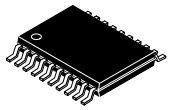
# Octal Buffer/Line Driver with 3-State Outputs

# 74VHC244



**TSSOP20, 4.4x6.5**
**CASE 948AQ**

### General Description

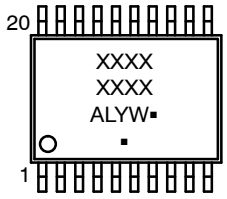
The VHC244 is an advanced high speed CMOS octal bus buffer fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation. The VHC244 is a non−inverting 3−STATE buffer having two active−LOW output enables. These devices are designed to be used as 3−STATE memory address drivers, clock drivers, and bus oriented transmitter/receivers.

An input protection circuit ensures that 0 V to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

### Features

- High Speed: $t_{PD}$ 3.9 ns (typ) at $V_{CC}$ 5 V
- High Noise Immunity: $V_{NIH} = V_{NIL}$ = 28% $V_{CC}$ (min)
- Power Down Protection is Provided on All Inputs
- Low Noise: $V_{OLP}$ = 0.6 V (typ)
- Low Power Dissipation: $I_{CC}$ = 4 μA (max) @ $T_A$ = 25 °C
- Pin and Function Compatible with 74HC244
- These are Pb−Free Devices

### MARKING DIAGRAMS

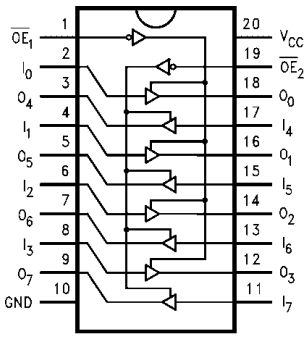



**TSSOP−20**

| | |
|---|---|
| XXXXXX | = Specific Device Code |
| A | = Assembly Location |
| L | = Wafer Lot |
| Y | = Year |
| W | = Work Week |
| ▪ | = Pb−Free Package |

(Note: Microdot may be in either location)

### CONNECTION DIAGRAM




### PIN DESCRIPTION

| Pin Names | Description |
|---|---|
| $\overline{OE}_1$, $\overline{OE}_2$ | Output Enable Inputs |
| $I_0$−$I_7$ | Inputs |
| $O_0$−$O_7$ | 3−State Outputs |

### ORDERING INFORMATION

See detailed ordering and shipping information on page 4 of this data sheet.

## LOGIC SYMBOL

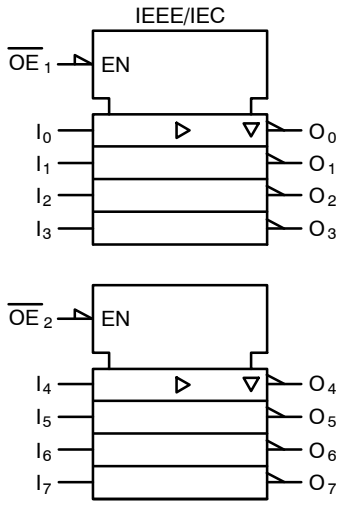



**Figure 1. Logic Symbol**

## TRUTH TABLES

| Inputs | | Outputs |
|---|---|---|
| $\overline{OE}_1$ | $I_n$ | (Pins 12, 14, 16, 18) |
| L | L | L |
| L | H | H |
| H | X | Z |

| Inputs | | Outputs |
|---|---|---|
| $\overline{OE}_2$ | $I_n$ | (Pins 3, 5, 7, 9) |
| L | L | L |
| L | H | H |
| H | X | Z |

