

SN5446A, '47A, '48, SN54LS47, 'LS48, 'LS49 SN7446A, '47A, '48, SN74LS47, 'LS48, 'LS49 BCD-TO-SEVEN-SEGMENT DECODERS/DRIVERS

SDLS111 – MARCH 1974 – REVISED MARCH 1988

'46A, '47A, 'LS47 feature

- Open-Collector Outputs Drive Indicators Directly
- Lamp-Test Provision
- Leading/Trailing Zero Suppression

'48, 'LS48 feature

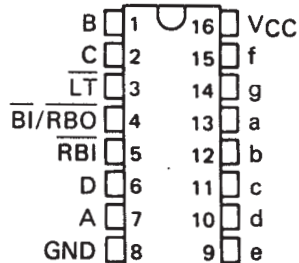
- Internal Pull-Ups Eliminate Need for External Resistors
- Lamp-Test Provision
- Leading/Trailing Zero Suppression

'LS49 feature

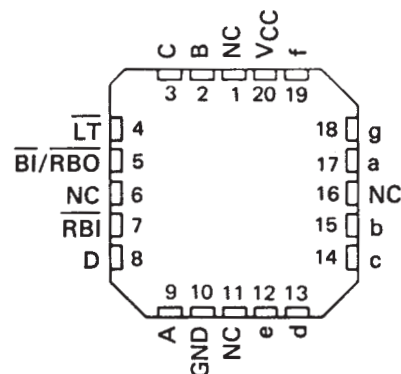
- Open-Collector Outputs
- Blanking Input

SN5446A, SN5447A, SN54LS47, SN5448,
SN54LS48 . . . J PACKAGE
SN7446A, SN7447A,
SN7448 . . . N PACKAGE
SN74LS47, SN74LS48 . . . D OR N PACKAGE

(TOP VIEW)

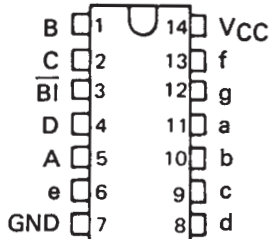


SN54LS47, SN54LS48 . . . FK PACKAGE
(TOP VIEW)

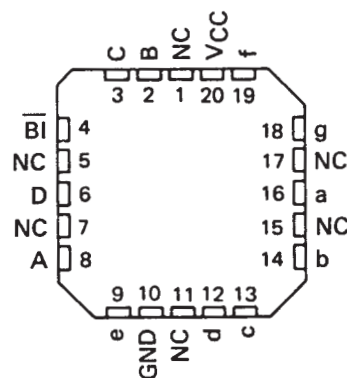


SN54LS49 . . . J OR W PACKAGE
SN74LS49 . . . D OR N PACKAGE

(TOP VIEW)



SN54LS49 . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection

PRODUCTION DATA information is 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**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 1988, Texas Instruments Incorporated

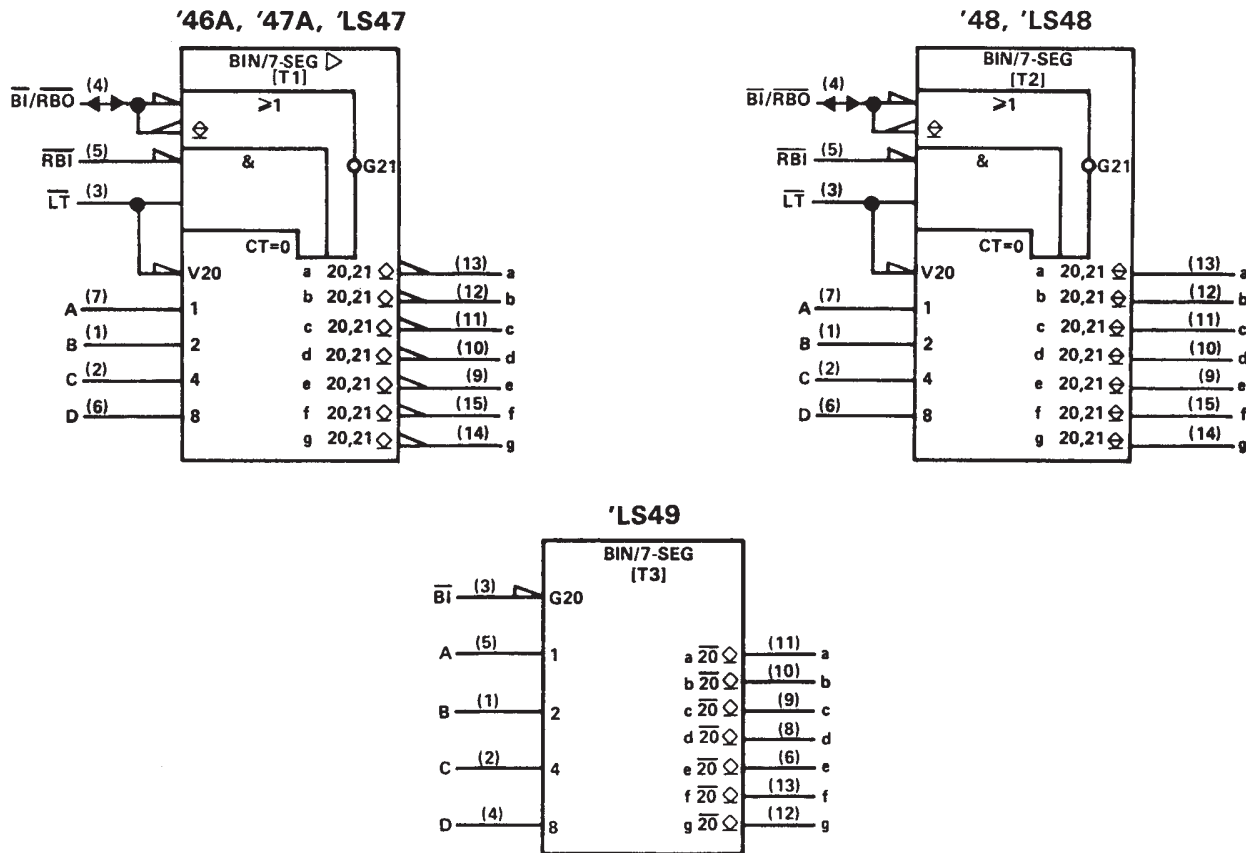
SN5446A, '47A, '48, SN54LS47, 'LS48, 'LS49
 SN7446A, '47A, '48, SN74LS47, 'LS48, 'LS49
 BCD-TO-SEVEN-SEGMENT DECODERS/DRIVERS

