CD54/74HC534, CD54/74HCT534, CD54/74HC564, CD54/74HCT564

Data sheet acquired from Harris Semiconductor
SCHS188C

January 1998 - Revised April 2004

High-Speed CMOS Logic Octal D-Type Flip-Flop, Three-State Inverting Positive-Edge Triggered

Features

- **Buffered Inputs**
- **Common Three-State Output-Enable Control**
- **Three-State Outputs**
- **Bus Line Driving Capability**
- **Typical Propagation Delay = 13ns at V_{CC} = 5V, C_L = 15pF, T_A = 25^oC (Clock to Output)**
- **Fanout (Over Temperature Range)**
  - **Standard Outputs . . . . . 10 LSTTL Loads**
  - **Bus Driver Outputs . . . . . 15 LSTTL Loads**
- **Wide Operating Temperature Range . . . -55^oC to 125^oC**
- **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 ’HC534, ’HCT534, ’HC564, and ’HCT564 are high speed Octal D-Type Flip-Flops manufactured with silicon gate CMOS technology. They possess the low power consumption of standard CMOS integrated circuits, as well as the ability to drive 15 LSTTL loads. Due to the large output drive capability and the three-state feature, these devices are ideally suited for interfacing with bus lines in a bus organized system. The two types are functionally identical and differ only in their pinout arrangements.

The ’HC534, ’HCT534, ’HC564, and ’HCT564 are positive edge triggered flip-flops. Data at the D inputs, meeting the setup and hold time requirements, are inverted and transferred to the Q outputs on the positive going transition of the CLOCK input. When a high logic level is applied to the OUTPUT ENABLE input, all outputs go to a high impedance state, regardless of what signals are present at the other inputs and the state of the storage elements.

The HCT logic family is speed, function, and pin compatible with the standard LS logic family.

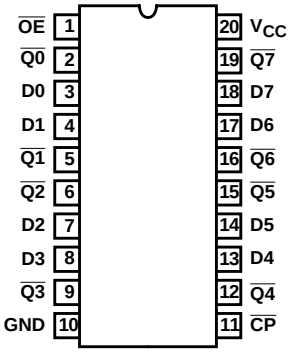
Ordering Information

PART NUMBER	TEMP. RANGE (^oC)	PACKAGE
CD54HC534F3A	-55 to 125	20 Ld CERDIP
CD54HC564F3A	-55 to 125	20 Ld CERDIP
CD54HCT534F3A	-55 to 125	20 Ld CERDIP
CD54HCT564F3A	-55 to 125	20 Ld CERDIP
CD74HC534E	-55 to 125	20 Ld PDIP
CD74HC564E	-55 to 125	20 Ld PDIP
CD74HC564M	-55 to 125	20 Ld SOIC
CD74HC564M96	-55 to 125	20 Ld SOIC
CD74HCT534E	-55 to 125	20 Ld PDIP
CD74HCT564E	-55 to 125	20 Ld PDIP
CD74HCT564M	-55 to 125	20 Ld SOIC

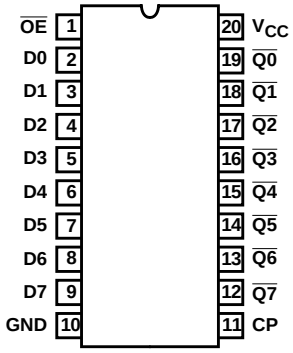
CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper IC Handling Procedures.

