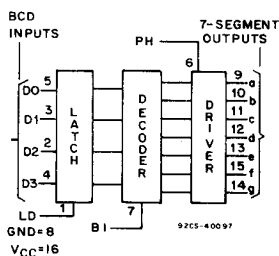


# CD54/74HC4543

## CD54/74HCT4543

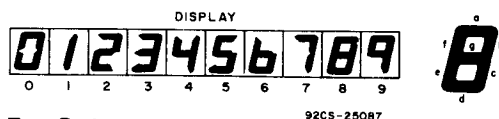
File Number 1822

### High-Speed CMOS Logic



FUNCTIONAL DIAGRAM

### BCD-to-7 Segment Latch/Decoder/Driver for LCDs

**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).

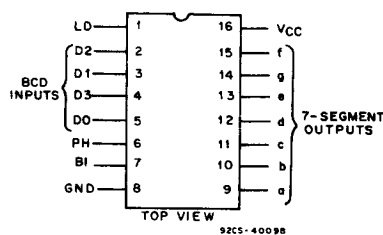
**Family Features:**

- 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  $V_{CC}$ ; @  $V_{CC}=5\text{ V}$
- CD54HCT/CD74HCT types:  
4.5 to 5.5 V operation  
Direct LSTTL input logic compatibility  
 $V_{IL}=0.8\text{ V max.}$ ,  $V_{IH}=2\text{ V min.}$   
CMOS input compatibility  
 $I_L \leq 1\text{ }\mu\text{A}$  @  $V_{OL}$ ,  $V_{OH}$

FUNCTION TABLE

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

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



TERMINAL ASSIGNMENT

# CD54/74HC4543

## CD54/74HCT4543

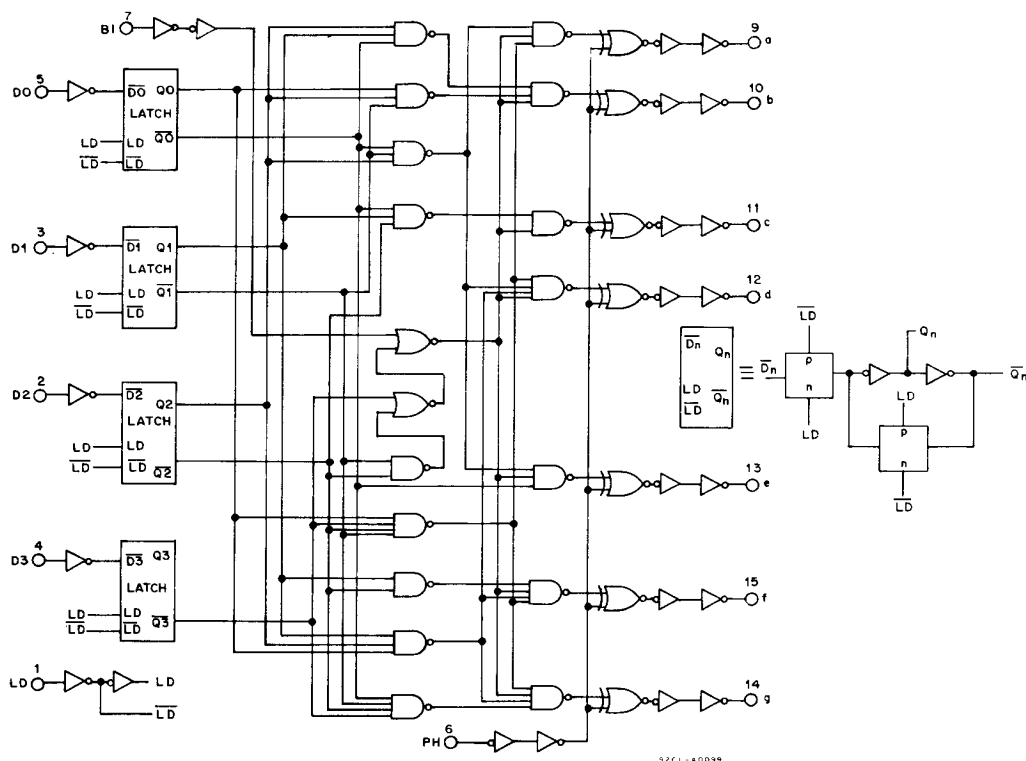


Fig. 1 - Logic diagram.