SDLS111 – MARCH 1974 – REVISED MARCH 1988

- All Circuit Types Feature Lamp Intensity Modulation Capability

| TYPE | DRIVER OUTPUTS | | | | TYPICAL POWER DISSIPATION | PACKAGES |
|----------|----------------|----------------------|--------------|-------------|---------------------------|----------|
| | ACTIVE LEVEL | OUTPUT CONFIGURATION | SINK CURRENT | MAX VOLTAGE | | |
| SN5446A | low | open-collector | 40 mA | 30 V | 320 mW | J, W |
| SN5447A | low | open-collector | 40 mA | 15 V | 320 mW | J, W |
| SN5448 | high | 2-k Ω pull-up | 6.4 mA | 5.5 V | 265 mW | J,W |
| SN54LS47 | low | open-collector | 12 mA | 15 V | 35 mW | J, W |
| SN54LS48 | high | 2-k Ω pull-up | 2 mA | 5.5 V | 125 mW | J, W |
| SN54LS49 | high | open-collector | 4 mA | 5.5 V | 40 mW | J, W |
| SN7446A | low | open-collector | 40 mA | 30 V | 320 mW | J, N |
| SN7447A | low | open-collector | 40 mA | 15 V | 320 mW | J, N |
| SN7448 | high | 2-k Ω pull-up | 6.4 mA | 5.5 V | 265 mW | J, N |
| SN74LS47 | low | open-collector | 24 mA | 15 V | 35 mW | J, N |
| SN74LS48 | high | 2-k Ω pull-up | 6 mA | 5.5 V | 125 mW | J, N |
| SN74LS49 | high | open-collector | 8 mA | 5.5 V | 40 mW | J, N |

logic symbols †



†These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12. Pin numbers shown are for D, J, N, and W packages.

SN5446A, '47A, '48, SN54LS47, 'LS48, 'LS49 SN7446A, '47A, '48, SN74LS47, 'LS48, 'LS49 BCD-TO-SEVEN-SEGMENT DECODERS/DRIVERS

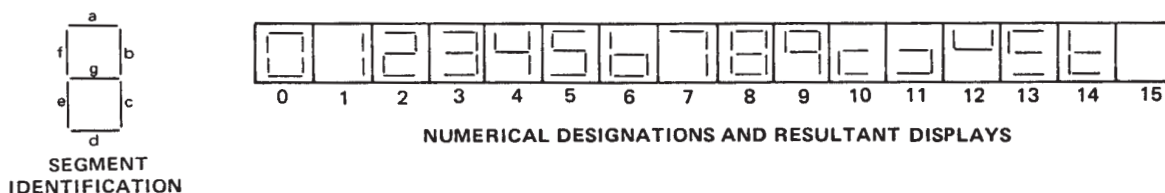
SDLS111 – MARCH 1974 – REVISED MARCH 1988

description

The '46A, '47A, and 'LS47 feature active-low outputs designed for driving common-anode LEDs or incandescent indicators directly. The '48, 'LS48, and 'LS49 feature active-high outputs for driving lamp buffers or common-cathode LEDs. All of the circuits except 'LS49 have full ripple-blanking input/output controls and a lamp test input. The 'LS49 circuit incorporates a direct blanking input. Segment identification and resultant displays are shown below. Display patterns for BCD input counts above 9 are unique symbols to authenticate input conditions.

The '46A, '47A, '48, 'LS47, and 'LS48 circuits incorporate automatic leading and/or trailing-edge zero-blanking control (\overline{RBI} and \overline{RBO}). Lamp test (\overline{LT}) of these types may be performed at any time when the $\overline{BI/RBO}$ node is at a high level. All types (including the '49 and 'LS49) contain an overriding blanking input (\overline{BI}), which can be used to control the lamp intensity by pulsing or to inhibit the outputs. Inputs and outputs are entirely compatible for use with TTL logic outputs.

The SN54246/SN74246 and '247 and the SN54LS247/SN74LS247 and 'LS248 compose the $\overline{6}$ and the $\overline{9}$ with tails and were designed to offer the designer a choice between two indicator fonts.



'46A, '47A, 'LS47 FUNCTION TABLE (T1)

| DECIMAL OR FUNCTION | INPUTS | | | | | | $\overline{BI/RBO}^\dagger$ | OUTPUTS | | | | | | | NOTE |
|---------------------|-----------------|------------------|---|---|---|---|-----------------------------|---------|-----|-----|-----|-----|-----|-----|------|
| | \overline{LT} | \overline{RBI} | D | C | B | A | | a | b | c | d | e | f | g | |
| 0 | H | H | L | L | L | L | H | ON | ON | ON | ON | ON | ON | OFF | OFF |
| 1 | H | X | L | L | L | H | H | OFF | ON | ON | OFF | OFF | OFF | OFF | OFF |
| 2 | H | X | L | L | H | L | H | ON | ON | OFF | ON | ON | OFF | ON | ON |
| 3 | H | X | L | L | H | H | H | ON | ON | ON | ON | OFF | OFF | ON | ON |
| 4 | H | X | L | H | L | L | H | OFF | ON | ON | OFF | OFF | ON | ON | ON |
| 5 | H | X | L | H | L | H | H | ON | OFF | ON | ON | OFF | ON | ON | ON |
| 6 | H | X | L | H | H | L | H | OFF | OFF | ON | ON | ON | ON | ON | ON |
| 7 | H | X | L | H | H | H | H | ON | ON | ON | OFF | OFF | OFF | OFF | OFF |
| 8 | H | X | H | L | L | L | H | ON | ON | ON | ON | ON | ON | ON | ON |
| 9 | H | X | H | L | L | H | H | ON | ON | ON | OFF | OFF | ON | ON | ON |
| 10 | H | X | H | L | H | L | H | OFF | OFF | OFF | ON | ON | OFF | ON | ON |
| 11 | H | X | H | L | H | H | H | OFF | OFF | ON | ON | OFF | OFF | ON | ON |
| 12 | H | X | H | H | L | L | H | OFF | ON | OFF | OFF | OFF | ON | ON | ON |
| 13 | H | X | H | H | L | H | H | ON | OFF | OFF | ON | OFF | ON | ON | ON |
| 14 | H | X | H | H | H | L | H | OFF | OFF | OFF | ON | ON | ON | ON | ON |
| 15 | H | X | H | H | H | H | H | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| BI | X | X | X | X | X | X | L | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| RBI | H | L | L | L | L | L | L | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| LT | L | X | X | X | X | X | H | ON | ON | ON | ON | ON | ON | ON | ON |

H = high level, L = low level, X = irrelevant

- NOTES:
1. The blanking input (\overline{BI}) must be open or held at a high logic level when output functions 0 through 15 are desired. The ripple-blanking input (\overline{RBI}) must be open or high if blanking of a decimal zero is not desired.
 2. When a low logic level is applied directly to the blanking input (\overline{BI}), all segment outputs are off regardless of the level of any other input.
 3. When ripple-blanking input (\overline{RBI}) and inputs A, B, C, and D are at a low level with the lamp test input high, all segment outputs go off and the ripple-blanking output (\overline{RBO}) goes to a low level (response condition).
 4. When the blanking input/ripple blanking output ($\overline{BI/RBO}$) is open or held high and a low is applied to the lamp-test input, all segment outputs are on.

