

# 74LVC541A

## Low-Voltage CMOS Octal Buffer Flow Through Pinout

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

The 74LVC541A is a high performance, non-inverting octal buffer operating from a 1.2 to 3.6 V supply. This device is similar in function to the MC74LCX244, 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 74LVC541A inputs to be safely driven from 5 V devices. The 74LVC541A 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 output by placing them in a HIGH Z condition.

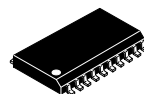
#### Features

- 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  $\mu$ 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

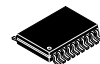


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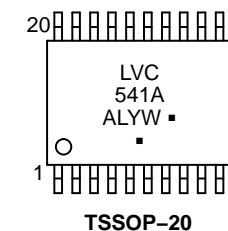
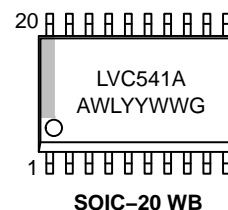


SOIC-20 WB  
DW SUFFIX  
CASE 751D



TSSOP-20  
DT SUFFIX  
CASE 948E

#### MARKING DIAGRAMS



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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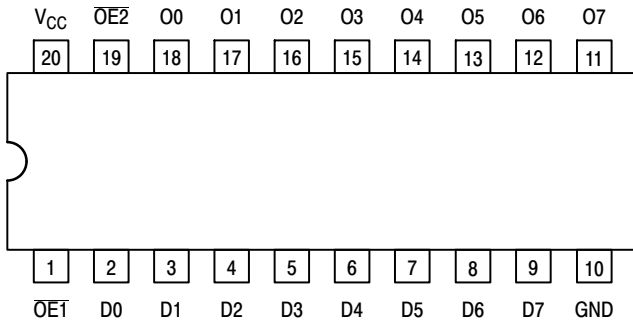


Figure 1. Pinout: 20-Lead (Top View)

## PIN NAMES

Pins	Function
$\overline{OE}1$	Output Enable Inputs
Dn	Data Inputs
On	3-State Outputs

## TRUTH TABLE

Inputs			Outputs
$\overline{OE}1$	$\overline{OE}2$	Dn	On
L	L	L	L
L	L	H	H
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

