

# SN54145, SN54LS145, SN74145, SN74LS145 BCD-TO-DECIMAL DECODERS/DRIVERS

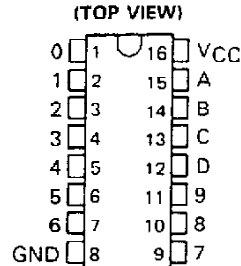
SDLS051

MARCH 1974 — REVISED MARCH 1988

FOR USE AS LAMP, RELAY, OR MOS DRIVERS

- Full Decoding of Input Logic
- SN54145, SN74145, and SN74LS145 Have 80-mA Sink-Current Capability
- All Outputs Are Off for Invalid BCD Input Conditions
- Low Power Dissipation of 'LS145 . . . 35 mW Typical

SN54145, SN54LS145 . . . J OR W PACKAGE  
SN74145 . . . N PACKAGE  
SN74LS145 . . . D OR N PACKAGE



FUNCTION TABLE

| NO.     | INPUTS |   |   |   | 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 | H |
| 1       | L      | L | L | H | H       | L | H | H | H | H | H | H | H | H | H |
| 2       | L      | L | H | L | H       | H | L | H | H | H | H | H | H | H | H |
| 3       | L      | L | H | H | H       | H | H | L | H | H | H | H | H | H | H |
| 4       | L      | H | L | L | H       | H | H | H | L | H | H | H | H | H | H |
| 5       | L      | H | L | H | H       | H | H | H | H | L | H | H | H | H | H |
| 6       | L      | H | H | L | H       | H | H | H | H | H | L | H | H | H | H |
| 7       | L      | H | H | H | H       | H | H | H | H | H | H | L | H | H | H |
| 8       | H      | L | L | L | H       | H | H | H | H | H | H | H | L | H | H |
| 9       | H      | L | L | H | H       | H | H | H | H | H | H | H | H | H | L |
| INVALID | H      | L | H | 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      | H | L | L | 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 | L | H       | H | H | H | H | H | H | H | H | H | H |

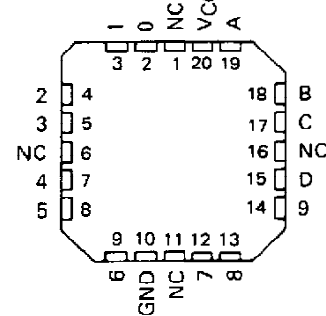
H = high level (off), L = low level (on)

## description

These monolithic BCD-to-decimal decoder/drivers 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 valid BCD input logic ensures that all outputs remain off for all invalid binary input conditions. These decoders feature high-performance, n-p-n output transistors designed for use as indicator/relay drivers or as open-collector logic-circuit drivers. Each of the high-breakdown output transistors (15 volts) of the SN54145, SN74145, or SN74LS145 will sink up to 80 milliamperes of current. Each input is one Series 54/74 or Series 54LS/74LS standard load, respectively. Inputs and outputs are entirely compatible for use with TTL or DTL logic circuits, and the outputs are compatible for interfacing with most MOS integrated circuits. Power dissipation is typically 215 milliwatts for the '145 and 35 milliwatts for the 'LS145.

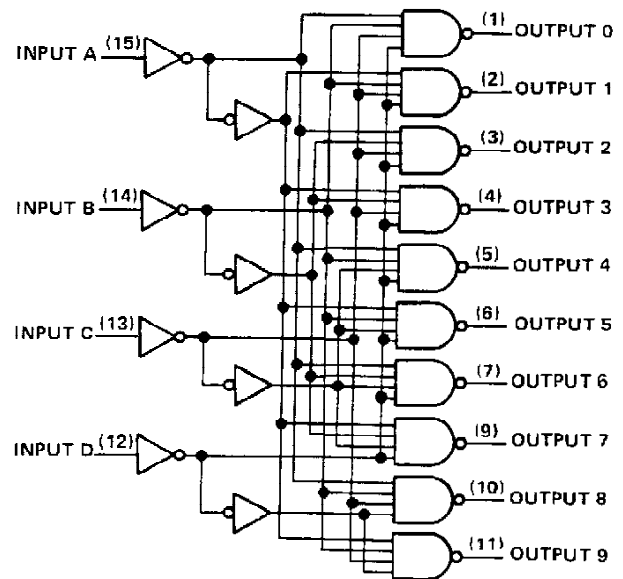
SN54LS145 . . . FK PACKAGE

(TOP VIEW)



NC : No internal connection

## logic diagram



Pin numbers shown are for D, J, N, and W packages.

PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS  
INSTRUMENTS**

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# SN54LS145, SN74LS145 BCD-TO-DECIMAL DECODERS/DRIVERS

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

|   |                |
|---|----------------|
| Supply voltage, $V_{CC}$ (see Note 1)         | 7 V            |
| Input voltage                                 | 5.5 V          |
| Maximum current into any output (off-state)   | 1 mA           |
| Operating free-air temperature range: SN54145 | -55°C to 125°C |
| SN74145                                       | 0°C to 70°C    |
| Storage temperature range                     | -65°C to 150°C |

NOTE 1: Voltage values are with respect to network ground terminal.

## recommended operating conditions

|  | SN54145 |     |     | SN74145 |     |      | UNIT |
|--|---------|-----|-----|---------|-----|------|------|
|  | MIN     | NOM | MAX | MIN     | NOM | MAX  |      |
| Supply voltage, $V_{CC}$               | 4.5     | 5   | 5.5 | 4.75    | 5   | 5.25 | V    |
| Off-state output voltage, $V_{O(off)}$ | 15      |     |     | 15      |     |      | V    |
| Operating free-air temperature, $T_A$  | -55     |     | 125 | 0       |     | 70   | °C   |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER                                    | TEST CONDITIONS†   | MIN     | TYP‡ | MAX  | UNIT          |
|--|--|---------|------|------|---------------|
| $V_{IH}$ High-level input voltage            |  | 2       |      |      | V             |
| $V_{IL}$ Low-level input voltage             |  |         |      | 0.8  | V             |
| $V_{IK}$ Input clamp voltage                 | $V_{CC} = \text{MIN}$ , $I_I = -12 \text{ mA}$   |         |      | -1.5 | V             |
| $I_{O(off)}$ Off-state output current        | $V_{CC} = \text{MIN}$ , $V_{IH} = 2 \text{ V}$ ,<br>$V_{IL} = 0.8 \text{ V}$ , $V_{O(off)} = 15 \text{ V}$ |         |      | 250  | $\mu\text{A}$ |
| $V_{O(on)}$ On-state output voltage          | $V_{CC} = \text{MIN}$ , $V_{IH} = 2 \text{ V}$ ,<br>$V_{IL} = 0.8 \text{ V}$                               |         | 0.5  | 0.9  | V             |
|  |  |         |      | 0.4  | V             |
| $I_I$ Input current at maximum input voltage | $V_{CC} = \text{MAX}$ , $V_I = 5.5 \text{ V}$  |         |      | 1    | mA            |
| $I_{IH}$ High-level input current            | $V_{CC} = \text{MAX}$ , $V_I = 2.4 \text{ V}$  |         |      | 40   | $\mu\text{A}$ |
| $I_{IL}$ Low-level input current             | $V_{CC} = \text{MAX}$ , $V_I = 0.4 \text{ V}$  |         |      | -1.6 | mA            |
| $I_{CC}$ Supply current                      | $V_{CC} = \text{MAX}$ . See Note 2   |         |      |      | mA            |
|  |  | SN54145 | 43   | 62   |               |
|  |  | SN74145 | 43   | 70   |               |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

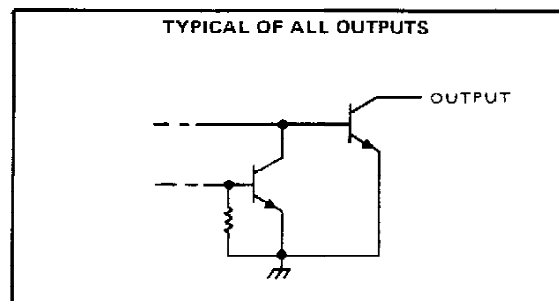
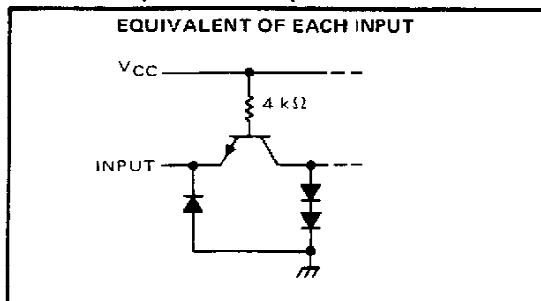
NOTE 2:  $I_{CC}$  is measured with all inputs grounded and outputs open.

switching characteristics,  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25^\circ\text{C}$

| PARAMETER  | TEST CONDITIONS   | MIN | MAX | UNIT |
|--|---|-----|-----|------|
| $t_{PLH}$ Propagation delay time, low-to-high-level output | $C_L = 15 \text{ pF}$ , $R_L = 100 \Omega$ , See Note 3 |     | 50  | ns   |
| $t_{PHL}$ Propagation delay time, high-to-low-level output |   |     | 50  | ns   |

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

## schematics of inputs and outputs



TEXAS  
INSTRUMENTS

POST OFFICE BOX 655012 • DALLAS, TEXAS 75265

# SN54145, SN74145 BCD-TO-DECIMAL DECODERS/DRIVERS

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

|   |                |
|---|----------------|
| Supply voltage, $V_{CC}$ (see Note 1)           | 7 V            |
| Input voltage                                   | 7 V            |
| Operating free-air temperature range: SN54LS145 | -55°C to 125°C |
| SN74LS145                                       | 0°C to 70°C    |
| Storage temperature range                       | -65°C to 150°C |

NOTE 1: Voltage values are with respect to network ground terminal.

