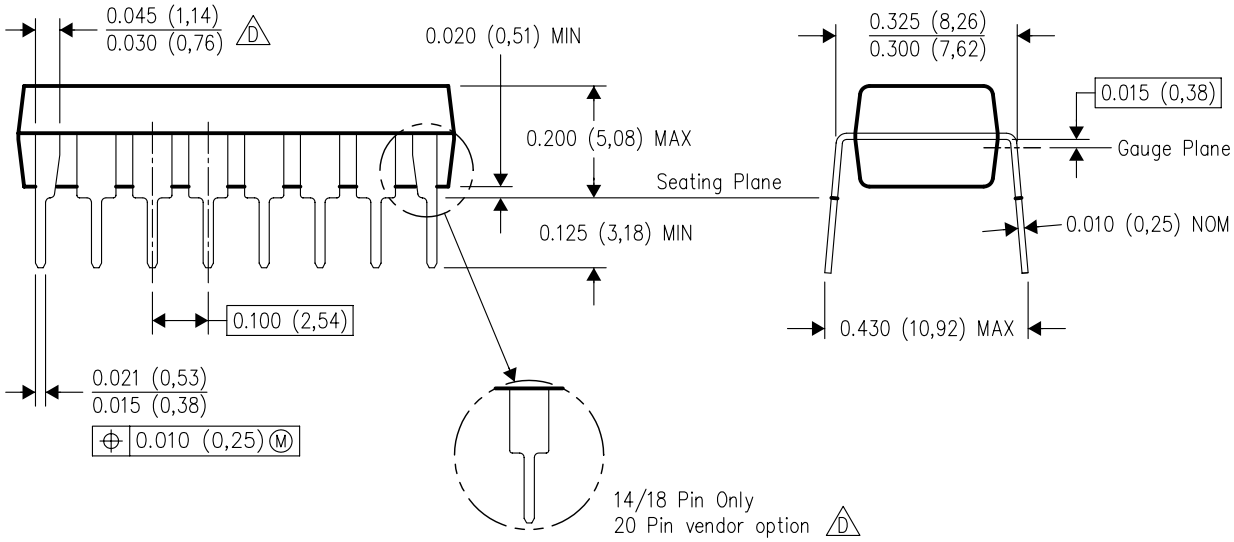
N (R–PDIP–T**)

PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



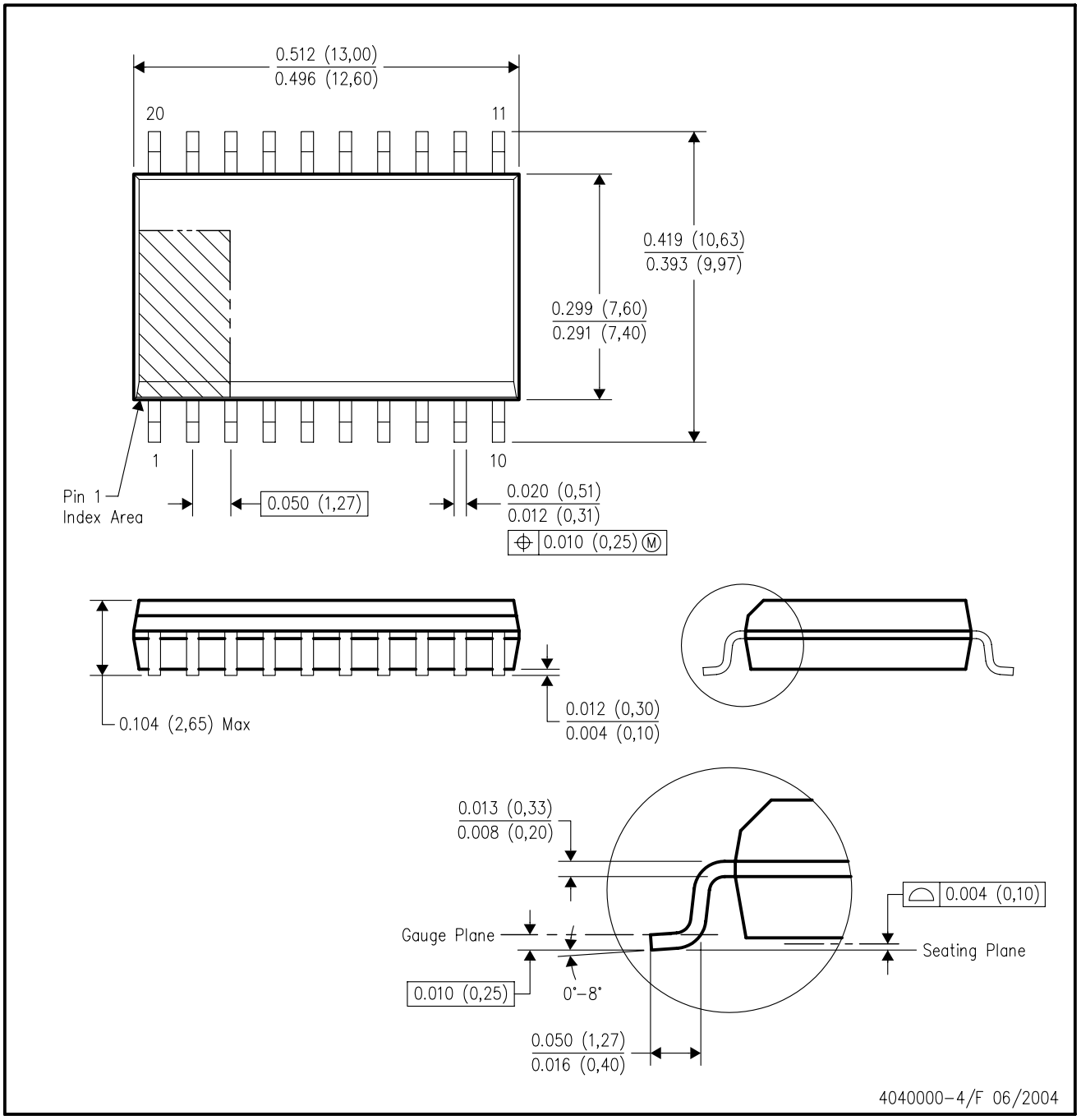
DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS–001 VARIATION (C)	AA	BB	AC	AD



