

High Speed CMOS Logic 8-Input Multiplexer/Register, Three-State

November 1997

Features

- CD74HC/HCT354
 - Transparent Data and Select Latches
- Buffered Inputs
- Three-State Complementary Outputs
- Bus Line Driving Capability
- Typical Propagation Delay: $V_{CC} = 5V$, $C_L = 15pF$, $T_A = 25^\circ C$
 - Data to Output (354) = 18ns
 - Clock to Output (356) = 22ns
- 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 Harris CD74HC354 and CD74HCT354 are data selectors/multiplexers that select one of eight sources. In both types, the data select bits S_0 , S_1 and S_2 are stored in transparent latches that are enabled by a low latch enable input, $\overline{LE}$.

In the HC/HCT354 the data enable input, $\overline{E}$, controls transparent latches that pass data to the outputs when $\overline{E}$ is high and latches in new data when $\overline{E}$ is low.

In both types the three-state outputs are controlled by three output-enable inputs $\overline{OE1}$, $\overline{OE2}$, and $\overline{OE3}$.

Ordering Information

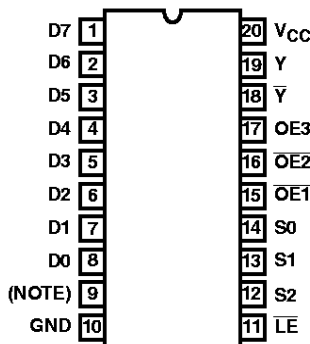
PART NUMBER	TEMP. RANGE ($^\circ C$)	PACKAGE	PKG. NO.
CD74HC354E	-55 to 125	20 Ld PDIP	E20.3
CD74HCT354E	-55 to 125	20 Ld PDIP	E20.3

NOTES:

1. When ordering, use the entire part number. Add the suffix 96 to obtain the variant in the tape and reel.
2. Wafer and die for this part number is available which meets all electrical specifications. Please contact your local sales office or Harris customer service for ordering information.

Pinout

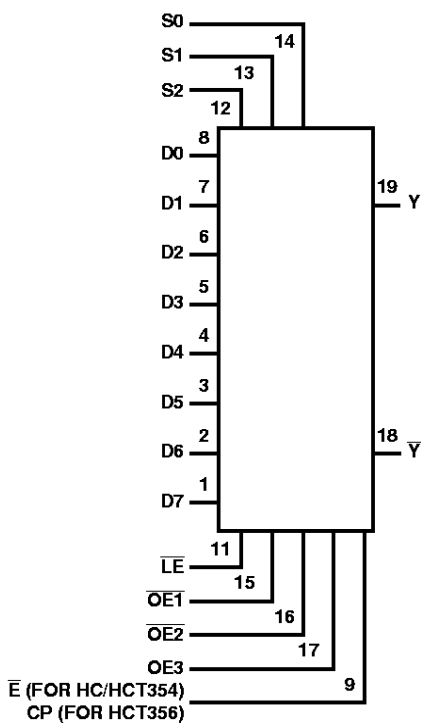
CD74HC354, CD74HCT354
(PDIP)
TOP VIEW



NOTE:
 $\overline{E} = 354$
 $CP = 356$

CD74HC354, CD74HCT354

Functional Diagram



TRUTH TABLE

INPUTS								OUTPUTS	
SELECT (NOTE 3)			ENABLE DATA HC354 HCT354	CLOCK HCT356	OUTPUT ENABLES				
S2	S1	S0	$\overline{E}$	CP	$\overline{OE1}$	$\overline{OE2}$	OE3	$\overline{Y}$	Y
X	X	X	X	X	H	X	X	Z	Z
X	X	X	X	X	X	H	X	Z	Z
X	X	X	X	X	X	X	L	Z	Z
L	L	L	L	↑	L	L	H	$\overline{D0}$	D0
L	L	L	H	H or L	L	L	H	$\overline{D0_n}$	D0 _n
L	L	H	L	↑	L	L	H	$\overline{D1}$	D1
L	L	H	H	H or L	L	L	H	$\overline{D1_n}$	D1 _n
L	H	L	L	↑	L	L	H	$\overline{D2}$	D2
L	H	L	H	H or L	L	L	H	$\overline{D2_n}$	D2 _n
L	H	H	L	↑	L	L	H	$\overline{D3}$	D3
L	H	H	H	H or L	L	L	H	$\overline{D3_n}$	D3 _n
H	L	L	L	↑	L	L	H	$\overline{D4}$	D4
H	L	L	H	H or L	L	L	H	$\overline{D4_n}$	D4 _n
H	L	H	L	↑	L	L	H	$\overline{D5}$	D5
H	L	H	H	H or L	L	L	H	$\overline{D5_n}$	D5 _n

