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

MARCH 1974 - REVISED MARCH 1988

**'46A, '47A, 'LS47 feature**

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

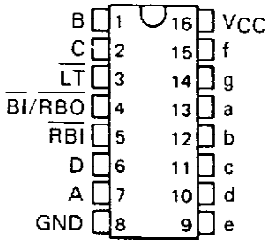
**'48, 'LS48 feature**

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

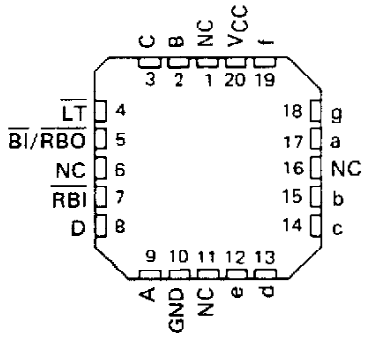
**'LS49 feature**

- Open-Collector Outputs
- Blanking Input

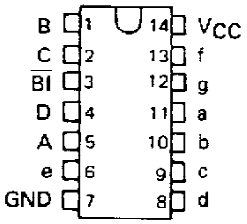
SN5446A, SN5447A, SN54LS47, SN5448, SN54LS48 . . . J PACKAGE
SN7446A, SN7447A, SN7448 . . . N PACKAGE
SN74LS47, SN74LS48 . . . D OR N PACKAGE
(TOP VIEW)



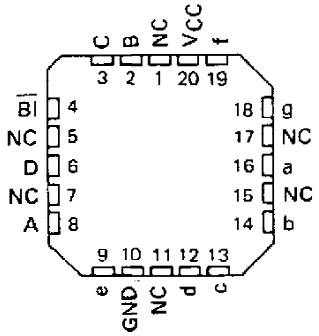

SN54LS47, SN54LS48 . . . FK PACKAGE
(TOP VIEW)




SN54LS49 . . . J OR W PACKAGE
SN74LS49 . . . D OR N PACKAGE
(TOP VIEW)




SN54LS49 . . . FK PACKAGE
(TOP VIEW)



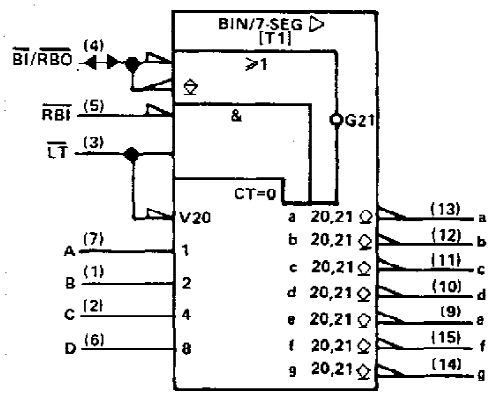

NC — No internal connection

- All Circuit Types Feature Lamp Intensity Modulation Capability

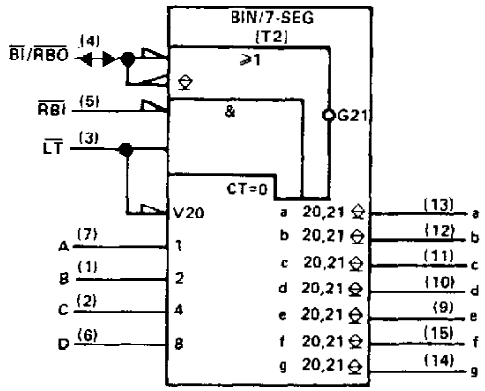
| TYPE | DRIVER OUTPUTS | | | | TYPICAL POWER DISSIPATION | PACKAGES |
|---|---|---|---|---|---|---|
| | ACTIVE LEVEL | OUTPUT CONFIGURATION | SINK CURRENT | MAX VOLTAGE | | |
| SN5446A | low | open-collector | 40 mA | 30 V | 320 mW | J, W |
| SN5447A | low | open-collector | 40 mA | 15 V | 320 mW | J, W |
| SN5448 | high | 2-kΩ 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-kΩ 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-kΩ 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-kΩ 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†

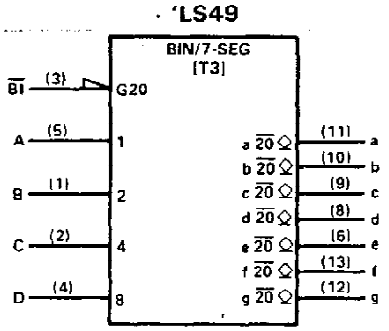
'46A, '47A, 'LS47




'48, 'LS48




'LS49



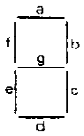

†These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for D, J, N, and W packages.

