

CD74HC137, CD74HCT137, CD54HC237, CD74HC237, CD74HCT237

High-Speed CMOS Logic, 3- to 8-Line Decoder/Demultiplexer with Address Latches

Features

- **Select One of Eight Data Outputs**
 - Active Low for CD74HC137 and CD74HCT137
 - Active High for 'HC237 and CD74HCT237
- **I/O Port or Memory Selector**
- **Two Enable Inputs to Simplify Cascading**
- **Typical Propagation Delay of 13ns at $V_{CC} = 5V$, 15pF, $T_A = 25^\circ C$ (CD74HC237)**
- **Fanout (Over Temperature Range)**
 - Standard Outputs 10 LSTTL Loads
 - Bus Driver Outputs 15 LSTTL Loads
- **Wide Operating Temperature Range . . . $-55^\circ C$ to $125^\circ C$**
- **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 CD74HC137, CD74HCT137, 'HC237, and CD74HCT237 are high speed silicon gate CMOS decoders well suited to memory address decoding or data routing applications. Both circuits feature low power consumption usually associated with CMOS circuitry, yet have speeds comparable to low power Schottky TTL logic.

Both circuits have three binary select inputs (A_0 , A_1 and A_2) that can be latched by an active High Latch Enable (LE) signal to isolate the outputs from select-input changes. A "Low" LE makes the output transparent to the input and the circuit functions as a one-of-eight decoder. Two Output Enable inputs (\overline{OE}_1 and OE_0) are provided to simplify cascading and to facilitate demultiplexing. The demultiplexing function is accomplished by using the A_0 , A_1 , A_2 inputs to select the desired output and using one of the other Output Enable inputs as the data input while holding the other Output Enable input in its active state. In the CD74HC137 and CD74HCT137 the selected output is a "Low"; in the 'HC237 and CD74HCT237 the selected output is a "High".

Ordering Information

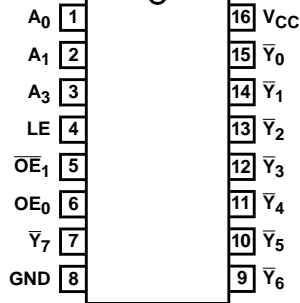
PART NUMBER	TEMP. RANGE ($^\circ C$)	PACKAGE
CD54HC237F3A	-55 to 125	16 Ld CERDIP
CD74HC137E	-55 to 125	16 Ld PDIP
CD74HC137PW	-55 to 125	16 Ld TSSOP
CD74HC137PWR	-55 to 125	16 Ld TSSOP
CD74HC137PWT	-55 to 125	16 Ld TSSOP
CD74HC237E	-55 to 125	16 Ld PDIP
CD74HC237M	-55 to 125	16 Ld SOIC
CD74HC237MT	-55 to 125	16 Ld SOIC
CD74HC237M96	-55 to 125	16 Ld SOIC
CD74HC237NSR	-55 to 125	16 Ld SOP
CD74HC237PW	-55 to 125	16 Ld TSSOP
CD74HC237PWR	-55 to 125	16 Ld TSSOP
CD74HC237PWT	-55 to 125	16 Ld TSSOP
CD74HCT137E	-55 to 125	16 Ld PDIP
CD74HCT137MT	-55 to 125	16 Ld SOIC
CD74HCT137M96	-55 to 125	16 Ld SOIC
CD74HCT237E	-55 to 125	16 Ld PDIP

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

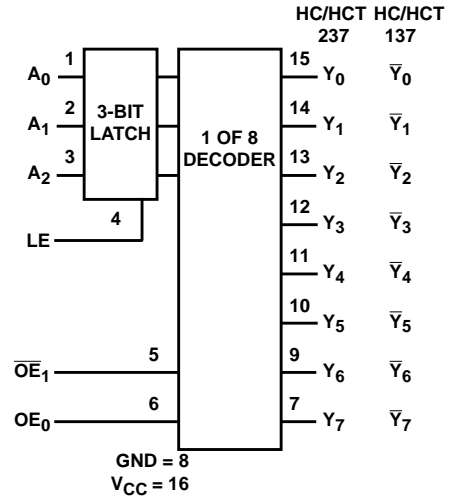
CD74HC137, CD74HCT137, CD54HC237, CD74HC237, CD74HCT237

Pinout

CD54HC237 (CERDIP)
 CD74HC137 (PDIP, TSSOP)
 CD74HCT137 (PDIP, SOIC)
 CD74HC237 (PDIP, SOIC, SOP, TSSOP)
 CD74HCT237 (PDIP)
 TOP VIEW