NOTE: H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
Z = High Impedance

## ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | | Value | Unit |
|---|---|---|---|---|
| $V_{CC}$ | DC Supply Voltage | | −0.5 to +6.5 | V |
| $V_{IN}$ | DC Input Voltage | | −0.5 to +6.5 | V |
| $V_{OUT}$ | DC Output Voltage | | −0.5 to $V_{CC}$ + 0.5 | V |
| $I_{IN}$ | DC Input Current, per Pin | | ±20 | mA |
| $I_{OUT}$ | DC Output Current, per Pin | | ±25 | mA |
| $I_{CC}$ | DC Supply Current, $V_{CC}$ and GND Pins | | ±75 | mA |
| $I_{IK}$ | Input Clamp Current | | −20 | mA |
| $I_{OK}$ | Output Clamp Current | | ±20 | mA |
| $T_{STG}$ | Storage Temperature Range | | −65 to +150 | °C |
| $T_L$ | Lead Temperature, 1 mm from Case for 10 Seconds | | 260 | °C |
| $T_J$ | Junction Temperature under Bias | | +150 | °C |
| $\theta_{JA}$ | Thermal Resistance (Note 2) | | 150 | °C/W |
| $P_D$ | Power Dissipation in Still Air at 25°C | | 833 | mW |
| MSL | Moisture Sensitivity | | Level 1 | |
| $F_R$ | Flammability Rating | Oxygen Index: 28 to 34 | UL 94 V−0 @ 0.24 in | |
| $V_{ESD}$ | ESD Withstand Voltage (Note 3) | Human Body Model | 2000 | V |
| | | Charged Device Model | N/A | |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Applicable to devices with outputs that may be tristated.
2. Measured with minimum pad spacing on an FR4 board, using 76 mm−by−114 mm, 2−ounce copper trace no air flow per JESD51−7.
3. HBM tested to EIA / JESD22−A114−A. CDM tested to JESD22−C101−A.

## RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | DC Supply Voltage | | 2.0 | 5.5 | V |
| $V_{IN}$ | DC Input Voltage (Note 4) | | 0 | 5.5 | V |
| $V_{OUT}$ | DC Output Voltage (Note 4) | | 0 | $V_{CC}$ | V |
| $T_A$ | Operating Temperature | | −40 | +85 | °C |
| $t_r$, $t_f$ | Input Rise or Fall Rate | $V_{CC}$ = 3.0 V to 3.6 V | 0 | 100 | ns/V |
| | | $V_{CC}$ = 4.5 V to 5.5 V | 0 | 20 | |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

4. Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or $V_{CC}$). Unused outputs must be left open.

## DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Conditions | | $V_{CC}$ (V) | $T_A$ = 25 °C | | | $T_A$ = −40°C to +85 °C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Min | Typ | Max | Min | Max | |
| $V_{IH}$ | HIGH Level Input Voltage | | | 2.0 | 1.5 | – | – | 1.5 | – | V |
| | | | | 3.0–5.5 | 0.7 x $V_{CC}$ | – | – | 0.7 x $V_{CC}$ | – | |
| $V_{IL}$ | LOW Level Input Voltage | | | 2.0 | – | – | 0.50 | – | 0.50 | V |
| | | | | 3.0–5.5 | – | – | 0.3 x $V_{CC}$ | – | 0.3 x $V_{CC}$ | |
| $V_{OH}$ | HIGH Level Output Voltage | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OH}$ = −50 μA | 2.0 | 1.9 | 2.0 | – | 1.9 | – | V |
| | | | | 3.0 | 2.9 | 3.0 | – | 2.9 | – | |
| | | | | 4.5 | 4.4 | 4.5 | – | 4.4 | – | |
| | | | $I_{OH}$ = −4 mA | 3.0 | 2.58 | – | – | 2.48 | – | |
| | | | $I_{OH}$ = −8 mA | 4.5 | 3.94 | – | – | 3.80 | – | |
| $V_{OL}$ | LOW Level Output Voltage | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 50 μA | 2.0 | – | 0.0 | 0.1 | – | 0.1 | V |
| | | | | 3.0 | – | 0.0 | 0.1 | – | 0.1 | |
| | | | | 4.5 | – | 0.0 | 0.1 | – | 0.1 | |
| | | | $I_{OL}$ = 4 mA | 3.0 | – | – | 0.36 | – | 0.44 | |
| | | | $I_{OL}$ = 8 mA | 4.5 | – | – | 0.36 | – | 0.44 | |
| $I_{OZ}$ | 3−STATE Output Off−State Current | $V_{IN}$ = $V_{IH}$ or $V_{IL}$; $V_{OUT}$ = $V_{CC}$ or GND | | 5.5 | – | – | ±0.25 | – | ±2.5 | μA |
| $I_{IN}$ | Input Leakage Current | $V_{IN}$ = 5.5 V or GND | | 0–5.5 | – | – | ±0.1 | – | ±1.0 | μA |
| $I_{CC}$ | Quiescent Supply Current | $V_{IN}$ = $V_{CC}$ or GND | | 5.5 | – | – | 4.0 | – | 40.0 | μA |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