## description

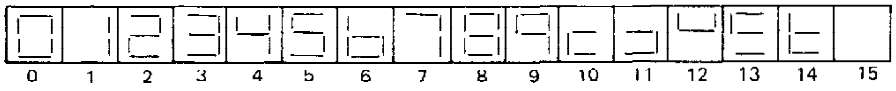
The '46A, '47A, and 'LS47 feature active-low outputs designed for driving common-anode LEDs or incandescent indicators directly. The '48, 'LS48, and 'LS49 feature active-high outputs for driving lamp buffers or common-cathode LEDs. All of the circuits except 'LS49 have full ripple-blanking input/output 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 $\overline{BI}/\overline{RBO}$ 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 6 and the 9 with tails and were designed to offer the designer a choice between two indicator fonts.




SEGMENT IDENTIFICATION




NUMERICAL DESIGNATIONS AND RESULTANT DISPLAYS

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

| DECIMAL OR FUNCTION | INPUTS | | | | | | $\overline{BI}/\overline{RBO}$† | 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 | 1 |
| 1 | H | X | L | L | L | H | H | OFF | ON | ON | OFF | OFF | OFF | OFF | |
| 2 | H | X | L | L | H | L | H | ON | ON | OFF | ON | ON | OFF | ON | |
| 3 | H | X | L | L | H | H | H | ON | ON | ON | ON | OFF | OFF | ON | |
| 4 | H | X | L | H | L | L | H | OFF | ON | ON | OFF | OFF | ON | ON | |
| 5 | H | X | L | H | L | H | H | ON | OFF | ON | ON | OFF | ON | ON | |
| 6 | H | X | L | H | H | L | H | OFF | OFF | ON | ON | ON | ON | ON | |
| 7 | H | X | L | H | H | H | H | ON | ON | ON | OFF | OFF | OFF | OFF | |
| 8 | H | X | H | L | L | L | H | ON | ON | ON | ON | ON | ON | ON | |
| 9 | H | X | H | L | L | H | H | ON | ON | ON | OFF | OFF | ON | ON | |
| 10 | H | X | H | L | H | L | H | OFF | OFF | OFF | ON | ON | OFF | ON | |
| 11 | H | X | H | L | H | H | H | OFF | OFF | ON | ON | OFF | OFF | ON | |
| 12 | H | X | H | H | L | L | H | OFF | ON | OFF | OFF | OFF | ON | ON | |
| 13 | H | X | H | H | L | H | H | ON | OFF | OFF | ON | OFF | ON | ON | |
| 14 | H | X | H | H | H | L | H | OFF | OFF | OFF | ON | ON | ON | ON | |
| 15 | H | X | H | H | H | H | H | OFF | OFF | OFF | OFF | OFF | OFF | OFF | |
| BI | X | X | X | X | X | X | L | OFF | OFF | OFF | OFF | OFF | OFF | OFF | 2 |
| RBI | H | L | L | L | L | L | L | OFF | OFF | OFF | OFF | OFF | OFF | OFF | 3 |
| LT | L | X | X | X | X | X | H | ON | ON | ON | ON | ON | ON | ON | 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 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 ($\overline{BI}/\overline{RBO}$) is open or held high and a low is applied to the lamp-test input, all segment outputs are on.

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

'48, 'LS48
FUNCTION TABLE (T2)