### recommended operating conditions

|  | SN54LS145 |     |     | SN74LS145 |     |      | UNIT |
|--|-----------|-----|-----|-----------|-----|------|------|
|  | MIN       | NOM | MAX | MIN       | NOM | MAX  |      |
| Supply voltage, $V_{CC}$               | 4.5       | 5   | 5.5 | 4.75      | 5   | 5.25 | V    |
| Off-state output voltage, $V_{O(off)}$ | 15        |     |     | 15        |     |      | V    |
| Operating free-air temperature, $T_A$  | -55       |     |     | 125       |     |      | °C   |
|  | 0         |     |     | 70        |     |      |      |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER                                    | TEST CONDITIONS†  | SN54LS145                |      |     | SN74LS145 |      |     | UNIT |
|--|---|--------------------------|------|-----|-----------|------|-----|------|
|  |   | MIN                      | TYP‡ | MAX | MIN       | TYP‡ | MAX |      |
| $V_{IH}$ High-level input voltage            |   | 2                        |      |     | 2         |      |     | V    |
| $V_{IL}$ Low-level input voltage             |   | 0.7                      |      |     | 0.8       |      |     | V    |
| $V_{IK}$ Input clamp voltage                 | $V_{CC} = \text{MIN}, I_I = -18 \text{ mA}$   | -1.5                     |      |     | -1.5      |      |     | V    |
| $I_{O(off)}$ Off-state output current        | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, V_{OH} = 15 \text{ V}$ | 250                      |      |     | 250       |      |     | μA   |
| $V_{O(on)}$ On-state output voltage          | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}$                        | $I_{OL} = 12 \text{ mA}$ | 0.25 | 0.4 | 0.25      | 0.4  | V   |      |
|  |   | $I_{OL} = 24 \text{ mA}$ |      |     | 0.35      | 0.5  |     |      |
|  |   | $I_{OL} = 80 \text{ mA}$ |      |     | 2.3       | 3    |     |      |
| $I_I$ Input current at maximum input voltage | $V_{CC} = \text{MAX}, V_I = 7 \text{ V}$  | 0.1                      |      |     | 0.1       |      |     | mA   |
| $I_{IH}$ High-level input current            | $V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$  | 20                       |      |     | 20        |      |     | μA   |
| $I_{IL}$ Low-level input current             | $V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$  | -0.4                     |      |     | -0.4      |      |     | mA   |
| $I_{CC}$ Supply current                      | $V_{CC} = \text{MAX},$ See Note 2   | 7                        | 13   |     |           | 7    | 13  | mA   |

† For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡ All typical values are at  $V_{CC} = 5 \text{ V}, T_A = 25^\circ \text{C}$ .

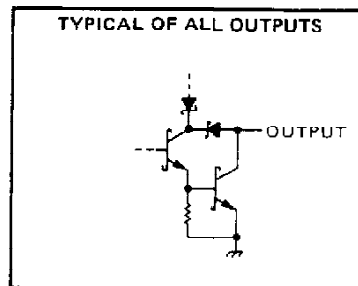
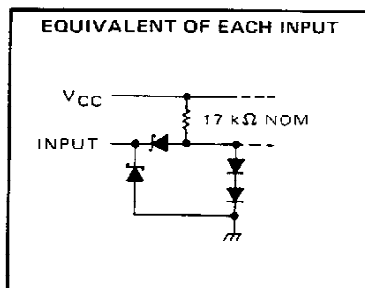
NOTE 2:  $I_{CC}$  is measured with all inputs grounded and outputs open.

### switching characteristics, $V_{CC} = 5 \text{ V}, T_A = 25^\circ \text{C}$

| PARAMETER  | TEST CONDITIONS                                     | MIN | MAX | UNIT |    |
|--|---|-----|-----|------|----|
| $t_{PLH}$ Propagation delay time, low-to-high-level output | $C_L = 45 \text{ pF}, R_L = 665 \Omega,$ See Note 3 |     |     | 50   | ns |
| $t_{PHL}$ Propagation delay time, high-to-low-level output |   |     |     | 50   |    |

NOTE 3: Load circuits and voltage waveforms are shown in Section 1.

### schematic of inputs and outputs



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