

CD54HC4514, CD74HC4514, CD74HC4515

High Speed CMOS Logic 4-to-16 Line Decoder/Demultiplexer with Input Latches

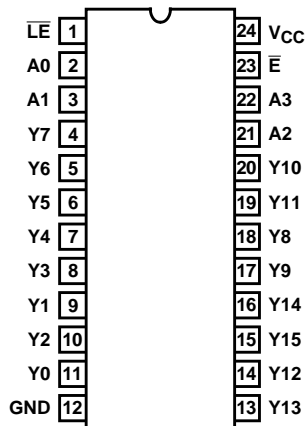
SCHS280A - November 1997 - Revised October 2000

Features

- Multifunction Capability
 - Binary to 1-of-16 Decoder
 - 1-to-16 Line Demultiplexer
- Fanout (Over Temperature Range)
 - Standard Outputs 10 LSTTL Loads
 - Bus Driver Outputs 15 LSTTL Loads
- Wide Operating Temperature Range . . . -55°C to 125°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 $V_{CC} = 5V$

Pinout

CD54HC4514
(CERDIP)
CD74HC4514, CD74HC4515
(PDIP, SOIC)
TOP VIEW



Description

The CD54HC4514, CD74HC4514, and CD74HC4515 are high-speed silicon gate devices consisting of a 4-bit strobed latch and a 4-to-16 line decoder. The selected output is enabled by a low on the enable input (E). A high on \bar{E} inhibits selection of any output. Demultiplexing is accomplished by using the \bar{E} input as the data input and the select inputs (A0-A3) as addresses. This \bar{E} input also serves as a chip select when these devices are cascaded.

When Latch Enable (\bar{LE}) is high the output follows changes in the inputs (see truth table). When \bar{LE} is low the output is isolated from changes in the input and remains at the level (high for the 4514, low for the 4515) it had before the latches were enabled. These devices, enhanced versions of the equivalent CMOS types, can drive 10 LSTTL loads.

Ordering Information

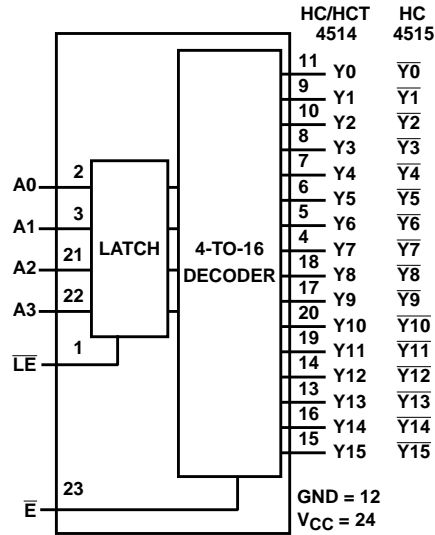
PART NUMBER	TEMP. RANGE (°C)	PACKAGE
CD54HC4514F3A	-55 to 125	24 Ld CERDIP
CD74HC4514E	-55 to 125	24 Ld PDIP
CD74HC4514M	-55 to 125	24 Ld SOIC
CD74HC4515M	-55 to 125	24 Ld SOIC

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.

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Functional Diagram



DECODE TRUTH TABLE (LE = 1)

ENABLE	DECODER INPUTS				ADDRESSED OUTPUT 4514 = LOGIC 1 (HIGH) 4515 = LOGIC 0 (HIGH)
	A3	A2	A1	A0	
0	0	0	0	0	Y0
0	0	0	0	1	Y1
0	0	0	1	0	Y2
0	0	0	1	1	Y3
0	0	1	0	0	Y4
0	0	1	0	1	Y5
0	0	1	1	0	Y6
0	0	1	1	1	Y7
0	1	0	0	0	Y8
0	1	0	0	1	Y9
0	1	0	1	0	Y10
0	1	0	1	1	Y11
0	1	1	0	0	Y12
0	1	1	0	1	Y13
0	1	1	1	0	Y14
0	1	1	1	1	Y15
1	X	X	X	X	All Outputs = 0, 4514 All Outputs = 1, 4515

X = Don't Care; Logic 1 = High; Logic 0 = Low

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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 $-0.5V < V_O < V_{CC} + 0.5V$	$\pm 25mA$
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 3)	θ_{JA} (°C/W)
E Package	67
M Package	46
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	-0.02	2	1.9	-	-	1.9	-	1.9	-	V
			-0.02	-0.02	4.5	4.4	-	-	4.4	-	4.4	-	V
			-0.02	-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	4.5	3.98	-	-	3.84	-	3.7	-	V
			-5.2	-5.2	6	5.48	-	-	5.34	-	5.2	-	V