CD74HC354, CD74HCT354

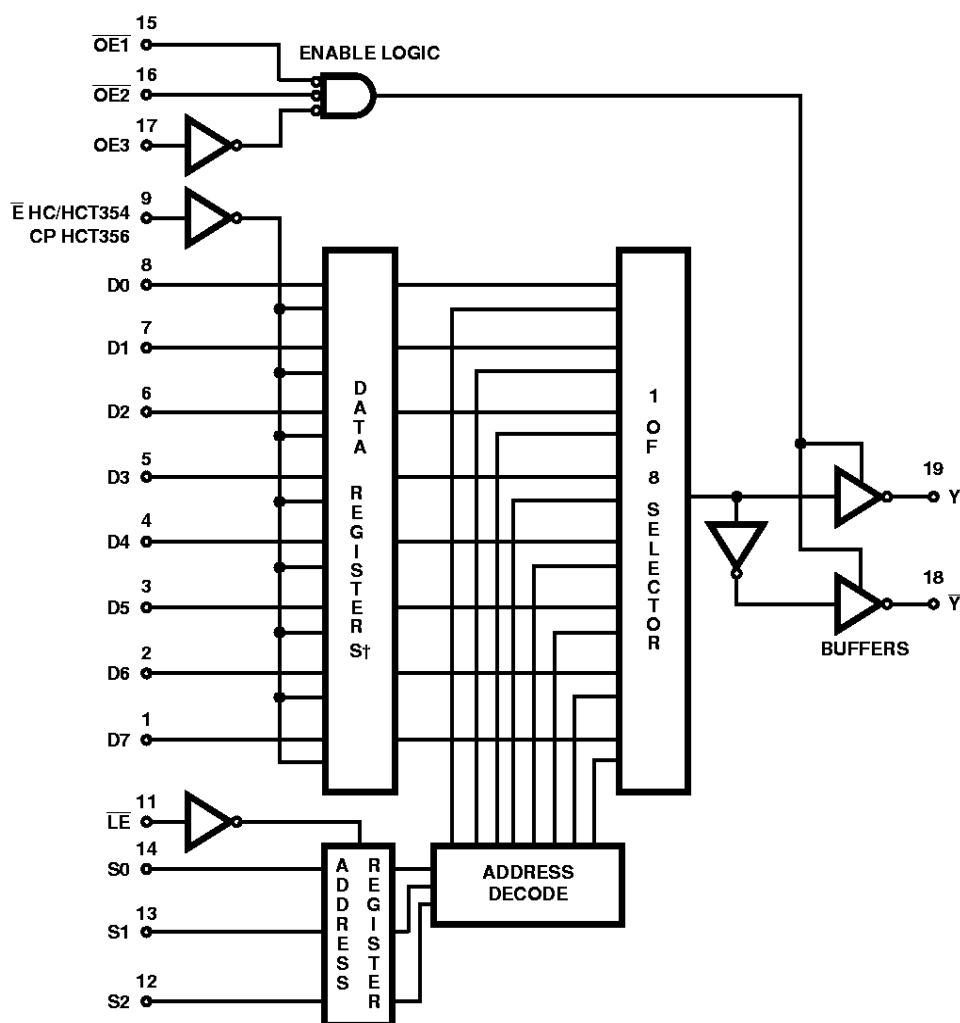
TRUTH TABLE (Continued)