| DECIMAL OR FUNCTION | INPUTS | | | | | | $\overline{BI}/\overline{RBO}$† | 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 | H | H | H | H | H | H | L | 1 |
| 1 | H | X | L | L | L | H | H | L | H | H | L | L | L | L | |
| 2 | H | X | L | L | H | L | H | H | H | L | H | H | L | H | |
| 3 | H | X | L | L | H | H | H | H | H | H | H | L | L | H | |
| 4 | H | X | L | H | L | L | H | L | H | H | L | L | H | H | |
| 5 | H | X | L | H | L | H | H | H | L | H | H | L | H | H | |
| 6 | H | X | L | H | H | L | H | L | L | H | H | H | H | H | |
| 7 | H | X | L | H | H | H | H | H | H | H | L | L | L | L | |
| 8 | H | X | H | L | L | L | H | H | H | H | H | H | H | H | |
| 9 | H | X | H | L | L | H | H | H | H | H | L | L | H | H | |
| 10 | H | X | H | L | H | L | H | L | L | L | H | H | L | H | |
| 11 | H | X | H | L | H | H | H | L | L | H | H | L | L | H | |
| 12 | H | X | H | H | L | L | H | L | H | L | L | L | H | H | |
| 13 | H | X | H | H | L | H | H | H | L | L | H | L | H | H | |
| 14 | H | X | H | H | H | L | H | L | L | L | H | H | H | H | |
| 15 | H | X | H | H | H | H | H | L | L | L | L | L | L | L | |
| BI | X | X | X | X | X | X | L | L | L | L | L | L | L | L | 2 |
| RBI | H | L | 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 | 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.

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

'LS49
FUNCTION TABLE (T3)

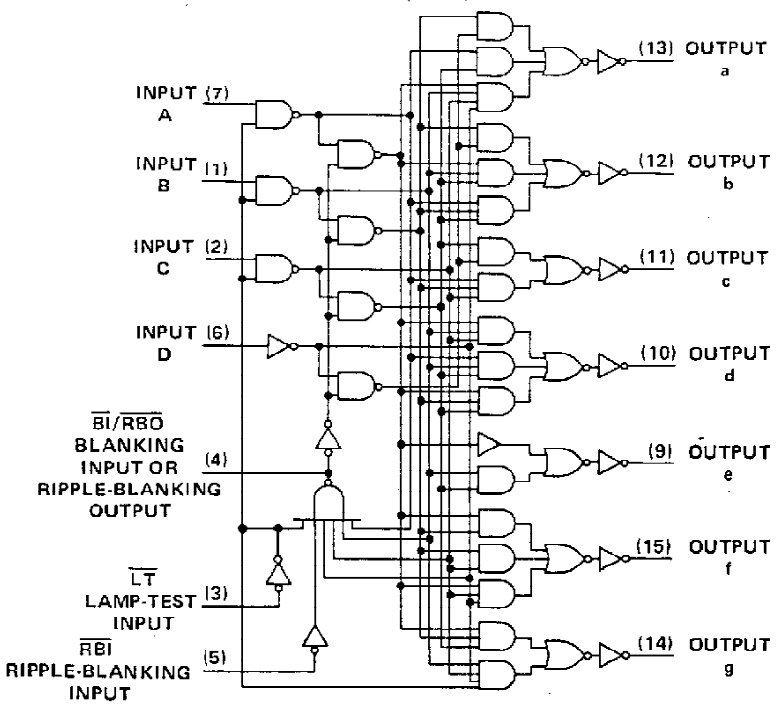
| DECIMAL OR FUNCTION | INPUTS | | | | | OUTPUTS | | | | | | | NOTE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D | C | B | A | $\overline{BI}$ | a | b | c | d | e | f | g | |
| 0 | L | L | L | L | H | H | H | H | H | H | H | L | 1 |
| 1 | L | L | L | H | H | L | H | H | L | L | L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

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

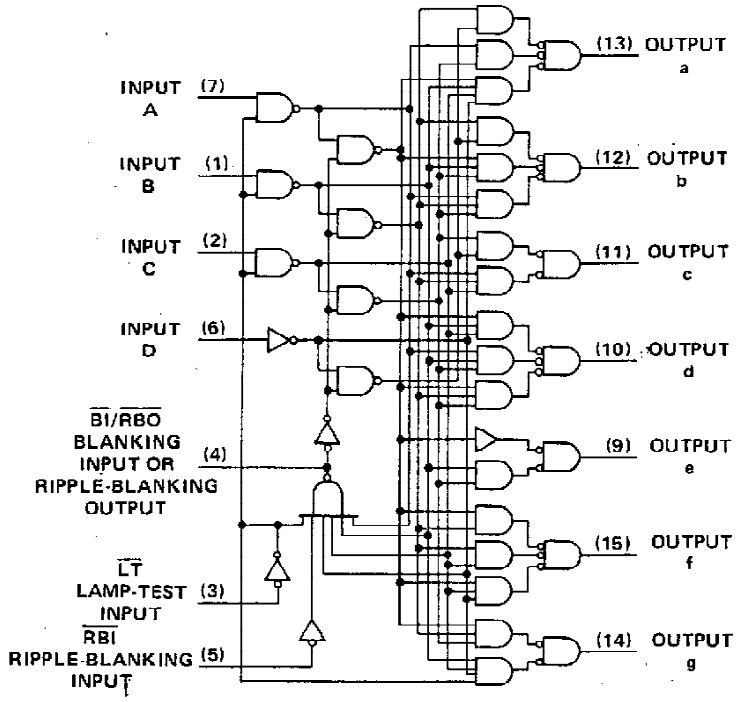
NOTES: 1. The blanking input ($\overline{BI}$) must be open or held at a high logic level when output functions 0 through 15 are desired.
2. When a low logic level is applied directly to the blanking input ($\overline{BI}$), all segment outputs are low regardless of the level of any other input.

