CD54/74HC4543
CD54/74HCT4543

File Number **1822**

High-Speed CMOS Logic

TEXAS INSTRUMENTS

Data sheet acquired from Harris Semiconductor
SCHS281

FUNCTIONAL DIAGRAM
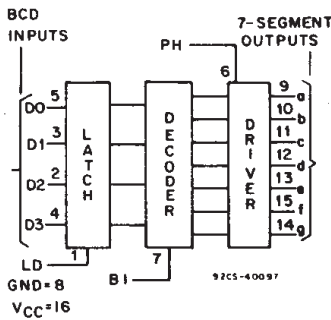
BCD-to-7 Segment Latch/Decoder/Driver for LCDs

92CS-25087
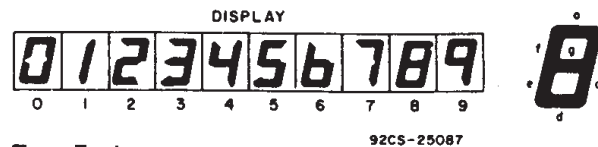
Type Features:
- *Input latches for BCD code storage*
- *Blanking capability*
- *Phase input for complementing outputs*

The RCA CD54/74HC4543 and CD54/74HCT4543 high-speed silicon-gate devices are BCD-to-7 segment latch/decoder/drivers designed primarily for directly driving liquid-crystal displays. They have an active-high disable input (LD), an active high blanking input (BI) and a phase input (PH) to which a square wave is applied for liquid-crystal applications. This square wave is also applied to the backplane of the liquid-crystal display.

These devices can also be used, in conjunction with current amplifying devices, for driving LEDs, incandescent, fluorescent, and gas-discharge displays. For these applications the phase input provides a means for obtaining active-high or active-low segment outputs. (See Function Table.)

The CD54HC/HCT4543 are supplied in 16-lead ceramic dual-in-line frit-seal packages (F suffix). The CD74HC/HCT-4543 are supplied in 16-lead dual-in-line plastic packages (E suffix) and in 16-lead dual-in-line surface-mount plastic packages (M suffix). Both types are also available in chip form (H suffix).

Family Features:
- *Fanout (over temperature range):*
  Standard outputs - 10 LSTTL loads
  Bus driver outputs - 15 LSTTL loads
- *Wide operating temperature range:*
  CD74HC/HCT: −40 to +85° C
- *Balanced propagation delay and transition times*
- *Significant power reduction compared to LSTTL logic ICs*
- *Alternate source is Philips/Signetics*
- *CD54HC/CD74HC types:*
  2 to 6 V operation
  High noise immunity:
  $N_{IL}=30\%$, $N_{IH}=30\%$ of V_{CC}; @ $V_{CC}=5$ V
- *CD54HCT/CD74HCT types:*
  4.5 to 5.5 V operation
  Direct LSTTL input logic compatibility
  $V_{IL}=0.8$ V max., $V_{IH}=2$ V min.
  CMOS input compatibility
  $I_i \leq 1$ μA @ V_{OL}, V_{OH}

FUNCTION TABLE

INPUTS							OUTPUTS							DISPLAY
LD	BI	PH	D3	D2	D1	D0	a	b	c	d	e	f	g	
X	H	L	X	X	X	X	L	L	L	L	L	L	L	Blank
H	L	L	L	L	L	L	H	H	H	H	H	H	L	0
H	L	L	L	L	L	H	L	H	H	L	L	L	L	1
H	L	L	L	L	H	L	H	H	L	H	H	L	H	2
H	L	L	L	L	H	H	H	H	H	H	L	L	H	3
H	L	L	L	H	L	L	L	H	H	L	L	H	H	4
H	L	L	L	H	L	H	H	L	H	H	L	H	H	5
H	L	L	L	H	H	L	H	L	H	H	H	H	H	6
H	L	L	L	H	H	H	H	H	H	L	L	L	L	7
H	L	L	H	L	L	L	H	H	H	H	H	H	H	8
H	L	L	H	L	L	H	H	H	H	H	L	L	H	9
H	L	L	H	L	H	L	L	L	L	L	L	L	L	Blank
H	L	L	H	L	H	H	L	L	L	L	L	L	L	Blank
H	L	L	H	H	L	L	L	L	L	L	L	L	L	Blank
H	L	L	H	H	L	H	L	L	L	L	L	L	L	Blank
H	L	L	H	H	H	L	L	L	L	L	L	L	L	Blank
H	L	L	H	H	H	H	L	L	L	L	L	L	L	Blank
L	L	L	X	X	X	X			**					**
as above	H		as above				inverse of above							as above

