

SN54AHC16240, SN74AHC16240 16-BIT BUFFERS/DRIVERS WITH 3-STATE OUTPUTS

SCLS326 – MARCH 1996

- Members of the Texas Instruments *Widebus*™ Family
- Operating Range 2-V to 5.5-V V_{CC}
- *EPIC*™ (Enhanced-Performance Implanted CMOS) Process
- Distributed V_{CC} and GND Pin Configuration Minimizes High-Speed Switching Noise
- Flow-Through Architecture Optimizes PCB Layout
- Package Options Include Plastic 300-mil Shrink Small-Outline (DL) Package and 380-mil Fine-Pitch Ceramic Flat (WD) Package Using 25-mil Center-to-Center Spacings

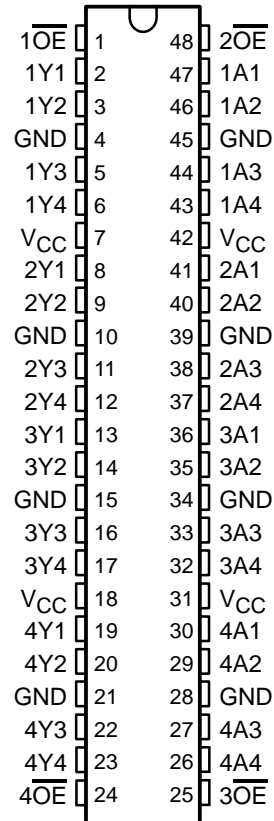
description

The 'AHC16240 are 16-bit buffers and line drivers designed specifically to improve both the performance and density of 3-state memory address drivers, clock drivers, and bus-oriented receivers and transmitters. These devices can be used as four 4-bit buffers, two 8-bit buffers, or one 16-bit buffer. These devices provide inverting outputs and symmetrical active-low output-enable (\overline{OE}) inputs.

The SN74AHC16240 is available in TI's shrink small-outline package (DL), which provides twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

The SN54AHC16240 is characterized for operation over the full military temperature range of -55°C to 125°C . The SN74AHC16240 is characterized for operation from -40°C to 85°C .

SN54AHC16240 . . . WD PACKAGE
SN74AHC16240 . . . DL PACKAGE
(TOP VIEW)



FUNCTION TABLE
(each 4-bit buffer)

| INPUTS | | OUTPUT Y |
|-----------------|---|-------------|
| \overline{OE} | A | |
| L | H | L |
| L | L | H |
| H | X | Z |



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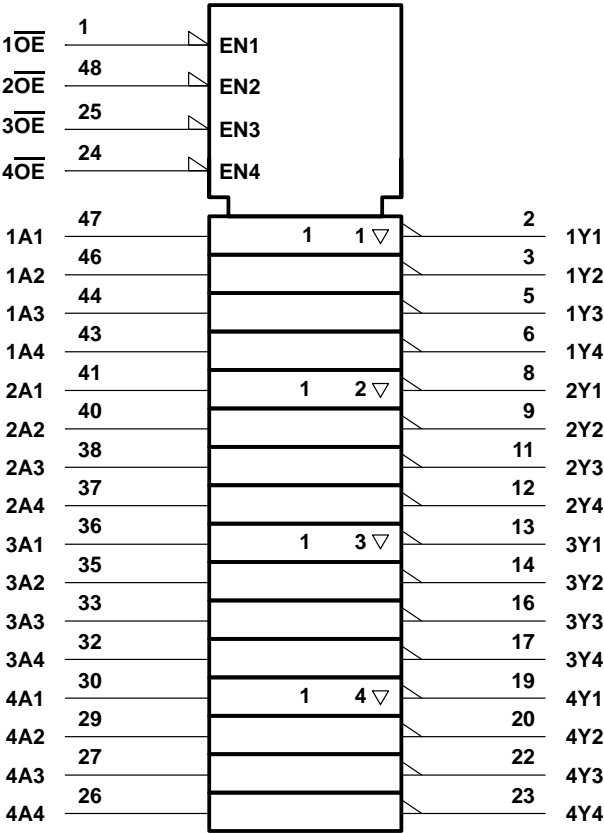
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WITH 3-STATE OUTPUTS

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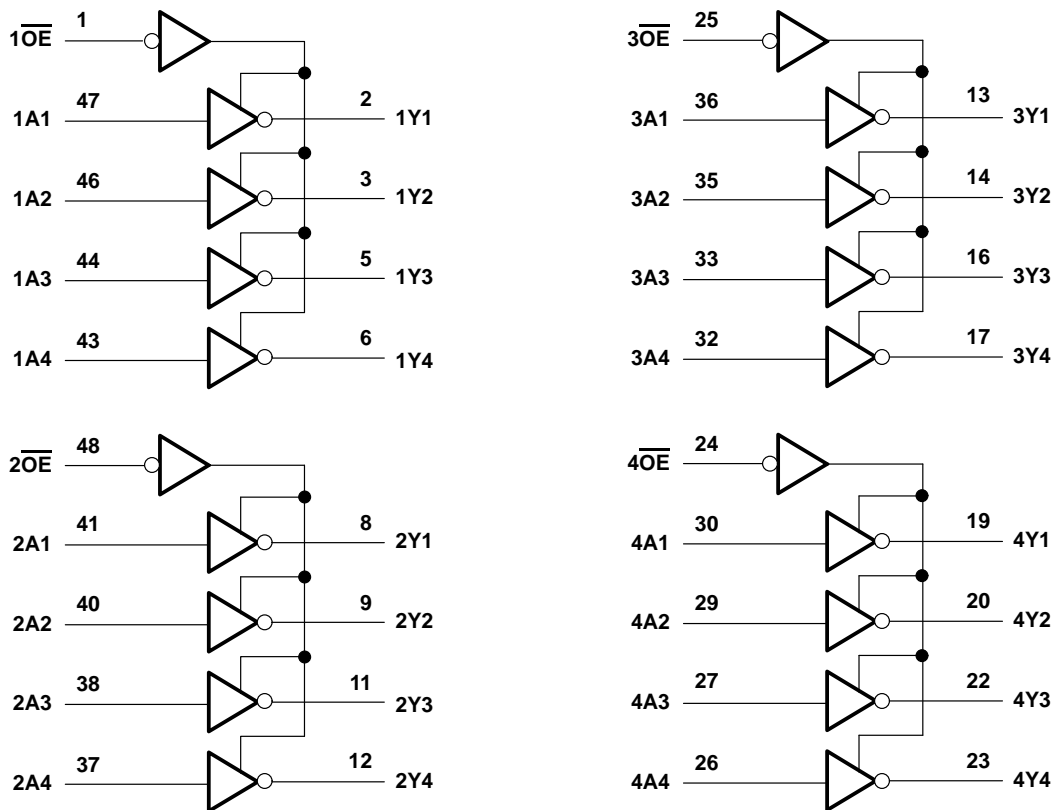
logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

PRODUCT PREVIEW

logic diagram (positive logic)



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

| | |
|---|----------------------------|
| Supply voltage range, V_{CC} | –0.5 V to 7 V |
| Input voltage range, V_I (see Note 1) | –0.5 V to 7 V |
| Output voltage range, V_O (see Note 1) | –0.5 V to $V_{CC} + 0.5$ V |
| Input clamp current, I_{IK} ($V_I < 0$ or $V_I > V_{CC}$) | –20 mA |
| Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$) | ±20 mA |
| Continuous output current, I_O ($V_O = 0$ to V_{CC}) | ±25 mA |
| Continuous current through each V_{CC} or GND | ±75 mA |
| Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 2): DL package | 1.2 W |
| Storage temperature range, T_{stg} | –65°C to 150°C |

[†] Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. The input and output voltage ratings may be exceeded if the input and output current ratings are observed.
2. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils.

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recommended operating conditions (see Note 3)

| | | | SN54AHC16240 | | SN74AHC16240 | | UNIT |
|-----------------|------------------------------------|------------------------------|--------------|-----------------|--------------|-----------------|------|
| | | | MIN | MAX | MIN | MAX | |
| V _{CC} | Supply voltage | | 2 | 5.5 | 2 | 5.5 | V |
| V _{IH} | High-level input voltage | V _{CC} = 2 V | 1.5 | | 1.5 | | V |
| | | V _{CC} = 3 V | 2.1 | | 2.1 | | |
| | | V _{CC} = 5.5 V | 3.85 | | 3.85 | | |
| V _{IL} | Low-level input voltage | V _{CC} = 2 V | | 0.5 | | 0.5 | V |
| | | V _{CC} = 3 V | | 0.9 | | 0.9 | |
| | | V _{CC} = 5.5 V | | 1.65 | | 1.65 | |
| V _I | Input voltage | | 0 | 5.5 | 0 | 5.5 | V |
| V _O | Output voltage | | 0 | V _{CC} | 0 | V _{CC} | V |
| I _{OH} | High-level output current | V _{CC} = 2 V | | –50 | | –50 | μA |
| | | V _{CC} = 3.3 ±0.3 V | | –4 | | –4 | |
| | | V _{CC} = 5 ±0.5 V | | –8 | | –8 | |
| I _{OL} | Low-level output current | V _{CC} = 2 V | | 50 | | 50 | μA |
| | | V _{CC} = 3.3 ±0.3 V | | 4 | | 4 | |
| | | V _{CC} = 5 ±0.5 V | | 8 | | 8 | |
| Δt/Δv | Input transition rise or fall rate | V _{CC} = 3.3 ±0.3 V | | 100 | | 100 | ns/V |
| | | V _{CC} = 5 ±0.5 V | | 20 | | 20 | |
| T _A | Operating free-air temperature | | –55 | 125 | –40 | 85 | °C |

NOTE 3: Unused inputs must be held high or low to prevent them from floating.

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

| PARAMETER | | TEST CONDITIONS | V _{CC} | T _A = 25°C | | | SN54AHC16240 | | SN74AHC16240 | | UNIT |
|------------------------------|----------------|---|-----------------|-----------------------|-----|-------|--------------|-----|--------------|-----|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| V _{OH} | | I _{OH} = –50 μA | 2 V | 1.9 | 2 | | 1.9 | | 1.9 | | V |
| | | | 3 V | 2.9 | 3 | | 2.9 | | 2.9 | | |
| | | | 4.5 V | 4.4 | 4.5 | | 4.4 | | 4.4 | | |
| | | I _{OH} = –4 mA | 3 V | 2.58 | | | 2.48 | | 2.48 | | |
| | | I _{OH} = –8 mA | 4.5 V | 3.94 | | | 3.8 | | 3.8 | | |
| V _{OL} | | I _{OL} = 50 μA | 2 V | | | 0.1 | | | 0.1 | | V |
| | | | 3 V | | | 0.1 | | | 0.1 | | |
| | | | 4.5 V | | | 0.1 | | | 0.1 | | |
| | | I _{OL} = 4 mA | 3 V | | | 0.36 | | | 0.5 | | |
| | | I _{OL} = 8 mA | 4.5 V | | | 0.36 | | | 0.5 | | |
| I _I | Data inputs | V _I = V _{CC} or GND | 5.5 V | | | ±0.1 | | | ±1 | | μA |
| | Control inputs | | | | | ±0.1 | | | ±1 | | |
| I _{OZ} [†] | | V _O = V _{CC} or GND, V _I (OE) = V _{IL} or V _{IH} | 5.5 V | | | ±0.25 | | | ±2.5 | | μA |
| I _{CC} | | V _I = V _{CC} or GND, I _O = 0 | 5.5 V | | | 4 | | | 40 | | μA |
| C _i | | V _I = V _{CC} or GND | 5 V | | | 2.5 | | | 10 | | pF |
| C _o | | V _O = V _{CC} or GND | 5 V | | | 3.5 | | | | | pF |

[†] The parameter I_{OZ} includes the input leakage current.

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switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE | $T_A = 25^\circ\text{C}$ | | | SN54AHC16240 | | SN74AHC16240 | | UNIT |
|-------------|-----------------|----------------|----------------------|--------------------------|------|-----|--------------|------|--------------|------|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| t_{PLH}^* | A | Y | $C_L = 15\text{ pF}$ | 5.3 | 7.5 | | 1 | 9 | 1 | 9 | ns |
| t_{PHL}^* | | | | 5.3 | 7.5 | | 1 | 9 | 1 | 9 | |
| t_{PZH}^* | \overline{OE} | Y | $C_L = 15\text{ pF}$ | 6.6 | 10.6 | | 1 | 12.5 | 1 | 12.5 | ns |
| t_{PZL}^* | | | | 6.6 | 10.6 | | 1 | 12.5 | 1 | 12.5 | |
| t_{PHZ}^* | \overline{OE} | Y | $C_L = 15\text{ pF}$ | 7.8 | 11.5 | | 1 | 12.5 | 1 | 12.5 | ns |
| t_{PLZ}^* | | | | 7.8 | 11.5 | | 1 | 12.5 | 1 | 12.5 | |
| t_{PLH} | A | Y | $C_L = 50\text{ pF}$ | 7.8 | 11 | | 1 | 12.5 | 1 | 12.5 | ns |
| t_{PHL} | | | | 7.8 | 11 | | 1 | 12.5 | 1 | 12.5 | |
| t_{PZH} | \overline{OE} | Y | $C_L = 50\text{ pF}$ | 9.1 | 14.1 | | 1 | 16 | 1 | 16 | ns |
| t_{PZL} | | | | 9.1 | 14.1 | | 1 | 16 | 1 | 16 | |
| t_{PHZ} | \overline{OE} | Y | $C_L = 50\text{ pF}$ | 10.3 | 14 | | 1 | 16 | 1 | 16 | ns |
| t_{PLZ} | | | | 10.3 | 14 | | 1 | 16 | 1 | 16 | |

