

74LVC540A

Low-Voltage CMOS Octal Buffer Flow Through Pinout

With 5 V-Tolerant Inputs and Outputs
(3-State, Inverting)

The 74LVC540A is a high performance, inverting octal buffer operating from a 1.2 to 3.6 V supply. This device is similar in function to the MC74LCX240, while providing flow through architecture. High impedance TTL compatible inputs significantly reduce current loading to input drivers while TTL compatible outputs offer improved switching noise performance. A V_I specification of 5.5 V allows 74LVC540A inputs to be safely driven from 5 V devices. The 74LVC540A is suitable for memory address driving and all TTL level bus oriented transceiver applications.

Current drive capability is 24 mA at the outputs. The Output Enable ($\overline{OE1}$, $\overline{OE2}$) inputs, when HIGH, disables the outputs by placing them in a HIGH Z condition.

Features

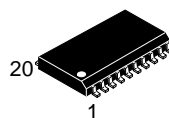
- Designed for 1.2 to 3.6 V V_{CC} Operation
- 5 V Tolerant – Interface Capability With 5 V TTL Logic
- Supports Live Insertion and Withdrawal
- I_{OFF} Specification Guarantees High Impedance When $V_{CC} = 0$ V
- 24 mA Output Sink and Source Capability
- Near Zero Static Supply Current in All Three Logic States (10 μ A)
Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 250 mA
- ESD Performance:
 - ◆ Human Body Model > 2000 V
 - ◆ Machine Model > 200 V
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant



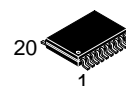
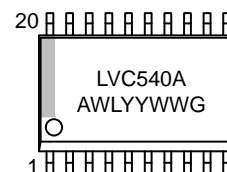
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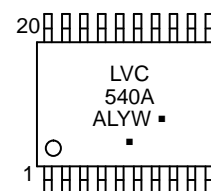
MARKING DIAGRAMS



SOIC-20 WB
DW SUFFIX
CASE 751D



TSSOP-20
DT SUFFIX
CASE 948E



A = Assembly Location
L, WL = Wafer Lot
Y, YY = Year
W, WW = Work Week
G or ■ = Pb-Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 7 of this data sheet.

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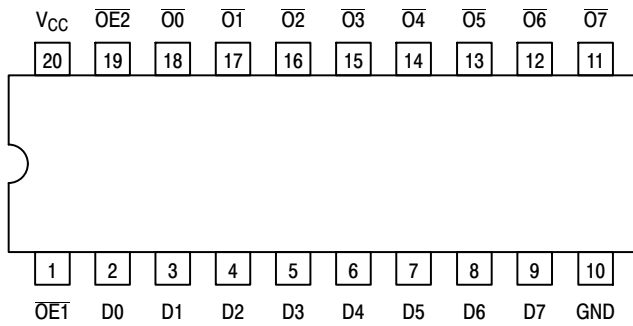


Figure 1. Pinout: 20-Lead (Top View)

PIN NAMES

| Pins | Function |
|------------------|----------------------|
| $\overline{OE}n$ | Output Enable Inputs |
| Dn | Data Inputs |
| $\overline{O}n$ | 3-State Outputs |

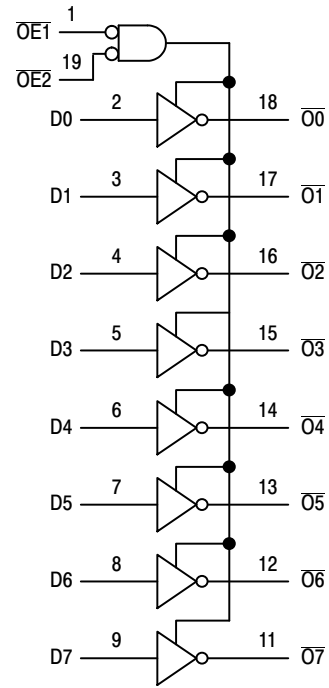


Figure 2. Logic Diagram

TRUTH TABLE

| Inputs | | | Outputs |
|------------------|------------------|------|-----------------|
| $\overline{OE}1$ | $\overline{OE}2$ | Dn | $\overline{O}n$ |
| L | L | L | H |
| L | L | H | L |
| X | H | X | Z |
| H | X | X | Z |