$^\dagger \overline{BI/RBO}$ is wire AND logic serving as blanking input (\overline{BI}) and/or ripple-blanking output (\overline{RBO}).



SN5446A, '47A, '48, SN54LS47, 'LS48, 'LS49
 SN7446A, '47A, '48, SN74LS47, 'LS48, 'LS49
 BCD-TO-SEVEN-SEGMENT DECODERS/DRIVERS

SDLS111 – MARCH 1974 – REVISED MARCH 1988

'48, 'LS48
 FUNCTION TABLE (T2)

| DECIMAL OR FUNCTION | INPUTS | | | | | $\overline{BI}/\overline{RBO}^\dagger$ | OUTPUTS | | | | | | | NOTE |
|---------------------|-----------------|------------------|---|---|---|--|---------|---|---|---|---|---|---|------|
| | \overline{LT} | \overline{RBI} | D | C | B | | A | a | b | c | d | e | f | |
| 0 | H | H | L | L | L | L | H | H | H | H | H | H | L | 1 |
| 1 | H | X | L | L | L | H | H | L | H | H | L | L | L | |
| 2 | H | X | L | L | H | L | H | H | H | L | H | H | L | |
| 3 | H | X | L | L | H | H | H | H | H | H | L | L | H | |
| 4 | H | X | L | H | L | L | H | L | H | H | L | L | H | |
| 5 | H | X | L | H | L | H | H | H | L | H | H | L | H | |
| 6 | H | X | L | H | H | L | H | L | L | H | H | H | H | |
| 7 | H | X | L | H | H | H | H | H | H | H | L | L | L | |
| 8 | H | X | H | L | L | L | H | H | H | H | H | H | H | |
| 9 | H | X | H | L | L | H | H | H | H | L | L | H | H | |
| 10 | H | X | H | L | H | L | H | L | L | L | H | H | L | |
| 11 | H | X | H | L | H | H | H | L | L | H | H | L | L | |
| 12 | H | X | H | H | L | L | H | L | H | L | L | L | H | |
| 13 | H | X | H | H | L | H | H | H | L | L | H | L | H | |
| 14 | H | X | H | H | H | L | H | L | L | L | H | H | H | |
| 15 | H | X | H | H | H | H | H | L | L | L | L | L | L | |
| BI | X | X | X | X | X | X | L | L | L | L | L | L | L | 2 |
| RBI | H | L | L | L | L | L | L | L | L | L | L | L | L | 3 |
| LT | L | X | X | X | X | X | H | H | H | H | H | H | H | 4 |

H = high level, L = low level, X = irrelevant

- NOTES: 1. The blanking input (\overline{BI}) must be open or held at a high logic level when output functions 0 through 15 are desired. The ripple-blanking input (\overline{RBI}) must be open or high, if blanking of a decimal zero is not desired.
2. When a low logic level is applied directly to the blanking input (\overline{BI}), all segment outputs are low regardless of the level of any other input.
3. When ripple-blanking input (\overline{RBI}) and inputs A, B, C, and D are at a low level with the lamp-test input high, all segment outputs go low and the ripple-blanking output (\overline{RBO}) goes to a low level (response condition).
4. When the blanking input/ripple-blanking output ($\overline{BI}/\overline{RBO}$) is open or held high and a low is applied to the lamp-test input, all segment outputs are high.

$^\dagger \overline{BI}/\overline{RBO}$ is wire-AND logic serving as blanking input (\overline{BI}) and/or ripple-blanking output (\overline{RBO}).

'LS49
 FUNCTION TABLE (T3)

| DECIMAL OR FUNCTION | INPUTS | | | | | \overline{BI} | OUTPUTS | | | | | | | NOTE |
|---------------------|--------|---|---|---|---|-----------------|---------|---|---|---|---|---|---|------|
| | D | C | B | A | a | | b | c | d | e | f | g | | |
| 0 | L | L | L | L | L | H | H | H | H | H | H | L | 1 | |
| 1 | L | L | L | H | L | H | L | H | H | L | L | L | | |
| 2 | L | L | H | L | L | H | H | H | L | H | H | L | | |
| 3 | L | L | H | H | L | H | H | H | H | H | L | L | | |
| 4 | L | H | L | L | L | H | L | H | H | L | L | H | | |
| 5 | L | H | L | H | L | H | H | L | H | H | L | H | | |
| 6 | L | H | H | L | L | H | L | L | H | H | H | H | | |
| 7 | L | H | H | H | L | H | H | H | H | L | L | L | | |
| 8 | H | L | L | L | L | H | H | H | H | H | H | H | | |
| 9 | H | L | L | H | L | H | H | H | H | L | L | H | | |
| 10 | H | L | H | L | L | H | L | L | L | H | H | L | | |
| 11 | H | L | H | H | L | H | L | L | H | H | L | L | | |
| 12 | H | H | L | L | L | H | L | H | L | L | L | H | | |
| 13 | H | H | L | H | L | H | H | L | L | L | H | H | | |
| 14 | H | H | H | L | L | H | L | L | L | H | H | H | | |
| 15 | H | H | H | H | L | H | L | L | L | L | L | L | | |
| BI | X | X | X | X | X | L | L | L | L | L | L | L | 2 | |