## NOISE CHARACTERISTICS

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | $T_A$ = 25 °C | | Unit |
|---|---|---|---|---|---|---|
| | | | | Typ | Limits | |
| $V_{OLP}$ (Note 5) | Quiet Output Maximum Dynamic $V_{OL}$ | $C_L$ = 50 pF | 5.0 | 0.6 | 0.9 | V |
| $V_{OLV}$ (Note 5) | Quiet Output Minimum Dynamic $V_{OL}$ | $C_L$ = 50 pF | 5.0 | −0.6 | −0.9 | V |
| $V_{IHD}$ (Note 5) | Minimum HIGH Level Dynamic Input Voltage | $C_L$ = 50 pF | 5.0 | – | 3.5 | V |
| $V_{ILD}$ (Note 5) | Maximum LOW Level Dynamic Input Voltage | $C_L$ = 50 pF | 5.0 | – | 1.5 | V |

5. Parameter guaranteed by design.

## AC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Conditions | | $V_{CC}$ (V) | $T_A$ = 25 °C | | | $T_A$ = −40 °C to +85 °C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Min | Typ | Max | Min | Max | |
| $t_{PLH}$, $t_{PHL}$ | Propagation Delay Time | | $C_L$ = 15 pF | 3.3 ±0.3 | – | 5.8 | 8.4 | 1.0 | 10.0 | ns |
| | | | $C_L$ = 50 pF | | – | 8.3 | 11.9 | 1.0 | 13.5 | |
| | | | $C_L$ = 15 pF | 5.0 ±0.5 | – | 3.9 | 5.5 | 1.0 | 6.5 | |
| | | | $C_L$ = 50 pF | | – | 5.4 | 7.5 | 1.0 | 8.5 | |
| $t_{PZL}$, $t_{PZH}$ | 3−STATE Output Enable Time | $R_L$ = 1 kΩ | $C_L$ = 15 pF | 3.3 ±0.3 | – | 6.6 | 10.6 | 1.0 | 12.5 | ns |
| | | | $C_L$ = 50 pF | | – | 9.1 | 14.1 | 1.0 | 16.0 | |
| | | | $C_L$ = 15 pF | 5.0 ±0.5 | – | 4.7 | 7.3 | 1.0 | 8.5 | |
| | | | $C_L$ = 50 pF | | – | 6.2 | 9.3 | 1.0 | 10.5 | |
| $t_{PLZ}$, $t_{PHZ}$ | 3−STATE Output Disable Time | $R_L$ = 1 kΩ | $C_L$ = 50 pF | 3.3 ±0.3 | – | 10.3 | 14.0 | 1.0 | 16.0 | ns |
| | | | $C_L$ = 50 pF | 5.0 ±0.5 | – | 6.7 | 9.2 | 1.0 | 10.5 | |
| $t_{OSLH}$, $t_{OSHL}$ | Output to Output Skew | (Note 6) | $C_L$ = 50 pF | 3.3 ±0.3 | – | – | 1.5 | – | 1.5 | ns |
| | | | $C_L$ = 50 pF | 5.0 ±0.5 | – | – | 1.0 | – | 1.0 | |
| $C_{IN}$ | Input Capacitance | $V_{CC}$ = Open | | | – | 4 | 10 | – | 10 | pF |
| $C_{OUT}$ | Output Capacitance | $V_{CC}$ = 5.0 V | | | – | 6 | – | – | – | pF |
| $C_{PD}$ | Power Dissipation Capacitance | (Note 7) | | | – | 19 | – | – | – | pF |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

6. Parameter guaranteed by design. $t_{OSLH} - |t_{PLHmax} - t_{PLHmin}|$; $t_{OSHL} - |t_{PHLmax} - t_{PHLmin}|$
7. $C_{PD}$ is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: $I_{CC}$ (OPR.) = $C_{PD}$ * $V_{CC}$ * $f_{IN}$ + $I_{CC}$/8 (per bit).