logic diagrams (positive logic)

'46A, '47A, 'LS47

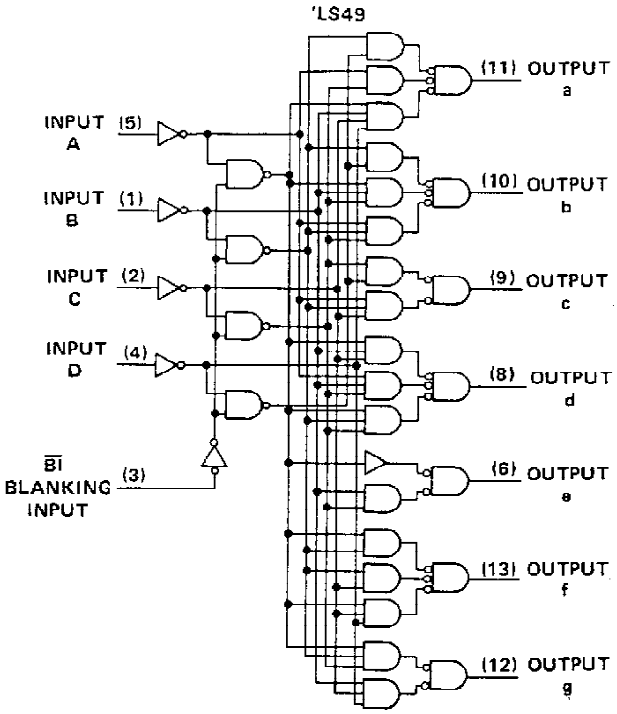



'48, 'LS48




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

logic diagrams (continued)

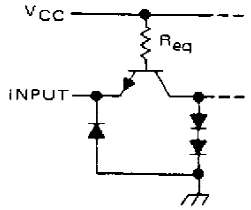



Pin numbers shown are for D, J, N, and W packages.

## schematics of inputs and outputs

'46A, '47A, '48

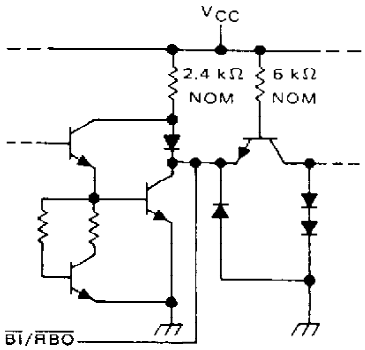
EQUIVALENT OF EACH INPUT EXCEPT $\overline{BI}/\overline{RBO}$