H = high level, L = low level, X = irrelevant

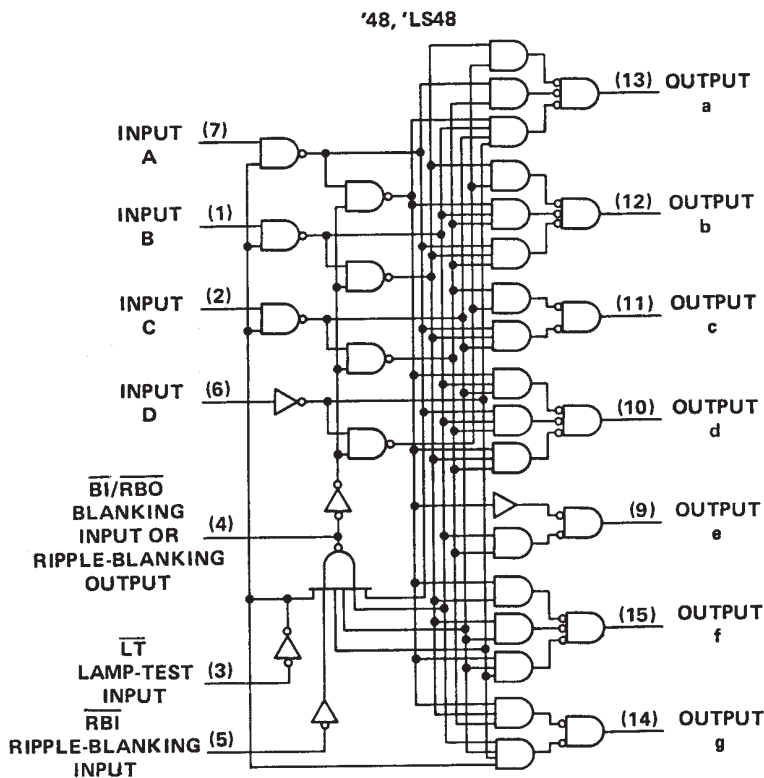
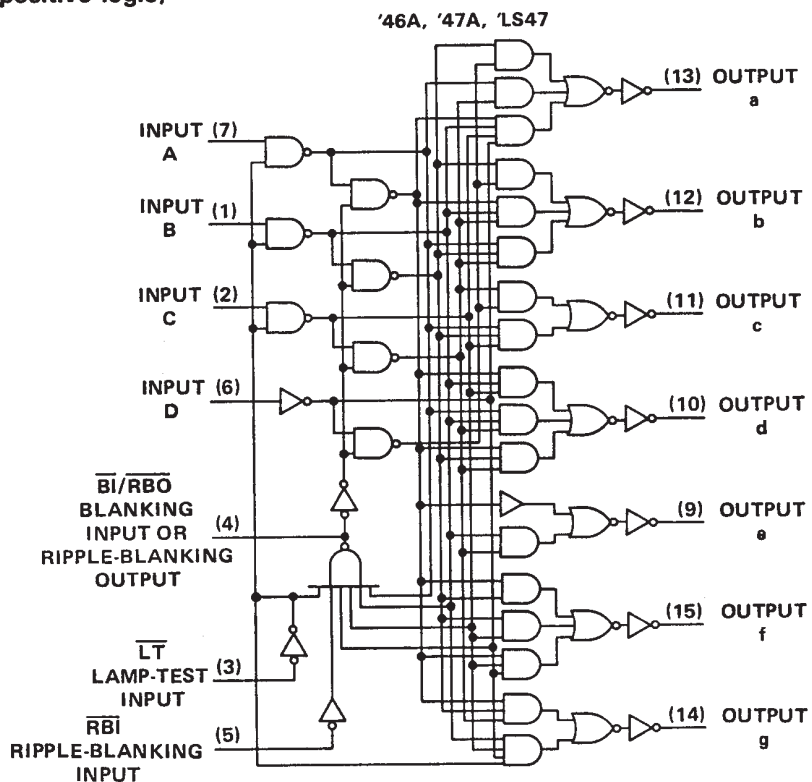
- NOTES: 1. The blanking input (\overline{BI}) must be open or held at a high logic level when output functions 0 through 15 are desired.
2. When a low logic level is applied directly to the blanking input (\overline{BI}), all segment outputs are low regardless of the level of any other input.



SN5446A, '47A, '48, SN54LS47, 'LS48, 'LS49
 SN7446A, '47A, '48, SN74LS47, 'LS48, 'LS49
 BCD-TO-SEVEN-SEGMENT DECODERS/DRIVERS

SDLS111 - MARCH 1974 - REVISED MARCH 1988

logic diagrams (positive logic)



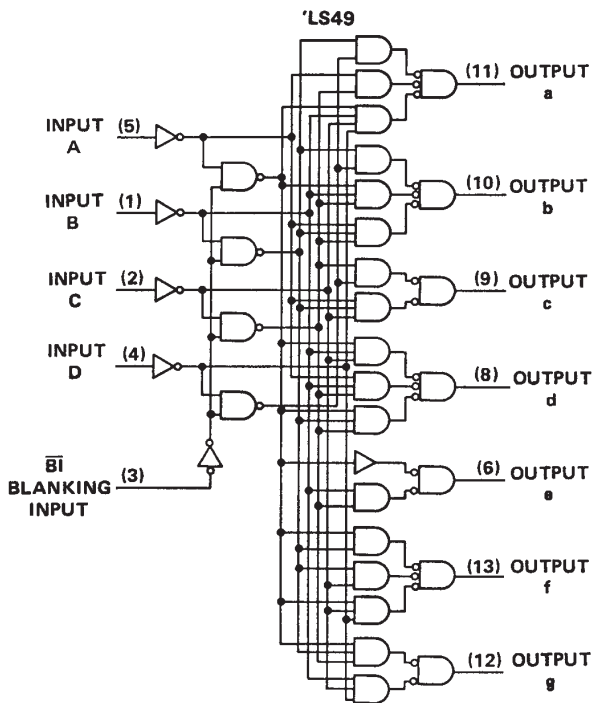
Pin numbers shown are for D, J, N, and W packages.



SN5446A, '47A, '48, SN54LS47, 'LS48, 'LS49
 SN7446A, '47A, '48, SN74LS47, 'LS48, 'LS49
 BCD-TO-SEVEN-SEGMENT DECODERS/DRIVERS

SDLS111 – MARCH 1974 – REVISED MARCH 1988

logic diagrams (continued)



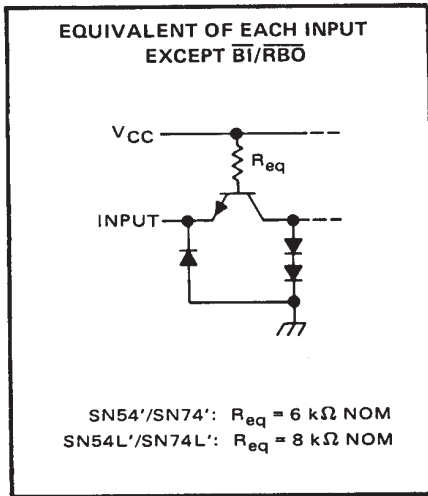
Pin numbers shown are for D, J, N, and W packages.

SN5446A, '47A, '48, SN54LS47, 'LS48, 'LS49
 SN7446A, '47A, '48, SN74LS47, 'LS48, 'LS49
 BCD-TO-SEVEN-SEGMENT DECODERS/DRIVERS

