



## 54LS42/DM54LS42/DM74LS42 BCD/Decimal Decoders

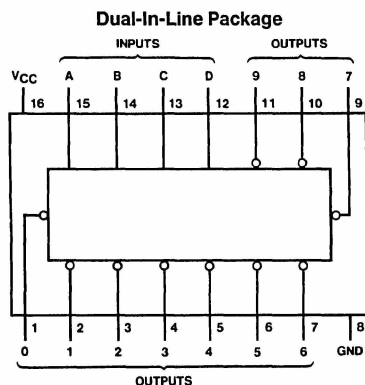
### General Description

These BCD-to-decimal decoders consist of eight inverters and ten, four-input NAND gates. The inverters are connected in pairs to make BCD input data available for decoding by the NAND gates. Full decoding of input logic ensures that all outputs remain off for all invalid (10–15) input conditions.

### Features

- Diode clamped inputs
- Also for applications as 4-line-to-16-line decoders; 3-line-to-8-line decoders
- All outputs are high for invalid input conditions
- Alternate Military/Aerospace device (54LS42) is available. Contact a National Semiconductor Sales Office/Distributor for specifications.

### Connection Diagram



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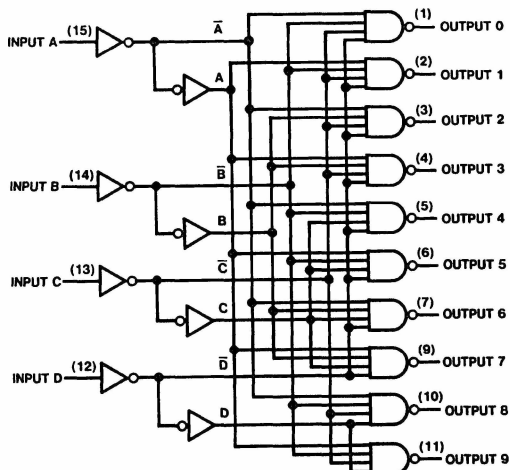
Order Number 54LS42DMQB, 54LS42FMQB,  
DM54LS42J, DM54LS42W, DM74LS42M or DM74LS42N  
See NS Package Number J16A, M16A, N16E or W16A

### Function Table

| No. | BCD Inputs |   |   |   | Decimal Outputs |   |   |   |   |   |   |   |   |   |
|-----|------------|---|---|---|-----------------|---|---|---|---|---|---|---|---|---|
|     | D          | C | B | A | 0               | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 0   | L          | L | L | L | L               | H | H | H | H | H | H | H | H | H |
| 1   | L          | L | L | H | H               | L | H | H | H | H | H | H | H | H |
| 2   | L          | L | H | L | H               | H | L | H | H | H | H | H | H | H |
| 3   | L          | L | H | H | H               | H | H | L | H | H | H | H | H | H |
| 4   | L          | H | L | L | H               | H | H | H | L | H | H | H | H | H |
| 5   | L          | H | L | H | H               | H | H | H | H | L | H | H | H | H |
| 6   | L          | H | H | L | H               | H | H | H | H | H | L | H | H | H |
| 7   | L          | H | H | H | H               | H | H | H | H | H | H | L | H | H |
| 8   | H          | L | L | L | H               | H | H | H | H | H | H | H | L | H |
| 9   | H          | L | L | H | H               | H | H | H | H | H | H | H | H | L |
| I   | H          | L | H | L | H               | H | H | H | H | H | H | H | H | H |
| N   | H          | L | H | H | H               | H | H | H | H | H | H | H | H | H |
| V   | H          | H | L | L | H               | H | H | H | H | H | H | H | H | H |
| A   | H          | H | L | H | H               | H | H | H | H | H | H | H | H | H |
| L   | H          | H | H | L | H               | H | H | H | H | H | H | H | H | H |
| I   | H          | H | H | H | H               | H | H | H | H | H | H | H | H | H |
| D   | H          | H | H | H | H               | H | H | H | H | H | H | H | H | H |

H = High Level  
L = Low Level

### Logic Diagram



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## Absolute Maximum Ratings (Note)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

|                                      |                 |
|--------------------------------------|-----------------|
| Supply Voltage                       | 7V              |
| Input Voltage                        | 7V              |
| Operating Free Air Temperature Range |                 |
| DM54LS and 54LS                      | −55°C to +125°C |
| DM74LS                               | 0°C to +70°C    |
| Storage Temperature Range            | −65°C to +150°C |

Note: The "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the "Electrical Characteristics" table are not guaranteed at the absolute maximum ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