SN54'/SN74': $R_{eq}$ = 6 kΩ NOM
SN54L'/SN74L': $R_{eq}$ = 8 kΩ NOM

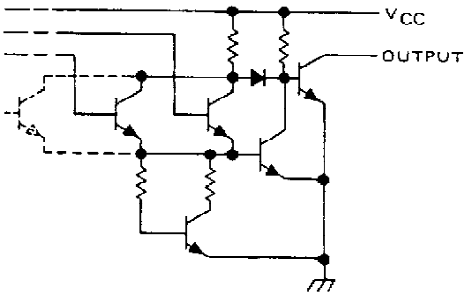
'46A, '47A, '48

EQUIVALENT OF $\overline{BI}/\overline{RBO}$



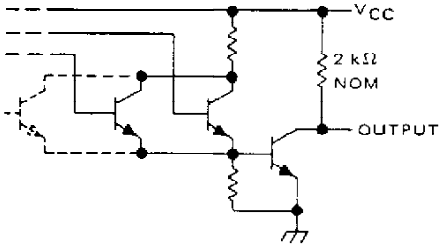

'46A, '47A

TYPICAL OF OUTPUTS a THRU g




'48

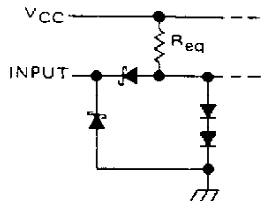
TYPICAL OF OUTPUTS a THRU g



## schematics of inputs and outputs

'LS47, 'LS48, 'LS49

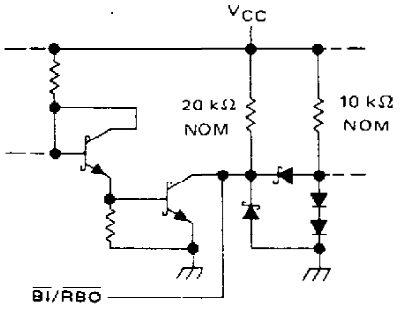
EQUIVALENT OF EACH INPUT
EXCEPT $\overline{BI}/\overline{RBO}$




$\overline{LT}$ and $\overline{RBI}$ ('LS47, 'LS48): $R_{eq}$ = 20 kΩ NOM
$\overline{BI}$ ('LS49): $R_{eq}$ = 20 kΩ NOM
A, B, C, and D: $R_{eq}$ = 25 kΩ NOM

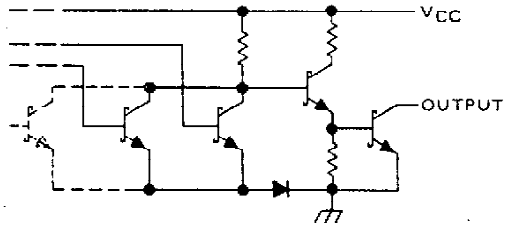
'LS47, 'LS48, 'LS49

EQUIVALENT OF $\overline{BI}/\overline{RBO}$



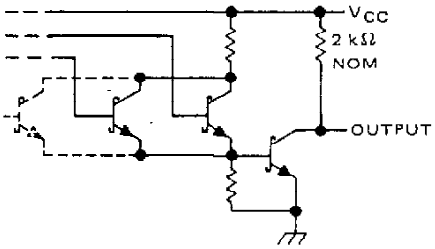

'LS47

TYPICAL OF OUTPUTS
a THRU g



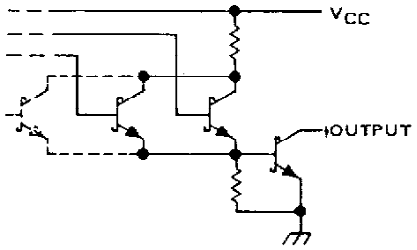

'LS48

TYPICAL OF OUTPUTS
a THRU g




'LS49

TYPICAL OF OUTPUTS
a THRU g



## 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 | μA |
| 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 | | $V_{CC}$ = MIN, $I_I$ = −12 mA | | | | −1.5 | V |
| $V_{OH}$ | High-level output voltage | $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $V_{IL}$ = 0.8 V, $I_{OH}$ = −200 μA | | 2.4 | 3.7 | | V |
| $V_{OL}$ | Low-level output voltage | $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $V_{IL}$ = 0.8 V, $I_{OL}$ = 8 mA | | | 0.27 | 0.4 | V |
| $I_{O(off)}$ | Off-state output current | a thru g | $V_{CC}$ = MAX, $V_{IH}$ = 2 V, $V_{IL}$ = 0.8 V, $V_{O(off)}$ = MAX | | | | 250 | μA |
| $V_{O(on)}$ | On-state output voltage | a thru g | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $V_{IL}$ = 0.8 V, $I_{O(on)}$ = 40 mA | | | 0.3 | 0.4 | V |
| $I_I$ | Input current at maximum input voltage | Any input except $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MAX, $V_I$ = 5.5 V | | | | 1 | mA |
| $I_{IH}$ | High-level input current | Any input except $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MAX, $V_I$ = 2.4 V | | | | 40 | μA |
| $I_{IL}$ | Low-level input current | Any input except $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MAX, $V_I$ = 0.4 V | | | | −1.6 | mA |
| | | $\overline{BI}/\overline{RBO}$ | | | | | −4 | |
| $I_{OS}$ | Short-circuit output current | $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MAX | | | | −4 | mA |
| $I_{CC}$ | Supply current | | $V_{CC}$ = 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 V, $T_A$ = 25°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°C