H = High Voltage Level

L = Low Voltage Level

Z = High Impedance State

X = High or Low Voltage Level and Transitions are Acceptable

For I_{CC} reasons, DO NOT FLOAT Inputs

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MAXIMUM RATINGS

| Symbol | Parameter | Value | Condition | Unit |
|---------------|---|-----------------------------------|--------------------------------------|------|
| V_{CC} | DC Supply Voltage | -0.5 to +6.5 | | V |
| V_I | DC Input Voltage | $-0.5 \leq V_I \leq +6.5$ | | V |
| V_O | DC Output Voltage | $-0.5 \leq V_O \leq +6.5$ | Output in 3-State | V |
| | | $-0.5 \leq V_O \leq V_{CC} + 0.5$ | Output in HIGH or LOW State (Note 1) | V |
| I_{IK} | DC Input Diode Current | -50 | $V_I < GND$ | mA |
| I_{OK} | DC Output Diode Current | -50 | $V_O < GND$ | mA |
| | | +50 | $V_O > V_{CC}$ | mA |
| I_O | DC Output Source/Sink Current | ± 50 | | mA |
| I_{CC} | DC Supply Current Per Supply Pin | ± 100 | | mA |
| I_{GND} | DC Ground Current Per Ground Pin | ± 100 | | mA |
| T_{STG} | Storage Temperature Range | -65 to +150 | | °C |
| T_L | Lead Temperature, 1 mm from Case for 10 Seconds | $T_L = 260$ | | °C |
| T_J | Junction Temperature Under Bias | $T_J = 135$ | | °C |
| θ_{JA} | Thermal Resistance (Note 2) | SOIC = 65.8 TSSOP = 110.7 | | °C/W |
| MSL | Moisture Sensitivity | | Level 1 | |
| $I_{LATCHUP}$ | Latch-up Performance at $V_{CC} = 3.6$ V and 125°C (Note 3) | | ± 250 | mA |

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.

- I_O absolute maximum rating must be observed.
- Measured with minimum pad spacing on an FR4 board, using 10 mm-by-1 inch, 2 ounce copper trace no air flow.
- Tested to EIA/JES078.

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Typ | Max | Units |
|---------------------|--|-------------|-----|-----------------|-------|
| V_{CC} | Supply Voltage Operating Functional | 1.65 1.2 | | 3.6 3.6 | V |
| V_I | Input Voltage | 0 | | 5.5 | V |
| V_O | Output Voltage HIGH or LOW State 3-State | 0 0 | | V_{CC} 5.5 | V |
| I_{OH} | HIGH Level Output Current $V_{CC} = 3.0$ V – 3.6 V $V_{CC} = 2.7$ V – 3.0 V | | | -24 -12 | mA |
| I_{OL} | LOW Level Output Current $V_{CC} = 3.0$ V – 3.6 V $V_{CC} = 2.7$ V – 3.0 V | | | 24 12 | mA |
| T_A | Operating Free-Air Temperature | -40 | | +125 | °C |
| $\Delta t/\Delta V$ | Input Transition Rise or Fall Rate, V_{IN} from 0.8 V to 2.0 V, $V_{CC} = 3.0$ V | 0 | | 10 | ns/V |

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.