* On products compliant to MIL-PRF-38535, this parameter is ensured but not production tested.

switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | LOAD CAPACITANCE | $T_A = 25^\circ\text{C}$ | | | SN54AHC16240 | | SN74AHC16240 | | UNIT |
|-------------|-----------------|----------------|----------------------|--------------------------|-----|-----|--------------|------|--------------|------|------|
| | | | | MIN | TYP | MAX | MIN | MAX | MIN | MAX | |
| t_{PLH}^* | A | Y | $C_L = 15\text{ pF}$ | 3.6 | 5.5 | | 1 | 6.5 | 1 | 6.5 | ns |
| t_{PHL}^* | | | | 3.6 | 5.5 | | 1 | 6.5 | 1 | 6.5 | |
| t_{PZH}^* | \overline{OE} | Y | $C_L = 15\text{ pF}$ | 4.7 | 7.3 | | 1 | 8.5 | 1 | 8.5 | ns |
| t_{PZL}^* | | | | 4.7 | 7.3 | | 1 | 8.5 | 1 | 8.5 | |
| t_{PHZ}^* | \overline{OE} | Y | $C_L = 15\text{ pF}$ | 5.2 | 7.2 | | 1 | 8.5 | 1 | 8.5 | ns |
| t_{PLZ}^* | | | | 5.2 | 7.2 | | 1 | 8.5 | 1 | 8.5 | |
| t_{PLH} | A | Y | $C_L = 50\text{ pF}$ | 5.1 | 7.5 | | 1 | 8.5 | 1 | 8.5 | ns |
| t_{PHL} | | | | 5.1 | 7.5 | | 1 | 8.5 | 1 | 8.5 | |
| t_{PZH} | \overline{OE} | Y | $C_L = 50\text{ pF}$ | 6.2 | 9.3 | | 1 | 10.5 | 1 | 10.5 | ns |
| t_{PZL} | | | | 6.2 | 9.3 | | 1 | 10.5 | 1 | 10.5 | |
| t_{PHZ} | \overline{OE} | Y | $C_L = 50\text{ pF}$ | 6.7 | 9.2 | | 1 | 10.5 | 1 | 10.5 | ns |
| t_{PLZ} | | | | 6.7 | 9.2 | | 1 | 10.5 | 1 | 10.5 | |

* On products compliant to MIL-PRF-38535, this parameter is ensured but not production tested.

output-skew characteristics, $C_L = 50\text{ pF}$ (see Note 4)

| PARAMETER | | VCC | SN74AHC16240 | | | | UNIT |
|--------------------|-------------|--------------|--------------|-----|-----|-----|------|
| | | | TA = 25°C | | MIN | MAX | |
| | | | MIN | MAX | | | |
| t _{sk(o)} | Output skew | 3.3 V ±0.3 V | 1.5 | | 1.5 | | ns |
| | | 5 V ±0.5 V | 1 | | 1 | | |

NOTE 4: Characteristics are determined during product characterization and ensured by design.