**Depends upon the BCD code previously applied when LD = High

TOP VIEW

92CS-40098
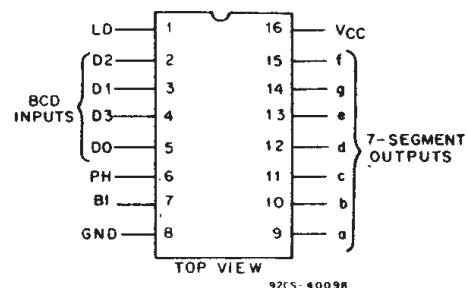
TERMINAL ASSIGNMENT

This data sheet is applicable to the CD74HCT4543. The CD54HC4543 and CD54HCT4543 were not acquired from Harris Semiconductor. See SCHS217 for information on the CD74HCT4543.
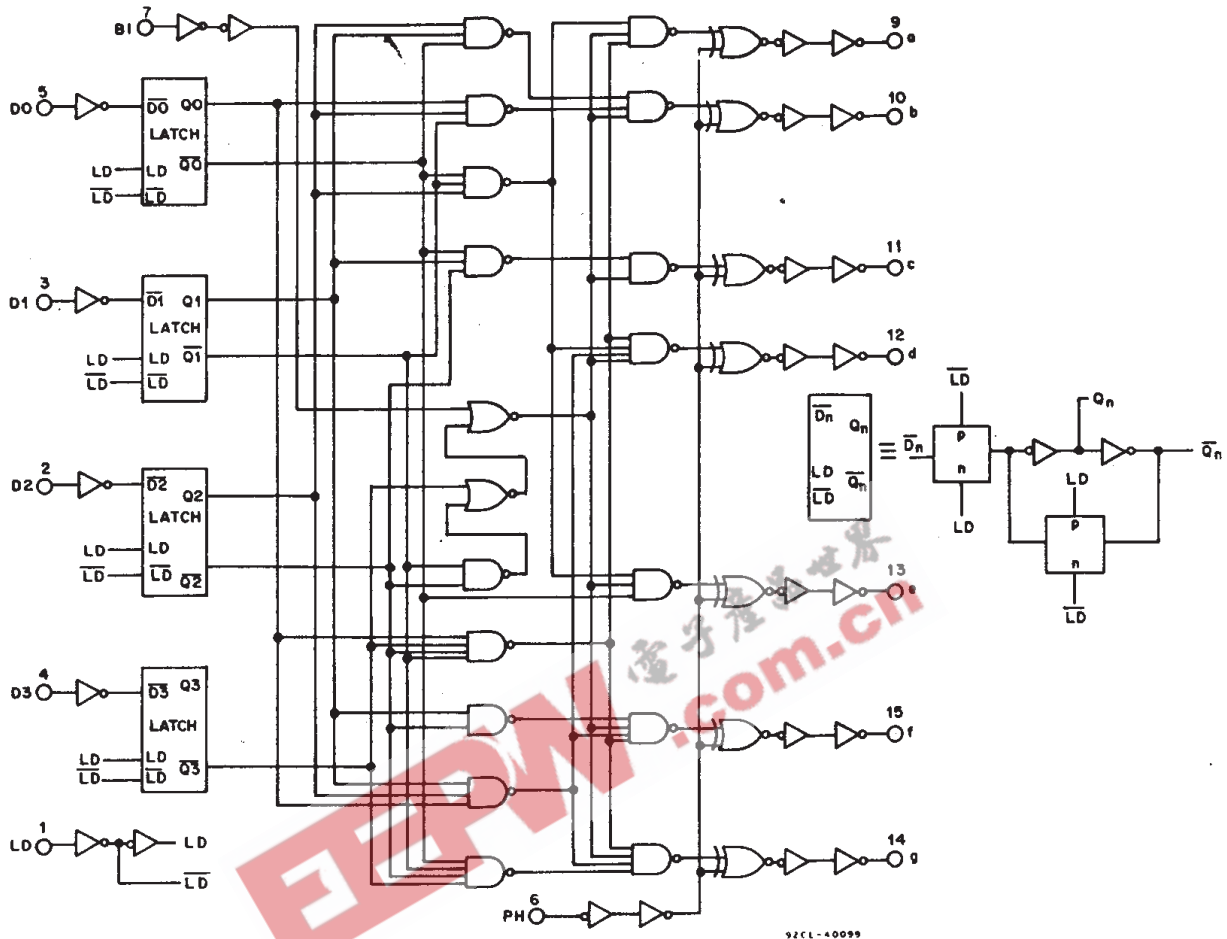
Fig. 1 - Logic diagram.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