INPUTS								OUTPUTS	
SELECT (NOTE 3)			ENABLE DATA HC354 HCT354	CLOCK HCT356	OUTPUT ENABLES				
S2	S1	S0	$\overline{E}$	CP	$\overline{OE1}$	$\overline{OE2}$	OE3	$\overline{Y}$	Y
H	H	L	L	↑	L	L	H	$\overline{D6}$	D6
H	H	L	H	H or L	L	L	H	$\overline{D6}_n$	D6 _n
H	H	H	L	↑	L	L	H	$\overline{D7}$	D7
H	H	H	H	H or L	L	L	H	$\overline{D7}_n$	D7 _n

NOTE: H = High Voltage Level (Steady State); L = Low Voltage Level (Steady State); X = Don't Care; Z = High Impedance State (Off State); ↑ = Transition from Low to High Level; D0...D7 = Level of steady-state inputs at input D0 through D7, respectively, at the time of the low-to-high clock transition in the case of HC356; D0_n...D7_n = the level of steady-state inputs D0 through D7, respectively, before the most recent low-to-high transition of data control or clock.

3. This column shows the input address setup with $\bar{LE}$ low.

Block Diagram



†354 8-Latches, 356 8-F/Fs.

Logic Diagram

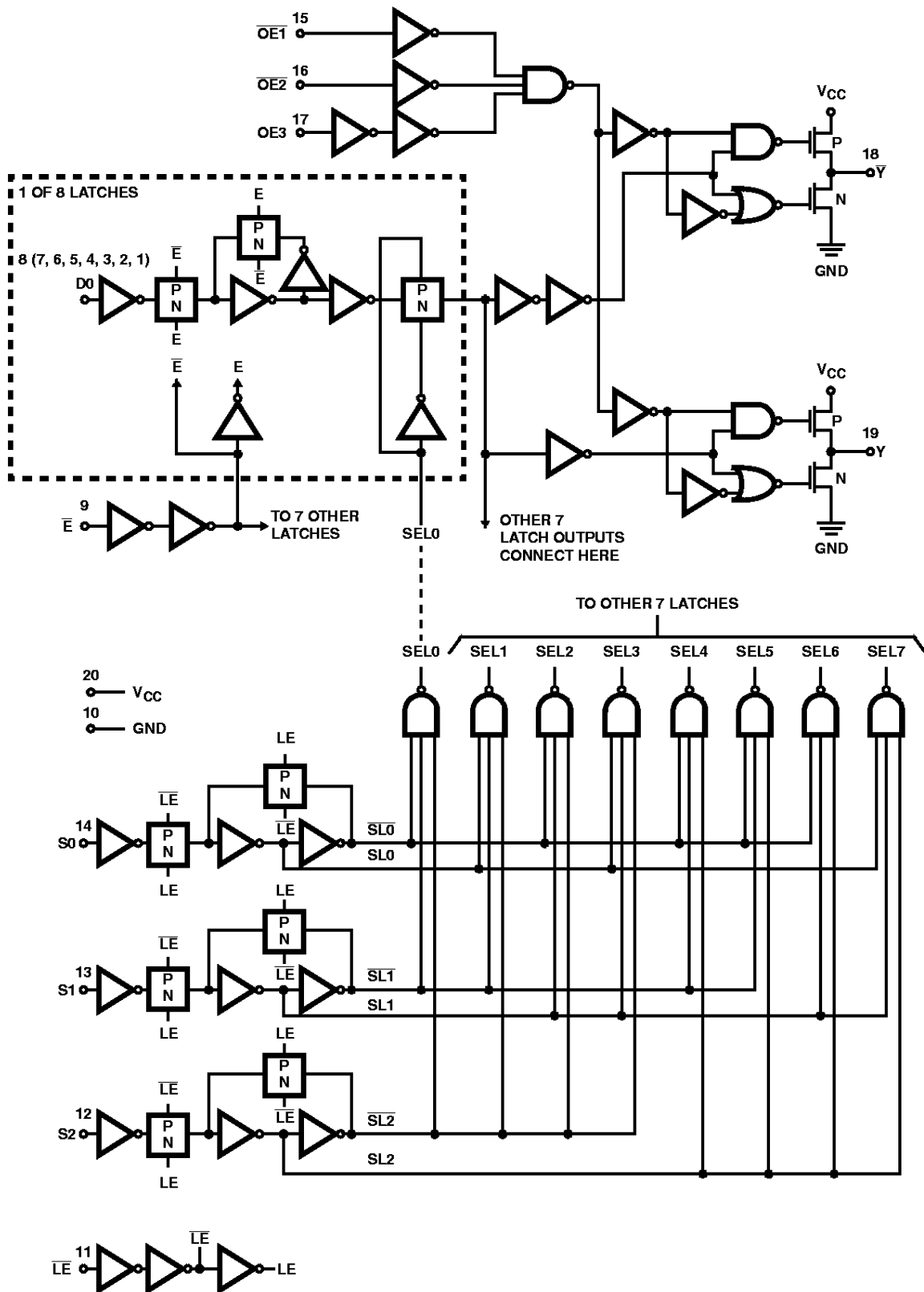


FIGURE 1. HC/HCT354 LOGIC DIAGRAM

CD74HC354, CD74HCT354

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 Drain Current, per Output, I_O
 For $-0.5V < V_O < V_{CC} + 0.5V$ $\pm 35mA$
 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

Thermal Resistance (Typical, Note 4) θ_{JA} ($^{\circ}C/W$)
 PDIP Package 125
 Maximum Junction Temperature $150^{\circ}C$
 Maximum Storage Temperature Range $-65^{\circ}C$ to $150^{\circ}C$
 Maximum Lead Temperature (Soldering 10s) $300^{\circ}C$
 (SOIC - Lead Tips Only)

Operating Conditions

Temperature Range, T_A $-55^{\circ}C$ to $125^{\circ}C$
 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)

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:

- θ_{JA} is measured with the component mounted on an evaluation PC board in free air.

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 (Bus Driver)			-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 (Bus Driver)			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