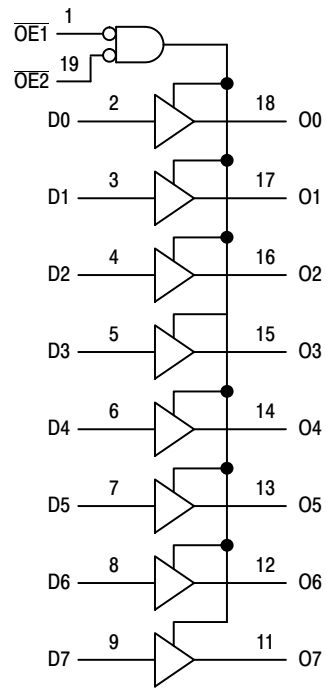


Figure 2. Logic Diagram

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## MAXIMUM RATINGS

Symbol	Parameter	Value	Condition	Unit
V <sub>CC</sub>	DC Supply Voltage	-0.5 to +6.5		V
V <sub>I</sub>	DC Input Voltage	-0.5 ≤ V <sub>I</sub> ≤ +6.5		V
V <sub>O</sub>	DC Output Voltage	-0.5 ≤ V <sub>O</sub> ≤ +6.5	Output in 3-State	V
		-0.5 ≤ V <sub>O</sub> ≤ V <sub>CC</sub> + 0.5	Output in HIGH or LOW State (Note 1)	V
I <sub>IK</sub>	DC Input Diode Current	-50	V <sub>I</sub> < GND	mA
I <sub>OK</sub>	DC Output Diode Current	-50	V <sub>O</sub> < GND	mA
		+50	V <sub>O</sub> > V <sub>CC</sub>	mA
I <sub>O</sub>	DC Output Source/Sink Current	±50		mA
I <sub>CC</sub>	DC Supply Current Per Supply Pin	±100		mA
I <sub>GND</sub>	DC Ground Current Per Ground Pin	±100		mA
T <sub>STG</sub>	Storage Temperature Range	-65 to +150		°C
T <sub>L</sub>	Lead Temperature, 1 mm from Case for 10 Seconds	T <sub>L</sub> = 260		°C
T <sub>J</sub>	Junction Temperature Under Bias	T <sub>J</sub> = 135		°C
θ <sub>JA</sub>	Thermal Resistance (Note 2)	SOIC = 65.8 TSSOP = 110.7		°C/W
MSL	Moisture Sensitivity		Level 1	
I <sub>LATCHUP</sub>	Latch-up Performance at V <sub>CC</sub> = 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<sub>O</sub> 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 <sub>CC</sub>	Supply Voltage Operating Functional	1.65 1.2		3.6 3.6	V
V <sub>I</sub>	Input Voltage	0		5.5	V
V <sub>O</sub>	Output Voltage HIGH or LOW State 3-State	0 0		V <sub>CC</sub> 5.5	V
I <sub>OH</sub>	HIGH Level Output Current V <sub>CC</sub> = 3.0 V – 3.6 V V <sub>CC</sub> = 2.7 V – 3.0 V			-24 -12	mA
I <sub>OL</sub>	LOW Level Output Current V <sub>CC</sub> = 3.0 V – 3.6 V V <sub>CC</sub> = 2.7 V – 3.0 V			24 12	mA
T <sub>A</sub>	Operating Free-Air Temperature	-40		+125	°C
Δt/ΔV	Input Transition Rise or Fall Rate, V <sub>IN</sub> from 0.8 V to 2.0 V, V <sub>CC</sub> = 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 <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 1.2 V	1.08	-	-	1.08	-	-	V
		V <sub>CC</sub> = 1.65 V to 1.95 V	0.65 x V <sub>CC</sub>	-	-	0.65 x V <sub>CC</sub>	-	-	
		V <sub>CC</sub> = 2.3 V to 2.7 V	1.7	-	-	1.7	-	-	
		V <sub>CC</sub> = 2.7 V to 3.6 V	2.0	-	-	2.0	-	-	
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 1.2 V	-	-	0.12	-	-	0.12	V
		V <sub>CC</sub> = 1.65 V to 1.95 V	-	-	0.35 x V <sub>CC</sub>	-	-	0.35 x V <sub>CC</sub>	
		V <sub>CC</sub> = 2.3 V to 2.7 V	-	-	0.7	-	-	0.7	
		V <sub>CC</sub> = 2.7 V to 3.6 V	-	-	0.8	-	-	0.8	
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>							V
		I <sub>O</sub> = -100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.3	-	-	
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 1.65 V	1.2	-	-	1.05	-	-	
		I <sub>O</sub> = -8 mA; V <sub>CC</sub> = 2.3 V	1.8	-	-	1.65	-	-	
		I <sub>O</sub> = -12 mA; V <sub>CC</sub> = 2.7 V	2.2	-	-	2.05	-	-	
		I <sub>O</sub> = -18 mA; V <sub>CC</sub> = 3.0 V	2.4	-	-	2.25	-	-	
		I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V	2.2	-	-	2.0	-	-	
VOL	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>							V
		I <sub>O</sub> = 100 μA; V <sub>CC</sub> = 1.65 V to 3.6 V	-	-	0.2	-	-	0.3	
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 1.65 V	-	-	0.45	-	-	0.65	
		I <sub>O</sub> = 8 mA; V <sub>CC</sub> = 2.3 V	-	-	0.6	-	-	0.8	
		I <sub>O</sub> = 12 mA; V <sub>CC</sub> = 2.7 V	-	-	0.4	-	-	0.6	
		I <sub>O</sub> = -24 mA; V <sub>CC</sub> = 3.0 V	-	-	0.55	-	-	0.8	
I <sub>I</sub>	Input leakage current	V <sub>I</sub> = 5.5V or GND; V <sub>CC</sub> = 3.6 V	-	±0.1	±5	-	±0.1	±20	μA
I <sub>OZ</sub>	OFF-state output current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = 5.5 V or GND; V <sub>CC</sub> = 3.6 V	-	±0.1	±5	-	±0.1	±20	μA
I <sub>OFF</sub>	Power-off leakage current	V <sub>I</sub> or V <sub>O</sub> = 5.5 V; V <sub>CC</sub> = 0.0 V	-	±0.1	±10	-	±0.1	±20	μA
I <sub>CC</sub>	Supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 3.6 V	-	0.1	10	-	0.1	40	μA
ΔI <sub>CC</sub>	Additional supply current	per input pin; V <sub>I</sub> = V <sub>CC</sub> - 0.6 V; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 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<sub>A</sub> = 25°C and V<sub>CC</sub> = 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 <sup>1</sup>	Max	Min	Typ <sup>1</sup>	Max	
$t_{pd}$	Propagation Delay (Note 6) nAn to nYn	$V_{CC} = 1.2$ V	–	14.0	–	–	–	–	ns
		$V_{CC} = 1.65$ V to $1.95$ V	1.5	6.5	13.8	1.5	–	16.0	
		$V_{CC} = 2.3$ V to $2.7$ V	1.0	3.5	6.8	1.0	–	7.9	
		$V_{CC} = 2.7$ V	1.5	3.5	5.6	1.5	–	7.0	
		$V_{CC} = 3.0$ V to $3.6$ V	1.0	2.9	5.1	1.0	–	6.5	
$t_{en}$	Enable Time (Note 7) nOE to nYn	$V_{CC} = 1.2$ V	–	20.0	–	–	–	–	ns
		$V_{CC} = 1.65$ V to $1.95$ V	1.8	7.7	16.0	1.8	–	18.5	
		$V_{CC} = 2.3$ V to $2.7$ V	1.5	4.3	8.8	1.5	–	10.2	
		$V_{CC} = 2.7$ V	1.5	4.4	7.5	1.5	–	9.5	
		$V_{CC} = 3.0$ V to $3.6$ V	1.0	3.5	7.0	1.0	–	9.0	
$t_{dis}$	Disable Time (Note 8) nOE to nYn	$V_{CC} = 1.2$ V	–	11.0	–	–	–	–	ns
		$V_{CC} = 1.65$ V to $1.95$ V	3.0	4.9	10.3	3.0	–	11.9	
		$V_{CC} = 2.3$ V to $2.7$ V	1.0	2.7	5.9	1.0	–	6.8	
		$V_{CC} = 2.7$ V	1.5	3.7	7.0	1.5	–	9.0	
		$V_{CC} = 3.0$ V to $3.6$ V	1.0	3.3	6.0	1.0	–	7.5	
$t_{sk(0)}$	Output Skew Time (Note 9)		–	–	1	–	–	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 $V_{CC}$	4.0	pF
$C_{OUT}$	Output Capacitance	$V_{CC} = 3.3$ V, $V_I = 0$ V or $V_{CC}$	5.0	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  $\mu\text{W}$ ).

