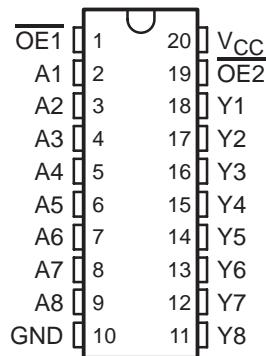


- Qualified for Automotive Applications
- Operating Range 2-V to 5.5-V  $V_{CC}$
- Latch-Up Performance Exceeds 250 mA Per JESD 17

### description/ordering information

The SN74AHC541 octal buffer/driver is ideal for driving bus lines or buffer memory address registers. This device features inputs and outputs on opposite sides of the package to facilitate printed circuit board layout.

#### DW OR PW PACKAGE (TOP VIEW)



The 3-state control gate is a two-input AND gate with active-low inputs so that if either output-enable ( $\overline{OE1}$  or  $\overline{OE2}$ ) input is high, all corresponding outputs are in the high-impedance state. The outputs provide noninverted data when they are not in the high-impedance state.

To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

### ORDERING INFORMATION<sup>†</sup>

| T <sub>A</sub> | PACKAGE <sup>‡</sup> |               | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|----------------------|---------------|-----------------------|------------------|
| –40°C to 125°C | SOIC – DW            | Tape and reel | SN74AHC541QDWRQ1      | AHC541Q          |
|                | TSSOP – PW           | Tape and reel | SN74AHC541QPWRQ1      | AHC541Q          |

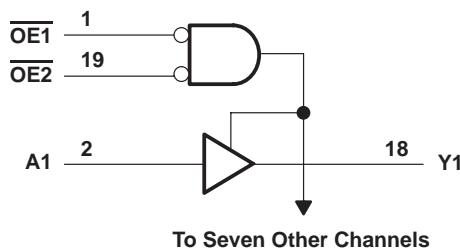
<sup>†</sup> For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at <http://www.ti.com>.

<sup>‡</sup> Package drawings, thermal data, and symbolization are available at <http://www.ti.com/packaging>.

#### FUNCTION TABLE (each buffer/driver)

| INPUTS           |                  |   | OUTPUT |
|------------------|------------------|---|--------|
| $\overline{OE1}$ | $\overline{OE2}$ | A | Y      |
| L                | L                | L | L      |
| L                | L                | H | H      |
| H                | X                | X | Z      |
| X                | H                | X | Z      |

### logic diagram (positive logic)



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

# **SN74AHC541-Q1**

## **OCTAL BUFFER/DRIVER**

### **WITH 3-STATE OUTPUTS**

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**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, $I_{IK}$ ( $V_I < 0$ ) .....                       | -20 mA                     |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) .....    | $\pm 20$ mA                |
| Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) .....        | $\pm 25$ mA                |
| Continuous current through $V_{CC}$ or GND .....                        | $\pm 75$ mA                |
| Package thermal impedance, $\theta_{JA}$ (see Note 2): DW package ..... | 58°C/W                     |
|   | PW package .....           |
| 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 package thermal impedance is calculated in accordance with JESD 51-7.

### **recommended operating conditions (see Note 3)**

|                     |                                    |  | MIN  | MAX      | UNIT          |
|---------------------|------------------------------------|--|------|----------|---------------|
| $V_{CC}$            | Supply voltage                     |  | 2    | 5.5      | V             |
| $V_{IH}$            | High-level input voltage           | $V_{CC} = 2\text{ V}$                    | 1.5  |          | V             |
|                     |                                    | $V_{CC} = 3\text{ V}$                    | 2.1  |          |               |
|                     |                                    | $V_{CC} = 5.5\text{ V}$                  | 3.85 |          |               |
| $V_{IL}$            | Low-level input voltage            | $V_{CC} = 2\text{ V}$                    | 0.5  |          | V             |
|                     |                                    | $V_{CC} = 3\text{ V}$                    | 0.9  |          |               |
|                     |                                    | $V_{CC} = 5.5\text{ V}$                  | 1.65 |          |               |
| $V_I$               | Input voltage                      |  | 0    | 5.5      | V             |
| $V_O$               | Output voltage                     |  | 0    | $V_{CC}$ | V             |
| $I_{OH}$            | High-level output current          | $V_{CC} = 2\text{ V}$                    | -50  |          | $\mu\text{A}$ |
|                     |                                    | $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ | -4   |          |               |
|                     |                                    | $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$   | -8   |          |               |
| $I_{OL}$            | Low-level output current           | $V_{CC} = 2\text{ V}$                    | 50   |          | $\mu\text{A}$ |
|                     |                                    | $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ | 4    |          |               |
|                     |                                    | $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$   | 8    |          |               |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ | 100  |          | $\text{ns/V}$ |
|                     |                                    | $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$   | 20   |          |               |
| $T_A$               | Operating free-air temperature     |  | -40  | 125      | °C            |

