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MC74VHCT540A

Octal Bus Buffer

Inverting

The MC74VHCT540A is an advanced high speed CMOS inverting octal bus buffer fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

The MC74VHCT540A features inputs and outputs on opposite sides of the package and two AND-ed active-low output enables. When either $\overline{OE1}$ or $\overline{OE2}$ are high, the terminal outputs are in the high impedance state.

The VHCT inputs are compatible with TTL levels. This device can be used as a level converter for interfacing 3.3 V to 5.0 V, because it has full 5.0 V CMOS level output swings.

The VHCT540A input and output (when disabled) structures provide protection when voltages between 0 V and 5.5 V are applied, regardless of the supply voltage. These input and output structures help prevent device destruction caused by supply voltage – input/output voltage mismatch, battery backup, hot insertion, etc.

The internal circuit is composed of three stages, including a buffer output which provides high noise immunity and stable output. The inputs tolerate voltages up to 7.0 V, allowing the interface of 5.0 V systems to 3.0 V systems.

Features

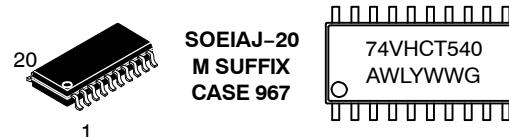
- High Speed: $t_{PD} = 3.7$ ns (Typ) at $V_{CC} = 5.0$ V
- Low Power Dissipation: $I_{CC} = 4.0$ μ A (Max) at $T_A = 25^\circ$ C
- TTL-Compatible Inputs: $V_{IL} = 0.8$ V; $V_{IH} = 2.0$ V
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Designed for 2.0 V to 5.5 V Operating Range
- Low Noise: $V_{OLP} = 1.2$ V (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300 mA
- ESD Performance: HBM > 2000 V; Machine Model > 200 V
- Chip Complexity: 124 FETs or 31 Equivalent Gates
- These Devices are Pb-Free and are RoHS Compliant



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MARKING DIAGRAM



1

SOEIAJ-20

M SUFFIX

CASE 967

A = Assembly Location
WL = Wafer Lot
Y = Year
WW = Work Week
G = Pb-Free Package

FUNCTION TABLE

| Inputs | | | Output \overline{Y} |
|------------------|------------------|---|-----------------------|
| $\overline{OE1}$ | $\overline{OE2}$ | A | |
| L | L | L | H |
| L | L | H | L |
| H | X | X | Z |
| X | H | X | Z |

ORDERING INFORMATION

| Device | Package | Shipping [†] |
|------------------|---------|-----------------------|
| MC74VHCT540AMG | SOEIAJ | 40 Units/Rail |
| MC74VHCT540AMELG | SOEIAJ | 2000 Units/T&R |

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

MC74VHCT540A

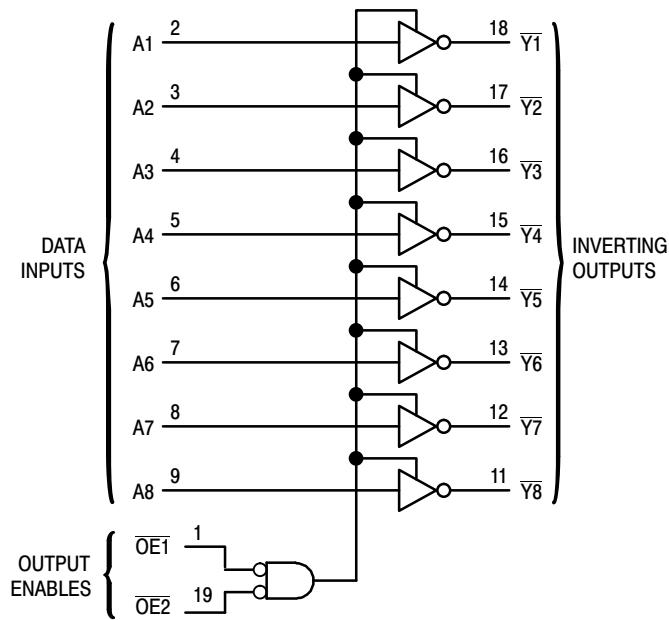


Figure 1. Logic Diagram

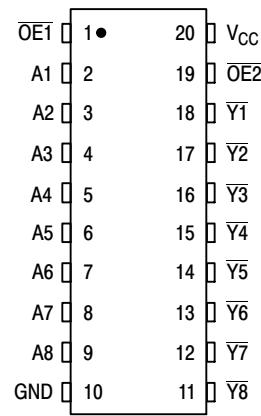


Figure 2. Pin Assignment

MC74VHCT540A

MAXIMUM RATINGS (Note 1)