CD74HC354, CD74HCT354

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	I _{OZ}	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			-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 (Note 5)	ΔI _{CC}	V _{CC} -2.1	-	4.5 to 5.5	-	100	360	-	450	-	490	μA
Three-State Leakage Current	I _{OZ}	V _{IL} or V _{IH}	V _O = V _{CC} or GND	5.5	-	-	±0.5	-	±5.0	-	±10	μA

NOTE:

5. 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
HCT354	
D0-D7	0.50
S0, S1, S3	0.70
OE1, OE2	0.80
OE3	0.25
LE	0.25
E	0.60

HCT Input Loading Table (Continued)

INPUT	UNIT LOADS
HCT356	
D0-D7	0.50
S0, S1, S3	0.70
OE1, OE2	0.80
OE3	0.25
LE	0.25
CP	0.60

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

CD74HC354, CD74HCT354

Prerequisite For Switching Specifications - HC/HCT354

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											
E Pulse Width	t _{PLH} , t _{PHL}	-	2	80	-	-	100	-	120	-	ns
			4.5	16	-	-	20	-	24	-	ns
			6	14	-	-	17	-	20	-	ns
LE Pulse Width	t _{PLH} , t _{PHL}	-	2	80	-	-	100	-	120	-	ns
			4.5	16	-	-	20	-	24	-	ns
			6	14	-	-	17	-	20	-	ns
Set-up Times Dn → E	t _{SU}	-	2	50	-	-	65	-	75	-	ns
			4.5	10	-	-	13	-	15	-	ns
			6	9	-	-	11	-	13	-	ns
Set-up Times Sn → LE	t _{SU}	-	2	50	-	-	65	-	75	-	ns
			4.5	10	-	-	13	-	15	-	ns
			6	9	-	-	11	-	13	-	ns
Hold Times Dn → E	t _H	-	2	45	-	-	55	-	70	-	ns
			4.5	9	-	-	11	-	14	-	ns
			6	8	-	-	9	-	12	-	ns
Hold Times Sn → LE	t _H	-	2	45	-	-	55	-	70	-	ns
			4.5	9	-	-	11	-	14	-	ns
			6	8	-	-	9	-	12	-	ns
HCT TYPES											
E Pulse Width	t _{PLH} , t _{PHL}	-	4.5	16	-	-	20	-	24	-	ns
LE Pulse Width	t _{PLH} , t _{PHL}	-	4.5	16	-	-	20	-	24	-	ns
Set-up Times Dn → E	t _{SU}	-	4.5	10	-	-	13	-	15	-	ns
Set-up Times Sn → LE	t _{SU}	-	4.5	10	-	-	13	-	15	-	ns
Hold Times Dn → E	t _H	-	4.5	9	-	-	11	-	14	-	ns
Hold Times Sn → LE	t _H	-	4.5	9	-	-	11	-	14	-	ns