4040049/E 12/2002

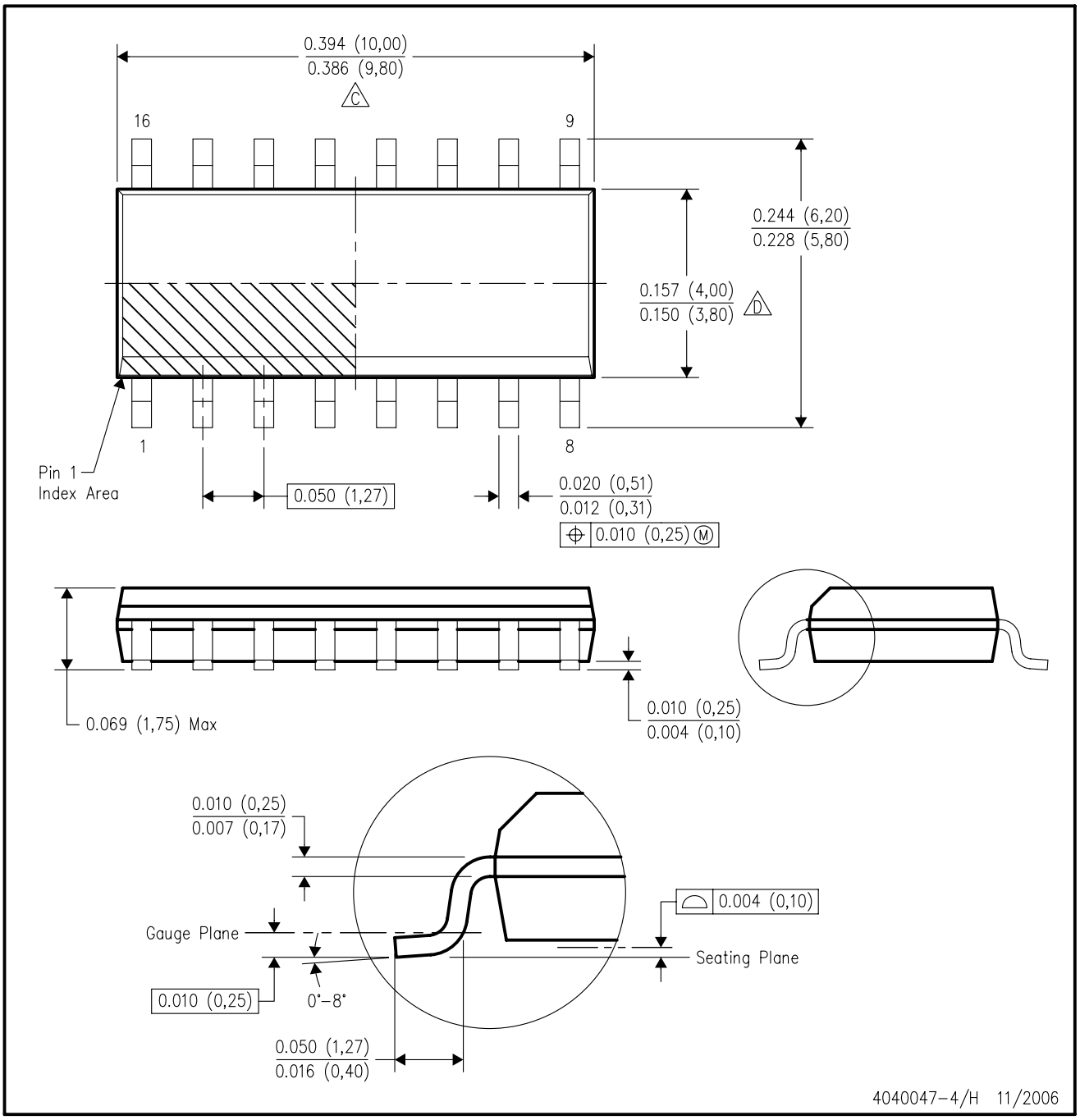
NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Falls within JEDEC MS–001, except 18 and 20 pin minimum body length (Dim A).
D. The 20 pin end lead shoulder width is a vendor option, either half or full width.