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

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

### 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 | μA |
| | $\overline{BI}/\overline{RBO}$ | | | −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 | | $V_{CC}$ = MIN, $I_I$ = −12 mA | | | | −1.5 | V |
| $V_{OH}$ | High-level output voltage | a thru g | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $V_{IL}$ = 0.8 V, $I_{OH}$ = MAX | | 2.4 | 4.2 | | V |
| | | $\overline{BI}/\overline{RBO}$ | | | 2.4 | 3.7 | | |
| $I_O$ | Output current | a thru g | $V_{CC}$ = MIN, $V_O$ = 0.85 V, Input conditions as for $V_{OH}$ | | −1.3 | −2 | | mA |
| $V_{OL}$ | Low-level output voltage | | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $V_{IL}$ = 0.8 V, $I_{OL}$ = MAX | | | 0.27 | 0.4 | V |
| $I_I$ | Input current at maximum input voltage | Any input except $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MAX, $V_I$ = 5.5 V | | | | 1 | mA |
| $I_{IH}$ | High-level input current | Any input except $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MAX, $V_I$ = 2.4 V | | | | 40 | μA |
| $I_{IL}$ | Low-level input current | Any input except $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MAX, $V_I$ = 0.4 V | | | | −1.6 | mA |
| | | $\overline{BI}/\overline{RBO}$ | | | | | −4 | |
| $I_{OS}$ | Short-circuit output current | $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MAX | | | | −4 | mA |
| $I_{CC}$ | Supply current | | $V_{CC}$ = MAX, See Note 2 | SN5448 | | 53 | 76 | mA |
| | | | | 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 V, $T_A$ = 25°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°C

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $t_{PHL}$ | Propagation delay time, high-to-low-level output from A input | $C_L$ = 15 pF, $R_L$ = 1 kΩ See Note 3 | | | 100 | ns |
| $t_{PLH}$ | Propagation delay time, low-to-high-level output from A input | | | | 100 | |
| $t_{PHL}$ | Propagation delay time, high-to-low-level output from $\overline{RBI}$ input | | | | 100 | ns |
| $t_{PLH}$ | Propagation delay time, low-to-high-level output from $\overline{RBI}$ input | | | | 100 | |

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

## 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 | | | 15 | V |
| On-state output current, $I_{O(on)}$ | a thru g | | | 12 | | | 24 | mA |
| High-level output current, $I_{OH}$ | $\overline{BI}/\overline{RBO}$ | | | −50 | | | −50 | μA |
| Low-level output current, $I_{OL}$ | $\overline{BI}/\overline{RBO}$ | | | 1.6 | | | 3.2 | 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† | | SN54LS47 | | | SN74LS47 | | | 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 | | $V_{CC}$ = MIN, | $I_I$ = −18 mA | | | −1.5 | | | −1.5 | V |
| $V_{OH}$ | High-level output voltage | $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MIN, $V_{IL}$ = $V_{IL}$ max, | $V_{IH}$ = 2 V, $I_{OH}$ = −50 μA | 2.4 | 4.2 | | 2.4 | 4.2 | | V |
| $V_{OL}$ | Low-level output voltage | $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $V_{IL}$ = $V_{IL}$ max | $I_{OL}$ = 1.6 mA | | 0.25 | 0.4 | | 0.25 | 0.4 | V |
| | | | | $I_{OL}$ = 3.2 mA | | | | | 0.35 | 0.5 | |
| $I_{O(off)}$ | Off-state output current | a thru g | $V_{CC}$ = MAX, $V_{IL}$ = $V_{IL}$ max, | $V_{IH}$ = 2 V, $V_{O(off)}$ = 15 V | | | 250 | | | 250 | μA |
| $V_{O(on)}$ | On-state output voltage | a thru g | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $V_{IL}$ = $V_{IL}$ max | $I_{O(on)}$ = 12 mA | | 0.25 | 0.4 | | 0.25 | 0.4 | V |
| | | | | $I_{O(on)}$ = 24 mA | | | | | 0.35 | 0.5 | |
| $I_I$ | Input current at maximum input voltage | | $V_{CC}$ = MAX, | $V_I$ = 7 V | | | 0.1 | | | 0.1 | mA |
| $I_{IH}$ | High-level input current | | $V_{CC}$ = MAX, | $V_I$ = 2.7 V | | | 20 | | | 20 | μA |
| $I_{IL}$ | Low-level input current | Any input except $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MAX, | $V_I$ = 0.4 V | | | −0.4 | | | −0.4 | mA |
| | | $\overline{BI}/\overline{RBO}$ | | | | | −1.2 | | | −1.2 | |
| $I_{OS}$ | Short-circuit output current | $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MAX | | −0.3 | | −2 | −0.3 | | −2 | mA |
| $I_{CC}$ | Supply current | | $V_{CC}$ = 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°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°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 $\overline{RBI}$ input, outputs (a-f) only | | | | 100 | ns |
| $t_{on}$ | Turn-on time from $\overline{RBI}$ input, outputs (a-f) only | | | | 100 | |