Switching Specifications - HC/HCT354 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
				TYP	MAX	MAX	MAX	
HC TYPES								
Propagation Delay, D _n → Y, $\bar{Y}$	t _{PLH} , t _{PHL}	C _L = 50pF	2	-	210	265	315	ns
			4.5	-	42	53	63	ns
			6	-	36	45	54	ns
		C _L = 15pF	5	18	-	-	-	ns
Propagation Delay, $\bar{E}$ → Y, $\bar{Y}$	t _{PLH} , t _{PHL}	C _L = 50pF	2	-	250	315	375	ns
			4.5	-	50	63	75	ns
			6	-	43	54	64	ns
		C _L = 15pF	5	21	-	-	-	ns

CD74HC354, CD74HCT354

Switching Specifications - HC/HCT354 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
				TYP	MAX	MAX	MAX	
Propagation Delay, $S_n \rightarrow Y, \bar{Y}$	t_{PLH}, t_{PHL}	$C_L = 50\text{pF}$	2	-	260	325	390	ns
			4.5	-	52	65	78	ns
			6	-	44	55	66	ns
		$C_L = 15\text{pF}$	5	22	-	-	-	ns
Propagation Delay, $\bar{LE} \rightarrow Y, \bar{Y}$	t_{PLH}, t_{PHL}	$C_L = 50\text{pF}$	2	-	290	365	435	ns
			4.5	-	58	73	87	ns
			6	-	49	62	74	ns
		$C_L = 15\text{pF}$	5	24	-	-	-	ns
Output Disabling Time, $\bar{OE}_n \rightarrow Y, \bar{Y}$	t_{PLZ}, t_{PHZ}	$C_L = 50\text{pF}$	2	-	155	195	235	ns
			4.5	-	31	39	47	ns
			6	-	26	33	40	ns
		$C_L = 15\text{pF}$	5	13	-	-	-	ns
Output Disabling Time, $\bar{OE}_3 \rightarrow Y, \bar{Y}$	t_{PLZ}, t_{PHZ}	$C_L = 50\text{pF}$	2	-	155	195	235	ns
			4.5	-	31	39	47	ns
			6	-	26	33	40	ns
		$C_L = 15\text{pF}$	5	13	-	-	-	ns
Output Enabling Time, $\bar{OE}_n \rightarrow Y, \bar{Y}$	t_{PZL}, t_{PZH}	$C_L = 50\text{pF}$	2	-	150	190	225	ns
			4.5	-	30	38	45	ns
			6	-	26	33	38	ns
		$C_L = 15\text{pF}$	5	12, 13	-	-	-	ns
Output Enabling Time, $\bar{OE}_3 \rightarrow Y, \bar{Y}$	t_{PZL}, t_{PZH}	$C_L = 50\text{pF}$	2	-	160	200	240	ns
			4.5	-	32	40	48	ns
			6	-	27	34	41	ns
		$C_L = 15\text{pF}$	5	12, 13	-	-	-	ns
Output Transition Time	t_{TLH}, t_{THL}	$C_L = 50\text{pF}$	2	-	60	75	90	ns
			4.5	-	12	15	18	ns
			6	-	10	13	15	ns
Input Capacitance	C_I	-	-	-	10	10	10	pF
Three-State Capacitance	C_O	-	-	-	20	20	20	pF
Power Dissipation Capacitance (Notes 6, 7)	C_{PD}	-	5	90	-	-	-	pF
HCT TYPES								
Propagation Delay, $D_n \rightarrow Y, \bar{Y}$	t_{PLH}, t_{PHL}	$C_L = 50\text{pF}$	4.5	-	47	59	71	ns
		$C_L = 15\text{pF}$	5	20	-	-	-	ns
Propagation Delay, $\bar{E} \rightarrow Y, \bar{Y}$	t_{PLH}, t_{PHL}	$C_L = 50\text{pF}$	4.5	-	54	68	81	ns
		$C_L = 15\text{pF}$	5	23	-	-	-	ns