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

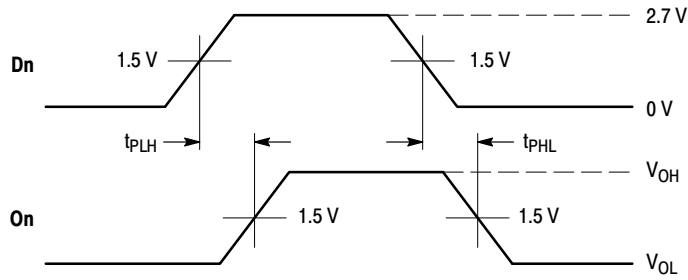
$f_i$  = input frequency in MHz;  $f_o$  = output frequency in MHz

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

$N$  = number of outputs switching

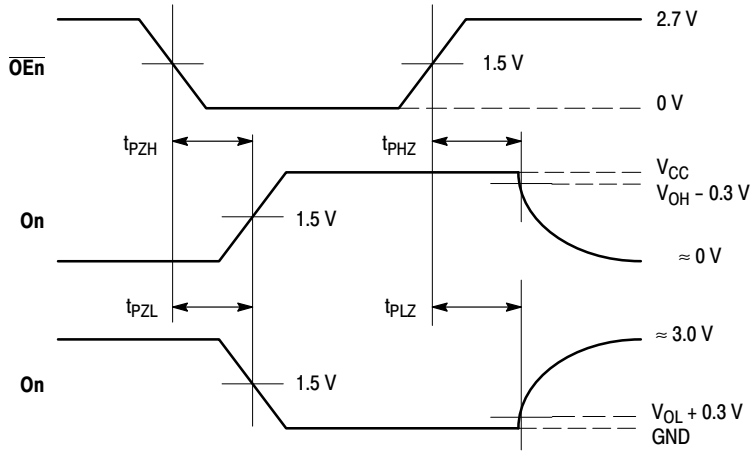
$\sum(C_L * V_{CC}^2 * f_o)$  = sum of the outputs.