### 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)  | $\pm 20$ mA  |
| DC OUTPUT DIODE CURRENT, $I_{OK}$ (FOR $V_o < -0.5$ V OR $V_o > V_{CC} + 0.5$ V) | $\pm 20$ mA  |
| DC DRAIN CURRENT, PER OUTPUT ( $I_o$ ) (FOR $-0.5$ V $< V_o < V_{CC} + 0.5$ V)   | $\pm 25$ mA  |
| DC $V_{CC}$ OR GROUND CURRENT ( $I_{CC}$ )                                       | $\pm 50$ mA  |

#### POWER DISSIPATION PER PACKAGE ( $P_D$ ):

|                                                             |                                                     |
|-------------------------------------------------------------|-----------------------------------------------------|
| For $T_A = -40$ to $+60^\circ\text{C}$ (PACKAGE TYPE E)     | 500 mW                                              |
| For $T_A = +60$ to $+85^\circ\text{C}$ (PACKAGE TYPE E)     | Derate Linearly at 8 mW/ $^\circ\text{C}$ to 300 mW |
| For $T_A = -55$ to $+100^\circ\text{C}$ (PACKAGE TYPE F,H)  | 500 mW                                              |
| For $T_A = +100$ to $+125^\circ\text{C}$ (PACKAGE TYPE F,H) | Derate Linearly at 8 mW/ $^\circ\text{C}$ to 300 mW |
| For $T_A = -40$ to $+70^\circ\text{C}$ (PACKAGE TYPE M)     | 400 mW                                              |
| For $T_A = +70$ to $+125^\circ\text{C}$ (PACKAGE TYPE M)    | Derate Linearly at 6 mW/ $^\circ\text{C}$ to 70 mW  |

#### OPERATING-TEMPERATURE RANGE ( $T_A$ ):

|                  |                               |
|------------------|-------------------------------|
| PACKAGE TYPE F,H | $-55$ to $+125^\circ\text{C}$ |
| PACKAGE TYPE E,M | $-40$ to $+85^\circ\text{C}$  |

#### STORAGE TEMPERATURE ( $T_{stg}$ ):

|                                                                               |                               |
|-------------------------------------------------------------------------------|-------------------------------|
| LEAD TEMPERATURE (DURING SOLDERING):                                          | $-65$ to $+150^\circ\text{C}$ |
| At distance $1/16 \pm 1/32$ in. ( $1.59 \pm 0.79$ mm) from case for 10 s max. | $+265^\circ\text{C}$          |
| Unit inserted into a PC Board (min. thickness $1/16$ in., 1.59 mm)            |                               |
| with solder contacting lead tips only                                         | $+300^\circ\text{C}$          |

# CD54/74HC4543

## CD54/74HCT4543

### 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)<br>$V_{CC}$ * |        |          |       |
| 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     | ns    |
| at 4.5 V                                                                       | 0      | 500      |       |
| at 6 V                                                                         | 0      | 400      |       |