CD74HC354, CD74HCT354

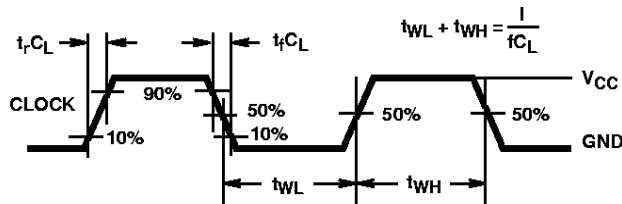
Switching Specifications - HC/HCT354 Input $t_r, t_f = 6\text{ns}$ (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	V_{CC} (V)	25°C		-40°C TO 85°C	-55°C TO 125°C	UNITS
				TYP	MAX	MAX	MAX	
Propagation Delay, $S_n \rightarrow Y, \bar{Y}$	t_{PLH}, t_{PHL}	$C_L = 50\text{pF}$	4.5	-	59	74	89	ns
		$C_L = 15\text{pF}$	5	25	-	-	-	ns
Propagation Delay, $\bar{LE} \rightarrow Y, \bar{Y}$	t_{PLH}, t_{PHL}	$C_L = 50\text{pF}$	4.5	-	63	79	94	ns
		$C_L = 15\text{pF}$	5	25	-	-	-	ns
Output Disabling Time, $\bar{OEn} \rightarrow Y, \bar{Y}$	t_{PLZ}, t_{PHZ}	$C_L = 50\text{pF}$	4.5	-	33	41	50	ns
		$C_L = 15\text{pF}$	5	13, 16	-	-	-	ns
Output Disabling Time, $OE3 \rightarrow Y, \bar{Y}$	t_{PLZ}, t_{PHZ}	$C_L = 50\text{pF}$	4.5	-	39	49	59	ns
		$C_L = 15\text{pF}$	5	13, 16	-	-	-	ns
Output Enabling Time, $\bar{OEn} \rightarrow Y, \bar{Y}$	t_{PZL}, t_{PZH}	$C_L = 50\text{pF}$	4.5	-	34	43	51	ns
		$C_L = 15\text{pF}$	5	14	-	-	-	ns
Output Enabling Time, $OE3 \rightarrow Y, \bar{Y}$	t_{PZL}, t_{PZH}	$C_L = 50\text{pF}$	4.5	-	34	43	51	ns
		$C_L = 15\text{pF}$	5	14	-	-	-	ns
Output Transition Time	t_{TLH}, t_{THL}	$C_L = 50\text{pF}$	4.5	-	12	15	18	ns
Input Capacitance	C_{IN}	-	-	-	10	10	10	pF
Three-State Capacitance	C_O	-	-	-	20	20	20	pF
Power Dissipation Capacitance (Notes 6, 7)	C_{PD}	-	5	92	-	-	-	pF

NOTES:

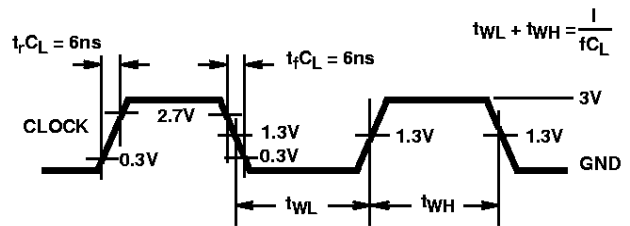
6. C_{PD} is used to determine the dynamic power consumption, per device.
7. $P_D = V_{CC}^2 (C_{PD} + C_L) f_i$ where f_i = Input Frequency, C_L = Output Load Capacitance, V_{CC} = Supply Voltage.

