![Texas Instruments logo]

CD54HC175, CD74HC175, CD54HCT175, CD74HCT175

Data sheet acquired from Harris Semiconductor
SCHS160C

High-Speed CMOS Logic
Quad D-Type Flip-Flop with Reset

August 1997 - Revised October 2003

Features

- **Common Clock and Asynchronous Reset on Four D-Type Flip-Flops**

- **Positive Edge Pulse Triggering**

- **Complementary Outputs**

- **Buffered Inputs**

- **Fanout (Over Temperature Range)**
  - **Standard Outputs . . . . 10 LSTTL Loads**
  - **Bus Driver Outputs . . . . 15 LSTTL Loads**

- **Wide Operating Temperature Range . . . -55°C to 125°C**

- **Balanced Propagation Delay and Transition Times**

- **Significant Power Reduction Compared to LSTTL Logic ICs**

- **HC Types**
  - **2V to 6V Operation**
  - **High Noise Immunity: N_{IL} = 30%, N_{IH} = 30% of V_{CC} at V_{CC} = 5V**

- **HCT Types**
  - **4.5V to 5.5V Operation**
  - **Direct LSTTL Input Logic Compatibility, V_{IL} = 0.8V (Max), V_{IH} = 2V (Min)**
  - **CMOS Input Compatibility, $I_I \leq 1\mu$A at V_{OL}, V_{OH}**
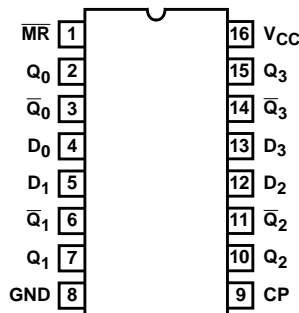
Description

The 'HC175 and 'HCT175 are high speed Quad D-type Flip-Flops with individual D-inputs and Q, $\overline{Q}$ complementary outputs. The devices are fabricated using silicon gate CMOS technology. They have the low power consumption advantage of standard CMOS ICs and the ability to drive 10 LSTTL devices.

Information at the D input is transferred to the Q, $\overline{Q}$ outputs on the positive going edge of the clock pulse. All four Flip-Flops are controlled by a common clock (CP) and a common reset ($\overline{MR}$). Resetting is accomplished by a low voltage level independent of the clock. All four Q outputs are reset to a logic 0 and all four $\overline{Q}$ outputs to a logic 1.

Ordering Information

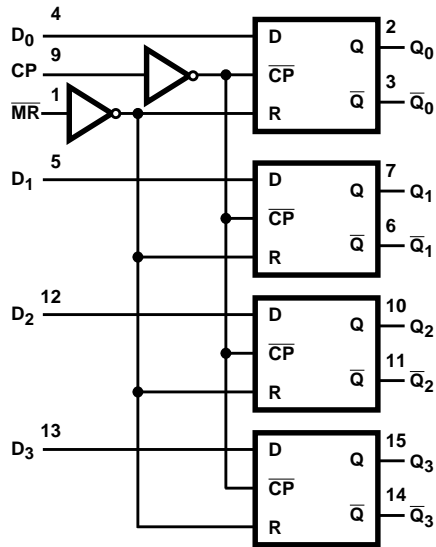| PART NUMBER	TEMP. RANGE (^{o}C)	PACKAGE
CD54HC175F3A	-55 to 125	16 Ld CERDIP
CD54HCT175F3A	-55 to 125	16 Ld CERDIP
CD74HC175E	-55 to 125	16 Ld PDIP
CD74HC175M	-55 to 125	16 Ld SOIC
CD74HC175MT	-55 to 125	16 Ld SOIC
CD74HC175M96	-55 to 125	16 Ld SOIC
CD74HCT175E	-55 to 125	16 Ld PDIP
CD74HCT175M	-55 to 125	16 Ld SOIC
CD74HCT175MT	-55 to 125	16 Ld SOIC
CD74HCT175M96	-55 to 125	16 Ld SOIC

NOTE: When ordering, use the entire part number. The suffix 96 denotes tape and reel. The suffix T denotes a small-quantity reel of 250.

