

November 1997 - Revised May 2000

High Speed CMOS Logic Quad 2-Input Multiplexer with Three-State Non-Inverting Outputs

Features

- Buffered Inputs
- Typical Propagation Delay (In to Output) = 12ns 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 'HC257 and 'HCT257 are quad 2-input multiplexers which select four bits of data from two sources under the control of a common Select Input (S). The Output Enable

input ($\overline{OE}$) is active LOW. When $\overline{OE}$ is HIGH, all of the outputs (1Y-4Y) are in the high impedance state regardless of all other input conditions.

Moving data from two groups of registers to four common output buses is a common use of the 257. The state of the Select input determines the particular register from which the data comes. It can also be used as a function generator.

Ordering Information

PART NUMBER	TEMP. RANGE ($^\circ C$)	PACKAGE
CD54HC257F3A	-55 to 125	16 Ld Cerdip
CD74HC257E	-55 to 125	16 Ld PDIP
CD74HC257M	-55 to 125	16 Ld SOIC
CD54HCT257F3A	-55 to 125	16 Ld Cerdip
CD74HCT257E	-55 to 125	16 Ld PDIP
CD74HCT257M	-55 to 125	16 Ld SOIC

NOTES:

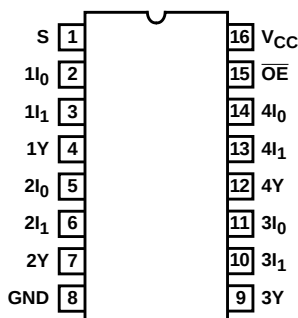
1. When ordering, use the entire part number. Add the suffix 96 to obtain the variant in the tape and reel.
2. Wafer or die for this part number is available which meets all electrical specifications. Please contact your local TI sales office or customer service for ordering information.

Pinout

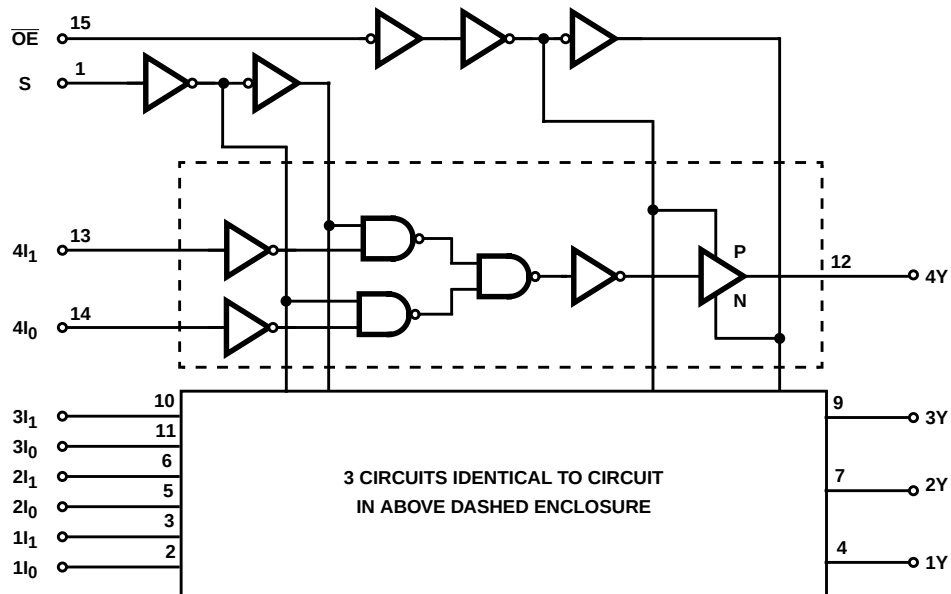
CD54HC257, CD54HC257
(CERDIP)

CD74HC257, CD74HC257
(PDIP, SOIC)

TOP VIEW



Functional Diagram



TRUTH TABLE

OUTPUT ENABLE	SELECT INPUT	DATA INPUTS		OUTPUT
OE	S	I ₀	I ₁	Y
H	X	X	X	Z
L	L	L	X	L
L	L	H	X	H
L	H	X	L	L
L	H	X	H	H

NOTE:

H = High Voltage Level

L = Low Voltage Level

X = Don't Care

Z = High Impedance, OFF State

CD54/74HC257, CD54/74HCT257

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} $\pm 70mA$

Thermal Information

Thermal Resistance (Typical, Note 3) θ_{JA} ($^{\circ}C/W$)
 PDIP Package 90
 SOIC Package 160
 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			-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			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

CD54/74HC257, CD54/74HCT257

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}	-	6	-	-	± 0.5	-	± 5	-	± 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} 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 4)	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}	-	5.5	-	-	± 0.5	-	± 5	-	± 10	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
Data	0.95
S	3
$\overline{OE}$	0.6