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

Test Circuits and Waveforms (Continued)

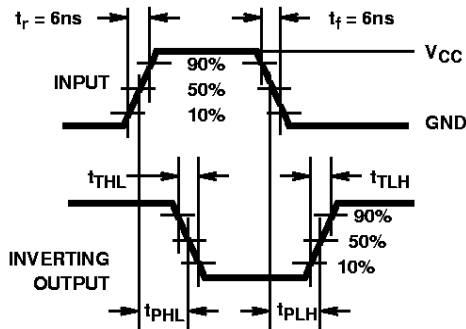


FIGURE 4. HC AND HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

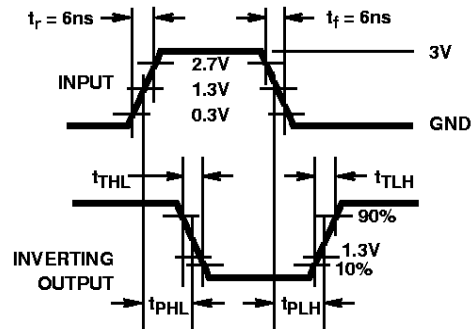


FIGURE 5. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

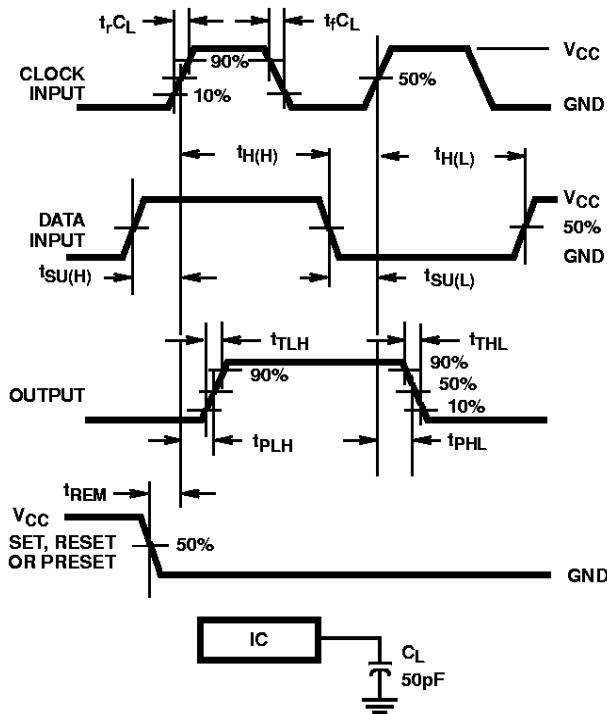


FIGURE 6. HC SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

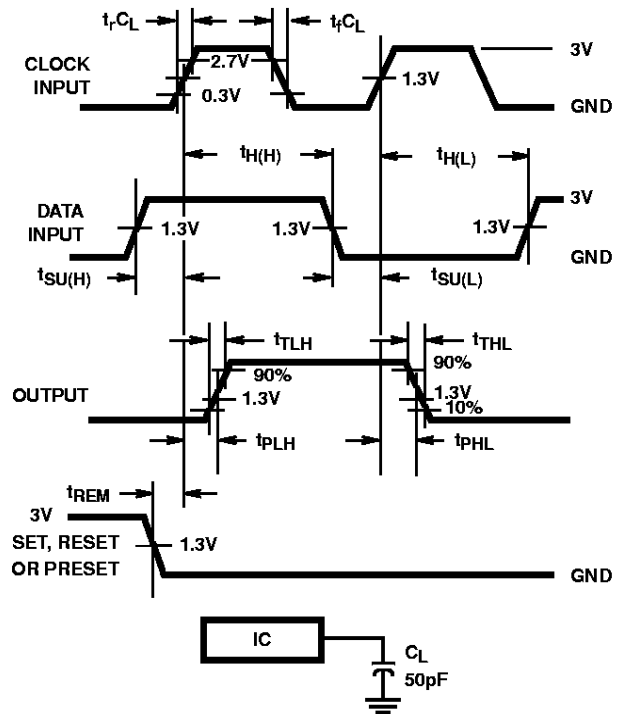


FIGURE 7. HCT SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

Test Circuits and Waveforms (Continued)