NOTE 3: All unused inputs of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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

| PARAMETER                    | TEST CONDITIONS  | V <sub>CC</sub> | T <sub>A</sub> = 25°C |     |       | T <sub>A</sub> = -40°C TO 125°C |      | T <sub>A</sub> = -40°C TO 85°C |      | UNIT |
|------------------------------|--|-----------------|-----------------------|-----|-------|---------------------------------|------|--------------------------------|------|------|
|                              |  |                 | MIN                   | TYP | MAX   | MIN                             | MAX  | MIN                            | MAX  |      |
| V <sub>OH</sub>              | I <sub>OH</sub> = -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 <sub>OH</sub> = -4 mA  | 3 V             | 2.58                  |     |       | 2.48                            |      | 2.48                           |      |      |
|                              | I <sub>OH</sub> = -8 mA  | 4.5 V           | 3.94                  |     |       | 3.8                             |      | 3.8                            |      |      |
|                              |  |                 |                       |     |       |                                 |      |                                |      |      |
| V <sub>OL</sub>              | I <sub>OL</sub> = 50 µA  | 2 V             |                       |     | 0.1   |                                 | 0.1  |                                | 0.1  | V    |
|                              |  | 3 V             |                       |     | 0.1   |                                 | 0.1  |                                | 0.1  |      |
|                              |  | 4.5 V           |                       |     | 0.1   |                                 | 0.1  |                                | 0.1  |      |
|                              | I <sub>OL</sub> = 4 mA   | 3 V             |                       |     | 0.36  |                                 | 0.5  |                                | 0.44 |      |
|                              | I <sub>OL</sub> = 8 mA   | 4.5 V           |                       |     | 0.36  |                                 | 0.5  |                                | 0.44 |      |
| I <sub>I</sub>               | V <sub>I</sub> = 5.5 V or GND  | 0 V to 5.5 V    |                       |     | ±0.1  |                                 | ±1   |                                | ±1   | µA   |
| I <sub>OZ</sub> <sup>†</sup> | V <sub>O</sub> = V <sub>CC</sub> or GND,<br>V <sub>I</sub> (OE) = V <sub>IL</sub> or V <sub>IH</sub> | 5.5 V           |                       |     | ±0.25 |                                 | ±2.5 |                                | ±2.5 | µA   |
| I <sub>CC</sub>              | V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0  | 5.5 V           |                       |     | 4     |                                 | 40   |                                | 40   | µA   |
| C <sub>i</sub>               | V <sub>I</sub> = V <sub>CC</sub> or GND  | 5 V             |                       | 2   | 10    |                                 |      |                                | 10   | pF   |
| C <sub>o</sub>               | V <sub>O</sub> = V <sub>CC</sub> or GND  | 5 V             |                       | 4   |       |                                 |      |                                |      | pF   |

<sup>†</sup> For input and output, I<sub>OZ</sub> includes the input leakage current.

switching characteristics over recommended operating free-air temperature range,  
V<sub>CC</sub> = 3.3 V ± 0.3 V (unless otherwise noted) (see Figure 1)