DC SUPPLY-VOLTAGE, (V_{CC}):
(Voltages referenced to ground) .... −0.5 to +7 V
DC INPUT DIODE CURRENT, I_{IK} (FOR V_i < −0.5 V OR V_i > V_{CC} +0.5 V) .... ±20 mA
DC OUTPUT DIODE CURRENT, I_{OK} (FOR V_o < −0.5 V OR V_o > V_{CC} +0.5 V) .... ±20 mA
DC DRAIN CURRENT, PER OUTPUT (I_o) (FOR −0.5 V < V_o < V_{CC} +0.5 V) .... ±25 mA
DC V_{CC} OR GROUND CURRENT (I_{CC}) .... ±50 mA
POWER DISSIPATION PER PACKAGE (P_D):
    For T_A = −40 to +60°C (PACKAGE TYPE E) .... 500 mW
    For T_A = +60 to +85°C (PACKAGE TYPE E) .... Derate Linearly at 8 mW/°C to 300 mW
    For T_A = −55 to +100°C (PACKAGE TYPE F,H) .... 500 mW
    For T_A = +100 to +125°C (PACKAGE TYPE F,H) .... Derate Linearly at 8 mW/°C to 300 mW
    For T_A = −40 to +70°C (PACKAGE TYPE M) .... 400 mW
    For T_A = +70 to +125°C (PACKAGE TYPE M) .... Derate Linearly at 6 mW/°C to 70 mW
OPERATING-TEMPERATURE RANGE (T_A):
    PACKAGE TYPE F,H .... −55 to +125°C
    PACKAGE TYPE E,M .... −40 to +85°C
STORAGE TEMPERATURE (T_{stg}) .... −65 to +150°C
LEAD TEMPERATURE (DURING SOLDERING):
    At distance 1/16 ± 1/32 in. (1.59 ± 0.79 mm) from case for 10 s max. .... +265°C
    Unit inserted into a PC Board (min. thickness 1/16 in., 1.59 mm)
      with solder contacting lead tips only .... +300°C

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RECOMMENDED OPERATING CONDITIONS

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges:

CHARACTERISTIC	LIMITS		UNITS
	MIN.	MAX.	
Supply-Voltage Range (For T_A=Full Package Temperature Range) V_{CC}:*			
CD54/74HC Types	2	6	V
CD54/74HCT Types	4.5	5.5	
DC Input or Output Voltage, V_I, V_O	0	V_{CC}	V
Operating Temperature, T_A:			
CD74 Types	-40	+85	°C
CD54 Types	-55	+125	
Input Rise and Fall Times, t_r, t_f:			
at 2 V	0	1000	
at 4.5 V	0	500	ns
at 6 V	0	400	

*Unless otherwise specified, all voltages are referenced to Ground.

