

August 1997

## High Speed CMOS Logic

### Features

- Buffered Inputs
- Typical Propagation Delay: 7ns at  $V_{CC} = 5V$ ,  $C_L = 15pF$ ,  $T_A = 25^\circ C$
- 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 CD54HC08, CD54HCT08, CD74HC08 and CD74HCT08 logic gates utilize silicon gate CMOS technology to achieve operating speeds similar to LSTTL gates with the low power consumption of standard CMOS integrated circuits. All devices have the ability to drive 10 LSTTL loads. The 74HCT logic family is functionally pin compatible with the standard 74LS logic family.

### Ordering Information

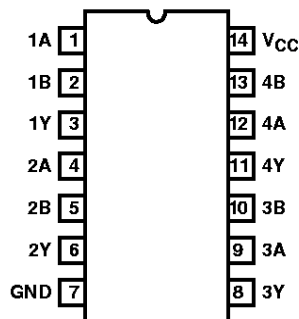
PART NUMBER	TEMP. RANGE ( $^\circ C$ )	PACKAGE	PKG. NO.
CD74HC08E	-55 to 125	14 Ld PDIP	E14.3
CD74HCT08E	-55 to 125	14 Ld PDIP	E14.3
CD74HC08M	-55 to 125	14 Ld SOIC	M14.15
CD74HCT08M	-55 to 125	14 Ld SOIC	M14.15
CD54HC08F	-55 to 125	14 Ld CERDIP	F14.3
CD54HCT08F	-55 to 125	14 Ld CERDIP	F14.3
CD54HC08W	-55 to 125	Wafer	
CD54HCT08W	-55 to 125	Wafer	
CD54HC08H	-55 to 125	Die	
CD54HCT80H	-55 to 125	Die	

NOTE:

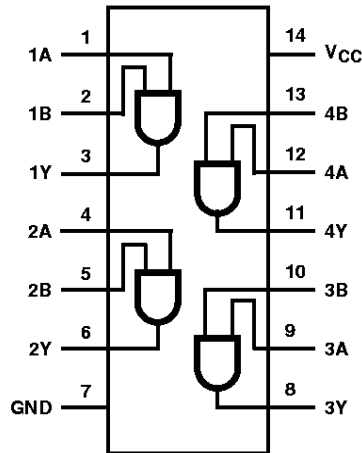
1. When ordering, use the entire part number. Add the suffix 96 to obtain the variant in the tape and reel.

### Pinout

CD54HC08, CD54HCT08, CD74HC08, CD74HCT08  
(PDIP, CERDIP, SOIC)  
TOP VIEW



**Functional Diagram**



TRUTH TABLE

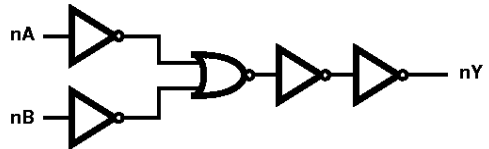
INPUTS		OUTPUT
nA	nB	nY
L	L	L
L	H	L
H	L	L
H	H	H

NOTE: H = High Voltage Level, L = Low Voltage Level

**HC Logic Symbol**



**HCT Logic Symbol**



## CD54HC08, CD54HCT08, CD74HC08, CD74HCT08

### 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, $I_{CC}$ or $I_{GND}$ .....	$\pm 50mA$

### Thermal Information

Thermal Resistance (Typical, Note 2)	$\theta_{JA}$ ( $^{\circ}C/W$ )	$\theta_{JC}$ ( $^{\circ}C/W$ )
PDIP Package .....	100	N/A
CERDIP Package .....	130	55
SOIC Package .....	180	N/A
Maximum Junction Temperature (Hermetic Package or Die) . . .	175 $^{\circ}C$	
Maximum Junction Temperature (Plastic Package) .....	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:

- $\theta_{JA}$  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 $^{\circ}C$			-40 $^{\circ}C$ TO 85 $^{\circ}C$		-55 $^{\circ}C$ TO 125 $^{\circ}C$		UNITS
		$V_I$ (V)	$I_O$ (mA)		MIN	TYP	MAX	MIN	MAX	MIN	MAX	
<b>HC TYPES</b>												
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
			-	-	-	-	-	-	-	-	-	V
			-4	4.5	3.98	-	-	3.84	-	3.7	-	V
			-5.2	6	5.48	-	-	5.34	-	5.2	-	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
			-	-	-	-	-	-	-	-	-	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
			-	-	-	-	-	-	-	-	-	V
			4	4.5	-	-	0.26	-	0.33	-	0.4	V
			5.2	6	-	-	0.26	-	0.33	-	0.4	V
Low Level Output Voltage TTL Loads	$V_{OL}$	$V_{IH}$ or $V_{IL}$	-	-	-	-	-	-	-	-	V	
Input Leakage Current	$I_I$	$V_{CC}$ or GND	-	6	-	-	$\pm 0.1$	-	$\pm 1$	-	$\pm 1$	$\mu A$