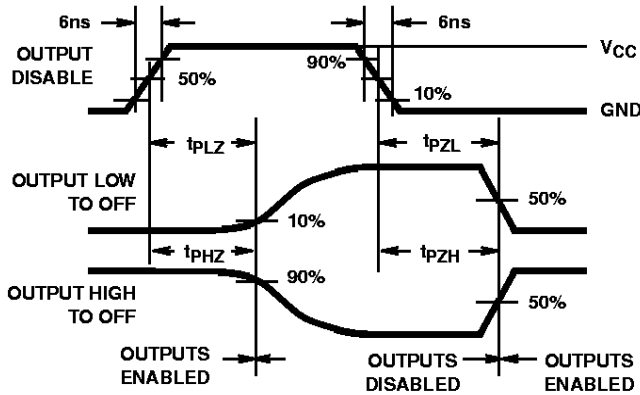


FIGURE 8. HC THREE-STATE PROPAGATION DELAY WAVEFORM

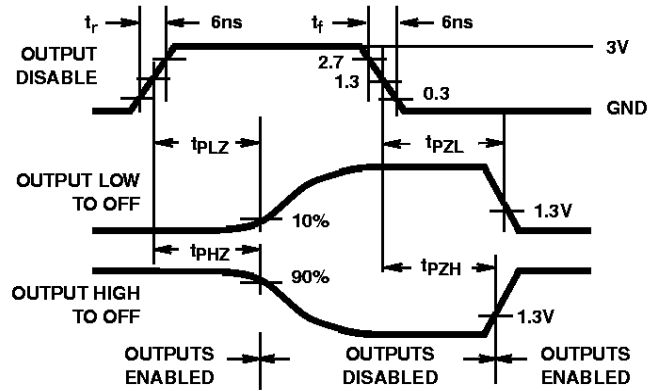
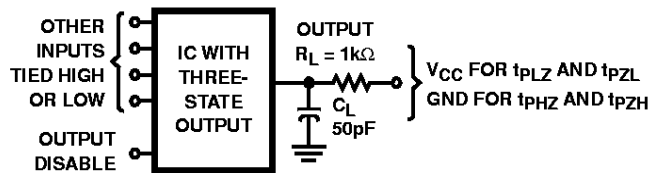


FIGURE 9. HCT THREE-STATE PROPAGATION DELAY WAVEFORM



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 $R_L = 1k\Omega$ to V_{CC} , $C_L = 50pF$.

FIGURE 10. HC AND HCT THREE-STATE PROPAGATION DELAY TEST CIRCUIT

All Harris Semiconductor products are manufactured, assembled and tested under **ISO9000** quality systems certification.

Harris Semiconductor products are sold by description only. Harris Semiconductor reserves the right to make changes in circuit design and/or specifications at any time without notice. Accordingly, the reader is cautioned to verify that data sheets are current before placing orders. Information furnished by Harris is believed to be accurate and reliable. However, no responsibility is assumed by Harris or its subsidiaries for its use; nor for any infringements of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Harris or its subsidiaries.

Sales Office Headquarters

For general information regarding Harris Semiconductor and its products, call **1-800-4-HARRIS**

NORTH AMERICA
Harris Semiconductor
P. O. Box 883, Mail Stop 53-210
Melbourne, FL 32902
TEL: 1-800-442-7747
(407) 729-4984
FAX: (407) 729-5321

EUROPE
Harris Semiconductor
Mercure Center
100, Rue de la Fusée
1130 Brussels, Belgium
TEL: (32) 2.724.2111
FAX: (32) 2.724.22.05

ASIA
Harris Semiconductor PTE Ltd.
No. 1 Tannery Road
Cencon 1, #09-01
Singapore 1334
TEL: (65) 748-4200
FAX: (65) 748-0400