Pinout

**CD54HC175, CD54HCT175
(CERDIP)
CD74HC175, CD74HCT175
(PDIP, SOIC)
TOP VIEW**

```
        ┌───┐ ┌───┐
  MR ──│1    16│── VCC
  Q0 ──│2    15│── Q3
  Q0 ──│3    14│── Q3
  D0 ──│4    13│── D3
  D1 ──│5    12│── D2
  Q1 ──│6    11│── Q2
  Q1 ──│7    10│── Q2
 GND ──│8     9│── CP
        └───────┘
```

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Functional Diagram

TRUTH TABLE

INPUTS			OUTPUTS	
RESET ($\overline{MR}$)	CLOCK CP	DATA D_n	Q_n	$\overline{Q}_n$
L	X	X	L	H
H	↑	H	H	L
H	↑	L	L	H
H	L	X	Q_0	$\overline{Q}_0$

H = High Voltage Level, L = Low Voltage Level, X = Don't Care, ↑ = Transition from Low to High Level,
Q_0 = Level Before the Indicated Steady-State Input Conditions Were Established.

Logic Diagram
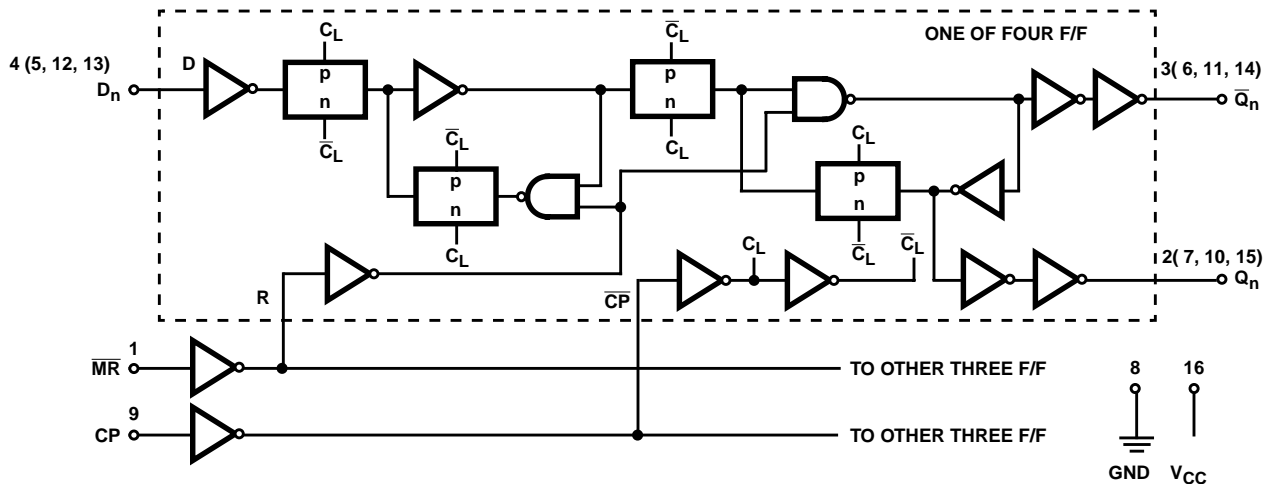
Absolute Maximum Ratings

DC Supply Voltage, V_{CC} . . . . -0.5V to 7V
DC Input Diode Current, I_{IK}
   For $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$ . . . .±20mA
DC Output Diode Current, I_{OK}
   For $V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$ . . . .±20mA
DC Output Source or Sink Current per Output Pin, I_O
   For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$ . . . .±25mA
DC V_{CC} or Ground Current, I_{CC} or I_{GND} . . . .±50mA

Operating Conditions

Temperature Range (T_A) . . . . -55°C to 125°C
Supply Voltage Range, V_{CC}
   HC Types . . . . .2V to 6V
   HCT Types . . . . .4.5V to 5.5V
DC Input or Output Voltage, V_I, V_O . . . . 0V to V_{CC}
Input Rise and Fall Time
   2V . . . . 1000ns (Max)
   4.5V . . . . 500ns (Max)
   6V . . . . 400ns (Max)

Thermal Information

Thermal Resistance (Typical, Note 1) θ_{JA} (°C/W)
   E (PDIP) Package 67
   M (SOIC) Package. 73
Maximum Junction Temperature . . . . 150°C
Maximum Storage Temperature Range . . . . -65°C to 150°C
Maximum Lead Temperature (Soldering 10s) . . . . 300°C
   (SOIC - Lead Tips Only)