Pinouts

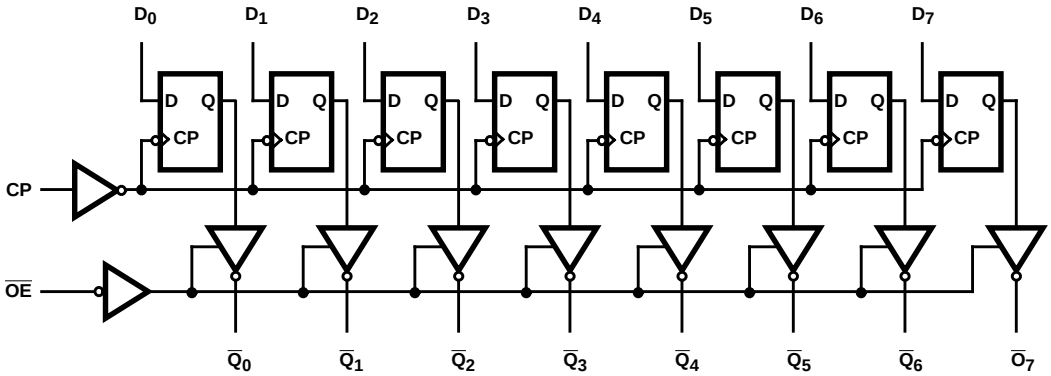
CD54HC534, CD54HCT534
(CERDIP)
CD74HC534, CD74HCT534
(PDIP)
TOP VIEW



CD54HC564, CD54HCT564
(CERDIP)
CD74HC564, CD74HCT564
(PDIP, SOIC)
TOP VIEW



Functional Diagram



TRUTH TABLE

INPUTS			OUTPUT
$\overline{OE}$	CP	Dn	$\overline{Qn}$
L	↑	H	L
L	↑	L	H
L	L	X	No Change
H	X	X	Z

H = High Level (Steady State)
L = Low Level (Steady State)
X= Don't Care
↑= Transition from Low to High Level
Z = High Impedance State

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 Drain Current, per Output, I_O
For -0.5V < V_O < V_{CC} + 0.5V . . . . . ±35mA
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} . . . . . ±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 69
M (SOIC) Package. 58
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 impedance is calculated in accordance with JESD 51-7.

DC Electrical Specifications

PARAMETER	SYMBOL	TEST CONDITIONS V_I (V)	TEST CONDITIONS I_O (mA)	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
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			-	-	-	-	-	-	-	-	-	V
			-6	4.5	3.98	-	-	3.84	-	3.7	-	V
			-7.8	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			-	-	-	-	-	-	-	-	-	V
			6	4.5	-	-	0.26	-	0.33	-	0.4	V
			7.8	6	-	-	0.26	-	0.33	-	0.4	V
Input Leakage Current	I_I	V_{CC} or GND	-	6	-	-	±0.1	-	±1	-	±1	µA

DC Electrical Specifications (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS		V_{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
		V_I (V)	I_O (mA)		MIN	TYP	MAX	MIN	MAX	MIN	MAX	
Quiescent Device Current	I_{CC}	V_{CC} or GND	0	6	-	-	8	-	80	-	160	µA
Three- State Leakage Current	V_{IL} or V_{IH}	$V_O = V_{CC}$ or GND	-	6	-	-	±0.5	-	±5.0	-	±10	µA
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			-6	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			6	4.5	-	-	0.26	-	0.33	-	0.4	V
Input Leakage Current	I_I	V_{CC} and 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
Three- State Leakage Current	V_{IL} or V_{IH}	$V_O = V_{CC}$ or GND	-	5.5	-	-	±0.5	-	±5.0	-	±10	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

NOTE:

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
D0 - D7	0.15
CP	0.30
$\overline{OE}$	0.55

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

Prerequisite for Switching Specifications

PARAMETER	SYMBOL	V_{CC} (V)	25°C			-40°C TO 85°C			-55°C TO 125°C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
HC TYPES												
Maximum Clock Frequency	f_{MAX}	2	6	-	-	5	-	-	4	-	-	MHz
		4.5	30	-	-	25	-	-	20	-	-	MHz
		6	35	-	-	29	-	-	23	-	-	MHz
Clock Pulse Width	t_W	2	80	-	-	100	-	-	120	-	-	ns
		4.5	16	-	-	20	-	-	24	-	-	ns
		6	14	-	-	17	-	-	20	-	-	ns
Setup Time Data to Clock	t_{SU}	2	60	-	-	75	-	-	90	-	-	ns
		4.5	12	-	-	15	-	-	18	-	-	ns
		6	10	-	-	13	-	-	15	-	-	ns
Hold Time Data to Clock	t_H	2	5	-	-	5	-	-	5	-	-	ns
		4.5	5	-	-	5	-	-	5	-	-	ns
		6	5	-	-	5	-	-	5	-	-	ns
HCT TYPES												
Maximum Clock Frequency	f_{MAX}	4.5	25	-	-	20	-	-	16	-	-	MHz
Clock 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 (534)	t_H	4.5	5	-	-	5	-	-	5	-	-	ns
Hold Time Data to Clock (564)	t_H	4.5	3	-	-	3	-	-	3	-	-	ns