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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			
Low Level Output Voltage CMOS Loads	V _{OL}	V _{IH} or V _{IL}	0.02	0.02	2	-	-	0.1	-	0.1	-	0.1	V	
			0.02	0.02	4.5	-	-	0.1	-	0.1	-	0.1	V	
			0.02	0.02	6	-	-	0.1	-	0.1	-	0.1	V	
-			-	-	-	-	-	-	-	-	-	-	V	
Low Level Output Voltage TTL Loads			4	4.5	-	-	0.26	-	0.33	-	0.4	-	0.4	V
			5.2	6	-	-	0.26	-	0.33	-	0.4	-	0.4	V
Input Leakage Current	I _I	V _{CC} or GND	-	6	-	-	±0.1	-	±1	-	±1	µA		
Quiescent Device Current	I _{CC}	V _{CC} or GND	0	6	-	-	8	-	80	-	160	µA		

NOTE: For dual-supply systems theoretical worst case (V_I = 2.4V, V_{CC} = 5.5V) specification is 1.8mA.

Prerequisite For Switching Specifications

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											
LE Pulse Width	t _W	-	2	75	-	-	95	-	110	-	ns
			4.5	30	-	-	19	-	22	-	ns
			6	35	-	-	16	-	19	-	ns
Select to LE Set-Up Time	t _{SU}	-	2	100	-	-	125	-	150	-	ns
			4.5	20	-	-	25	-	30	-	ns
			6	17	-	-	21	-	26	-	ns
Select to LE Hold Time	t _H	-	2	0	-	-	0	-	0	-	ns
			4.5	0	-	-	0	-	0	-	ns
			6	0	-	-	0	-	0	-	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 Select to Outputs	t _{PHL} , t _{PLH}	C _L = 50pF	2	-	-	275	-	345	-	415	ns
			4.5	-	-	55	-	69	-	83	ns
		C _L = 15pF	5	-	23	-	-	-	-	-	ns
		C _L = 50pF	6	-	-	47	-	59	-	71	ns

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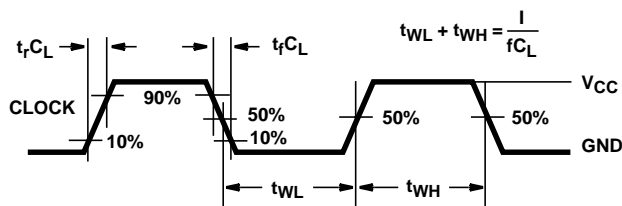
Switching Specifications $C_L = 50\text{pF}$, Input $t_r, t_f = 6\text{ns}$ (Continued)

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	
\overline{LE} to Outputs	t_{PHL}, t_{PLH}	$C_L = 50\text{pF}$	2	-	-	225	-	280	-	340	ns
			4.5	-	-	45	-	56	-	68	ns
		$C_L = 15\text{pF}$	5	-	19	-	-	-	-	-	ns
		$C_L = 50\text{pF}$	6	-	-	38	-	48	-	58	ns
\overline{E} to Outputs	t_{PHL}, t_{PLH}	$C_L = 50\text{pF}$	2	-	-	175	-	220	-	265	ns
			4.5	-	-	35	-	44	-	53	ns
		$C_L = 15\text{pF}$	5	-	14	-	-	-	-	-	ns
		$C_L = 50\text{pF}$	6	-	-	30	-	37	-	45	ns
Output Transition Time	t_{THL}, t_{TLH}	$C_L = 50\text{pF}$	2	-	-	75	-	95	-	110	ns
			4.5	-	-	15	-	19	-	22	ns
			6	-	-	13	-	16	-	19	ns
Input Capacitance	C_{IN}	$C_L = 50\text{pF}$	-	10	-	10	-	10	-	10	pF
Power Dissipation Capacitance (Notes 4, 5)	C_{PD}	-	5	-	70	-	-	-	-	-	pF

NOTES:

4. C_{PD} is used to determine the dynamic power consumption, per package.
5. $P_D = V_{CC}^2 f_i (C_{PD} + C_L)$ 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