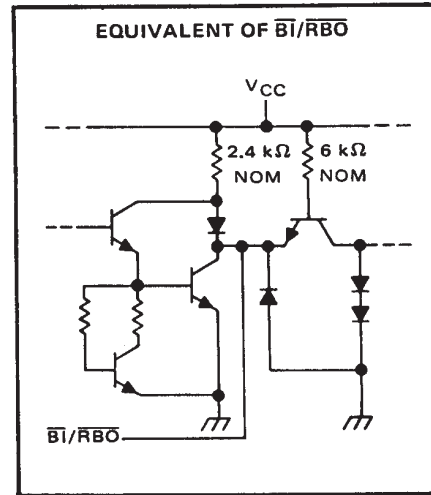
SDLS111 - MARCH 1974 - REVISED MARCH 1988

schematics of inputs and outputs

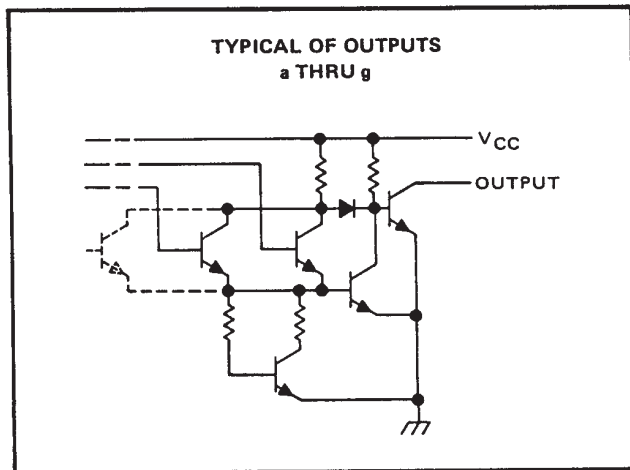
'46A, '47A, '48



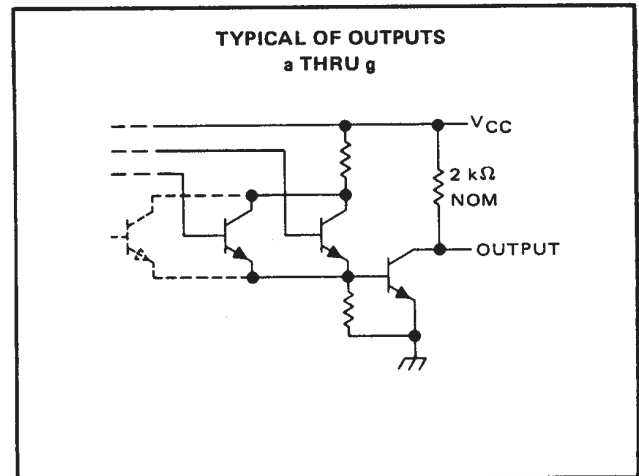
'46A, '47A, '48



'46A, '47A



'48

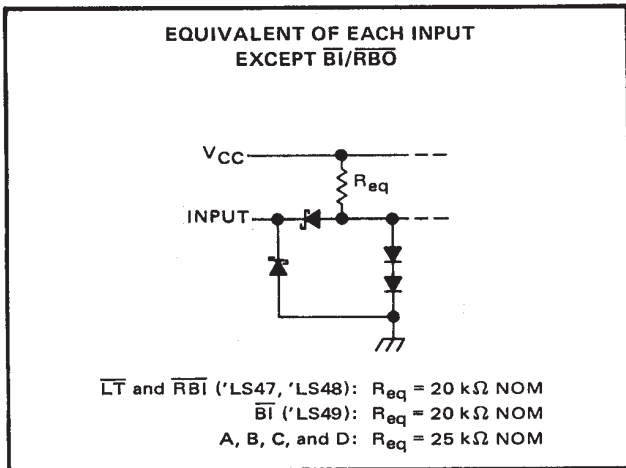


SN5446A, '47A, '48, SN54LS47, 'LS48, 'LS49
 SN7446A, '47A, '48, SN74LS47, 'LS48, 'LS49
 BCD-TO-SEVEN-SEGMENT DECODERS/DRIVERS

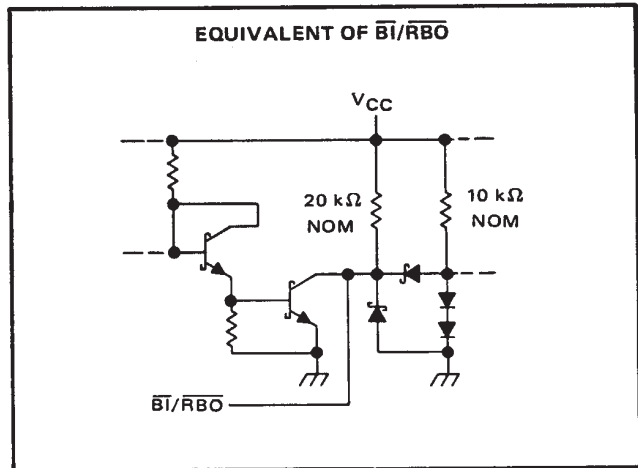
SDLS111 - MARCH 1974 - REVISED MARCH 1988

schematics of inputs and outputs

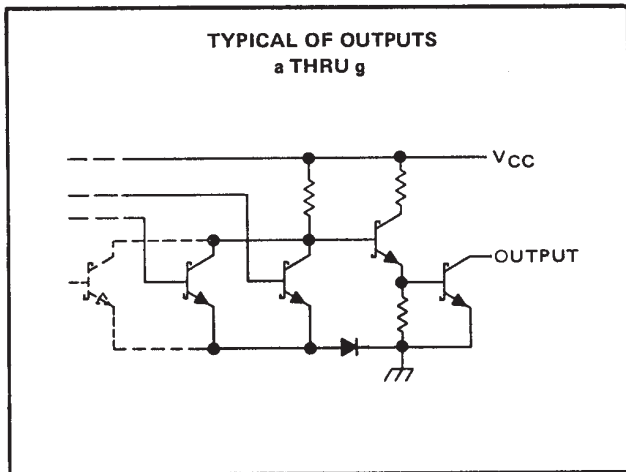
'LS47, 'LS48, 'LS49



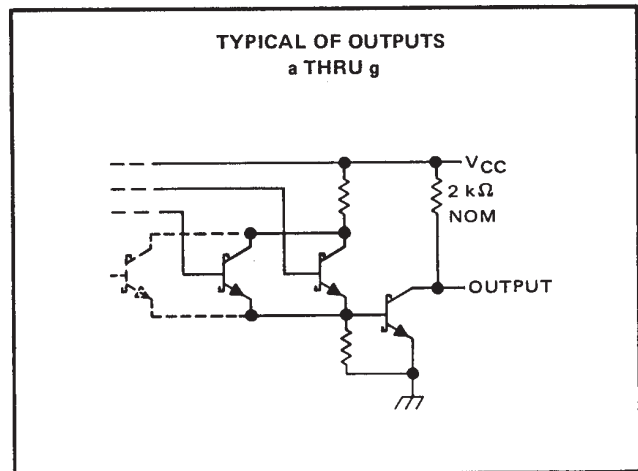
'LS47, 'LS48, 'LS49



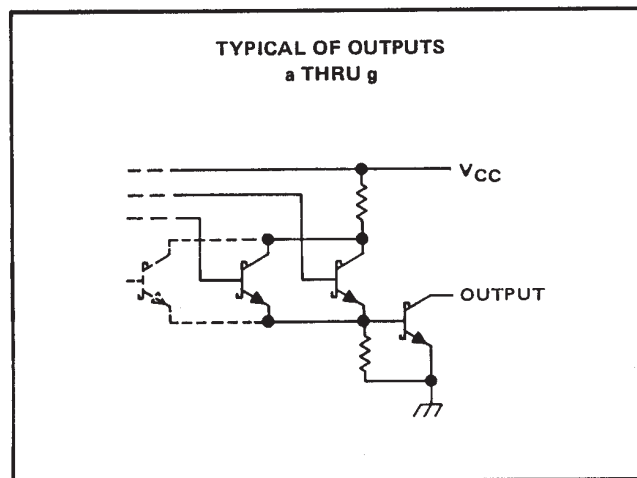
'LS47



'LS48



'LS49



SN5446A, '47A, '48, SN54LS47, 'LS48, 'LS49
SN7446A, '47A, '48, SN74LS47, 'LS48, 'LS49
BCD-TO-SEVEN-SEGMENT DECODERS/DRIVERS