Switching Specifications C_L = 50pF, Input t_r, t_f = 6ns

PARAMETER	SYMBOL	TEST CONDITIONS	V_{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
HC TYPES											
Propagation Delay Clock to Output	t_{PLH}, t_{PHL}	C_L = 50pF	2	-	-	165	-	205	-	250	ns
			4.5	-	-	33	-	41	-	50	ns
		C_L = 15pF	5	-	13	-	-	-	-	-	ns
		C_L = 50pF	6	-	-	28	-	35	-	43	ns
Output Disable to Q (534)	t_{PLZ}, t_{PHZ}	C_L = 50pF	2	-	-	150	-	190	-	225	ns
			4.5	-	-	30	-	38	-	45	ns
		C_L = 15pF	5	-	12	-	-	-	-	-	ns
		C_L = 50pF	6	-	-	26	-	33	-	38	ns

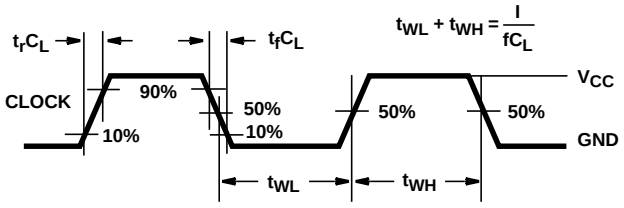
Switching Specifications C_L = 50pF, Input t_r, t_f = 6ns **(Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS	V_{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
Output Disable to Q (564)	t_{PLZ}, t_{PHZ}	C_L = 50pF	2	-	-	135	-	170	-	205	ns
			4.5	-	-	27	-	34	-	41	ns
		C_L = 15pF	5	-	12	-	-	-	-	-	ns
		C_L = 50pF	6	-	-	23	-	29	-	35	ns
Output Enable to Q	t_{PZL}, t_{PZH}	C_L = 50pF	2	-	-	150	-	190	-	225	ns
			4.5	-	-	30	-	38	-	45	ns
		C_L = 15pF	5	-	12	-	-	-	-	-	ns
		C_L = 50pF	6	-	-	26	-	33	-	38	ns
Maximum Clock Frequency	f_{MAX}	C_L = 15pF	5	-	60	-	-	-	-	-	MHz
Output Transition Time	t_{THL}, t_{TLH}	C_L = 50pF	2	-	-	60	-	75	-	90	ns
			4.5	-	-	12	-	15	-	18	ns
			6	-	-	10	-	13	-	15	ns
Input Capacitance	C_I	C_L = 50pF	-	10	-	10	-	10	-	10	pF
Three-State Output Capacitance	C_O	-	-	20	-	20	-	20	-	20	pF
Power Dissipation Capacitance (Notes 3, 4)	C_{PD}	-	5	-	32	-	-	-	-	-	pF
HCT TYPES											
Propagation Delay Clock to Output	t_{PHL}, t_{PLH}	C_L = 50pF	4.5	-	-	35	-	44	-	53	ns
		C_L = 15pF	5	-	14	-	-	-	-	-	ns
Output Disable to Q	t_{PLZ}, t_{PHZ}	C_L = 50pF	4.5	-	-	30	-	38	-	45	ns
		C_L = 15pF	5	-	12	-	-	-	-	-	ns
Output Enable to Q	t_{PZL}, t_{PZH}	C_L = 50pF	4.5	-	-	35	-	44	-	53	ns
		C_L = 15pF	5	-	14	-	-	-	-	-	ns
Maximum Clock Frequency	f_{MAX}	C_L = 15pF	5	-	50	-	-	-	-	-	MHz
Output Transition Time	t_{TLH}, t_{THL}	C_L = 50pF	4.5	-	-	12	-	15	-	18	ns
Input Capacitance	C_I	C_L = 50pF	-	10	-	10	-	10	-	10	pF
Three-State Output Capacitance	C_O	-	-	20	-	20	-	20	-	20	pF
Power Dissipation Capacitance (Notes 3, 4)	C_{PD}	-	5	-	36	-	-	-	-	-	pF