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

### SWITCHING CHARACTERISTICS ( $V_{CC}=5$ V, $T_A=25^\circ$ C, Input $t_r, t_f=6$ ns)

| CHARACTERISTIC                                 |                  | C <sub>L</sub> (pF) | TYPICAL VALUES |     | UNITS |
|------------------------------------------------|------------------|---------------------|----------------|-----|-------|
|                                                |                  |                     | HC             | HCT |       |
| Propagation Delay:<br>D <sub>n</sub> to Output | t <sub>PLH</sub> | 15                  | 28             | 33  | ns    |
|                                                | t <sub>PHL</sub> |                     |                |     |       |
| LD to Output                                   | t <sub>PLH</sub> | 15                  | 31             | 32  |       |
|                                                | t <sub>PHL</sub> |                     |                |     |       |
| BI to Output                                   | t <sub>PLH</sub> | 15                  | 22             | 27  |       |
|                                                | t <sub>PHL</sub> |                     |                |     |       |
| PH to Output                                   | t <sub>PLH</sub> | 15                  | 17             | 27  |       |
|                                                | t <sub>PHL</sub> |                     |                |     |       |
| Power Dissipation Capacitance*                 | C <sub>PD</sub>  | —                   | 52             | 54  | pF    |

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

$P_D = C_{PD} V_{CC}^2 f_i + \sum C_L V_{CC}^2 f_o$  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 | 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,<br>D <sub>n</sub> to LD | t <sub>su</sub> | 2      |      |      |      | 75             |      |       |      | 90              |      |       |      | ns    |   |
|                                     |                 | 4.5    | 12   | —    | 12   | —              | 15   | —     | 15   | —               | 18   | —     | 18   |       | — |
|                                     |                 | 6      | 10   | —    | —    | —              | 13   | —     | —    | —               | 15   | —     | —    |       | — |
| Hold Time,<br>D <sub>n</sub> to LD  | t <sub>H</sub>  | 2      |      |      |      | 40             |      |       |      | 45              |      |       |      |       |   |
|                                     |                 | 4.5    | 6    | —    | 8    | —              | 8    | —     | 10   | —               | 9    | —     | 12   |       | — |
|                                     |                 | 6      | 5    | —    | —    | —              | 7    | —     | —    | —               | 8    | —     | —    |       | — |
| Latch Disable<br>Pulse Width,       | t <sub>w</sub>  | 2      |      |      |      | 65             |      |       |      | 75              |      |       |      |       |   |
|                                     |                 | 4.5    | 10   | —    | 10   | —              | 13   | —     | 13   | —               | 15   | —     | 15   |       | — |
|                                     |                 | 6      | 9    | —    | —    | —              | 11   | —     | —    | —               | 13   | —     | —    |       | — |

# CD54/74HC4543

## CD54/74HCT4543

### STATIC ELECTRICAL CHARACTERISTICS

| CHARACTERISTIC                                                                       | CD74HC4543/CD54HC4543              |                      |                      |                 |      |      |               |      |                |      | CD74HCT4543/CD54HCT4543                   |                      |                   |     |      |               |      |                |     |    | UNITS |
|--------------------------------------------------------------------------------------|------------------------------------|----------------------|----------------------|-----------------|------|------|---------------|------|----------------|------|-------------------------------------------|----------------------|-------------------|-----|------|---------------|------|----------------|-----|----|-------|
|                                                                                      | TEST CONDITIONS                    |                      |                      | 74HC/54HC TYPES |      |      | 74HC TYPES    |      | 54HC TYPES     |      | TEST CONDITIONS                           |                      | 74HCT/54HCT TYPES |     |      | 74HCT TYPES   |      | 54HCT TYPES    |     |    |       |
|                                                                                      | V <sub>I</sub><br>V                | I <sub>O</sub><br>mA | V <sub>CC</sub><br>V | +25°C           |      |      | -40/<br>+85°C |      | -55/<br>+125°C |      | V <sub>I</sub><br>V                       | V <sub>CC</sub><br>V | +25°C             |     |      | -40/<br>+85°C |      | -55/<br>+125°C |     |    |       |
|                                                                                      |                                    |                      |                      | Min             | Typ  | Max  | Min           | Max  | Min            | Max  |                                           |                      | Min               | Typ | Max  | Min           | Max  | Min            | Max |    |       |
| High-Level Input Voltage<br>V <sub>IH</sub>                                          |                                    |                      | 2                    | 1.5             | —    | —    | 1.5           | —    | 1.5            | —    | —                                         | 4.5 to 5.5           | 2                 | —   | —    | 2             | —    | 2              | —   | V  |       |
|                                                                                      |                                    |                      | 4.5                  | 3.15            | —    | —    | 3.15          | —    | 3.15           | —    |                                           |                      |                   |     |      |               |      |                |     |    |       |
|                                                                                      |                                    |                      | 6                    | 4.2             | —    | —    | 4.2           | —    | 4.2            | —    |                                           |                      |                   |     |      |               |      |                |     |    |       |
| Low-Level Input Voltage<br>V <sub>IL</sub>                                           |                                    |                      | 2                    | —               | —    | 0.5  | —             | 0.5  | —              | 0.5  | —                                         | 4.5 to 5.5           | —                 | —   | 0.8  | —             | 0.8  | —              | 0.8 | V  |       |
|                                                                                      |                                    |                      | 4.5                  | —               | —    | 1.35 | —             | 1.35 | —              | 1.35 | —                                         |                      |                   |     |      |               |      |                |     |    |       |
|                                                                                      |                                    |                      | 6                    | —               | —    | 1.8  | —             | 1.8  | —              | 1.8  | —                                         |                      |                   |     |      |               |      |                |     |    |       |
| High-Level Output Voltage<br>V <sub>OH</sub>                                         | V <sub>IL</sub> or V <sub>IH</sub> | -0.02                | 2                    | 1.9             | —    | —    | 1.9           | —    | 1.9            | —    | V <sub>IL</sub> or V <sub>IH</sub>        | 4.5                  | 4.4               | —   | —    | 4.4           | —    | 4.4            | —   | V  |       |
| CMOS Loads                                                                           |                                    |                      | 4.5                  | 4.4             | —    | —    | 4.4           | —    | 4.4            | —    |                                           |                      |                   |     |      |               |      |                |     |    |       |
|                                                                                      |                                    |                      | 6                    | 5.9             | —    | —    | 5.9           | —    | 5.9            | —    |                                           |                      |                   |     |      |               |      |                |     |    |       |
| TTL Loads                                                                            | V <sub>IL</sub> or V <sub>IH</sub> |                      |                      |                 |      |      |               |      |                |      | V <sub>IL</sub> or V <sub>IH</sub>        | 4.5                  | 3.98              | —   | —    | 3.84          | —    | 3.7            | —   | V  |       |
| Non-Standard Output                                                                  |                                    |                      | -1                   | 4.5             | 3.98 | —    | —             | 3.84 | —              | 3.7  | —                                         |                      |                   |     |      |               |      |                |     |    |       |
|                                                                                      |                                    |                      | -1.3                 | 6               | 5.48 | —    | —             | 5.34 | —              | 5.2  | —                                         |                      |                   |     |      |               |      |                |     |    |       |
| Low-Level Output Voltage<br>V <sub>OL</sub>                                          | V <sub>IL</sub> or V <sub>IH</sub> | 0.02                 | 2                    | —               | —    | 0.1  | —             | 0.1  | —              | 0.1  | V <sub>IL</sub> or V <sub>IH</sub>        | 4.5                  | —                 | —   | 0.1  | —             | 0.1  | —              | 0.1 | V  |       |
| CMOS Loads                                                                           |                                    |                      | 4.5                  | —               | —    | 0.1  | —             | 0.1  | —              | 0.1  |                                           |                      |                   |     |      |               |      |                |     |    |       |
|                                                                                      |                                    |                      | 6                    | —               | —    | 0.1  | —             | 0.1  | —              | 0.1  |                                           |                      |                   |     |      |               |      |                |     |    |       |
| TTL Loads                                                                            | V <sub>IL</sub> or V <sub>IH</sub> |                      |                      |                 |      |      |               |      |                |      | V <sub>IL</sub> or V <sub>IH</sub>        | 4.5                  | —                 | —   | 0.26 | —             | 0.33 | —              | 0.4 | V  |       |
| Non-Standard Output                                                                  |                                    |                      | 1                    | 4.5             | —    | —    | 0.26          | —    | 0.33           | —    | 0.4                                       |                      |                   |     |      |               |      |                |     |    |       |
|                                                                                      |                                    |                      | 1.3                  | 6               | —    | —    | 0.26          | —    | 0.33           | —    | 0.4                                       |                      |                   |     |      |               |      |                |     |    |       |
| Input Leakage Current<br>I <sub>I</sub>                                              | V <sub>CC</sub> or Gnd             |                      | 6                    | —               | —    | ±0.1 | —             | ±1   | —              | ±1   | Any Voltage Between V <sub>CC</sub> & Gnd | 5.5                  | —                 | —   | ±0.1 | —             | ±1   | —              | ±1  | μA |       |
| Quiescent Device Current<br>I <sub>CC</sub>                                          | V <sub>CC</sub> or Gnd             | 0                    | 6                    | —               | —    | 8    | —             | 80   | —              | 160  | V <sub>CC</sub> or Gnd                    | 5.5                  | —                 | —   | 8    | —             | 80   | —              | 160 | μA |       |
| Additional Quiescent Device Current per input pin: 1 unit load<br>ΔI <sub>CC</sub> * |                                    |                      |                      |                 |      |      |               |      |                |      | V <sub>CC</sub> -2.1                      | 4.5 to 5.5           | —                 | 100 | 360  | —             | 450  | —              | 490 | μA |       |