| Symbol | Parameter | Value | Unit |
|-----------|---|------------------------|------|
| V_{CC} | DC Supply Voltage | –0.5 to + 7.0 | V |
| V_{in} | DC Input Voltage | –0.5 to + 7.0 | V |
| V_{out} | DC Output Voltage | –0.5 to V_{CC} + 0.5 | V |
| I_{IK} | Input Diode Current | –20 | mA |
| I_{OK} | Output Diode Current | ±20 | mA |
| I_{out} | DC Output Current, per Pin | ±25 | mA |
| I_{CC} | DC Supply Current, V_{CC} and GND Pins | ±75 | mA |
| P_D | Power Dissipation in Still Air (Note 2) SOIC Packages TSSOP Package | 500 450 | mW |
| T_{stg} | Storage Temperature | –65 to + 150 | °C |

1. Maximum Ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute maximum-rated conditions is not implied. Functional operation should be restricted to the Recommended Operating Conditions.
2. Derating – SOIC Packages: –7.0 mW/°C from 65° to 125°C
TSSOP Package: –6.1 mW/°C from 65° to 125°C

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit |
|------------|--|--------|-----------------|------|
| V_{CC} | DC Supply Voltage | 4.5 | 5.5 | V |
| V_{in} | DC Input Voltage | 0 | 5.5 | V |
| V_{out} | DC Output Voltage Outputs in 3-State High or Low State | 0 0 | 5.5 V_{CC} | V |
| T_A | Operating Temperature | –55 | 125 | °C |
| t_p, t_f | Input Rise and Fall Time $V_{CC} = 5.0$ V ±0.5 V | 0 | 20 | ns/V |

DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Test Conditions | V_{CC} (V) | $T_A = 25^\circ\text{C}$ | | | $T_A \leq 85^\circ\text{C}$ | | $T_A \leq 125^\circ\text{C}$ | | Unit |
|-----------|--|---|-------------------|--------------------------|------------|--------------------|-----------------------------|--------------------|------------------------------|--------------------|------|
| | | | | Min | Typ | Max | Min | Max | Min | Max | |
| V_{IH} | Minimum High-Level Input Voltage | | 3.0 4.5 5.5 | 1.2 2.0 2.0 | | | 1.2 2.0 2.0 | | 1.2 2.0 2.0 | | V |
| V_{IL} | Maximum Low-Level Input Voltage | | 3.0 4.5 5.5 | | | 0.53 0.8 0.8 | | 0.53 0.8 0.8 | | 0.53 0.8 0.8 | V |
| V_{OH} | Minimum High-Level Output Voltage $V_{IN} = V_{IH}$ or V_{IL} | $V_{IN} = V_{IH}$ or V_{IL} $I_{OH} = -50$ μA | 3.0 4.5 | 2.9 4.4 | 3.0 4.5 | | 2.9 4.4 | | 2.9 4.4 | | V |
| | | $V_{IN} = V_{IH}$ or V_{IL} $I_{OH} = -4.0$ mA $I_{OH} = -8.0$ mA | 3.0 4.5 | 2.58 3.94 | | | 2.48 3.80 | | 2.34 3.66 | | |
| V_{OL} | Maximum Low-Level Output Voltage $V_{IN} = V_{IH}$ or V_{IL} | $V_{IN} = V_{IH}$ or V_{IL} $I_{OL} = 50$ μA | 3.0 4.5 | | 0.0 0.0 | 0.1 0.1 | | 0.1 0.1 | | 0.1 0.1 | V |
| | | $V_{IN} = V_{IH}$ or V_{IL} $I_{OL} = 4.0$ mA $I_{OL} = 8.0$ mA | 3.0 4.5 | | | 0.36 0.36 | | 0.44 0.44 | | 0.52 0.52 | |
| I_{IN} | Maximum Input Leakage Current | $V_{in} = 5.5$ V or GND | 0 to 5.5 | | | ±0.1 | | ±1.0 | | ±1.0 | µA |
| I_{CC} | Maximum Quiescent Supply Current | $V_{in} = V_{CC}$ or GND | 5.5 | | | 2.0 | | 20 | | 40 | µA |
| I_{CCT} | Quiescent Supply Current | Input: $V_{IN} = 3.4$ V | 5.5 | | | 1.35 | | 1.50 | | 1.65 | mA |
| I_{OPD} | Output Leakage Current | $V_{OUT} = 5.5$ V | 0.0 | | | 0.5 | | 5.0 | | 10 | µA |

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AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0$ ns)

| Symbol | Parameter | Test Conditions | $T_A = 25^\circ\text{C}$ | | | $T_A = -40 \text{ to } 85^\circ\text{C}$ | | $T_A \leq 125^\circ\text{C}$ | | Unit |
|----------------------------|---|--|--------------------------|------------|--------------|--|--------------|------------------------------|--------------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| t_{PLH} , t_{PHL} | Maximum Propagation Delay, A to \bar{Y} (Figures 1 and 3) | $V_{CC} = 3.3 \pm 0.3$ V $C_L = 15$ pF $C_L = 50$ pF | | 4.8 7.3 | 7.0 10.5 | 1.0 1.0 | 8.5 12.0 | | 10.5 14.0 | ns |
| | | $V_{CC} = 5.0 \pm 0.5$ V $C_L = 15$ pF $C_L = 50$ pF | | 3.7 5.2 | 5.0 7.0 | 1.0 1.0 | 6.0 8.0 | | 8.0 10.0 | |
| t_{PZL} , t_{PZH} | Output Enable Time, \bar{OE}_n to \bar{Y} (Figures 2 and 4) | $V_{CC} = 3.3 \pm 0.3$ V $C_L = 15$ pF $R_L = 1.0$ k Ω $C_L = 50$ pF | | 6.8 9.3 | 10.5 14.0 | 1.0 1.0 | 12.5 16.0 | | 15.0 19.0 | ns |
| | | $V_{CC} = 5.0 \pm 0.5$ V $C_L = 15$ pF $R_L = 1.0$ k Ω $C_L = 50$ pF | | 4.7 6.2 | 7.2 9.2 | 1.0 1.0 | 8.5 10.5 | | 10.5 13.0 | |
| t_{PLZ} , t_{PHZ} | Output Disable Time, \bar{OE}_n to \bar{Y} (Figures 2 and 4) | $V_{CC} = 3.3 \pm 0.3$ V $C_L = 50$ pF $R_L = 1.0$ k Ω | | 11.2 | 15.4 | 1.0 | 17.5 | | 20.0 | ns |
| | | $V_{CC} = 5.0 \pm 0.5$ V $C_L = 50$ pF $R_L = 1.0$ k Ω | | 6.0 | 8.8 | 1.0 | 10.0 | | 11.5 | |
| t_{OSLH} , t_{OSHL} | Output to Output Skew | $V_{CC} = 3.3 \pm 0.3$ V $C_L = 50$ pF (Note 3) | | | 1.5 | | 1.5 | | 2.0 | ns |
| | | $V_{CC} = 5.0 \pm 0.5$ V $C_L = 50$ pF (Note 3) | | | 1.0 | | 1.0 | | 1.5 | |
| C_{in} | Maximum Input Capacitance | | | 4.0 | 10 | | 10 | | 10 | pF |
| C_{out} | Maximum Three-State Output Capacitance (Output in High Impedance State) | | | 6.0 | | | | | | pF |

| C_{PD} | Power Dissipation Capacitance (Note 4) | Typical @ 25°C , $V_{CC} = 5.0$ V | | pF |
|----------|--|---|--|----|
| | | 17 | | |

3. Parameter guaranteed by design. $t_{OSLH} = |t_{PLHm} - t_{PLLn}|$, $t_{OSHL} = |t_{PHLm} - t_{PHLn}|$.

4. 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: $I_{CC(OPR)} = C_{PD} \cdot V_{CC} \cdot f_{in} + I_{CC}/8$ (per bit). C_{PD} is used to determine the no-load dynamic power consumption; $P_D = C_{PD} \cdot V_{CC}^2 \cdot f_{in} + I_{CC} \cdot V_{CC}$.

NOISE CHARACTERISTICS (Input $t_r = t_f = 3.0$ ns, $C_L = 50$ pF, $V_{CC} = 5.0$ V)

| Symbol | Parameter | $T_A = 25^\circ\text{C}$ | | Unit |
|-----------|--|--------------------------|------|------|
| | | Typ | Max | |
| V_{OLP} | Quiet Output Maximum Dynamic V_{OL} | 0.9 | 1.2 | V |
| V_{OLV} | Quiet Output Minimum Dynamic V_{OL} | -0.9 | -1.2 | V |
| V_{IHD} | Minimum High Level Dynamic Input Voltage | | 3.5 | V |
| V_{ILD} | Maximum Low Level Dynamic Input Voltage | | 1.5 | V |

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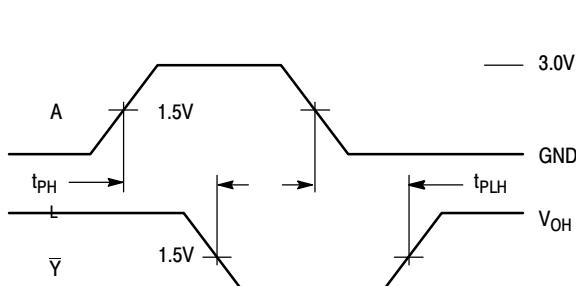