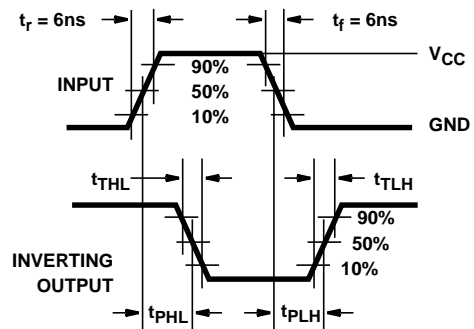


FIGURE 2. HC TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

Test Circuits and Waveforms (Continued)

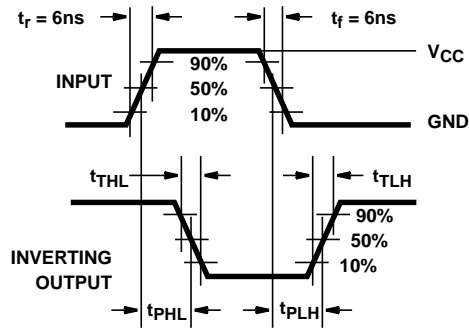


FIGURE 3. HC TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

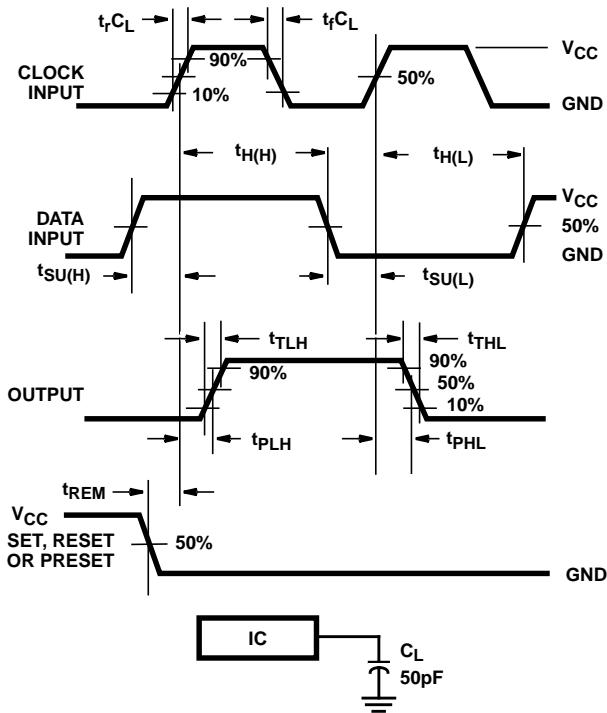


FIGURE 4. HC SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

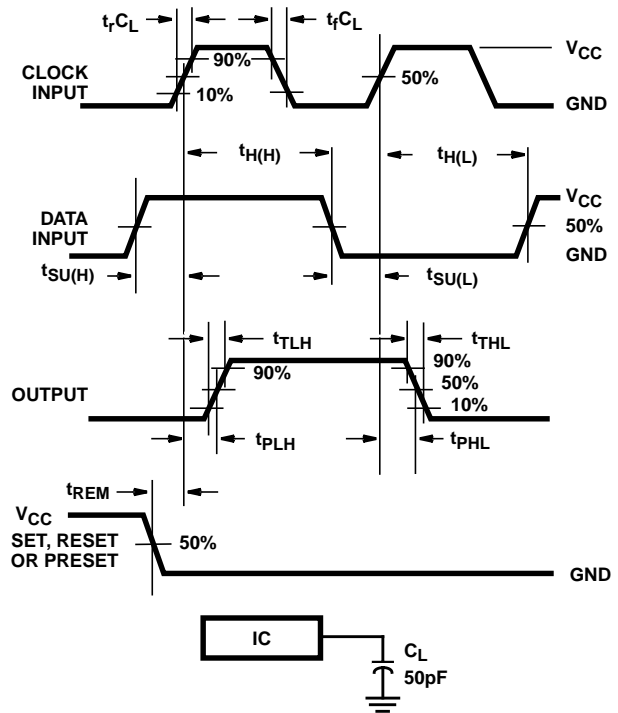


FIGURE 5. HC SETUP TIMES, HOLD TIMES, REMOVAL TIME, AND PROPAGATION DELAY TIMES FOR EDGE TRIGGERED SEQUENTIAL LOGIC CIRCUITS

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