SDLS111 – MARCH 1974 – REVISED MARCH 1988

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 |
| Current forced into any output in the off state | 1 mA |
| Operating free-air temperature range: SN5446A, SN5447A | –55°C to 125°C |
| SN7446A, SN7447A | 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

| | SN5446A | | | SN5447A | | | SN7446A | | | SN7447A | | | UNIT | | | | |
|--|--------------------------------|-----|-----|---------|-----|-----|---------|-----|------|---------|-----|------|------|---------|---|----|----|
| | MIN | NOM | MAX | MIN | NOM | MAX | MIN | NOM | MAX | MIN | NOM | MAX | | | | | |
| Supply voltage, V_{CC} | 4.5 | 5 | 5.5 | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | 4.75 | 5 | 5.25 | V | | | | |
| Off-state output voltage, $V_{O(off)}$ | a thru g | | | 30 | | | 15 | | | 30 | | | 15 | V | | | |
| On-state output current, $I_{O(on)}$ | a thru g | | | 40 | | | 40 | | | 40 | | | 40 | mA | | | |
| High-level output current, I_{OH} | $\overline{BI}/\overline{RBO}$ | | | –200 | | | –200 | | | –200 | | | –200 | μ A | | | |
| Low-level output current, I_{OL} | $\overline{BI}/\overline{RBO}$ | | | 8 | | | 8 | | | 8 | | | 8 | mA | | | |
| Operating free-air temperature, T_A | –55 | | | 125 | | | –55 | | | 125 | | | 0 | 70 | 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 | |
| V_{OH} | High-level output voltage | $\overline{BI}/\overline{RBO}$ $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V},$ $V_{IL} = 0.8 \text{ V}, I_{OH} = -200 \mu\text{A}$ | 2.4 | 3.7 | | V | |
| V_{OL} | Low-level output voltage | $\overline{BI}/\overline{RBO}$ $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V},$ $V_{IL} = 0.8 \text{ V}, I_{OL} = 8 \text{ mA}$ | | 0.27 | 0.4 | V | |
| $I_{O(off)}$ | Off-state output current | a thru g $V_{CC} = \text{MAX}, V_{IH} = 2 \text{ V},$ $V_{IL} = 0.8 \text{ V}, V_{O(off)} = \text{MAX}$ | | | 250 | μ A | |
| $V_{O(on)}$ | On-state output voltage | a thru g $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V},$ $V_{IL} = 0.8 \text{ V}, I_{O(on)} = 40 \text{ mA}$ | | 0.3 | 0.4 | V | |
| I_I | Input current at maximum input voltage | Any input except $\overline{BI}/\overline{RBO}$ $V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$ | | | 1 | mA | |
| I_{IH} | High-level input current | Any input except $\overline{BI}/\overline{RBO}$ $V_{CC} = \text{MAX}, V_I = 2.4 \text{ V}$ | | | 40 | μ A | |
| I_{IL} | Low-level input current | Any input except $\overline{BI}/\overline{RBO}$ $V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$ | | | –1.6 | mA | |
| | | $\overline{BI}/\overline{RBO}$ | | | –4 | | |
| I_{OS} | Short-circuit output current | $\overline{BI}/\overline{RBO}$ $V_{CC} = \text{MAX}$ | | | –4 | mA | |
| I_{CC} | Supply current | $V_{CC} = \text{MAX},$ See Note 2 | SN54' | | 64 | 85 | mA |
| | | | SN74' | | 64 | 103 | |

† 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 outputs open and all inputs at 4.5 V.

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

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------|---|--|-----|-----|-----|------|
| t_{off} | Turn-off time from A input | $C_L = 15 \text{ pF}, R_L = 120 \Omega,$ See Note 3 | | | 100 | ns |
| t_{on} | Turn-on time from A input | | | | 100 | |
| t_{off} | Turn-off time from $\overline{RB1}$ input | | | | 100 | ns |
| t_{on} | Turn-on time from $\overline{RB1}$ input | | | | 100 | |

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



**SN5446A, '47A, '48, SN54LS47, 'LS48, 'LS49
SN7446A, '47A, '48, SN74LS47, 'LS48, 'LS49
BCD-TO-SEVEN-SEGMENT DECODERS/DRIVERS**

SDLS111 – MARCH 1974 – REVISED MARCH 1988

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 |
| Operating free-air temperature range: SN5448 | -55°C to 125°C |
| SN7448 | 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

| | SN5448 | | | SN7448 | | | UNIT | | |
|---------------------------------------|--------------------------------|-----|------|--------|-----|------|---------|----|----|
| | MIN | NOM | MAX | MIN | NOM | MAX | | | |
| Supply voltage, V_{CC} | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V | | |
| High-level output current, I_{OH} | a thru g | | -400 | | | -400 | μ A | | |
| | $\overline{BI}/\overline{RBO}$ | | -200 | | | -200 | | | |
| Low-level output current, I_{OL} | a thru g | | 6.4 | | | 6.4 | mA | | |
| | $\overline{BI}/\overline{RBO}$ | | 8 | | | 8 | | | |
| 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 |
| V_{OH} | High-level output voltage | a thru g | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V},$ | 2.4 | 4.2 | V |
| | | $\overline{BI}/\overline{RBO}$ | $V_{IL} = 0.8 \text{ V}, I_{OH} = \text{MAX}$ | 2.4 | 3.7 | |
| I_O | Output current | a thru g | $V_{CC} = \text{MIN}, V_O = 0.85 \text{ V},$ | -1.3 | -2 | mA |
| | | | Input conditions as for V_{OH} | | | |
| V_{OL} | Low-level output voltage | | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V},$ | 0.27 | 0.4 | V |
| | | | $V_{IL} = 0.8 \text{ V}, I_{OL} = \text{MAX}$ | | | |
| I_I | Input current at maximum input voltage | Any input except $\overline{BI}/\overline{RBO}$ | $V_{CC} = \text{MAX}, V_I = 5.5 \text{ V}$ | | 1 | mA |
| I_{IH} | High-level input current | Any input except $\overline{BI}/\overline{RBO}$ | $V_{CC} = \text{MAX}, V_I = 2.4 \text{ V}$ | | 40 | |
| I_{IL} | Low-level input current | Any input except $\overline{BI}/\overline{RBO}$ | $V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$ | | -1.6 | mA |
| | | $\overline{BI}/\overline{RBO}$ | | | -4 | |
| I_{OS} | Short-circuit output current | $\overline{BI}/\overline{RBO}$ | $V_{CC} = \text{MAX}$ | | -4 | mA |
| I_{CC} | Supply current | | $V_{CC} = \text{MAX},$ See Note 2 | SN5448 | 53 | |
| | | | | SN7448 | 53 | 90 |

† 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 outputs open and all inputs at 4.5 V.