NOTES:

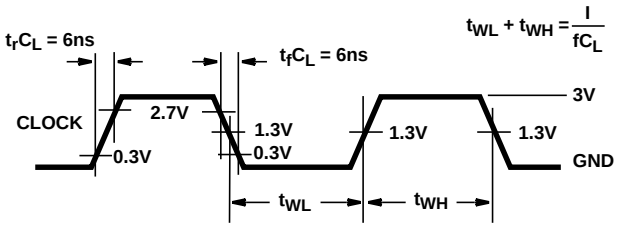
3. C_{PD} is used to determine the dynamic power consumption, per package.
4. $P_D = C_{PD} V_{CC}^2 f_i + \Sigma C_L V_{CC}^2 f_O$ where f_i = Input Frequency, f_O = Output Frequency, C_L = Output Load Capacitance, V_{CC} = Supply Voltage.

Test Circuits and Waveforms



NOTE: Outputs should be switching from 10% V_{CC} to 90% V_{CC} in accordance with device truth table. For f_{MAX}, input duty cycle = 50%.

FIGURE 1. HC CLOCK PULSE RISE AND FALL TIMES AND PULSE WIDTH



NOTE: Outputs should be switching from 10% V_{CC} to 90% V_{CC} in accordance with device truth table. For f_{MAX}, input duty cycle = 50%.