SWITCHING CHARACTERISTICS (V_{CC}=5 V, T_A=25°C, Input t_r, t_f=6 ns)

CHARACTERISTIC		C_L (pF)	TYPICAL VALUES		UNITS
			HC	HCT	
Propagation Delay:					
D_n to Output	t_{PLH}	15	28	33	
	t_{PHL}				
LD to Output	t_{PLH}	15	31	32	
	t_{PHL}				ns
BI to Output	t_{PLH}	15	22	27	
	t_{PHL}				
PH to Output	t_{PLH}	15	17	27	
	t_{PHL}				
Power Dissipation Capacitance*	C_{PD}	—	52	54	pF

*C_{PD} is used to determine the dynamic power consumption, per package.

$P_D = C_{PD} V_{CC}^2 f_i + \Sigma C_L V_{CC}^2 f_o$ where f_i = input frequency

                     f_o = output frequency

                     C_L = output load capacitance

                     V_{CC} = supply voltage.

PRE-REQUISITE FOR SWITCHING FUNCTION

CHARACTERISTIC		TEST CONDITIONS V_{CC} (V)	LIMITS												UNITS
			25°C				-40°C to +85°C				-55°C to +125°C				
			HC		HCT		74HC		74HCT		54HC		54HCT		
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Setup Time,	t_{SU}	2	60	—	—	—	75	—	—	—	90	—	—	—	
D_n to LD		4.5	12	—	12	—	15	—	15	—	18	—	18	—	
		6	10	—	—	—	13	—	—	—	15	—	—	—	
Hold Time,	t_H	2	30	—	—	—	40	—	—	—	45	—	—	—	
D_n to LD		4.5	6	—	8	—	8	—	10	—	9	—	12	—	ns
		6	5	—	—	—	7	—	—	—	8	—	—	—	
Latch Disable		2	50	—	—	—	65	—	—	—	75	—	—	—	
Pulse Width,	t_W	4.5	10	—	10	—	13	—	13	—	15	—	15	—	
		6	9	—	—	—	11	—	—	—	13	—	—	—	

CD54/74HC4543
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STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	V_I V	I_O mA	V_{CC} V	74HC/54HC TYPES +25°C Min	Typ	Max	74HC TYPES -40/+85°C Min	Max	54HC TYPES -55/+125°C Min	Max	V_I V	V_{CC} V	74HCT/54HCT TYPES +25°C Min	Typ	Max	74HCT TYPES -40/+85°C Min	Max	54HCT TYPES -55/+125°C Min	Max	UNITS
High-Level Input Voltage V_{IH}			2	1.5	—	—	1.5	—	1.5	—		4.5								V
			4.5	3.15	—	—	3.15	—	3.15	—	—	to	2	—	—	2	—	2	—	
			6	4.2	—	—	4.2	—	4.2	—		5.5								
Low-Level Input Voltage V_{IL}			2	—	—	0.5	—	0.5	—	0.5		4.5								V
			4.5	—	—	1.35	—	1.35	—	1.35	—	to	—	—	0.8	—	0.8	—	0.8	
			6	—	—	1.8	—	1.8	—	1.8		5.5								
High-Level Output Voltage V_{OH} CMOS Loads	V_{IL} or V_{IH}	-0.02	2	1.9	—	—	1.9	—	1.9	—	V_{IL} or V_{IH}	4.5	4.4	—	—	4.4	—	4.4	—	V
			4.5	4.4	—	—	4.4	—	4.4	—										
			6	5.9	—	—	5.9	—	5.9	—										
TTL Loads Non-Standard Output	V_{IL} or V_{IH}	-1	4.5	3.98	—	—	3.84	—	3.7	—	V_{IL} or V_{IH}	4.5	3.98	—	—	3.84	—	3.7	—	V
		-1.3	6	5.48	—	—	5.34	—	5.2	—										
Low-Level Output Voltage V_{OL} CMOS Loads	V_{IL} or V_{IH}	0.02	2	—	—	0.1	—	0.1	—	0.1	V_{IL} or V_{IH}	4.5	—	—	0.1	—	0.1	—	0.1	V
			4.5	—	—	0.1	—	0.1	—	0.1										
			6	—	—	0.1	—	0.1	—	0.1										
TTL Loads Non-Standard Output	V_{IL} or V_{IH}	1	4.5	—	—	0.26	—	0.33	—	0.4	V_{IL} or V_{IH}	4.5	—	—	0.26	—	0.33	—	0.4	V
		1.3	6	—	—	0.26	—	0.33	—	0.4										
Input Leakage Current I_I	V_{CC} or Gnd		6	—	—	±0.1	—	±1	—	±1	Any Voltage Between V_{CC} & Gnd	5.5	—	—	±0.1	—	±1	—	±1	µA
Quiescent Device Current I_{CC}	V_{CC} or Gnd	0	6	—	—	8	—	80	—	160	V_{CC} or Gnd	5.5	—	—	8	—	80	—	160	µA
Additional Quiescent Device Current per input pin: 1 unit load ΔI_{CC}*											V_{CC} -2.1	4.5 to 5.5	—	100	360	—	450	—	490	µA