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

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------|--|-----|-----|-----|------|
| t_{PHL} | $C_L = 15 \text{ pF}, R_L = 1 \text{ k}\Omega$ See Note 3 | | | 100 | ns |
| t_{PLH} | | | | 100 | |
| t_{PHL} | | | | 100 | ns |
| t_{PLH} | | | | 100 | |

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



SN5446A, '47A, '48, SN54LS47, 'LS48, 'LS49
SN7446A, '47A, '48, SN74LS47, 'LS48, 'LS49
BCD-TO-SEVEN-SEGMENT DECODERS/DRIVERS

SDLS111 – MARCH 1974 – REVISED MARCH 1988

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 |
| Peak output current ($t_w \leq 1$ ms, duty cycle $\leq 10\%$) | 200 mA |
| Current forced into any output in the off state | 1 mA |
| Operating free-air temperature range: SN54LS47 | -55°C to 125°C |
| SN74LS47 | 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

| | SN54LS47 | | | SN74LS47 | | | 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, $V_{O(off)}$ | a thru g | | | 15 | | | V |
| On-state output current, $I_{O(on)}$ | a thru g | | | 12 | | | 24 mA |
| High-level output current, I_{OH} | $\overline{BI}/\overline{RB\overline{O}}$ | | | -50 | | | μA |
| Low-level output current, I_{OL} | $\overline{BI}/\overline{RB\overline{O}}$ | | | 1.6 | | | 3.2 mA |
| Operating free-air temperature, T_A | -55 | 125 | | 0 | 70 | | $^\circ\text{C}$ |

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

| PARAMETER | | TEST CONDITIONS† | SN54LS47 | | SN74LS47 | | UNIT |
|--------------|--|--|--|------|----------------------------------|-----|---------------|
| | | | MIN | TYP‡ | MAX | MIN | |
| 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 | $V_{CC} = \text{MIN}, I_I = -18$ mA | -1.5 | | -1.5 | | V |
| V_{OH} | High-level output voltage | $\overline{BI}/\overline{RB\overline{O}}$ $V_{CC} = \text{MIN}, V_{IH} = 2$ V, $V_{IL} = V_{IL \text{ max}}, I_{OH} = -50$ μA | 2.4 | 4.2 | 2.4 | 4.2 | V |
| V_{OL} | Low-level output voltage | $\overline{BI}/\overline{RB\overline{O}}$ $V_{CC} = \text{MIN}, V_{IH} = 2$ V, $V_{IL} = V_{IL \text{ max}}$ | $I_{OL} = 1.6$ mA $I_{OL} = 3.2$ mA | | 0.25 0.4 0.25 0.4 0.35 0.5 | | V |
| $I_{O(off)}$ | Off-state output current | a thru g $V_{CC} = \text{MAX}, V_{IH} = 2$ V, $V_{IL} = V_{IL \text{ max}}, V_{O(off)} = 15$ V | 250 | | 250 | | μA |
| $V_{O(on)}$ | On-state output voltage | a thru g $V_{CC} = \text{MIN}, V_{IH} = 2$ V, $V_{IL} = V_{IL \text{ max}}$ | $I_{O(on)} = 12$ mA $I_{O(on)} = 24$ mA | | 0.25 0.4 0.25 0.4 0.35 0.5 | | V |
| I_I | Input current at maximum input voltage | $V_{CC} = \text{MAX}, V_I = 7$ V | 0.1 | | 0.1 | | mA |
| I_{IH} | High-level input current | $V_{CC} = \text{MAX}, V_I = 2.7$ V | 20 | | 20 | | μA |
| I_{IL} | Low-level input current | $V_{CC} = \text{MAX}, V_I = 0.4$ V | Any input except $\overline{BI}/\overline{RB\overline{O}}$ | | -0.4 | | mA |
| | | | $\overline{BI}/\overline{RB\overline{O}}$ | | -1.2 | | |
| I_{OS} | Short-circuit output current | $\overline{BI}/\overline{RB\overline{O}}$ $V_{CC} = \text{MAX}$ | -0.3 | -2 | -0.3 | -2 | 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 $V_{CC} = 5$ V, $T_A = 25^\circ\text{C}$.

NOTE 2: I_{CC} is measured with all outputs open and all inputs at 4.5 V.

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

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|-----------|--|---|-----|-----|-----|------|
| t_{off} | Turn-off time from A input | $C_L = 15$ pF, $R_L = 665$ Ω , See Note 3 | 100 | | | ns |
| t_{on} | Turn-on time from A input | | 100 | | | |
| t_{off} | Turn-off time from $\overline{RB\overline{I}}$ input, outputs (a-f) only | | 100 | | | ns |
| t_{on} | Turn-on time from $\overline{RB\overline{I}}$ input, outputs (a-f) only | | 100 | | | |

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



**SN5446A, '47A, '48, SN54LS47, 'LS48, 'LS49
SN7446A, '47A, '48, SN74LS47, 'LS48, 'LS49
BCD-TO-SEVEN-SEGMENT DECODERS/DRIVERS**

SDLS111 – MARCH 1974 – REVISED MARCH 1988

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: SN54LS48 | -55°C to 125°C |
| SN74LS48 | 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