Functional Diagram



'HC137, 'HCT137 TRUTH TABLE

INPUTS						OUTPUTS							
LE	OE ₀	OE ₁	A ₂	A ₁	A ₀	Y ₀	Y ₁	Y ₂	Y ₃	Y ₄	Y ₅	Y ₆	Y ₇
X	X	H	X	X	X	H	H	H	H	H	H	H	H
X	L	X	X	X	X	H	H	H	H	H	H	H	H
L	H	L	L	L	L	L	H	H	H	H	H	H	H
L	H	L	L	L	H	H	L	H	H	H	H	H	H
L	H	L	L	H	L	H	H	L	H	H	H	H	H
L	H	L	L	H	H	H	H	H	L	H	H	H	H
L	H	L	H	L	L	H	H	H	H	L	H	H	H
L	H	L	H	L	H	H	H	H	H	H	L	H	H
L	H	L	H	H	L	H	H	H	H	H	H	L	H
L	H	L	H	H	H	H	H	H	H	H	H	H	L
H	H	L	X	X	X	Depends upon the address previously applied while LE was at a logic low.							

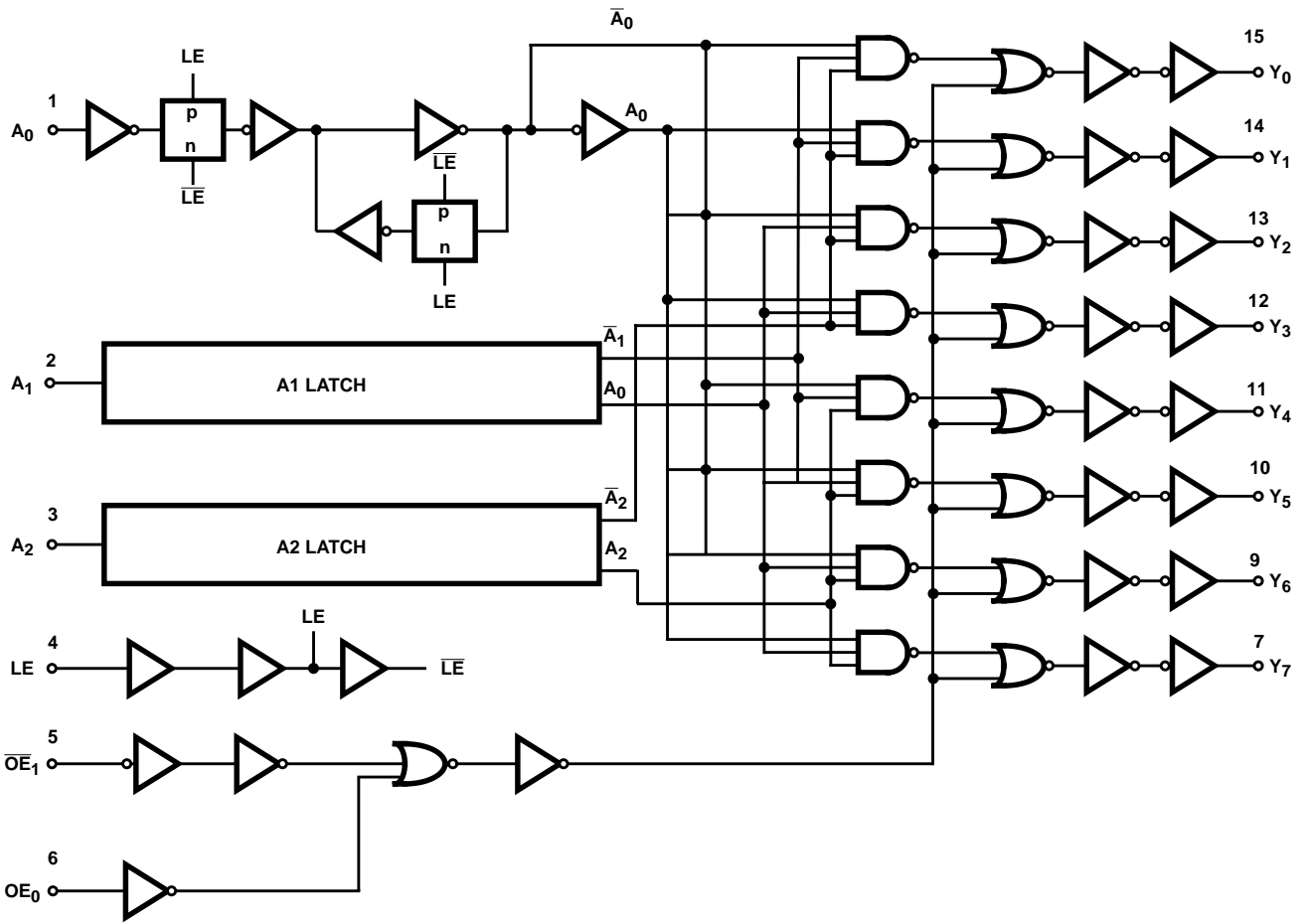
H = High Voltage Level, L = Low Voltage Level, X = Don't Care