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

HCT Input Loading Table

| Input	Unit Loads*
D0, D1, D2	1
D3, BI	0.5
PH	1.25
LD	1.5

*Unit Load is ΔI_{CC} limit specified in Static Characteristics Chart, e.g., 360 µA max. @ 25°C.

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SWITCHING CHARACTERISTICS (C_L=50 pF, Input t_r, t_f=6 ns)

CHARACTERISTIC		V_{CC}	LIMITS											UNITS
			25°C				-40°C to +85°C				-55°C to +125°C			
			HC		HCT		74HC		74HCT		54HC		54HCT		
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Propagation Delay,	t_{PLH}	2	—	340	—	—	—	425	—	—	—	510	—	—	
Dn to Output	t_{PHL}	4.5	—	68	—	80	—	85	—	100	—	102	—	120	ns
		6	—	58	—	—	—	72	—	—	—	87	—	—	
	t_{PLH}	2	—	370	—	—	—	465	—	—	—	555	—	—	
LD to Output	t_{PHL}	4.5	—	74	—	77	—	93	—	96	—	111	—	116	ns
		6	—	63	—	—	—	79	—	—	—	94	—	—	
	t_{PLH}	2	—	265	—	—	—	330	—	—	—	400	—	—	
BI to Output	t_{PHL}	4.5	—	53	—	66	—	66	—	83	—	80	—	99	ns
		6	—	45	—	—	—	56	—	—	—	68	—	—	
	t_{PLH}	2	—	200	—	—	—	250	—	—	—	300	—	—	
PH to Output	t_{PHL}	4.5	—	40	—	66	—	50	—	83	—	60	—	99	ns
		6	—	34	—	—	—	43	—	—	—	51	—	—	
	t_{TLH}	2	—	250	—	—	—	315	—	—	—	375	—	—	
Transition Time	t_{THL}	4.5	—	50	—	50	—	63	—	63	—	75	—	75	ns
		6	—	43	—	—	—	54	—	—	—	64	—	—	
Input Capacitance	C_I		—	10	—	10	—	10	—	10	—	10	—	10	pF
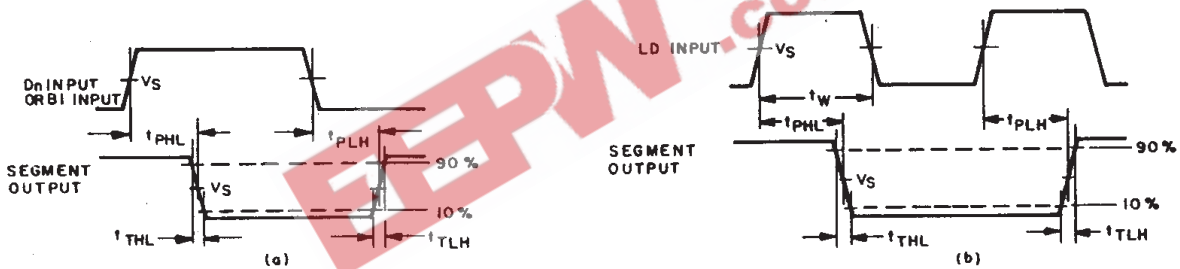
(a) WAVEFORMS SHOWING THE ADDRESS AND BLANKING (D_n, BI) TO OUTPUT PROPAGATION DELAYS AND THE OUTPUT TRANSITION TIMES.