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**WAVEFORM 1 - PROPAGATION DELAYS**

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



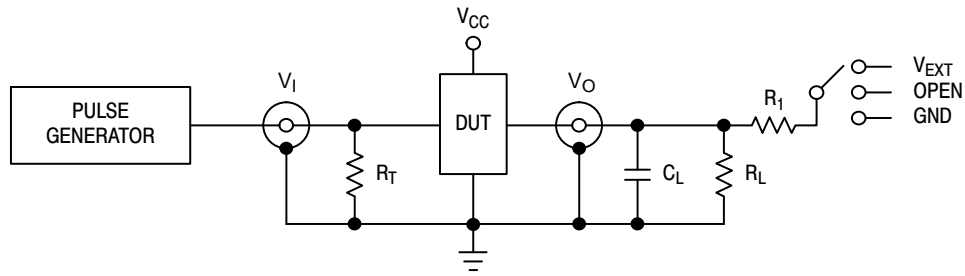
**WAVEFORM 2 - OUTPUT ENABLE AND DISABLE TIMES**

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

**Figure 3. AC Waveforms**

Symbol	$V_{CC}$		
	$3.3 \text{ V} \pm 0.3 \text{ V}$	$2.7 \text{ V}$	$V_{CC} < 2.7 \text{ V}$
$V_{mi}$	$1.5 \text{ V}$	$1.5 \text{ V}$	$V_{CC}/2$
$V_{mo}$	$1.5 \text{ V}$	$1.5 \text{ V}$	$V_{CC}/2$
$V_{HZ}$	$V_{OL} + 0.3 \text{ V}$	$V_{OL} + 0.3 \text{ V}$	$V_{OL} + 0.15 \text{ V}$
$V_{LZ}$	$V_{OH} - 0.3 \text{ V}$	$V_{OH} - 0.3 \text{ V}$	$V_{OH} - 0.15 \text{ V}$

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

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	$V_{CC}$	$\leq 2$ ns	30 pF	1 k $\Omega$	Open	2 x $V_{CC}$	GND
1.65 – 1.95	$V_{CC}$	$\leq 2$ ns	30 pF	1 k $\Omega$	Open	2 x $V_{CC}$	GND
2.3 – 2.7	$V_{CC}$	$\leq 2$ ns	30 pF	500 $\Omega$	Open	2 x $V_{CC}$	GND
2.7	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	Open	2 x $V_{CC}$	GND
3 – 3.6	2.7 V	$\leq 2.5$ ns	50 pF	500 $\Omega$	Open	2 x $V_{CC}$	GND

Figure 4. Test Circuit

## ORDERING INFORMATION

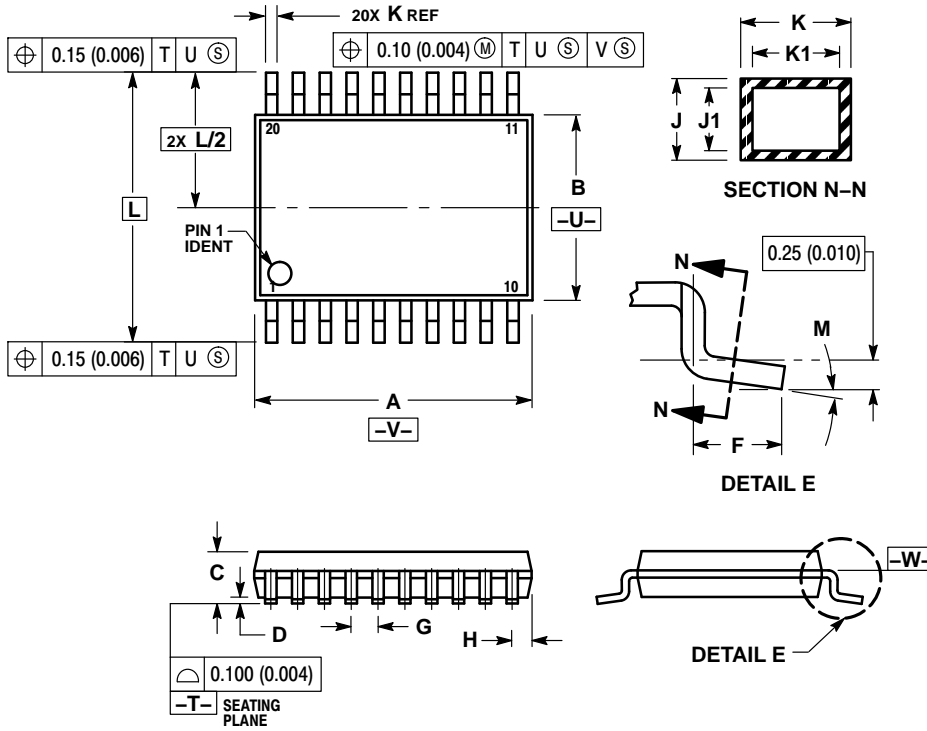
Device	Package	Shipping <sup>†</sup>
74LVC541ADWR2G	SOIC-20 (Pb-Free)	1000 / Tape & Reel
74LVC541ADTR2G	TSSOP-20 (Pb-Free)	2500 / Tape & Reel