'HC237, 'HCT237 TRUTH TABLE

INPUTS						OUTPUTS							
LE	OE ₀	OE ₁	A ₂	A ₁	A ₀	Y ₀	Y ₁	Y ₂	Y ₃	Y ₄	Y ₅	Y ₆	Y ₇
X	X	H	X	X	X	L	L	L	L	L	L	L	L
X	L	X	X	X	X	L	L	L	L	L	L	L	L
L	H	L	L	L	L	H	L	L	L	L	L	L	L
L	H	L	L	L	H	L	H	L	L	L	L	L	L
L	H	L	L	H	L	L	L	H	L	L	L	L	L
L	H	L	L	H	H	L	L	L	H	L	L	L	L
L	H	L	H	L	L	L	L	L	L	H	L	L	L
L	H	L	H	L	H	L	L	L	L	L	H	L	L
L	H	L	H	H	L	L	L	L	L	L	L	H	L
L	H	L	H	H	H	L	L	L	L	L	L	L	H
H	H	L	X	X	X	Depends upon the address previously applied while LE was at a logic low.							

H = High Voltage Level, L = Low Voltage Level, X = Don't Care

Functional Block Diagram



CD74HC137, CD74HCT137, CD54HC237, CD74HC237, CD74HCT237

Absolute Maximum Ratings

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

Thermal Information

Package Thermal Impedance, θ_{JA} (see Note 1):	
E (PDIP) Package	67°C/W
M (SOIC) Package	73°C/W
NS (SOP) Package	64°C/W
PW (TSSOP) Package	108°C/W
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)	

Operating Conditions

Temperature Range (T_A)	-55°C to 125°C
Supply Voltage Range, V_{CC}	
HC Types2V 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)

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:

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

DC Electrical Specifications

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	
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_{OH}	V_{IH} or V_{IL}	-	-	-	-	-	-	-	-	-	V
			-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	V_{OL}	V_{IH} or V_{IL}	-	-	-	-	-	-	-	-	-	V
			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

CD74HC137, CD74HCT137, CD54HC237, CD74HC237, CD74HCT237

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
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} 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
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:

- 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
All	1.5

NOTE: Unit Load is ΔI_{CC} limit specified in DC Electrical 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	MAX	MIN	MAX	
HC TYPES										
A _n to LE Setup Time	t _{SU}	2	50	-	-	65	-	75	-	ns
		4.5	10	-	-	13	-	15	-	ns
		6	9	-	-	11	-	13	-	ns
A _n to LE Hold Time	t _H	2	30	-	-	40	-	45	-	ns
		4.5	6	-	-	8	-	9	-	ns
		6	5	-	-	7	-	8	-	ns

CD74HC137, CD74HCT137, CD54HC237, CD74HC237, CD74HCT237

Prerequisite For Switching Specifications (Continued)

PARAMETER	SYMBOL	V _{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
LE Pulse Width	t _W	2	50	-	-	65	-	75	-	ns
		4.5	10	-	-	13	-	15	-	ns
		6	9	-	-	1	-	13	-	ns
HCT TYPES										
An to LE Setup Time	t _{SU}	4.5	10	-	-	13	-	15	-	ns
An to LE Hold Time	t _H	4.5	7	-	-	9	-	11	-	ns
		CD74HCT237	t _H	4.5	5	-	-	5	-	5
LE Pulse Width	t _W	4.5	10	-	-	13	-	15	-	ns