(b) WAVEFORMS SHOWING THE LATCH DISABLE INPUT (LD) TO OUTPUT PROPAGATION DELAYS AND THE OUTPUT TRANSITION TIMES.
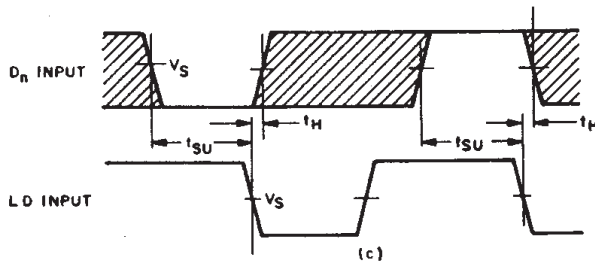
NOTE:
THE SHADED AREAS INDICATE WHEN THE INPUT IS PERMITTED TO CHANGE FOR PREDICTABLE OUTPUT PERFORMANCE.

(c) WAVEFORMS SHOWING THE ADDRESS (D_n) TO LATCH DISABLE (LD) INPUT SET-UP AND HOLD TIMES.

92CM-40103

	54/74HC	54/74HCT
Input Level	V_{CC}	3 V
Switching Voltage, V_S	50% V_{CC}	1.3 V

Fig. 2 - AC waveforms.
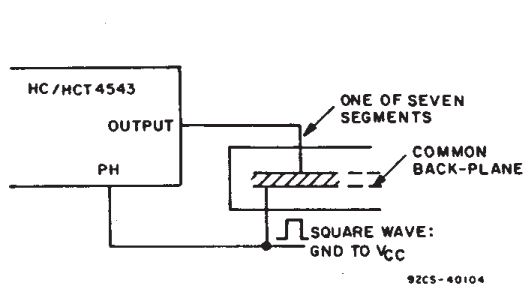
APPLICATION CIRCUITS

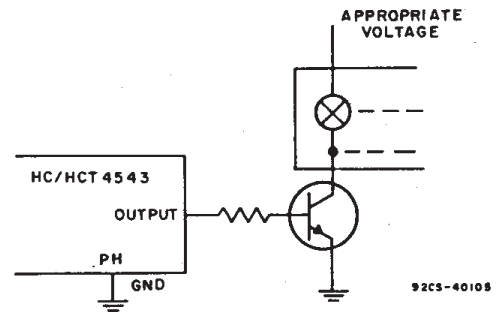Fig. 3 - Connection to liquid-crystal (LCD) display readout.

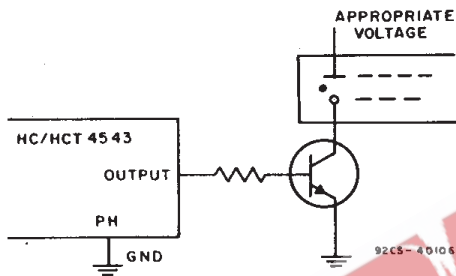Fig. 4 - Connection to incandescent display readout.
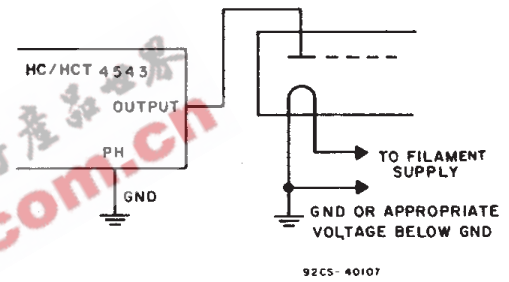
Fig. 5 - Connection to gas-discharge display readout.

Fig. 6 - Connection to fluorescent display readout.

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