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

## 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 | μA |
| | $\overline{BI}/\overline{RBO}$ | | | −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 | | $V_{CC}$ = MIN, | $I_I$ = −18 mA | | | −1.5 | | | −1.5 | V |
| $V_{OH}$ | High-level output voltage | a thru g and $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MIN, $V_{IL}$ = $V_{IL}$ max, | $V_{IH}$ = 2 V, $I_{OH}$ = MAX | 2.4 | 4.2 | | 2.4 | 4.2 | | V |
| $I_O$ | Output current | a thru g | $V_{CC}$ = MIN, Input conditions as for $V_{OH}$ | $V_O$ = 0.85 V, | −1.3 | −2 | | −1.3 | −2 | | mA |
| $V_{OL}$ | Low-level output voltage | a thru g | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $V_{IL}$ = $V_{IL}$ max | $I_{OL}$ = 2 mA | | 0.25 | 0.4 | | 0.25 | 0.4 | V |
| | | | | $I_{OL}$ = 6 mA | | | | | 0.35 | 0.5 | |
| | | $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $V_{IL}$ = $V_{IL}$ max | $I_{OL}$ = 1.6 mA | | 0.25 | 0.4 | | 0.25 | 0.4 | V |
| | | | | $I_{OL}$ = 3.2 mA | | | | | 0.35 | 0.5 | |
| $I_I$ | Input current at maximum input voltage | Any input except $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MAX, | $V_I$ = 7 V | | | 0.1 | | | 0.1 | mA |
| $I_{IH}$ | High-level input current | Any input except $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MAX, | $V_I$ = 2.7 V | | | 20 | | | 20 | μA |
| $I_{IL}$ | Low-level input current | Any input except $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MAX, | $V_I$ = 0.4 V | | | −0.4 | | | −0.4 | mA |
| | | $\overline{BI}/\overline{RBO}$ | | | | | −1.2 | | | −1.2 | |
| $I_{OS}$ | Short-circuit output current | $\overline{BI}/\overline{RBO}$ | $V_{CC}$ = MAX | | −0.3 | | −2 | −0.3 | | −2 | mA |
| $I_{CC}$ | Supply current | | $V_{CC}$ = 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 V, $T_A$ 25°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°C

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

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

## 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 | | | 8 | 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 | $V_{CC}$ = MIN, | $I_I$ = −18 mA | | | −1.5 | | | −1.5 | V |
| $I_{OH}$ | High-level output current | $V_{CC}$ = MIN, $V_{IL}$ = $V_{IL}$ max, | $V_{IH}$ = 2 V, $V_{OH}$ = 5.5 V | | | 250 | | | 250 | μA |
| $V_{OL}$ | Low-level output voltage | $V_{CC}$ = MIN, $V_{IH}$ = 2 V, $V_{IL}$ = $V_{IL}$ max | $I_{OL}$ = 4 mA | | 0.25 | 0.4 | | 0.25 | 0.4 | V |
| | | | $I_{OL}$ = 8 mA | | | | | 0.35 | 0.5 | |
| $I_I$ | Input current at maximum input voltage | $V_{CC}$ = MAX, | $V_I$ = 7 V | | | 0.1 | | | 0.1 | mA |
| $I_{IH}$ | High-level input current | $V_{CC}$ = MAX, | $V_I$ = 2.7 V | | | 20 | | | 20 | μA |
| $I_{IL}$ | Low-level input current | $V_{CC}$ = MAX, | $V_I$ = 0.4 V | | | −0.4 | | | −0.4 | mA |
| $I_{CC}$ | Supply current | $V_{CC}$ = MAX, | 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 V, $T_A$ = 25°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°C

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

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

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