Figure 3. Switching Waveform

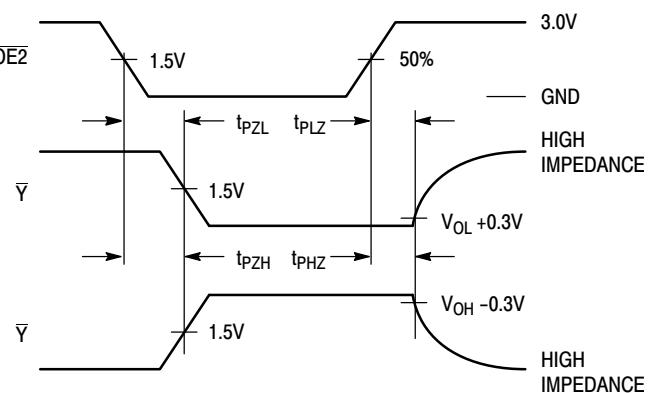
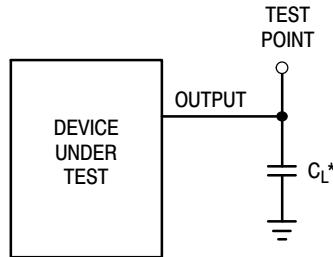
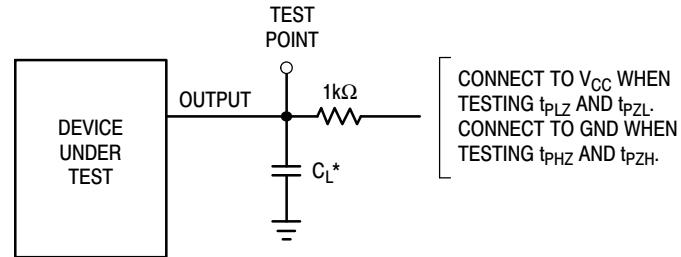


Figure 4. Switching Waveform



*Includes all probe and jig capacitance

Figure 5. Test Circuit



*Includes all probe and jig capacitance

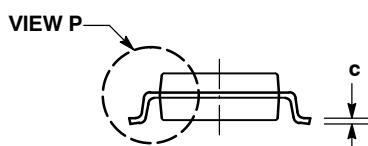
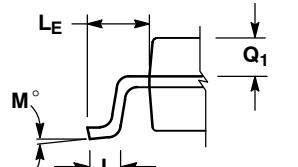
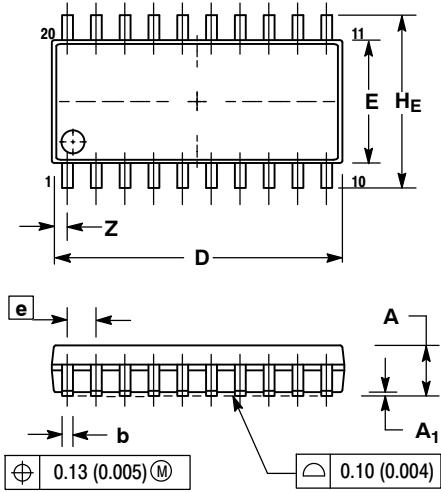
Figure 6. Test Circuit

CONNECT TO V_{CC} WHEN
TESTING t_{PLZ} AND t_{PZL} .
CONNECT TO GND WHEN
TESTING t_{PHZ} AND t_{PZH} .

MC74VHCT540A

PACKAGE DIMENSIONS

SOEIAJ-20
M SUFFIX
CASE 967-01
ISSUE A



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

| DIM | MILLIMETERS | | INCHES | |
|----------------|-------------|-------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | --- | 2.05 | --- | 0.081 |
| A ₁ | 0.05 | 0.20 | 0.002 | 0.008 |
| b | 0.35 | 0.50 | 0.014 | 0.020 |
| c | 0.15 | 0.25 | 0.006 | 0.010 |
| D | 12.35 | 12.80 | 0.486 | 0.504 |
| E | 5.10 | 5.45 | 0.201 | 0.215 |
| e | 1.27 BSC | | 0.050 BSC | |
| H _E | 7.40 | 8.20 | 0.291 | 0.323 |
| L | 0.50 | 0.85 | 0.020 | 0.033 |
| L _E | 1.10 | 1.50 | 0.043 | 0.059 |
| M | 0 ° | 10 ° | 0 ° | 10 ° |
| Q ₁ | 0.70 | 0.90 | 0.028 | 0.035 |
| Z | --- | 0.81 | --- | 0.032 |

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