Switching Specifications 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 CD74HC137, CD74HCT137 An to any \bar{Y}	t _{PLH} , t _{PHL}	C _L = 50pF	2	-	-	180	-	225	-	270	ns
			4.5	-	-	36	-	45	-	54	ns
			6	-	-	31	-	38	-	46	ns
Propagation Delay 'HC237, CD74HCT237 An to any Y	t _{PLH} , t _{PHL}	C _L = 50pF	2	-	-	160	-	200	-	240	ns
			4.5	-	-	32	-	40	-	48	ns
			6	-	-	27	-	34	-	41	ns
Address to Output CD74HC137	t _{PLH} , t _{PHL}	C _L = 15pF	5	5	15	-	-	-	-	ns	
'HC237	t _{PLH} , t _{PHL}	C _L = 15pF	5	-	13	-	-	-	-	ns	
OE ₀ to any \bar{Y} or Y	t _{PLH} , t _{PHL}	C _L = 50pF	2	-	-	145	-	180	-	220	ns
			4.5	-	-	29	-	36	-	44	ns
			6	-	-	25	-	31	-	38	ns
OE ₁ to any \bar{Y} or Y	t _{TLH} , t _{THL}	C _L = 50pF	2	-	-	145	-	180	-	220	ns
			4.5	-	-	29	-	36	-	44	ns
			6	-	-	25	-	31	-	38	ns
LE to any \bar{Y} or Y	t _{TLH} , t _{THL}	C _L = 50pF	2	-	-	190	-	240	-	285	ns
			4.5	-	-	38	-	48	-	57	ns
			6	-	-	32	-	41	-	48	ns
Power Dissipation Capacitance, (Notes 3, 4) CD74HC137	C _{PD}	C _L = 15pF	5	-	19	-	-	-	-	-	pF
			'HC237	C _{PD}	C _L = 15pF	5	-	23	-	-	-
Output Transition Time	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 _I	-	-	-	-	-	10	-	10	pF	

CD74HC137, CD74HCT137, CD54HC237, CD74HC237, CD74HCT237

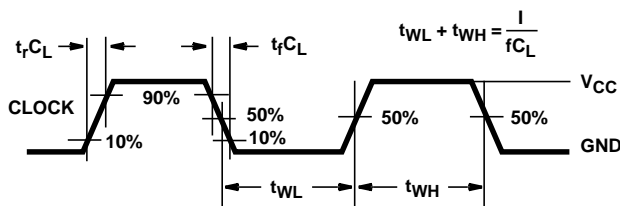
Switching Specifications Input $t_r, t_f = 6\text{ns}$ (Continued)

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	
HCT TYPES											
Propagation Delay An to any \bar{Y} or Y Address to Output	t_{PLH}, t_{PHL}	$C_L = 50\text{pF}$	4.5	-	-	38	-	48	-	57	ns
	t_{PLH}, t_{PHL}	$C_L = 15\text{pF}$	5	-	16	-	-	-	-	-	ns
OE_0 to any Y (HC137)	t_{PLH}, t_{PHL}	$C_L = 50\text{pF}$	4.5	-	-	35	-	44	-	53	ns
OE_0 to any \bar{Y} (HC237)	t_{PLH}, t_{PHL}	$C_L = 50\text{pF}$	4.5	-	-	33	-	41	-	60	ns
\bar{OE}_1 to any \bar{Y} (HC137)	t_{TLH}, t_{THL}	$C_L = 50\text{pF}$	4.5	-	-	37	-	46	-	56	ns
\bar{OE}_1 to any \bar{Y} (HC237)	t_{TLH}, t_{THL}	$C_L = 50\text{pF}$	4.5	-	-	35	-	44	-	53	ns
LE to any Y (HC137)	t_{TLH}, t_{THL}	$C_L = 50\text{pF}$	4.5	-	-	44	-	55	-	66	ns
LE to any \bar{Y} (HC237)	t_{TLH}, t_{THL}	$C_L = 50\text{pF}$	4.5	-	-	42	-	53	-	63	ns
Power Dissipation Capacitance, (Notes 3, 4)											
CD74HC137	C_{PD}	$C_L = 15\text{pF}$	5	-	19	-	-	-	-	-	pF
'HC237	C_{PD}	$C_L = 15\text{pF}$	5	-	23	-	-	-	-	-	pF
Output Transition Time	t_{TLH}, t_{THL}	$C_L = 50\text{pF}$	4.5			15		19		22	ns
Input Capacitance	C_i	-	-	-	-	10	-	10	-	10	pF

NOTES:

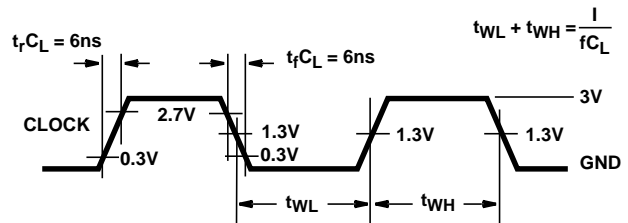
- C_{PD} is used to determine the dynamic power consumption, per gate.
- $P_D = V_{CC}^2 f_i (C_{PD} + C_L)$ where: f_i = Input Frequency, C_L = Output Load Capacitance, V_{CC} = Supply Voltage.