FIGURE 2. HCT CLOCK PULSE RISE AND FALL TIMES AND PULSE WIDTH

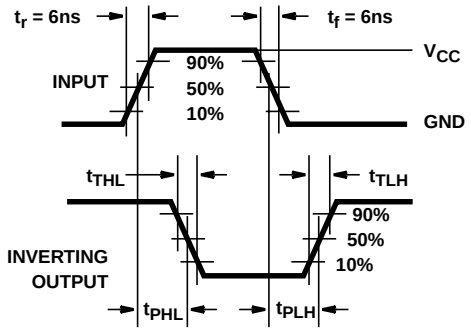


FIGURE 3. HC TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

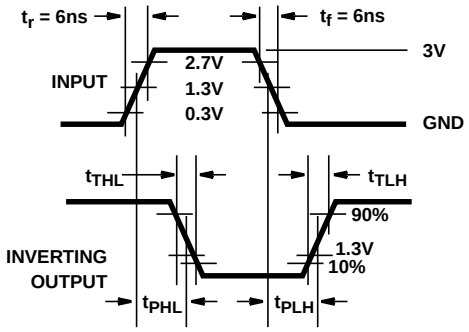


FIGURE 4. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

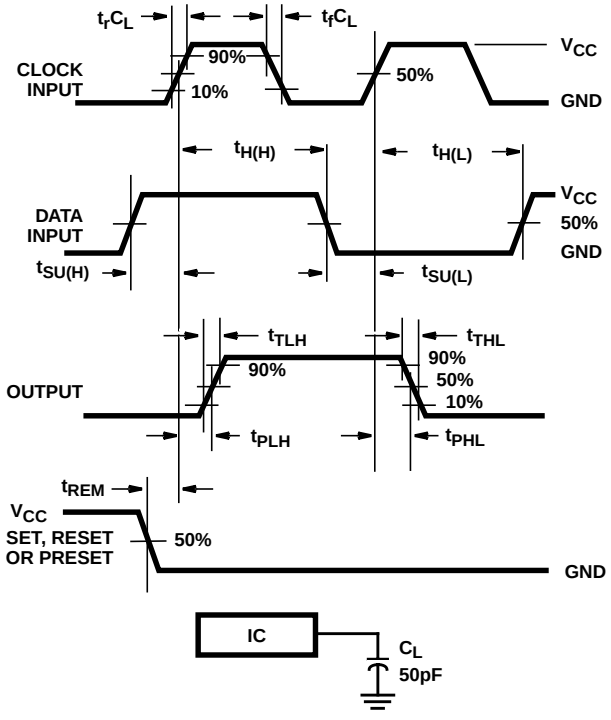


FIGURE 5. HC SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

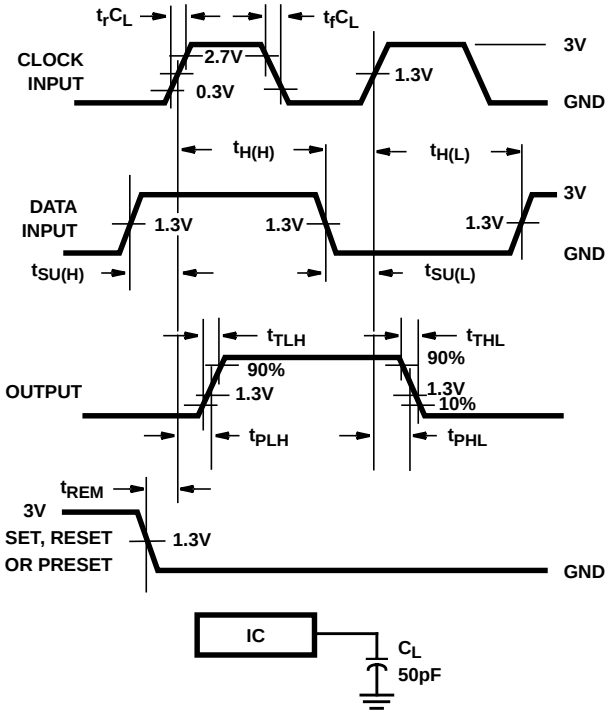


FIGURE 6. HCT SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

Test Circuits and Waveforms (Continued)

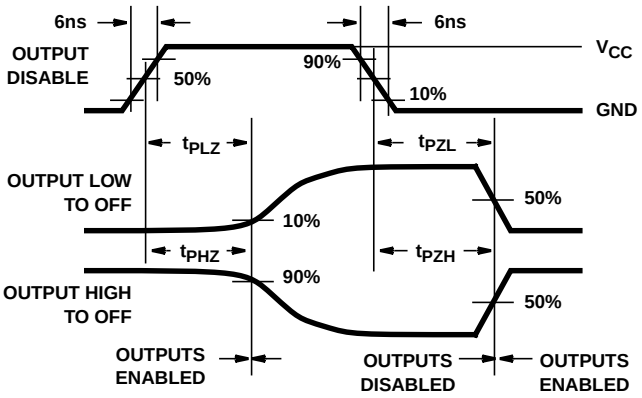


FIGURE 7. HC THREE-STATE PROPAGATION DELAY WAVEFORM

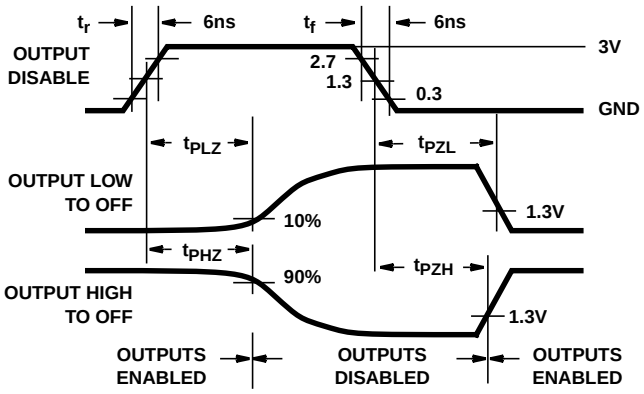
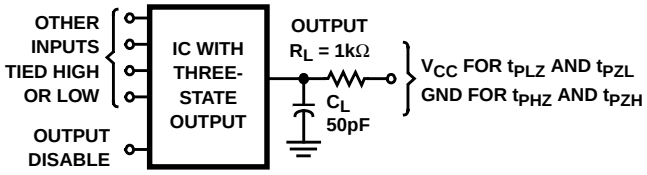