| | SN54LS48 | | | SN74LS48 | | | UNIT |
|---------------------------------------|--------------------------------|-----|------|----------|-----|------|---------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| Supply voltage, V_{CC} | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| High-level output current, I_{OH} | a thru g | | -100 | | | -100 | μ A |
| | $\overline{BI}/\overline{RBO}$ | | -50 | | | -50 | |
| Low-level output current, I_{OL} | a thru g | | 2 | | | 6 | mA |
| | $\overline{BI}/\overline{RBO}$ | | 1.6 | | | 3.2 | |
| 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† | SN54LS48 | | | SN74LS48 | | | 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 |
| V_{OH} | High-level output voltage | a thru g and $\overline{BI}/\overline{RBO}$ $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, I_{OH} = \text{MAX}$ | 2.4 | 4.2 | | 2.4 | 4.2 | | V |
| I_O | Output current | a thru g $V_{CC} = \text{MIN}, V_O = 0.85 \text{ V},$ Input conditions as for V_{OH} | -1.3 | -2 | | -1.3 | -2 | | mA |
| V_{OL} | Low-level output voltage | a thru g $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}$ | $I_{OL} = 2 \text{ mA}$ | | 0.25 | 0.4 | 0.25 | 0.4 | V |
| | | | $I_{OL} = 6 \text{ mA}$ | | | | 0.35 | 0.5 | |
| | $\overline{BI}/\overline{RBO}$ | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}$ | $I_{OL} = 1.6 \text{ mA}$ | | 0.25 | 0.4 | 0.25 | 0.4 | V |
| | | | $I_{OL} = 3.2 \text{ mA}$ | | | | 0.35 | 0.5 | |
| I_I | Input current at maximum input voltage | Any input except $\overline{BI}/\overline{RBO}$ $V_{CC} = \text{MAX}, V_I = 7 \text{ V}$ | | | 0.1 | | 0.1 | | mA |
| I_{IH} | High-level input current | Any input except $\overline{BI}/\overline{RBO}$ $V_{CC} = \text{MAX}, V_I = 2.7 \text{ V}$ | | | 20 | | 20 | | μ A |
| I_{IL} | Low-level input current | Any input except $\overline{BI}/\overline{RBO}$ $V_{CC} = \text{MAX}, V_I = 0.4 \text{ V}$ | | | -0.4 | | -0.4 | | mA |
| | | | $\overline{BI}/\overline{RBO}$ | | | -1.2 | | -1.2 | |
| I_{OS} | Short-circuit output current | $\overline{BI}/\overline{RBO}$ $V_{CC} = \text{MAX}$ | -0.3 | | -2 | -0.3 | | -2 | mA |
| I_{CC} | Supply current | $V_{CC} = \text{MAX},$ See Note 2 | | 25 | 38 | | 25 | 38 | 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 outputs open and all inputs at 4.5 V.

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

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|-----|-----|-----|------|
| t_{PHL} Propagation delay time, high-to-low-level output from A input | $C_L = 15 \text{ pF}, R_L = 4 \text{ k}\Omega,$ | | | 100 | ns |
| t_{PLH} Propagation delay time, low-to-high-level output from A input | See Note 3 | | | 100 | |
| t_{PHL} Propagation delay time, high-to-low-level output (a-f only) from \overline{RBI} input | $C_L = 15 \text{ pF}, R_L = 6 \text{ k}\Omega,$ | | | 100 | ns |
| t_{PLH} Propagation delay time, low-to-high-level output (a-f only) from \overline{RBI} input | See Note 3 | | | 100 | |

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



SN5446A, '47A, '48, SN54LS47, 'LS48, 'LS49
SN7446A, '47A, '48, SN74LS47, 'LS48, 'LS49
BCD-TO-SEVEN-SEGMENT DECODERS/DRIVERS

SDLS111 – MARCH 1974 – REVISED MARCH 1988

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 |
| Current forced into any output in the off state | 1 mA |
| Operating free-air temperature range: SN54LS49 | -55°C to 125°C |
| SN74LS49 | 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

| | SN54LS49 | | | SN74LS49 | | | UNIT |
|---------------------------------------|----------|-----|-----|----------|-----|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX | |
| Supply voltage, V_{CC} | 4.5 | 5 | 5.5 | 4.75 | 5 | 5.25 | V |
| High-level output voltage, V_{OH} | | | 5.5 | | | 5.5 | V |
| Low-level output current, I_{OL} | | | 4 | | | β | mA |
| 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† | SN54LS49 | | | SN74LS49 | | | 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_{OH} High-level output current | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, V_{OH} = 5.5 \text{ V}$ | | | 250 | | | 250 | μA |
| V_{OL} Low-level output voltage | $V_{CC} = \text{MIN}, V_{IH} = 2 \text{ V}, V_{IL} = V_{IL \text{ max}}, I_{OL} = 4 \text{ mA}$ | | 0.25 | 0.4 | | 0.25 | 0.4 | V |
| | $I_{OL} = 8 \text{ mA}$ | | | | | 0.35 | 0.5 | |
| 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 | $V_{CC} = \text{MAX}, \text{ See Note 2}$ | | 8 | 15 | | 8 | 15 | 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 outputs open and all inputs at 4.5 V.

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

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|--|-----|-----|-----|------|
| t_{PHL} Propagation delay time, high-to-low-level output from A input | $C_L = 15 \text{ pF}, R_L = 4 \text{ k}\Omega$ | | | 100 | ns |
| t_{PLH} Propagation delay time, low-to-high-level output from A input | See Note 3 | | | 100 | |
| t_{PHL} Propagation delay time, high-to-low-level output (a-f only) from RBI input | $C_L = 15 \text{ pF}, R_L = 6 \text{ k}\Omega$ | | | 100 | ns |
| t_{PLH} Propagation delay time, low-to-high-level output (a-f only) from RBI input | See Note 3 | | | 100 | |

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



TAPE AND REEL INFORMATION
REEL DIMENSIONS

TAPE DIMENSIONS


| | |
|----|---|
| A0 | Dimension designed to accommodate the component width |
| B0 | Dimension designed to accommodate the component length |
| K0 | Dimension designed to accommodate the component thickness |
| W | Overall width of the carrier tape |
| P1 | Pitch between successive cavity centers |

TAPE AND REEL INFORMATION

*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LS47NSR | SO | NS | 16 | 2000 | 330.0 | 16.4 | 8.2 | 10.5 | 2.5 | 12.0 | 16.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LS47NSR | SO | NS | 16 | 2000 | 367.0 | 367.0 | 38.0 |

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46C and to discontinue any product or service per JESD48B. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

Products

| | |
|------------------------|--|
| Audio | www.ti.com/audio |
| Amplifiers | amplifier.ti.com |
| Data Converters | dataconverter.ti.com |
| DLP® Products | www.dlp.com |
| DSP | dsp.ti.com |
| Clocks and Timers | www.ti.com/clocks |
| Interface | interface.ti.com |
| Logic | logic.ti.com |
| Power Mgmt | power.ti.com |
| Microcontrollers | microcontroller.ti.com |
| RFID | www.ti-rfid.com |
| OMAP Mobile Processors | www.ti.com/omap |
| Wireless Connectivity | www.ti.com/wirelessconnectivity |

Applications

| | |
|-------------------------------|--|
| Automotive and Transportation | www.ti.com/automotive |
| Communications and Telecom | www.ti.com/communications |
| Computers and Peripherals | www.ti.com/computers |
| Consumer Electronics | www.ti.com/consumer-apps |
| Energy and Lighting | www.ti.com/energy |
| Industrial | www.ti.com/industrial |
| Medical | www.ti.com/medical |
| Security | www.ti.com/security |
| Space, Avionics and Defense | www.ti.com/space-avionics-defense |
| Video and Imaging | www.ti.com/video |

TI E2E Community e2e.ti.com