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

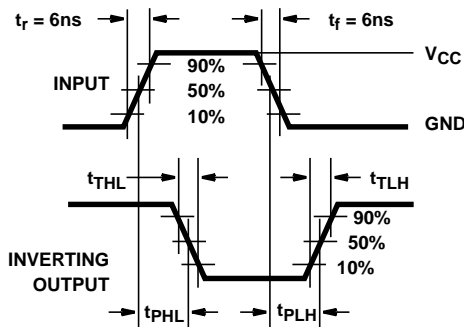


FIGURE 3. HC AND HCU TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

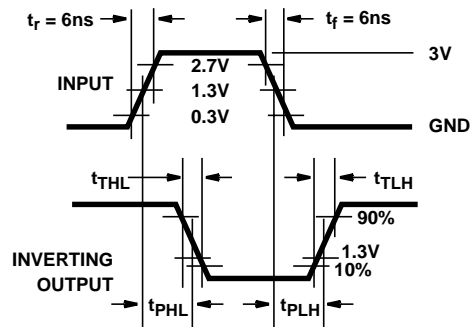


FIGURE 4. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

Test Circuits and Waveforms (Continued)

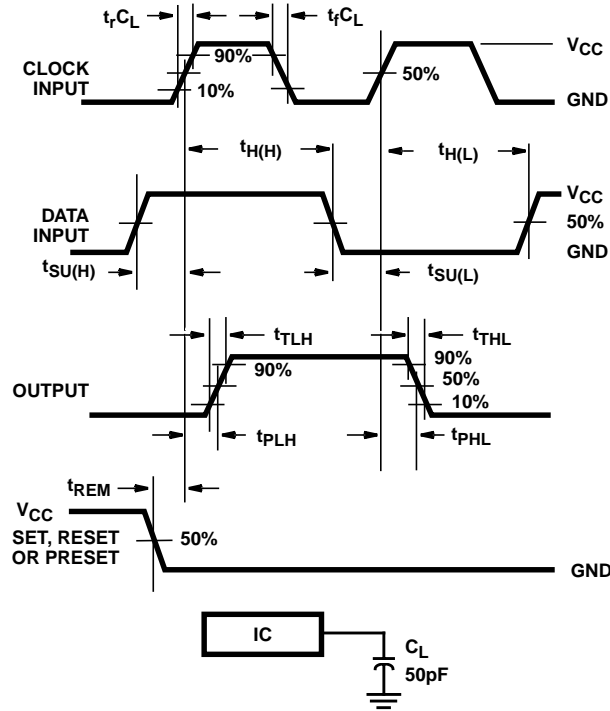


FIGURE 5. HC SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

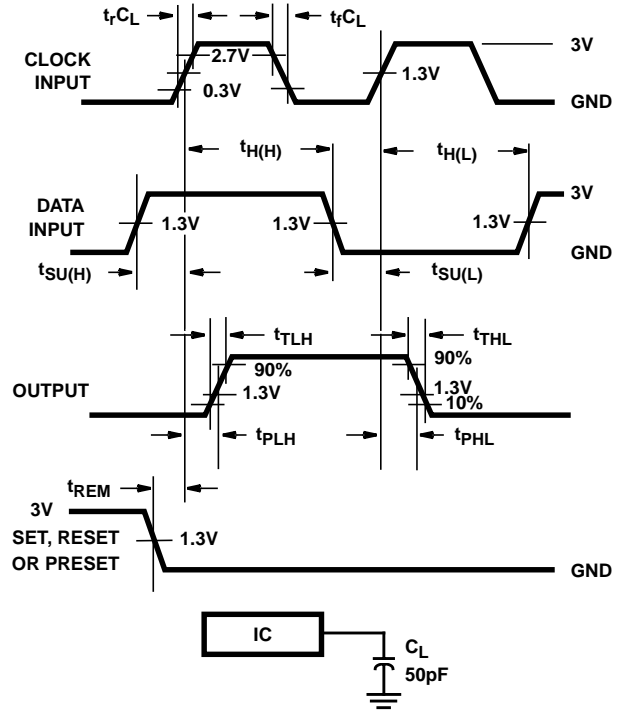


FIGURE 6. HCT SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

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)