FIGURE 8. HCT THREE-STATE PROPAGATION DELAY WAVEFORM



NOTE: Open drain waveforms t_{PLZ} and t_{PZL} are the same as those for three-state shown on the left. The test circuit is Output R_L = 1kΩ to V_{CC}, C_L = 50pF.

FIGURE 9. HC AND HCT THREE-STATE PROPAGATION DELAY TEST CIRCUIT

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
5962-8681401RA	ACTIVE	CDIP	J	20	1	None	Call TI	Level-NC-NC-NC
5962-8681501RA	ACTIVE	CDIP	J	20	1	None	Call TI	Level-NC-NC-NC
5962-8984901RA	ACTIVE	CDIP	J	20	1	None	Call TI	Level-NC-NC-NC
CD54HC534F3A	ACTIVE	CDIP	J	20	1	None	Call TI	Level-NC-NC-NC
CD54HC564F3A	ACTIVE	CDIP	J	20	1	None	Call TI	Level-NC-NC-NC
CD54HCT534F3A	ACTIVE	CDIP	J	20	1	None	Call TI	Level-NC-NC-NC
CD54HCT564F3A	ACTIVE	CDIP	J	20	1	None	Call TI	Level-NC-NC-NC
CD74HC534E	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
CD74HC564E	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
CD74HC564M	ACTIVE	SOIC	DW	20	25	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
CD74HC564M96	ACTIVE	SOIC	DW	20	2000	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
CD74HCT534E	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
CD74HCT564E	ACTIVE	PDIP	N	20	20	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
CD74HCT564M	ACTIVE	SOIC	DW	20	25	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-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.

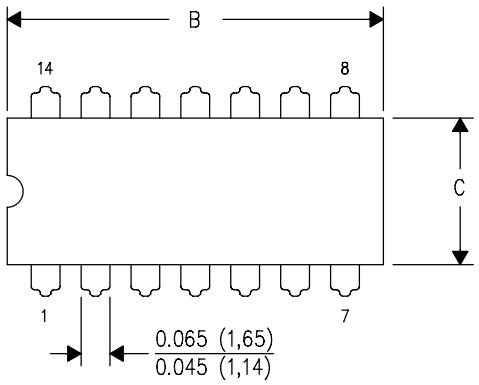
[2] Eco Plan - May not be currently available - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
None: Not yet available Lead (Pb-Free).
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are 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.

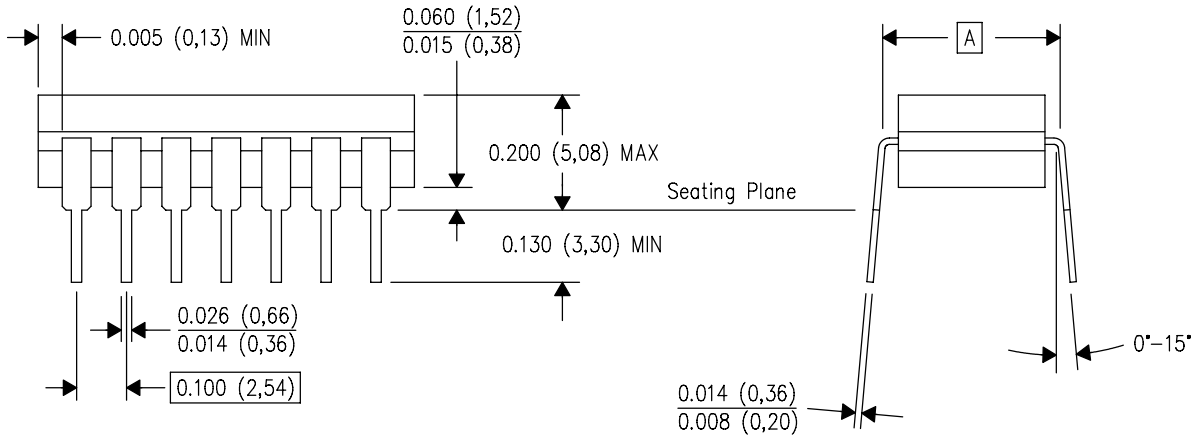
J (R–GDIP–T**)