DW (R–PDSO–G20) PLASTIC SMALL–OUTLINE PACKAGE



NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
D. Falls within JEDEC MS–013 variation AC.

D (R–PDSO–G16) PLASTIC SMALL–OUTLINE PACKAGE

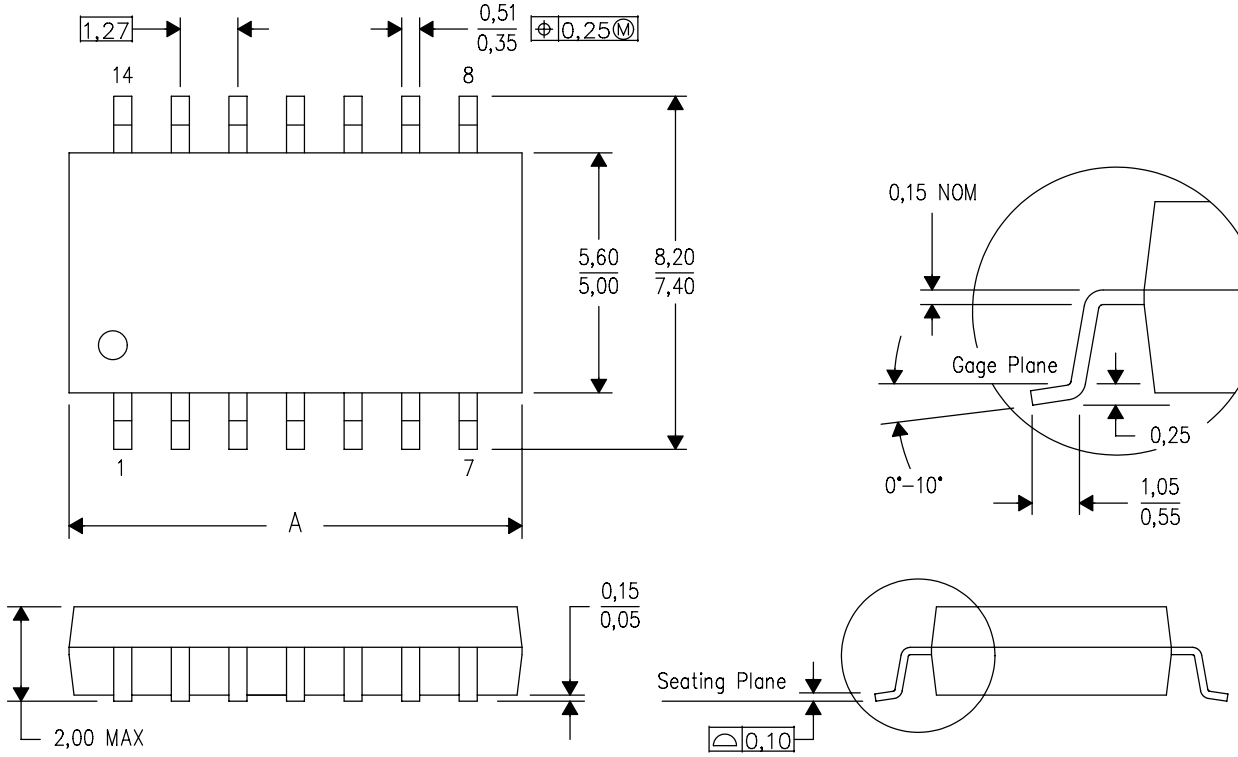


NOTES:
A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed .006 (0,15) per end.
D. Body width does not include interlead flash. Interlead flash shall not exceed .017 (0,43) per side.
E. Reference JEDEC MS–012 variation AC.

MECHANICAL DATA

NS (R-PDSO-G)** **PLASTIC SMALL-OUTLINE PACKAGE**

14-PINS SHOWN



DIM \ PINS **	14	16	20	24
A MAX	10,50	10,50	12,90	15,30
A MIN	9,90	9,90	12,30	14,70

4040062/C 03/03

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.

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