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

1. The package thermal impedance is calculated in accordance with JESD 51-7.

DC Electrical Specifications

PARAMETER	SYMBOL	TEST CONDITIONS			25°C			-40°C TO +85°C		-55°C TO 125°C		UNITS
		V_I (V)	I_O (mA)	V_{CC} (V)	MIN	TYP	MAX	MIN	MAX	MIN	MAX	
HC TYPES												
High Level Input Voltage	V_{IH}	-	-	2	1.5	-	-	1.5	-	1.5	-	V
				4.5	3.15	-	-	3.15	-	3.15	-	V
				6	4.2	-	-	4.2	-	4.2	-	V
Low Level Input Voltage	V_{IL}	-	-	2	-	-	0.5	-	0.5	-	0.5	V
				4.5	-	-	1.35	-	1.35	-	1.35	V
				6	-	-	1.8	-	1.8	-	1.8	V
High Level Output Voltage CMOS Loads	V_{OH}	V_{IH} or V_{IL}	-0.02	2	1.9	-	-	1.9	-	1.9	-	V
			-0.02	4.5	4.4	-	-	4.4	-	4.4	-	V
			-0.02	6	5.9	-	-	5.9	-	5.9	-	V
High Level Output Voltage TTL Loads			-4	4.5	3.98	-	-	3.84	-	3.7	-	V
			-5.2	6	5.48	-	-	5.34	-	5.2	-	V
Low Level Output Voltage CMOS Loads	V_{OL}	V_{IH} or V_{IL}	0.02	2	-	-	0.1	-	0.1	-	0.1	V
			0.02	4.5	-	-	0.1	-	0.1	-	0.1	V
			0.02	6	-	-	0.1	-	0.1	-	0.1	V
Low Level Output Voltage TTL Loads			4	4.5	-	-	0.26	-	0.33	-	0.4	V
			5.2	6	-	-	0.26	-	0.33	-	0.4	V
Input Leakage Current	I_I	V_{CC} or GND	-	6	-	-	±0.1	-	±1	-	±1	µA
Quiescent Device Current	I_{CC}	V_{CC} or GND	0	6	-	-	8	-	80	-	160	µA

DC Electrical Specifications   (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS V_I (V)	I_O (mA)	V_{CC} (V)	25°C MIN	TYP	MAX	-40°C TO +85°C MIN	MAX	-55°C TO 125°C MIN	MAX	UNITS
HCT TYPES												
High Level Input Voltage	V_{IH}	-	-	4.5 to 5.5	2	-	-	2	-	2	-	V
Low Level Input Voltage	V_{IL}	-	-	4.5 to 5.5	-	-	0.8	-	0.8	-	0.8	V
High Level Output Voltage CMOS Loads	V_{OH}	V_{IH} or V_{IL}	-0.02	4.5	4.4	-	-	4.4	-	4.4	-	V
High Level Output Voltage TTL Loads			-4	4.5	3.98	-	-	3.84	-	3.7	-	V
Low Level Output Voltage CMOS Loads	V_{OL}	V_{IH} or V_{IL}	0.02	4.5	-	-	0.1	-	0.1	-	0.1	V
Low Level Output Voltage TTL Loads			4	4.5	-	-	0.26	-	0.33	-	0.4	V
Input Leakage Current	I_I	V_{CC} to GND	0	5.5	-	-	±0.1	-	±1	-	±1	µA
Quiescent Device Current	I_{CC}	V_{CC} or GND	0	5.5	-	-	8	-	80	-	160	µA
Additional Quiescent Device Current Per Input Pin: 1 Unit Load	ΔI_{CC} (Note 2)	V_{CC} -2.1	-	4.5 to 5.5	-	100	360	-	450	-	490	µA

NOTES:

2. For dual-supply systems theoretical worst case (V_I = 2.4V, V_{CC} = 5.5V) specification is 1.8mA.

HCT Input Loading Table

INPUT	UNIT LOADS
$\overline{MR}$	1
CP	0.60
D	0.15

NOTE: Unit Load is ΔI_{CC} limit specified in DC Electrical Specifications table, e.g. 360µA max at 25°C.