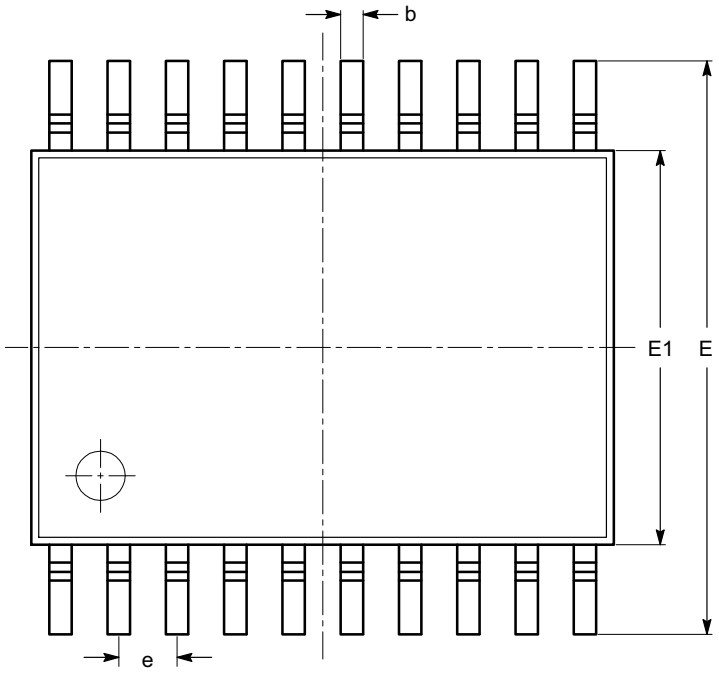
## ORDERING INFORMATION

| Device | Marking | Package | Shipping† |
|---|---|---|---|
| 74VHC244MTC | VHC 244 | TSSOP20 (Pb−Free) | 75 Units / Tube |
| 74VHC244MTCX | VHC 244 | TSSOP20 (PF−Free) | 2500 Units / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

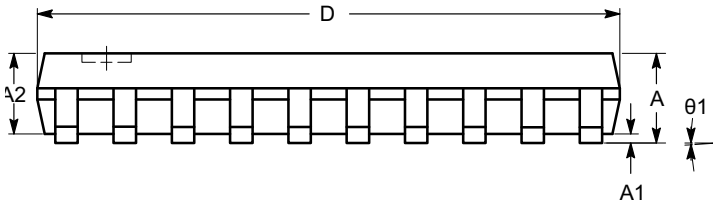
**TSSOP20, 4.4x6.5**
CASE 948AQ
ISSUE A

DATE 19 MAR 2009

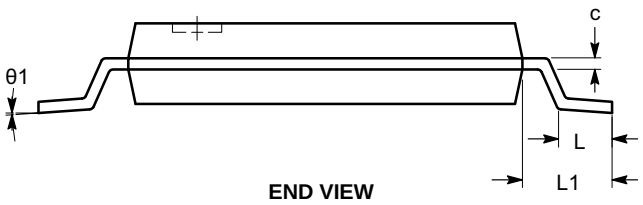



TOP VIEW

| SYMBOL | MIN | NOM | MAX |
|---|---|---|---|
| A | | | 1.20 |
| A1 | 0.05 | | 0.15 |
| A2 | 0.80 | | 1.05 |
| b | 0.19 | | 0.30 |
| c | 0.09 | | 0.20 |
| D | 6.40 | 6.50 | 6.60 |
| E | 6.30 | 6.40 | 6.50 |
| E1 | 4.30 | 4.40 | 4.50 |
| e | | 0.65 BSC | |
| L | 0.45 | 0.60 | 0.75 |
| L1 | | 1.00 REF | |
| θ | 0° | | 8° |




SIDE VIEW




END VIEW

**Notes:**
(1) All dimensions are in millimeters. Angles in degrees.
(2) Complies with JEDEC MO-153.

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