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)



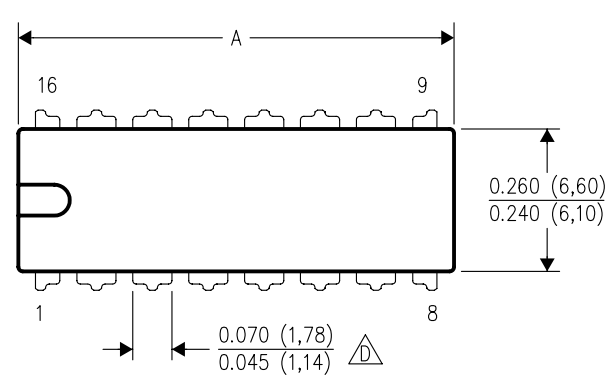
4040083/F 03/03

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.

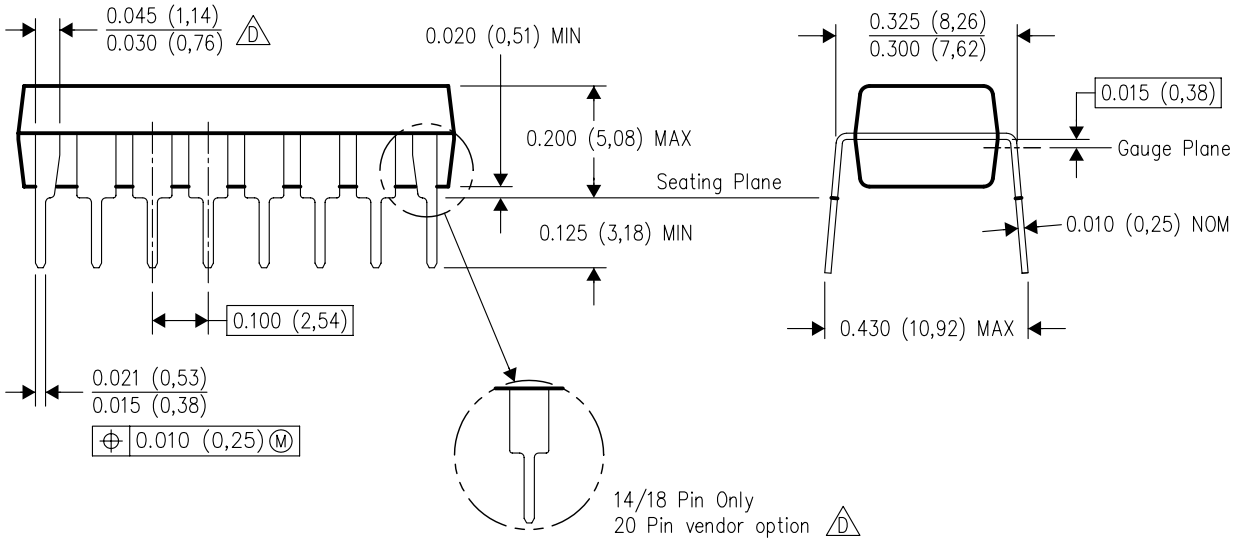
N (R–PDIP–T**)