Prerequisite For Switching Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	V_{CC} (V)	25°C MIN	TYP	MAX	-40°C TO 85°C MIN	MAX	-55°C TO 125°C MIN	MAX	UNITS
HC TYPES											
Clock Pulse Width	t_W	-	2	80	-	-	100	-	120	-	ns
			4.5	16	-	-	20	-	24	-	ns
			6	14	-	-	17	-	20	-	ns
$\overline{MR}$ Pulse Width	t_W	-	2	80	-	-	100	-	120	-	ns
			4.5	16	-	-	20	-	24	-	ns
			6	14	-	-	17	-	20	-	ns

Prerequisite For Switching Specifications   (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	V_CC (V)	25°C MIN	25°C TYP	25°C MAX	-40°C TO 85°C MIN	-40°C TO 85°C MAX	-55°C TO 125°C MIN	-55°C TO 125°C MAX	UNITS
Setup Time, Data to Clock	t_SU	-	2	80	-	-	100	-	120	-	ns
			4.5	16	-	-	20	-	24	-	ns
			6	14	-	-	17	-	20	-	ns
Hold Time, Data to Clock	t_H	-	2	5	-	-	5	-	5	-	ns
			4.5	5	-	-	5	-	5	-	ns
			6	5	-	-	5	-	5	-	ns
Removal Time, $\overline{MR}$ to Clock	t_REM	-	2	5	-	-	5	-	5	-	ns
			4.5	5	-	-	5	-	5	-	ns
			6	5	-	-	5	-	5	-	ns
Clock Frequency	f_MAX	-	2	6	-	-	5	-	4	-	MHz
			4.5	30	-	-	25	-	20	-	MHz
			6	35	-	-	29	-	23	-	MHz
HCT TYPES											
Clock Pulse Width	t_W	-	4.5	20	-	-	25	-	30	-	ns
$\overline{MR}$ Pulse Width	t_W	-	4.5	20	-	-	25	-	30	-	ns
Setup Time Data to Clock	t_SU	-	4.5	20	-	-	25	-	30	-	ns
Hold Time Data to Clock	t_H	-	4.5	5	-	-	5	-	5	-	ns
Removal Time $\overline{MR}$ to Clock	t_REM	-	4.5	5	-	-	5	-	5	-	ns
Clock Frequency	f_MAX	-	4.5	25	-	-	20	-	16	-	MHz

Switching Specifications   Input t_r, t_f = 6ns

PARAMETER	SYMBOL	TEST CONDITIONS	V_CC (V)	25°C TYP	25°C MAX	-40°C TO 85°C MAX	-55°C TO 125°C MAX	UNITS
HC TYPES								
Propagation Delay, Clock to Q or $\overline{Q}$	t_PLH, t_PHL	C_L = 50pF	2	-	175	220	265	ns
			4.5	-	35	44	53	ns
			6	-	30	37	45	ns
		C_L = 15pF	5	14	-	-	-	ns
Propagation Delay, $\overline{MR}$ to Q or $\overline{Q}$	t_PLH, t_PHL	C_L = 50pF	2	-	175	220	265	ns
			4.5	-	35	44	53	ns
			6	-	30	37	45	ns
		C_L = 15pF	5	14	-	-	-	ns
Output Transition Times	t_TLH, t_THL	C_L = 50pF	2	-	75	95	110	ns
			4.5	-	15	19	22	ns
			6	-	13	16	19	ns
Input Capacitance	C_IN	-	-	-	10	10	10	pF
Power Dissipation Capacitance (Notes 3, 4)	C_PD	-	5	65	-	-	-	pF

Switching Specifications Input t_r, t_f = 6ns **(Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS	V_{CC} (V)	25°C		-40°C TO 85°C	-55°C TO 125°C	UNITS
				TYP	MAX	MAX	MAX	
HCT TYPES								
Propagation Delay, Clock to Q or $\overline{Q}$	t_{PLH}, t_{PHL}	C_L = 50pF	4.5	-	33	41	50	ns
		C_L = 15pF	5	13	-	-	-	ns
Propagation Delay, $\overline{MR}$ to Q or $\overline{Q}$	t_{PLH}, t_{PHL}	C_L = 50pF	4.5	-	35	44	53	ns
		C_L = 15pF	5	17	-	-	-	ns
Output Transition Times	t_{TLH}, t_{THL}	C_L = 50pF	4.5	-	15	19	22	ns
Input Capacitance	C_{IN}	-	-	-	10	10	10	pF
Power Dissipation Capacitance (Notes 3, 4)	C_{PD}	-	5	67	-	-	-	pF

NOTES:

3. C_{PD} is used to determine the dynamic power consumption, per flip-flop.

4. $P_D = V_{CC}^2 f_i + \sum (C_L V_{CC}^2 + f_O)$ where f_i = Input Frequency, f_O = Input Frequency, C_L = Output Load Capacitance, V_{CC} = Supply Voltage.

Test Circuits and Waveforms
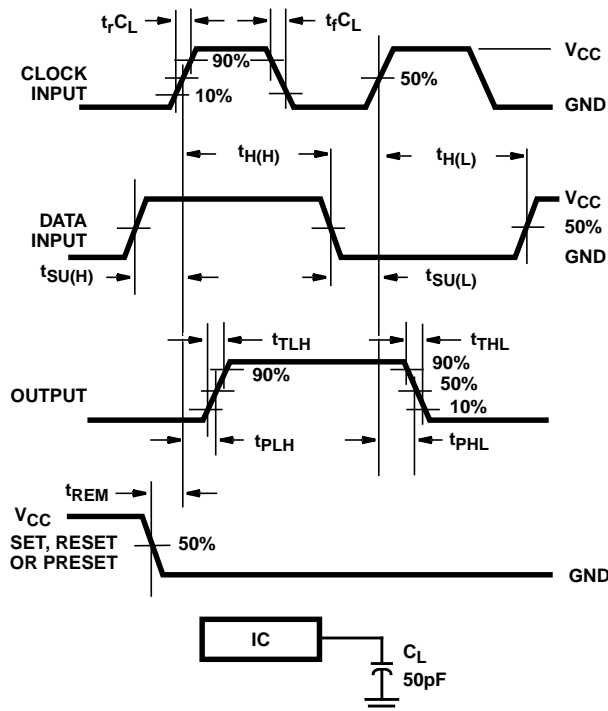
FIGURE 1. HC SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS
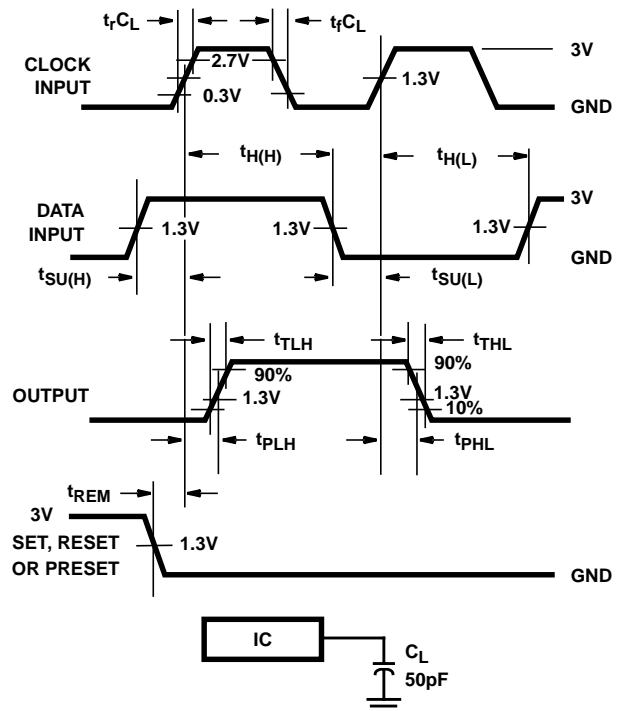
FIGURE 2. HCT SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

TEXAS INSTRUMENTS
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28-Feb-2005

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
5962-8970101EA	ACTIVE	CDIP	J	16	1	None	Call TI	Level-NC-NC-NC
CD54HC175F3A	ACTIVE	CDIP	J	16	1	None	Call TI	Level-NC-NC-NC
CD54HCT175F3A	ACTIVE	CDIP	J	16	1	None	Call TI	Level-NC-NC-NC
CD74HC175E	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
CD74HC175M	ACTIVE	SOIC	D	16	40	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
CD74HC175M96	ACTIVE	SOIC	D	16	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
CD74HC175MT	ACTIVE	SOIC	D	16	250	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
CD74HCT175E	ACTIVE	PDIP	N	16	25	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
CD74HCT175M	ACTIVE	SOIC	D	16	40	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
CD74HCT175M96	ACTIVE	SOIC	D	16	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM
CD74HCT175MT	ACTIVE	SOIC	D	16	250	Pb-Free (RoHS)	CU NIPDAU	Level-2-260C-1 YEAR/ Level-1-235C-UNLIM

[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 - May not be currently available - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
None: Not yet available Lead (Pb-Free).
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.
Green (RoHS & no Sb/Br): TI defines "Green" to mean "Pb-Free" and in addition, uses package materials that do not contain halogens, including bromine (Br) or antimony (Sb) above 0.1% of total product weight.

[3] MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDECindustry standard classifications, and peak solder temperature.

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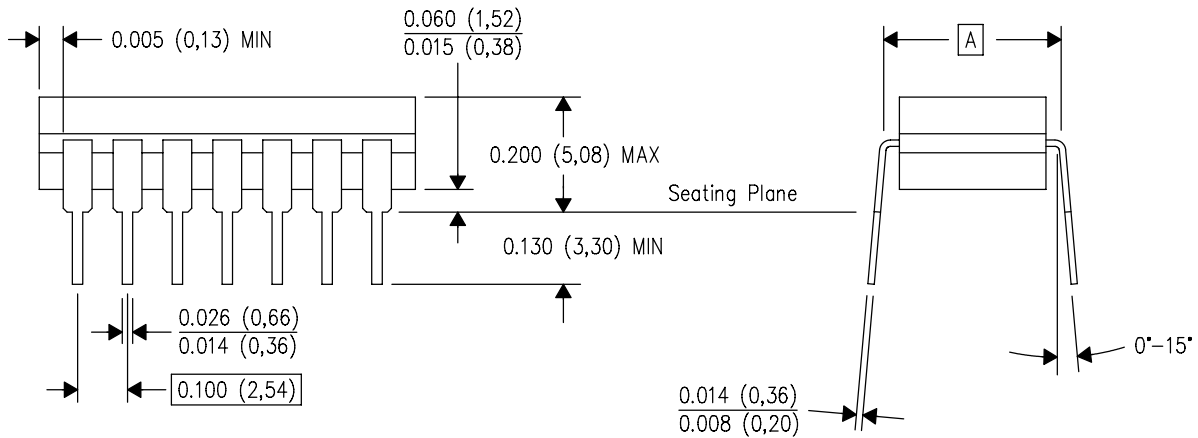
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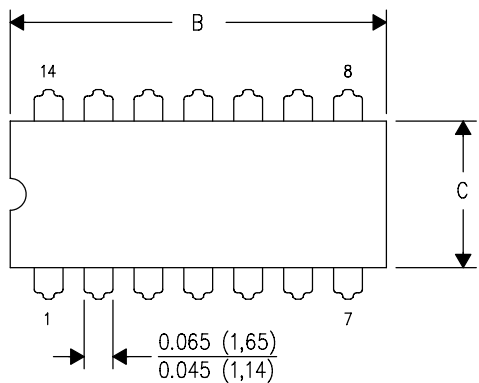
DIM	PINS ∗∗ 14	16	18	20
A	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC	0.300 (7,62) BSC
B MAX	0.785 (19,94)	.840 (21,34)	0.960 (24,38)	1.060 (26,92)
B MIN	——	——	——	——
C MAX	0.300 (7,62)	0.300 (7,62)	0.310 (7,87)	0.300 (7,62)
C MIN	0.245 (6,22)	0.245 (6,22)	0.220 (5,59)	0.245 (6,22)

B

14   8

C

1   7

0.065 (1,65)
0.045 (1,14)

0.005 (0,13) MIN

0.060 (1,52)
0.015 (0,38)

0.200 (5,08) MAX

Seating Plane

0.130 (3,30) MIN

A

0.026 (0,66)
0.014 (0,36)

0.100 (2,54)

0°−15°

0.014 (0,36)
0.008 (0,20)

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.