**CD54HC08, CD54HCT08, CD74HC08, CD74HCT08**

**DC Electrical Specifications (Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS		V <sub>CC</sub> (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
		V <sub>I</sub> (V)	I <sub>O</sub> (mA)		MIN	TYP	MAX	MIN	MAX	MIN	MAX	
Quiescent Device Current	I <sub>CC</sub>	V <sub>CC</sub> or GND	0	6	-	-	2	-	20	-	40	μA
<b>HCT TYPES</b>												
High Level Input Voltage	V <sub>IH</sub>	-	-	4.5 to 5.5	2	-	-	2	-	2	-	V
Low Level Input Voltage	V <sub>IL</sub>	-	-	4.5 to 5.5	-	-	0.8	-	0.8	-	0.8	V
High Level Output Voltage CMOS Loads	V <sub>OH</sub>	V <sub>IH</sub> or V <sub>IL</sub>	-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 <sub>OL</sub>	V <sub>IH</sub> or V <sub>IL</sub>	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 <sub>I</sub>	V <sub>CC</sub> and GND	0	5.5	-	-	±0.1	-	±1	-	±1	μA
Quiescent Device Current	I <sub>CC</sub>	V <sub>CC</sub> or GND	0	5.5	-	-	2	-	20	-	40	μA
Additional Quiescent Device Current Per Input Pin: 1 Unit Load (Note)	ΔI <sub>CC</sub>	V <sub>CC</sub> - 2.1	-	4.5 to 5.5	-	100	360	-	450	-	490	μA

NOTE: For dual-supply systems theoretical worst case (V<sub>I</sub> = 2.4V, V<sub>CC</sub> = 5.5V) specification is 1.8mA.

**HCT Input Loading Table**

INPUT	UNIT LOADS
All	0.6

NOTE: Unit Load is ΔI<sub>CC</sub> limit specified in DC Electrical Specifications table, e.g. 360μA max at 25°C.

**Switching Specifications** Input t<sub>r</sub>, t<sub>f</sub> = 6ns

PARAMETER	SYMBOL	TEST CONDITIONS	V <sub>CC</sub> (V)	25°C			-40°C to 85°C		-55°C to 125°C		UNITS
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
<b>HC TYPES</b>											
Propagation Delay, Input to Output (Figure 1)	t <sub>PLH</sub> , t <sub>PHL</sub>	C <sub>L</sub> = 50pF	2	-	-	90	-	115	-	135	ns
			4.5	-	-	18	-	23	-	27	ns
			6	-	-	15	-	20	-	23	ns
Propagation Delay, Data Input to Output Y	t <sub>PLH</sub> , t <sub>PHL</sub>	C <sub>L</sub> = 15pF	5	-	7	-	-	-	-	ns	

**CD54HC08, CD54HCT08, CD74HC08, CD74HCT08**

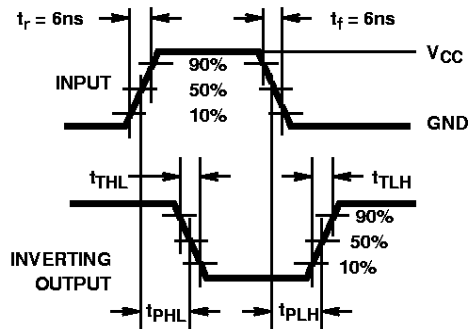
**Switching Specifications** Input  $t_r, t_f = 6\text{ns}$  (Continued)

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	
Transition Times (Figure 1)	$t_{TLH}, t_{THL}$	$C_L = 50\text{pF}$	2	-	-	75	-	95	-	110	ns
			4.5	-	-	15	-	19	-	22	ns
			6	-	-	13	-	16	-	19	ns
Input Capacitance	$C_I$	-	-	-	10	-	10	-	10	pF	
Power Dissipation Capacitance (Note 3, 4)	$C_{PD}$	-	5	-	37	-	-	-	-	pF	
<b>HCT TYPES</b>											
Propagation Delay, Input to Output Y (Figure 2)	$t_{PLH}, t_{PHL}$	$C_L = 50\text{pF}$	4.5	-	-	25	-	31	-	38	ns
Propagation Delay, Data Input to Output Y	$t_{PLH}, t_{PHL}$	$C_L = 15\text{pF}$	5	-	10	-	-	-	-	-	ns
Transition Times (Figure 2)	$t_{TLH}, t_{THL}$	$C_L = 50\text{pF}$	4.5	-	-	15	-	19	-	22	ns
Input Capacitance	$C_I$	$C_L = 50\text{pF}$	-	-	-	10	-	10	-	10	pF
Power Dissipation Capacitance (Notes 3, 4)	$C_{PD}$	-	5	-	51	-	-	-	-	-	pF

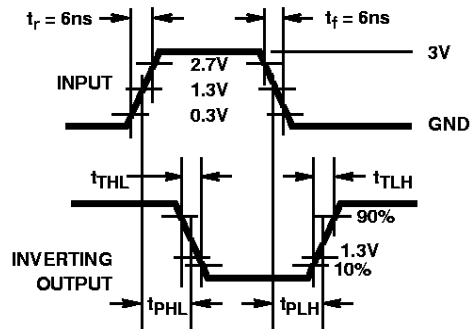
**NOTES:**

- $C_{PD}$  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**



**FIGURE 1. HC AND HCU TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC**



**FIGURE 2. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC**