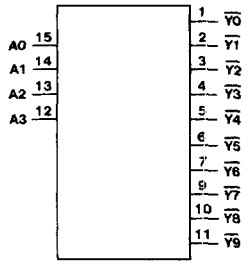
# CD54/74HC42
# CD54/74HCT42

File Number **1689**

## High-Speed CMOS Logic




**FUNCTIONAL DIAGRAM**

## BCD to Decimal Decoder (1-of-10)

**Type Features:**

- *Buffered inputs and outputs*
- *Typical propagation delay = 12 ns @ $V_{CC}$ = 5V, $C_L$ = 15 pF $T_A$ = 25°C (HC42)*

The RCA-CD54/74HC42 and CD54/74HCT42 BCD-to-Decimal Decoders utilize silicon-gate CMOS technology to achieve operating speeds similar to LSTTL decoders with the low power consumption of standard CMOS integrated circuits. These devices have the capability of driving 10 LSTTL loads and are compatible with the standard 54LS /74LS logic family. One of ten outputs (low on select) is selected in accordance with the BCD input. Non-valid BCD inputs result in none of the outputs being selected (all outputs are high).

The CD54HC42 and CD54HCT42 are supplied in 16-lead hermetic dual-in-line ceramic packages (F suffix). The CD74HC42 and CD74HCT42 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*
  *$I_I \leq 1\ \mu A$ @ $V_{OL}$, $V_{OH}$*

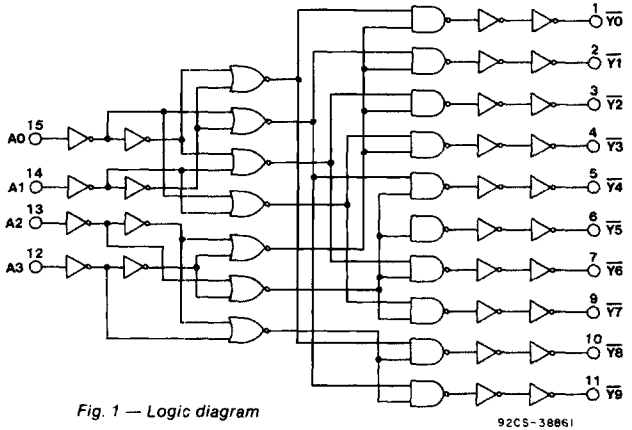
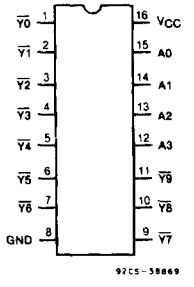



*Fig. 1 — Logic diagram*




**TERMINAL ASSIGNMENT**

# CD54/74HC42
# CD54/74HCT42

**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) ..... ±20mA
DC OUTPUT DIODE CURRENT, $I_{OK}$ (FOR $V_O < -0.5$ V OR $V_O > V_{CC} + 0.5$V) ..... ±20mA
DC DRAIN CURRENT, PER OUTPUT ($I_O$) (FOR $-0.5\text{ V} < V_O < V_{CC} + 0.5$V) ..... ±25mA
DC $V_{CC}$ OR GROUND CURRENT ($I_{CC}$) ..... ±50mA
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

**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.

**TRUTH TABLE**

| Inputs | | | | Outputs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A3 | A2 | A1 | A0 | $\overline{Y0}$ | $\overline{Y1}$ | $\overline{Y2}$ | $\overline{Y3}$ | $\overline{Y4}$ | $\overline{Y5}$ | $\overline{Y6}$ | $\overline{Y7}$ | $\overline{Y8}$ | $\overline{Y9}$ |
| L | L | L | L | L | H | H | H | H | H | H | H | H | H |
| L | L | L | H | H | L | H | H | H | H | H | H | H | H |
| L | L | H | L | H | H | L | H | H | H | H | H | H | H |
| L | L | H | H | H | H | H | L | H | H | H | H | H | H |
| L | H | L | L | H | H | H | H | L | H | H | H | H | H |
| L | H | L | H | H | H | H | H | H | L | H | H | H | H |
| L | H | H | L | H | H | H | H | H | H | L | H | H | H |
| L | H | H | H | H | H | H | H | H | H | H | L | H | H |
| H | L | L | L | H | H | H | H | H | H | H | H | L | H |
| H | L | L | H | H | H | H | H | H | H | H | H | H | L |
| H | L | H | L | H | H | H | H | H | H | H | H | H | H |
| H | L | H | H | H | H | H | H | H | H | H | H | H | H |
| H | H | L | L | H | H | H | H | H | H | H | H | H | H |
| H | H | L | H | H | H | H | H | H | H | H | H | H | H |
| H | H | H | L | H | H | H | H | H | H | H | H | H | H |
| H | H | H | H | H | H | H | H | H | H | H | H | H | H |