N (R−PDIP−T**)
16 PINS SHOWN

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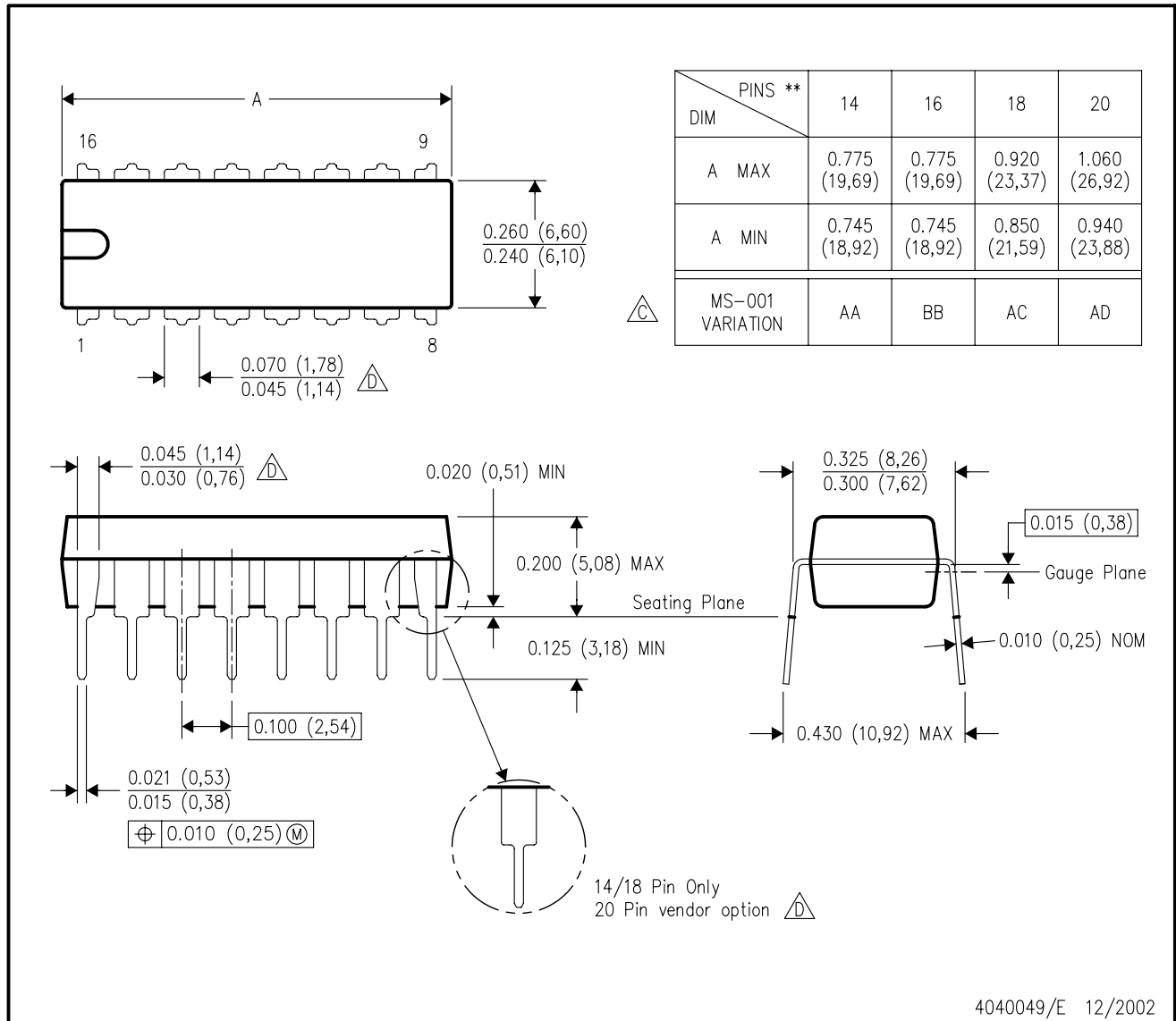
DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
△C△ MS−001 VARIATION	AA	BB	AC	AD

0.260 (6,60) / 0.240 (6,10)

0.070 (1,78) / 0.045 (1,14) △D△

0.045 (1,14) / 0.030 (0,76) △D△

0.020 (0,51) MIN

0.200 (5,08) MAX

Seating Plane

0.125 (3,18) MIN

0.100 (2,54)

0.021 (0,53) / 0.015 (0,38)

⊕ 0.010 (0,25) Ⓜ

14/18 Pin Only
20 Pin vendor option △D△

0.325 (8,26) / 0.300 (7,62)

0.015 (0,38)

Gauge Plane

0.010 (0,25) NOM

0.430 (10,92) MAX

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.