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

CD54/74HC257, CD54/74HCT257

Switching Specifications

Input $t_r, t_f = 6\text{ns}$

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 In to Y	t _{PLH} , t _{PHL}	C _L = 50pF	2	-	150	190	225	ns
			4.5	-	30	38	45	ns
		C _L = 15pF	5	12	-	-	-	ns
		CL = 50pF	6	-	26	33	38	ns
Propagation Delay S to Y	t _{PLH} , t _{PHL}	C _L = 50pF	2	-	175	220	265	ns
			4.5	-	35	44	53	ns
		C _L = 15pF	5	14	-	-	-	ns
		CL = 50pF	6	-	30	37	45	ns
Propagation Delay OE to Y	t _{PLZ} , t _{PHZ} , t _{PZL} , t _{PZH}	CL = 50pF	2	-	150	190	225	ns
		C _L = 50pF	4.5	-	30	38	45	ns
		C _L = 15pF	5	12	-	-	-	ns
		CL = 50pF	6	-	26	33	38	ns
Output Transition Times	t _{TLH} , t _{THL}	C _L = 50pF	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 Output Capacitance	C _O	-	-	-	20	20	20	pF
Power Dissipation Capacitance (Notes 5, 6)	C _{PD}	-	5	45	-	-	-	pF
HCT TYPES								
Propagation Delay In to Y	t _{PLH} , t _{PHL}	C _L = 50pF	4.5	-	33	41	50	ns
		C _L = 15pF	5	13	-	-	-	ns
Propagation Delay S to Y	t _{PZL} , t _{PZH}	C _L = 50pF	4.5	-	38	48	57	ns
		C _L = 15pF	5	12	-	-	-	ns
Propagation Delay OE to Y	t _{PLZ} , t _{PHZ}	C _L = 50pF	4.5	-	30	38	45	ns
		C _L = 15pF	5	16	-	-	-	ns
Output Transition Times	t _{TLH} , t _{THL}	C _L = 50pF	4.5	-	12	15	18	ns
Input Capacitance	C _I	-	-	-	10	10	10	pF
Three-State Output Capacitance	C _O	-	-	-	20	20	20	pF
Power Dissipation Capacitance (Notes 5, 6)	C _{PD}	-	5	45	-	-	-	pF

NOTES:

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

Test Circuits and Waveforms

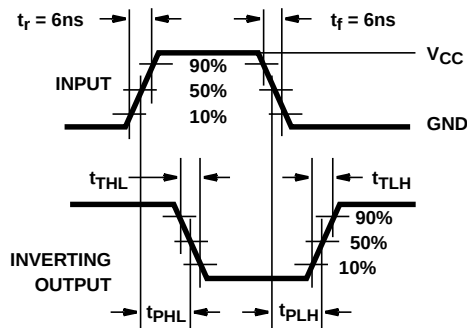


FIGURE 1. HC TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

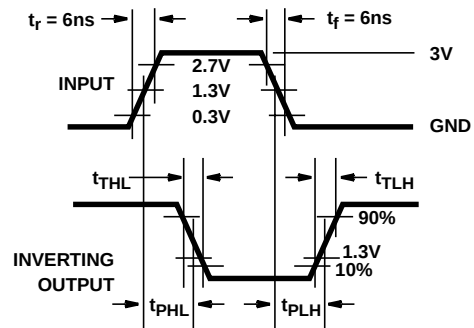


FIGURE 2. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

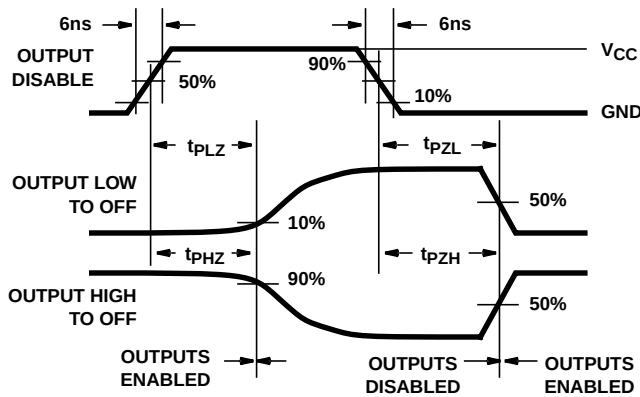


FIGURE 3. HC THREE-STATE PROPAGATION DELAY WAVEFORM

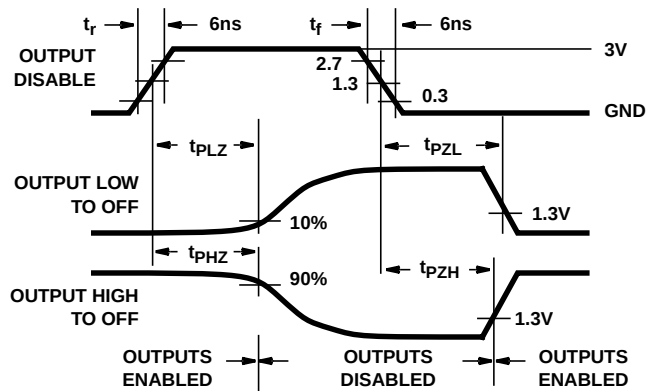
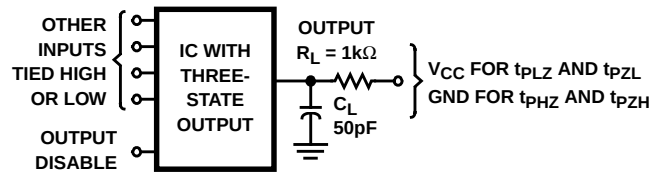


FIGURE 4. HCT THREE-STATE PROPAGATION DELAY WAVEFORM



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 5. HC AND HCT THREE-STATE PROPAGATION DELAY TEST CIRCUIT

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