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DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Conditions | -40°C to +85°C | | | -40°C to +125°C | | | Unit |
|------------------|---------------------------|---|------------------------|-----------------|------------------------|------------------------|-----------------|------------------------|------|
| | | | Min | Typ (Note 4) | Max | Min | Typ (Note 4) | Max | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 1.2 V | 1.08 | - | - | 1.08 | - | - | V |
| | | V _{CC} = 1.65 V to 1.95 V | 0.65 x V _{CC} | - | - | 0.65 x V _{CC} | - | - | |
| | | V _{CC} = 2.3 V to 2.7 V | 1.7 | - | - | 1.7 | - | - | |
| | | V _{CC} = 2.7 V to 3.6 V | 2.0 | - | - | 2.0 | - | - | |
| V _{IL} | LOW-level input voltage | V _{CC} = 1.2 V | - | - | 0.12 | - | - | 0.12 | V |
| | | V _{CC} = 1.65 V to 1.95 V | - | - | 0.35 x V _{CC} | - | - | 0.35 x V _{CC} | |
| | | V _{CC} = 2.3 V to 2.7 V | - | - | 0.7 | - | - | 0.7 | |
| | | V _{CC} = 2.7 V to 3.6 V | - | - | 0.8 | - | - | 0.8 | |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | | V |
| | | I _O = -100 μA; V _{CC} = 1.65 V to 3.6 V | V _{CC} - 0.2 | - | - | V _{CC} - 0.3 | - | - | |
| | | I _O = -4 mA; V _{CC} = 1.65 V | 1.2 | - | - | 1.05 | - | - | |
| | | I _O = -8 mA; V _{CC} = 2.3 V | 1.8 | - | - | 1.65 | - | - | |
| | | I _O = -12 mA; V _{CC} = 2.7 V | 2.2 | - | - | 2.05 | - | - | |
| | | I _O = -18 mA; V _{CC} = 3.0 V | 2.4 | - | - | 2.25 | - | - | |
| | | I _O = -24 mA; V _{CC} = 3.0 V | 2.2 | - | - | 2.0 | - | - | |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | | V |
| | | I _O = 100 μA; V _{CC} = 1.65 V to 3.6 V | - | - | 0.2 | - | - | 0.3 | |
| | | I _O = 4 mA; V _{CC} = 1.65 V | - | - | 0.45 | - | - | 0.65 | |
| | | I _O = 8 mA; V _{CC} = 2.3 V | - | - | 0.6 | - | - | 0.8 | |
| | | I _O = 12 mA; V _{CC} = 2.7 V | - | - | 0.4 | - | - | 0.6 | |
| | | I _O = -24 mA; V _{CC} = 3.0 V | - | - | 0.55 | - | - | 0.8 | |
| I _I | Input leakage current | V _I = 5.5V or GND; V _{CC} = 3.6 V | - | ±0.1 | ±5 | - | ±0.1 | ±20 | μA |
| I _{OZ} | OFF-state output current | V _I = V _{IH} or V _{IL} ; V _O = 5.5 V or GND; V _{CC} = 3.6 V | - | ±0.1 | ±5 | - | ±0.1 | ±20 | μA |
| I _{OFF} | Power-off leakage current | V _I or V _O = 5.5 V; V _{CC} = 0.0 V | - | ±0.1 | ±10 | - | ±0.1 | ±20 | μA |
| I _{CC} | Supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 3.6 V | - | 0.1 | 10 | - | 0.1 | 40 | μA |
| ΔI _{CC} | Additional supply current | per input pin; V _I = V _{CC} - 0.6 V; I _O = 0 A; V _{CC} = 2.7 V to 3.6 V | - | 5 | 500 | - | 5 | 5000 | 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.

4. All typical values are measured at T_A = 25°C and V_{CC} = 3.3 V, unless stated otherwise.

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AC ELECTRICAL CHARACTERISTICS ($t_R = t_F = 2.5$ ns)