D (R−PDSO−G16)   PLASTIC SMALL−OUTLINE PACKAGE
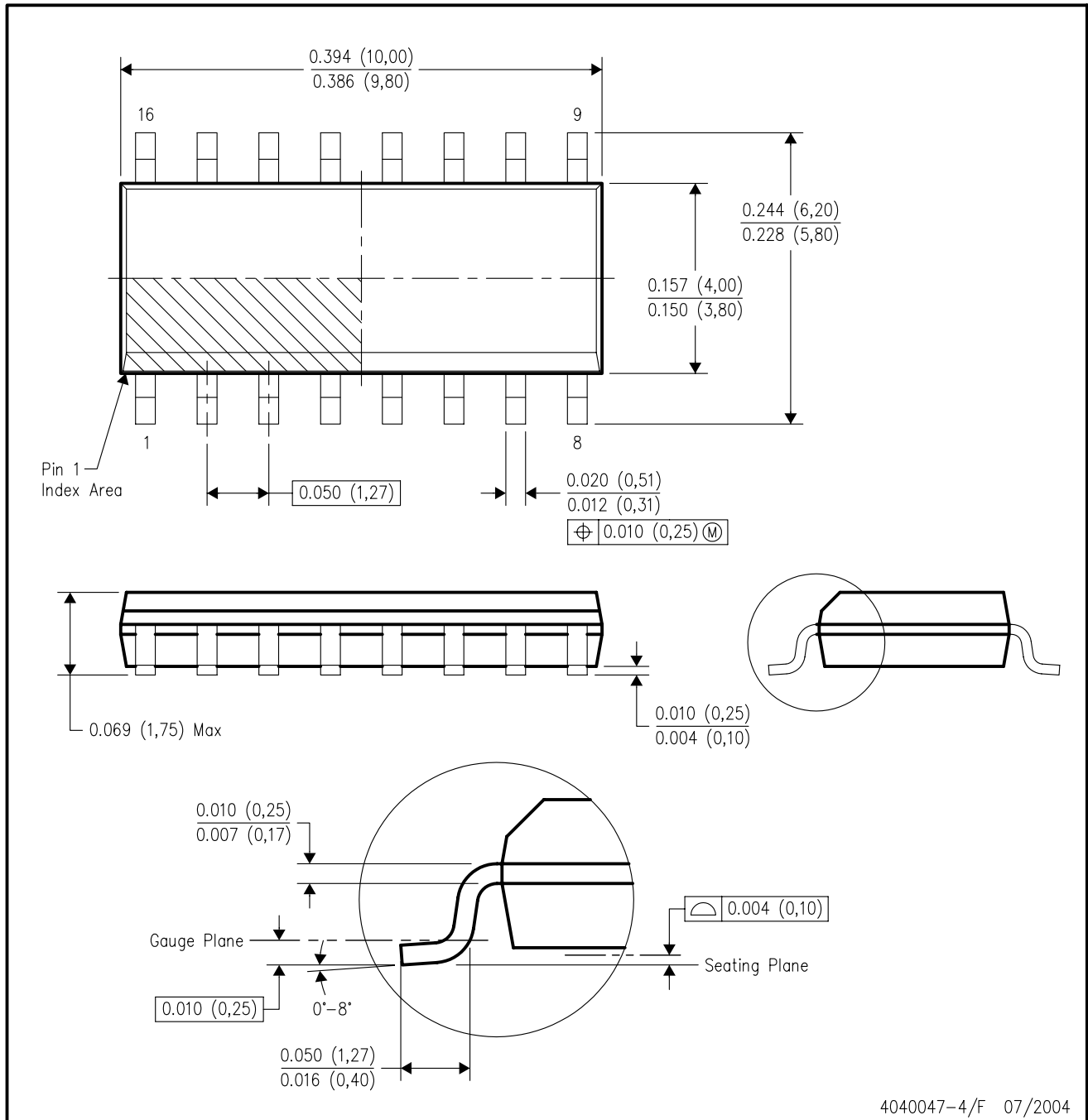
0.394 (10,00)
0.386 (9,80)

16   9

0.244 (6,20)
0.228 (5,80)

0.157 (4,00)
0.150 (3,80)

1   8

Pin 1
Index Area

0.050 (1,27)

0.020 (0,51)
0.012 (0,31)

⊕ 0.010 (0,25) Ⓜ

0.069 (1,75) Max

0.010 (0,25)
0.004 (0,10)

0.010 (0,25)
0.007 (0,17)

Gauge Plane

0.004 (0,10)

Seating Plane

0.010 (0,25)   0°–8°

0.050 (1,27)
0.016 (0,40)

4040047−4/F 07/2004

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−012 variation AC.

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