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- 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

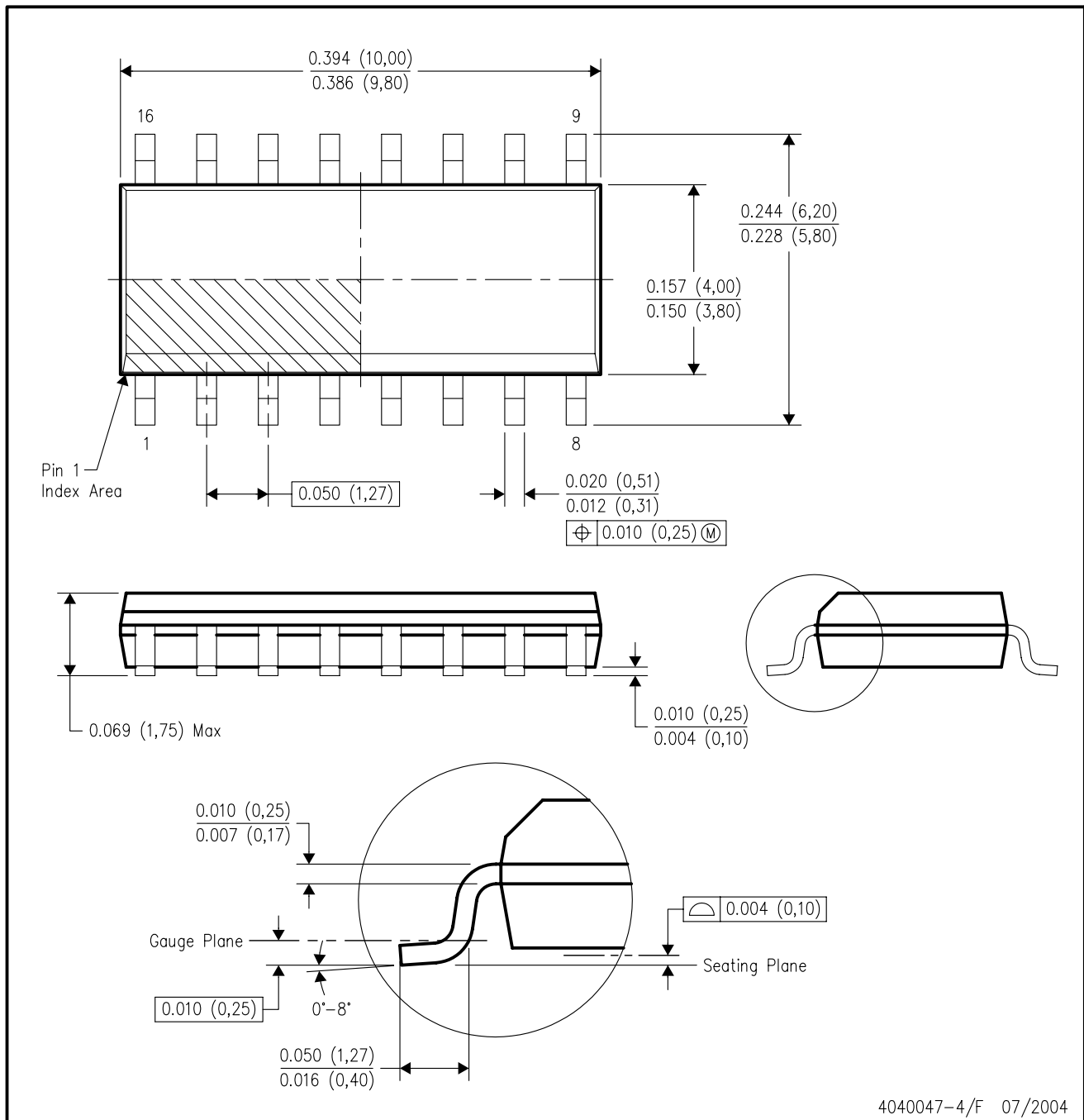


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- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - $\triangle C$ Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - $\triangle D$ The 20 pin end lead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

D (R-PDSO-G16)

PLASTIC SMALL-OUTLINE PACKAGE



- 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.

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.

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- 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.
 D. Falls within JEDEC MO-153

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