| Symbol | Parameter | Conditions | -40°C to +85°C | | | -40°C to +125°C | | | Unit |
|-------------|--|-------------------------------|----------------|------------------|------|-----------------|------------------|------|------|
| | | | Min | Typ ⁵ | Max | Min | Typ ⁵ | Max | |
| t_{pd} | Propagation Delay (Note 6) nDn to nOn | $V_{CC} = 1.2$ V | - | 18.0 | - | - | - | - | ns |
| | | $V_{CC} = 1.65$ V to 1.95 V | 1.0 | - | 16.4 | 1.0 | - | 16.4 | |
| | | $V_{CC} = 2.3$ V to 2.7 V | 1.0 | - | 7.8 | 1.0 | - | 7.8 | |
| | | $V_{CC} = 2.7$ V | 1.0 | - | 7.1 | 1.0 | - | 7.1 | |
| | | $V_{CC} = 3.0$ V to 3.6 V | 1.0 | - | 5.3 | 1.0 | - | 5.3 | |
| t_{en} | Enable Time (Note 7) nOE to nOn | $V_{CC} = 1.2$ V | - | 20.0 | - | - | - | - | ns |
| | | $V_{CC} = 1.65$ V to 1.95 V | 1.0 | - | 16.5 | 1.0 | - | 16.5 | |
| | | $V_{CC} = 2.3$ V to 2.7 V | 1.0 | - | 10.5 | 1.0 | - | 10.5 | |
| | | $V_{CC} = 2.7$ V | 1.0 | - | 8.0 | 1.0 | - | 8.0 | |
| | | $V_{CC} = 3.0$ V to 3.6 V | 1.0 | - | 6.6 | 1.0 | - | 6.6 | |
| t_{dis} | Disable Time (Note 8) nOE to nOn | $V_{CC} = 1.2$ V | - | 18.0 | - | - | - | - | ns |
| | | $V_{CC} = 1.65$ V to 1.95 V | 1.0 | - | 15.9 | 1.0 | - | 15.9 | |
| | | $V_{CC} = 2.3$ V to 2.7 V | 1.0 | - | 9.0 | 1.0 | - | 9.0 | |
| | | $V_{CC} = 2.7$ V | 1.0 | - | 8.2 | 1.0 | - | 8.2 | |
| | | $V_{CC} = 3.0$ V to 3.6 V | 1.0 | - | 7.4 | 1.0 | - | 7.4 | |
| $t_{sk(0)}$ | Output Skew Time (Note 9) | | - | - | 1.0 | - | - | 1.5 | ns |

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.

5. Typical values are measured at $T_A = 25^\circ\text{C}$ and $V_{CC} = 3.3$ V, unless stated otherwise.

6. t_{pd} is the same as t_{PLH} and t_{PHL} .

7. t_{en} is the same as t_{PZL} and t_{PZH} .

8. t_{dis} is the same as t_{PLZ} and t_{PHZ} .

9. Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

DYNAMIC SWITCHING CHARACTERISTICS

| Symbol | Characteristic | Condition | $T_A = +25^\circ\text{C}$ | | | Unit |
|-----------|--------------------------------------|--|---------------------------|--------------|-----|------|
| | | | Min | Typ | Max | |
| V_{OLP} | Dynamic LOW Peak Voltage (Note 10) | $V_{CC} = 3.3$ V, $C_L = 50$ pF, $V_{IH} = 3.3$ V, $V_{IL} = 0$ V $V_{CC} = 2.5$ V, $C_L = 30$ pF, $V_{IH} = 2.5$ V, $V_{IL} = 0$ V | | 0.8 0.6 | | V |
| V_{OLV} | Dynamic LOW Valley Voltage (Note 10) | $V_{CC} = 3.3$ V, $C_L = 50$ pF, $V_{IH} = 3.3$ V, $V_{IL} = 0$ V $V_{CC} = 2.5$ V, $C_L = 30$ pF, $V_{IH} = 2.5$ V, $V_{IL} = 0$ V | | -0.8 -0.6 | | V |

10. Number of outputs defined as "n". Measured with "n-1" outputs switching from HIGH-to-LOW or LOW-to-HIGH. The remaining output is measured in the LOW state.

CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | Condition | Typical | Unit |
|-----------|---|---|---------|------|
| C_{IN} | Input Capacitance | $V_{CC} = 3.3$ V, $V_I = 0$ V or V_{CC} | 5.0 | pF |
| C_{OUT} | Output Capacitance | $V_{CC} = 3.3$ V, $V_I = 0$ V or V_{CC} | 7.0 | pF |
| C_{PD} | Power Dissipation Capacitance (Note 11) | Per input; $V_I = \text{GND}$ or V_{CC} | | pF |
| | | $V_{CC} = 1.65$ V to 1.95 V | 7.7 | |
| | | $V_{CC} = 2.3$ V to 2.7 V | 11.3 | |
| | | $V_{CC} = 3.0$ V to 3.6 V | 14.4 | |

11. C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

$P_D = C_{PD} * V_{CC}^2 * f_i * N + \sum (C_L * V_{CC}^2 * f_o)$ where:

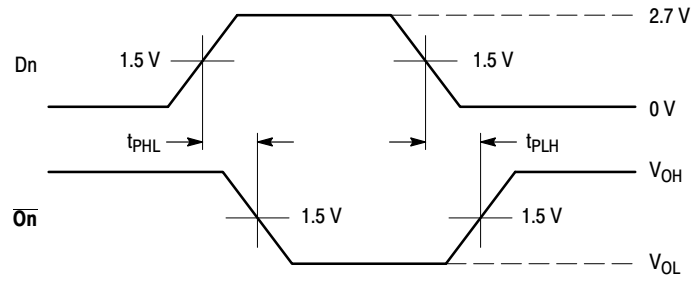
f_i = input frequency in MHz; f_o = output frequency in MHz

C_L = output load capacitance in pF V_{CC} = supply voltage in Volts

N = number of outputs switching

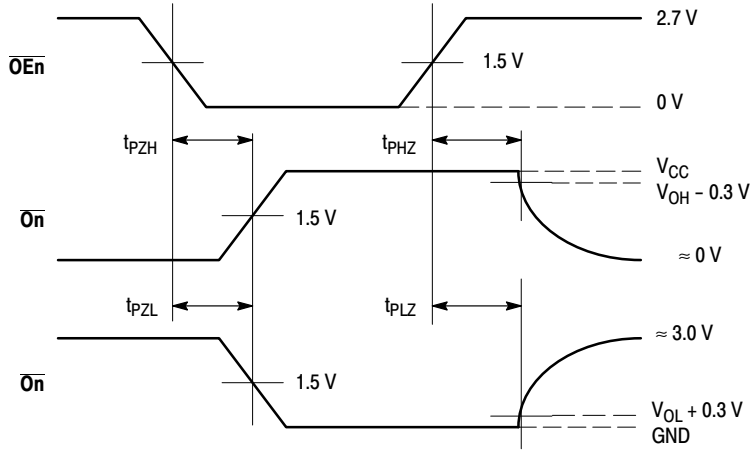
$\sum(C_L * V_{CC}^2 * f_o)$ = sum of the outputs.

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WAVEFORM 1 - PROPAGATION DELAYS

$t_R = t_F = 2.5 \text{ ns}$, 10% to 90%; $f = 1 \text{ MHz}$; $t_W = 500 \text{ ns}$



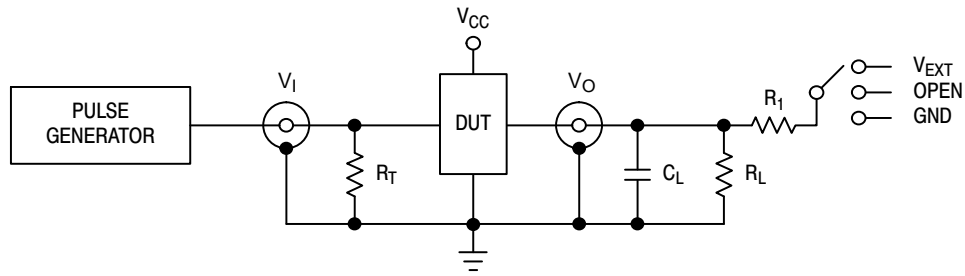
WAVEFORM 2 - OUTPUT ENABLE AND DISABLE TIMES