<sup>†</sup>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.

# 74LVC541A

## PACKAGE DIMENSIONS

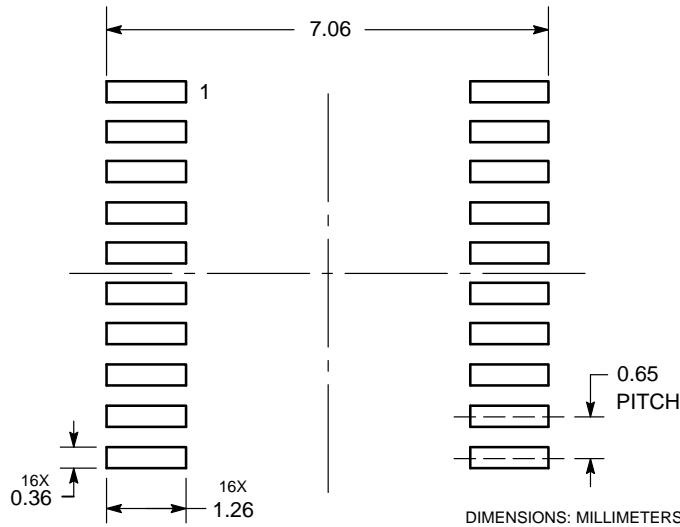
TSSOP-20  
CASE 948E-02  
ISSUE C



- 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  $-W-$ .

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.40	6.60	0.252	0.260
B	4.30	4.50	0.169	0.177
C	---	1.20	---	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.27	0.37	0.011	0.015
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

### SOLDERING FOOTPRINT\*



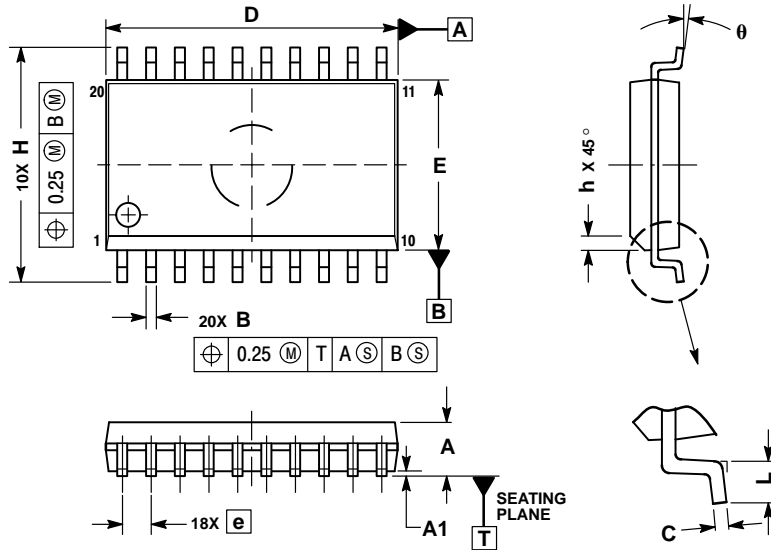
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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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
$\theta$	0°	7°

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