L = Low Voltage Level
H = High Voltage Level

# CD54/74HC42
# CD54/74HCT42

## STATIC ELECTRICAL CHARACTERISTICS

| CHARACTERISTIC | CD74HC42/CD54HC42 | | | | | | | | | | CD74HCT42/CD54HCT42 | | | | | | | | | | UNITS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TEST CONDITIONS | | | 74HC/54HC TYPES | | | 74HC TYPES | | 54HC TYPES | | TEST CONDITIONS | | 74HCT/54HCT TYPES | | | 74HCT TYPES | | 54HCT TYPES | | | |
| | $V_I$ V | $I_O$ mA | $V_{CC}$ V | +25°C | | | -40/ +85°C | | -55/ +125°C | | $V_I$ V | $V_{CC}$ V | +25°C | | | -40/ +85°C | | -55/ +125°C | | | |
| | | | | Min | Typ | Max | Min | Max | Min | Max | | | Min | Typ | Max | Min | Max | Min | Max | | |
| High-Level Input Voltage $V_{IH}$ | | | 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 $V_{IL}$ | | | 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 $V_{OH}$ 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 | $V_{IL}$ or $V_{IH}$ | -4 | 4.5 | 3.98 | — | — | 3.84 | — | 3.7 | — | $V_{IL}$ or $V_{IH}$ | 4.5 | 3.98 | — | — | 3.84 | — | 3.7 | — | | V |
| | | -5.2 | 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 | $V_{IL}$ or $V_{IH}$ | 4 | 4.5 | — | — | 0.26 | — | 0.33 | — | 0.4 | $V_{IL}$ or $V_{IH}$ | 4.5 | — | — | 0.26 | — | 0.33 | — | 0.4 | | V |
| | | 5.2 | 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 $\Delta I_{CC}$* | | | | | | | | | | | $V_{CC}$-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* |
|---|---|
| ALL | 1 |

*Unit Load is $\Delta I_{CC}$ limit specified in Static Characteristic Chart, e.g., 360 μA max. @ 25°C.

# CD54/74HC42
# CD54/74HCT42

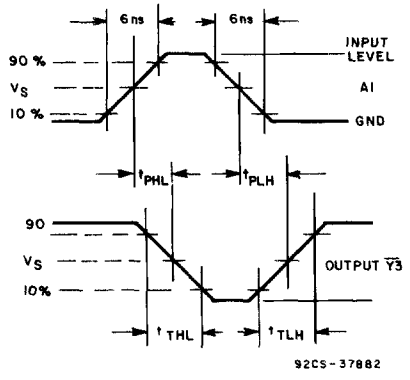
**SWITCHING CHARACTERISTICS ($V_{CC}$ = 5 V, $T_A$ = 25°C, Input $t_r$, $t_f$ = 6 ns)**

| CHARACTERISTIC | $C_L$ (pF) | SYMBOL | TYPICAL | | UNITS |
|---|---|---|---|---|---|
| | | | 54/74HC | 54/74HCT | |
| Any Input to $\overline{Y}$ | 15 | $t_{PHL}$, $t_{PLH}$ | 12 | 14 | ns |
| Power Dissipation Capacitance* | — | $C_{PD}$ | 65 | 70 | pF |

*$C_{PD}$ is used to determine the dynamic power consumption, per package.
$P_D = V_{CC}^2 f_i (C_{PD} + C_L)$ where:
$f_i$ = input frequency.
$C_L$ = output load capacitance.
$V_{CC}$ = supply voltage.

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

| CHARACTERISTIC | SYMBOL | $V_{CC}$ | 25°C | | | | -40°C to +85°C | | | | -55°C to +125°C | | | | UNITS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | HC | | HCT | | 74HC | | 74HCT | | 54HC | | 54HCT | | |
| | | | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | |
| Propagation Delay, Any Input to $\overline{Y}$ | $t_{PLH}$ | 2 | — | 150 | — | — | — | 190 | — | — | — | 225 | — | — | ns |
| | $t_{PHL}$ | 4.5 | — | 30 | — | 35 | — | 38 | — | 44 | — | 45 | — | 53 | |
| | | 6 | — | 26 | — | — | — | 33 | — | — | — | 38 | — | — | |
| Output Transition Time | $t_{THL}$ | 2 | — | 75 | — | — | — | 95 | — | — | — | 110 | — | — | ns |
| | $t_{TLH}$ | 4.5 | — | 15 | — | 15 | — | 19 | — | 19 | — | 22 | — | 22 | |
| | | 6 | — | 13 | — | — | — | 16 | — | — | — | 19 | — | — | |
| Input Capacitance | $C_I$ | | — | — | — | — | — | — | — | — | — | — | — | — | pF |
| | | | — | 10 | — | 10 | — | 10 | — | 10 | — | 10 | — | 10 | |
| | | | — | — | — | — | — | — | — | — | — | — | — | — | |




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

*Transition times and propagation delay times.*