$t_R = t_F = 2.5 \text{ ns}$, 10% to 90%; $f = 1 \text{ MHz}$; $t_W = 500 \text{ ns}$

Figure 3. AC Waveforms

| Symbol | V _{CC} | | |
|-----------------|-------------------------|-------------------------|--------------------------|
| | 3.3 V ± 0.3 V | 2.7 V | V _{CC} < 2.7 V |
| V _{mi} | 1.5 V | 1.5 V | V _{CC} /2 |
| V _{mo} | 1.5 V | 1.5 V | V _{CC} /2 |
| V _{HZ} | V _{OL} + 0.3 V | V _{OL} + 0.3 V | V _{OL} + 0.15 V |
| V _{LZ} | V _{OH} - 0.3 V | V _{OH} - 0.3 V | V _{OH} - 0.15 V |

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C_L includes jig and probe capacitance
 $R_T = Z_{OUT}$ of pulse generator (typically 50 Ω)
 $R_1 = R_L$

| Supply Voltage | Input | | Load | | V_{EXT} | | |
|----------------|----------|---------------|-------|--------------|--------------------|--------------------|--------------------|
| V_{CC} (V) | V_I | t_r, t_f | C_L | R_L | t_{PLH}, t_{PHL} | t_{PLZ}, t_{PZL} | t_{PHZ}, t_{PZH} |
| 1.2 | V_{CC} | ≤ 2 ns | 30 pF | 1 k Ω | Open | $2 \times V_{CC}$ | GND |
| 1.65 – 1.95 | V_{CC} | ≤ 2 ns | 30 pF | 1 k Ω | Open | $2 \times V_{CC}$ | GND |
| 2.3 – 2.7 | V_{CC} | ≤ 2 ns | 30 pF | 500 Ω | Open | $2 \times V_{CC}$ | GND |
| 2.7 | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | Open | $2 \times V_{CC}$ | GND |
| 3 – 3.6 | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω | Open | $2 \times V_{CC}$ | GND |

Figure 4. Test Circuit

ORDERING INFORMATION

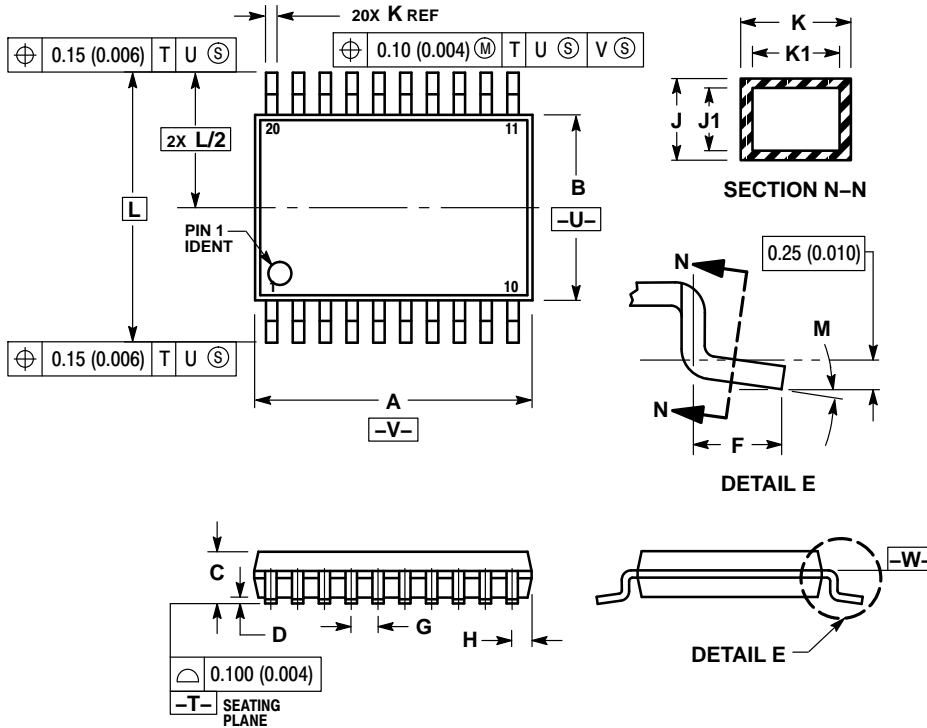
| Device | Package | Shipping [†] |
|----------------|-----------------------|-----------------------|
| 74LVC540ADWR2G | SOIC-20 (Pb-Free) | 1000 / Tape & Reel |
| 74LVC540ADTR2G | TSSOP-20 (Pb-Free) | 2500 / Tape & Reel |

[†]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.