PLASTIC DUAL–IN–LINE PACKAGE

16 PINS SHOWN



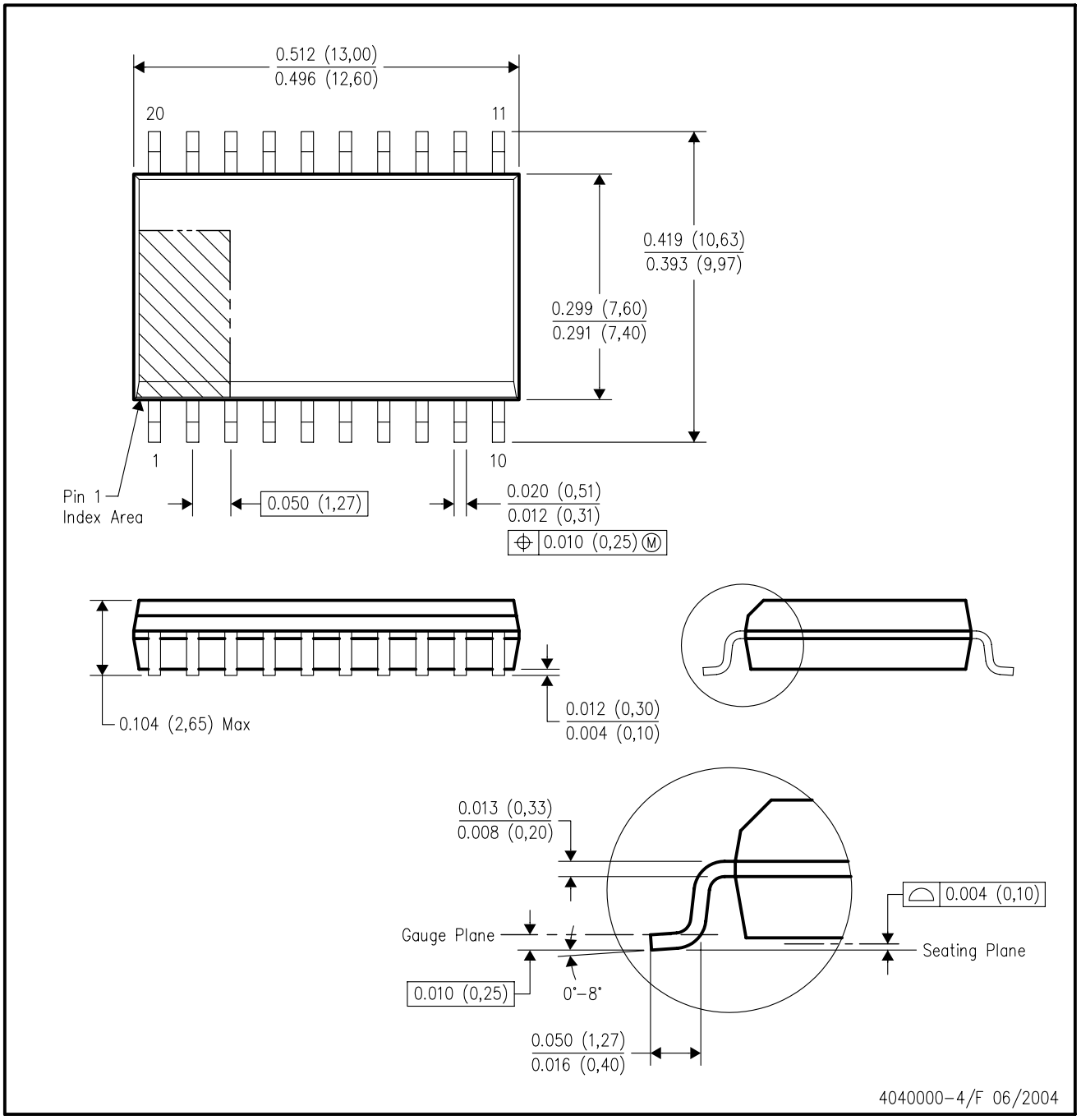
DIM \ PINS **	14	16	18	20
A MAX	0.775 (19,69)	0.775 (19,69)	0.920 (23,37)	1.060 (26,92)
A MIN	0.745 (18,92)	0.745 (18,92)	0.850 (21,59)	0.940 (23,88)
MS–001 VARIATION (C)	AA	BB	AC	AD



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.

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