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

HCT Input Loading Table

| Input      | Unit Loads* |
|------------|-------------|
| D0, D1, D2 | 1           |
| D3, B1     | 0.5         |
| PH         | 1.25        |
| LD         | 1.5         |

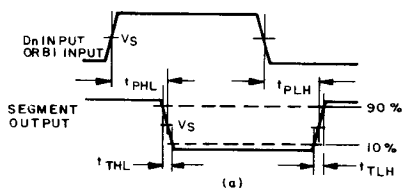
\*Unit Load is ΔI<sub>CC</sub> limit specified in Static Characteristics Chart, e.g., 360 μA max. @ 25°C.

# CD54/74HC4543

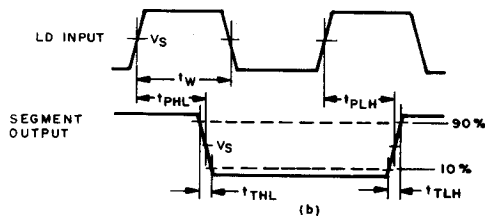
## CD54/74HCT4543

SWITCHING CHARACTERISTICS ( $C_L=50$  pF, Input  $t_1, t_2=6$  ns)

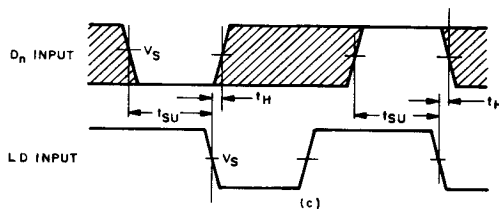
| CHARACTERISTIC                                 |                  | VCC | LIMITS |      |      |      |      |      |                |      |      |      |                 |      | UNITS |  |  |
|------------------------------------------------|------------------|-----|--------|------|------|------|------|------|----------------|------|------|------|-----------------|------|-------|--|--|
|                                                |                  |     | 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,<br>D <sub>n</sub> to Output | t <sub>PLH</sub> | 2   | —      | 340  | —    | —    | —    | 425  | —              | —    | —    | 510  | —               | —    | ns    |  |  |
|                                                | t <sub>PHL</sub> | 4.5 | —      | 68   | —    | 80   | —    | 85   | —              | 100  | —    | 102  | —               | 120  |       |  |  |
|                                                |                  | 6   | —      | 58   | —    | —    | —    | 72   | —              | —    | —    | 87   | —               | —    |       |  |  |
| LD to Output                                   | t <sub>PLH</sub> | 2   | —      | 370  | —    | —    | —    | 465  | —              | —    | —    | 555  | —               | —    | ns    |  |  |
|                                                | t <sub>PHL</sub> | 4.5 | —      | 74   | —    | 77   | —    | 93   | —              | 96   | —    | 111  | —               | 116  |       |  |  |
|                                                |                  | 6   | —      | 63   | —    | —    | —    | 79   | —              | —    | —    | 94   | —               | —    |       |  |  |
| BI to Output                                   | t <sub>PLH</sub> | 2   | —      | 265  | —    | —    | —    | 330  | —              | —    | —    | 400  | —               | —    | ns    |  |  |
|                                                | t <sub>PHL</sub> | 4.5 | —      | 53   | —    | 66   | —    | 66   | —              | 83   | —    | 80   | —               | 99   |       |  |  |
|                                                |                  | 6   | —      | 45   | —    | —    | —    | 56   | —              | —    | —    | 68   | —               | —    |       |  |  |
| PH to Output                                   | t <sub>PLH</sub> | 2   | —      | 200  | —    | —    | —    | 250  | —              | —    | —    | 300  | —               | —    | ns    |  |  |
|                                                | t <sub>PHL</sub> | 4.5 | —      | 40   | —    | 66   | —    | 50   | —              | 83   | —    | 60   | —               | 99   |       |  |  |
|                                                |                  | 6   | —      | 34   | —    | —    | —    | 43   | —              | —    | —    | 51   | —               | —    |       |  |  |
| Transition Time                                | t <sub>TLH</sub> | 2   | —      | 250  | —    | —    | —    | 315  | —              | —    | —    | 375  | —               | —    | ns    |  |  |
|                                                | t <sub>THL</sub> | 4.5 | —      | 50   | —    | 50   | —    | 63   | —              | 63   | —    | 75   | —               | 75   |       |  |  |
|                                                |                  | 6   | —      | 43   | —    | —    | —    | 54   | —              | —    | —    | 64   | —               | —    |       |  |  |
| Input Capacitance                              | C <sub>i</sub>   |     | —      | 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.

# CD54/74HC4543

## CD54/74HCT4543

### APPLICATION CIRCUITS

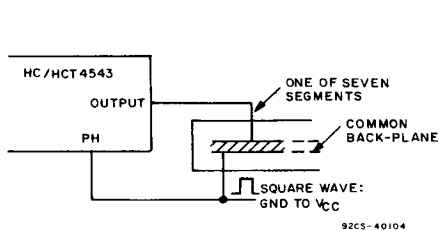


Fig. 3 - Connection to liquid-crystal (LCD) display readout.

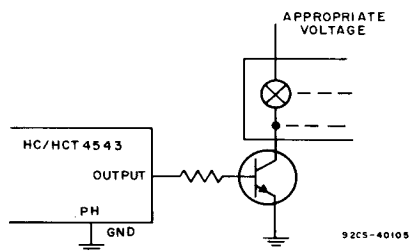


Fig. 4 - Connection to incandescent display readout.

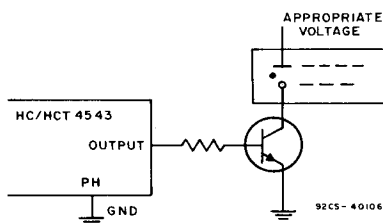


Fig. 5 - Connection to gas-discharge display readout.

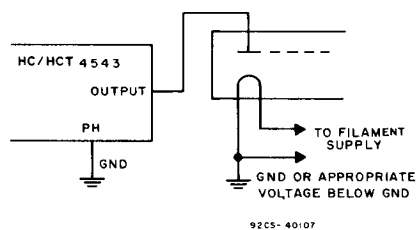


Fig. 6 - Connection to fluorescent display readout.