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PACKAGE DIMENSIONS

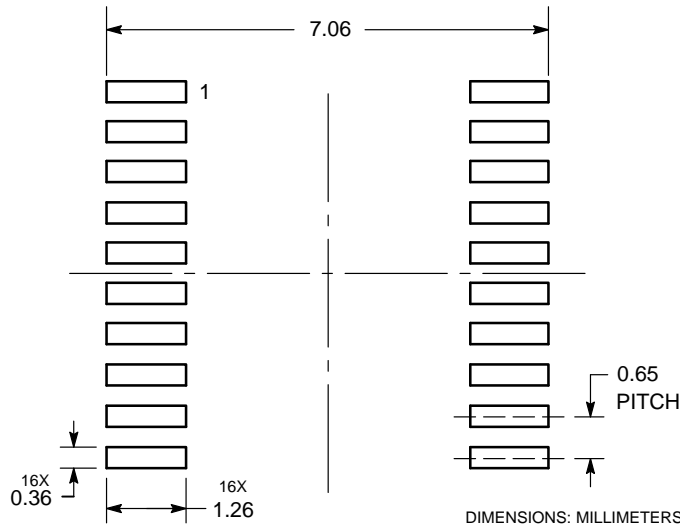
TSSOP-20
CASE 948E-02
ISSUE C



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

SOLDERING FOOTPRINT*

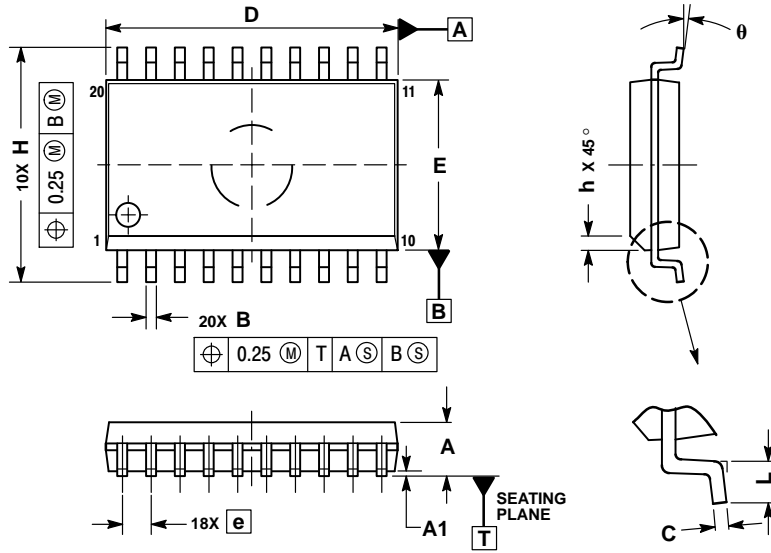


*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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PACKAGE DIMENSIONS


SOIC-20 WB
CASE 751D-05
ISSUE G



NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS | |
|----------|-------------|-------|
| | MIN | MAX |
| A | 2.35 | 2.65 |
| A1 | 0.10 | 0.25 |
| B | 0.35 | 0.49 |
| C | 0.23 | 0.32 |
| D | 12.65 | 12.95 |
| E | 7.40 | 7.60 |
| e | 1.27 BSC | |
| H | 10.05 | 10.55 |
| h | 0.25 | 0.75 |
| L | 0.50 | 0.90 |
| θ | 0° | 7° |

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