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noise characteristics, $V_{CC} = 5\text{ V}$, $C_L = 50\text{ pF}$, $T_A = 25^\circ\text{C}$ (see Note 5)

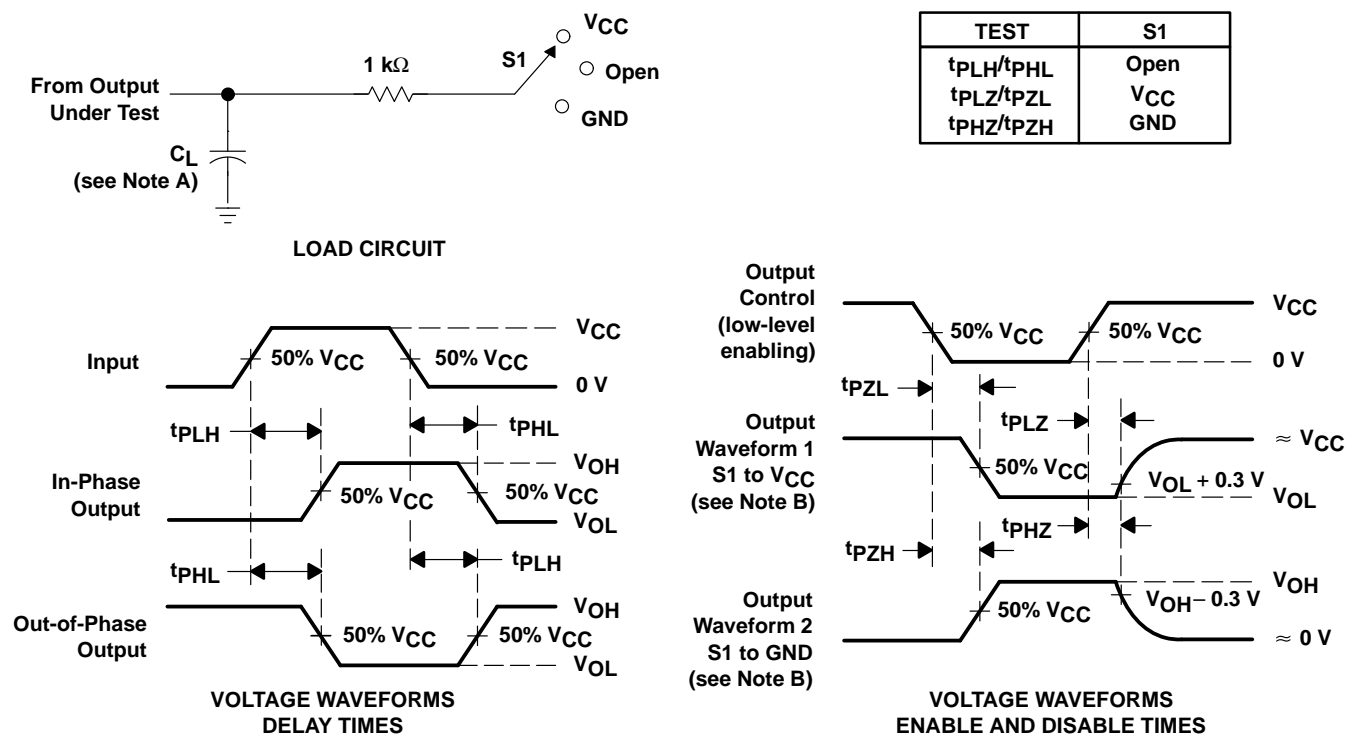
| PARAMETER | SN74AHC16240 | | | UNIT |
|--|--------------|------|-----|------|
| | MIN | TYP | MAX | |
| $V_{OL(P)}$ Quiet output, maximum dynamic V_{OL} | | 0.6 | | V |
| $V_{OL(V)}$ Quiet output, minimum dynamic V_{OL} | | -0.6 | | V |
| $V_{OH(V)}$ Quiet output, minimum dynamic V_{OH} | | 4.6 | | V |
| $V_{IH(D)}$ High-level dynamic input voltage | 3.5 | | | V |
| $V_{IL(D)}$ Low-level dynamic input voltage | | | 1.5 | V |

NOTE 5: Characteristics are determined during product characterization and ensured by design for surface-mount packages only.

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

| PARAMETER | TEST CONDITIONS | TYP | UNIT |
|--|-----------------------------|-----|------|
| C_{pd} Power dissipation capacitance | No load, $f = 1\text{ MHz}$ | 10 | pF |

PARAMETER MEASUREMENT INFORMATION



NOTES: A. C_L includes probe and jig capacitance.

B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control.

Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.

C. All input pulses are supplied by generators having the following characteristics: $PRR \leq 1\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r = 3\text{ ns}$, $t_f = 3\text{ ns}$.

D. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms

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