## Recommended Operating Conditions

| Symbol          | Parameter                      | DM54LS42 |     |      | DM74LS42 |     |      | Units |
|-----------------|--------------------------------|----------|-----|------|----------|-----|------|-------|
|                 |                                | Min      | Nom | Max  | Min      | Nom | Max  |       |
| V <sub>CC</sub> | Supply Voltage                 | 4.5      | 5   | 5.5  | 4.75     | 5   | 5.25 | V     |
| V <sub>IH</sub> | High Level Input Voltage       | 2        |     |      | 2        |     |      | V     |
| V <sub>IL</sub> | Low Level Input Voltage        |          |     | 0.7  |          |     | 0.8  | V     |
| I <sub>OH</sub> | High Level Output Current      |          |     | −0.4 |          |     | −0.4 | mA    |
| I <sub>OL</sub> | Low Level Output Current       |          |     | 4    |          |     | 8    | mA    |
| T <sub>A</sub>  | Free Air Operating Temperature | −55      |     | 125  | 0        |     | 70   | °C    |

## Electrical Characteristics over recommended operating free air temperature range (unless otherwise noted)

| Symbol          | Parameter                         | Conditions                                                                                   | Min  | Typ<br>(Note 1) | Max  | Units |
|-----------------|-----------------------------------|----------------------------------------------------------------------------------------------|------|-----------------|------|-------|
| V <sub>I</sub>  | Input Clamp Voltage               | V <sub>CC</sub> = Min, I <sub>I</sub> = −18 mA                                               |      |                 | −1.5 | V     |
| V <sub>OH</sub> | High Level Output Voltage         | V <sub>CC</sub> = Min, I <sub>OH</sub> = Max<br>V <sub>IL</sub> = Max, V <sub>IH</sub> = Min | DM54 | 2.5             | 3.4  | V     |
|                 |                                   |                                                                                              | DM74 | 2.7             | 3.4  |       |
| V <sub>OL</sub> | Low Level Output Voltage          | V <sub>CC</sub> = Min, I <sub>OL</sub> = Max<br>V <sub>IL</sub> = Max, V <sub>IH</sub> = Min | DM54 |                 | 0.25 | V     |
|                 |                                   |                                                                                              | DM74 |                 | 0.35 |       |
|                 |                                   | I <sub>OL</sub> = 4 mA, V <sub>CC</sub> = Min                                                | DM74 |                 | 0.25 |       |
| I <sub>I</sub>  | Input Current @ Max Input Voltage | V <sub>CC</sub> = Max, V <sub>I</sub> = 7V                                                   |      |                 | 0.1  | mA    |
| I <sub>IH</sub> | High Level Input Current          | V <sub>CC</sub> = Max, V <sub>I</sub> = 2.7V                                                 |      |                 | 20   | μA    |
| I <sub>IL</sub> | Low Level Input Current           | V <sub>CC</sub> = Max, V <sub>I</sub> = 0.4V                                                 |      |                 | −0.4 | mA    |
| I <sub>OS</sub> | Short Circuit Output Current      | V <sub>CC</sub> = Max<br>(Note 2)                                                            | DM54 | −20             | −100 | mA    |
|                 |                                   |                                                                                              | DM74 | −20             | −100 |       |
| I <sub>CC</sub> | Supply Current                    | V <sub>CC</sub> = Max (Note 3)                                                               |      | 7               | 13   | mA    |

Note 1: All typicals are at V<sub>CC</sub> = 5V, T<sub>A</sub> = 25°C.

Note 2: Not more than one output should be shorted at a time, and the duration should not exceed one second.

Note 3: I<sub>CC</sub> is measured with all outputs open and all inputs grounded.

**Switching Characteristics** at  $V_{CC} = 5V$  and  $T_A = 25^\circ C$  (See Section 1 for Test Waveforms and Output Load)

| Symbol           | Parameter                                          | From (Input)<br>To (Output)                    | R <sub>L</sub> = 2 kΩ  |     |                        |     | Units |
|------------------|----------------------------------------------------|------------------------------------------------|------------------------|-----|------------------------|-----|-------|
|                  |                                                    |                                                | C <sub>L</sub> = 15 pF |     | C <sub>L</sub> = 50 pF |     |       |
|                  |                                                    |                                                | Min                    | Max | Min                    | Max |       |
| t <sub>PHL</sub> | Propagation Delay Time<br>High to Low Level Output | A, B, C, or D (2 Levels<br>of Logic) to Output |                        | 25  |                        | 30  | ns    |
| t <sub>PHL</sub> | Propagation Delay Time<br>High to Low Level Output | A, B, C, or D (3 Levels<br>of Logic) to Output |                        | 30  |                        | 35  | ns    |
| t <sub>PLH</sub> | Propagation Delay Time<br>Low to High Level Output | A, B, C, or D (2 Levels<br>of Logic) to Output |                        | 25  |                        | 30  | ns    |
| t <sub>PLH</sub> | Propagation Delay Time<br>Low to High Level Output | A, B, C, or D (3 Levels<br>of Logic) to Output |                        | 30  |                        | 35  | ns    |