| PARAMETER          | FROM<br>(INPUT) | TO<br>(OUTPUT) | LOAD<br>CAPACITANCE    | T <sub>A</sub> = 25°C |      |     | T <sub>A</sub> = -40°C TO 125°C |      | T <sub>A</sub> = -40°C TO 85°C |      | UNIT |
|--------------------|-----------------|----------------|------------------------|-----------------------|------|-----|---------------------------------|------|--------------------------------|------|------|
|                    |                 |                |                        | MIN                   | TYP  | MAX | MIN                             | MAX  | MIN                            | MAX  |      |
| t <sub>PLH</sub>   | A               | Y              | C <sub>L</sub> = 15 pF | 5                     | 7    |     | 1                               | 8.5  | 1                              | 8.5  | ns   |
| t <sub>PHL</sub>   |                 |                |                        | 5                     | 7    |     | 1                               | 8.5  | 1                              | 8.5  |      |
| t <sub>PZH</sub>   | OE              | Y              | C <sub>L</sub> = 15 pF | 6                     | 10.5 |     | 1                               | 11   | 1                              | 11   | ns   |
| t <sub>PZL</sub>   |                 |                |                        | 6                     | 10.5 |     | 1                               | 11   | 1                              | 11   |      |
| t <sub>PHZ</sub>   | OE              | Y              | C <sub>L</sub> = 15 pF | 7                     | 11   |     | 1                               | 12   | 1                              | 12   | ns   |
| t <sub>PLZ</sub>   |                 |                |                        | 7                     | 11   |     | 1                               | 12   | 1                              | 12   |      |
| t <sub>PLH</sub>   | A               | Y              | C <sub>L</sub> = 50 pF | 7.5                   | 10.5 |     | 1                               | 12   | 1                              | 12   | ns   |
| t <sub>PHL</sub>   |                 |                |                        | 7.5                   | 10.5 |     | 1                               | 12   | 1                              | 12   |      |
| t <sub>PZH</sub>   | OE              | Y              | C <sub>L</sub> = 50 pF | 8                     | 14   |     | 1                               | 16   | 1                              | 16   | ns   |
| t <sub>PZL</sub>   |                 |                |                        | 8                     | 14   |     | 1                               | 16   | 1                              | 16   |      |
| t <sub>PHZ</sub>   | OE              | Y              | C <sub>L</sub> = 50 pF | 9                     | 15.4 |     | 1                               | 17.5 | 1                              | 17.5 | ns   |
| t <sub>PLZ</sub>   |                 |                |                        | 9                     | 15.4 |     | 1                               | 17.5 | 1                              | 17.5 |      |
| t <sub>sk(o)</sub> |                 |                | C <sub>L</sub> = 50 pF |                       | 1.5  |     |                                 |      | 1.5                            |      | ns   |

**SN74AHC541-Q1**  
**OCTAL BUFFER/DRIVER**  
**WITH 3-STATE OUTPUTS**

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

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | LOAD<br>CAPACITANCE | TA = 25°C |     |     | TA = -40°C<br>TO 125°C |     | TA = -40°C<br>TO 85°C |     | UNIT |
|-----------|-----------------|----------------|---------------------|-----------|-----|-----|------------------------|-----|-----------------------|-----|------|
|           |                 |                |                     | MIN       | TYP | MAX | MIN                    | MAX | MIN                   | MAX |      |
| tPLH      |                 |                |                     | 3.5       | 5   | 1   | 6                      | 1   | 6                     | 1   |      |
| tPHL      | A               | Y              | CL = 15 pF          | 3.5       | 5   | 1   | 6                      | 1   | 6                     | 1   | 6    |
| tPZH      |                 |                |                     | 4.7       | 7.2 | 1   | 8.5                    | 1   | 8.5                   | 1   | ns   |
| tPZL      | OE              | Y              | CL = 15 pF          | 4.7       | 7.2 | 1   | 8.5                    | 1   | 8.5                   | 1   |      |
| tPHZ      |                 |                |                     | 5         | 7.5 | 1   | 8                      | 1   | 8                     | 1   | ns   |
| tPLZ      | OE              | Y              | CL = 15 pF          | 5         | 7.5 | 1   | 8                      | 1   | 8                     | 1   |      |
| tPLH      | A               | Y              | CL = 50 pF          | 5         | 7   | 1   | 8                      | 1   | 8                     | 1   | ns   |
| tPHL      |                 |                |                     | 5         | 7   | 1   | 8                      | 1   | 8                     | 1   |      |
| tPZH      | OE              | Y              | CL = 50 pF          | 6.2       | 9.2 | 1   | 10.5                   | 1   | 10.5                  | 1   | ns   |
| tPZL      |                 |                |                     | 6.2       | 9.2 | 1   | 10.5                   | 1   | 10.5                  | 1   |      |
| tPHZ      | OE              | Y              | CL = 50 pF          | 6         | 8.8 | 1   | 10                     | 1   | 10                    | 1   | ns   |
| tPLZ      |                 |                |                     | 6         | 8.8 | 1   | 10                     | 1   | 10                    | 1   |      |
| tsk(o)    |                 |                | CL = 50 pF          |           | 1   |     |                        |     | 1                     | ns  |      |

noise characteristics,  $V_{CC} = 5 V$ ,  $C_L = 50 \text{ pF}$ ,  $T_A = 25^\circ\text{C}$  (see Note 4)

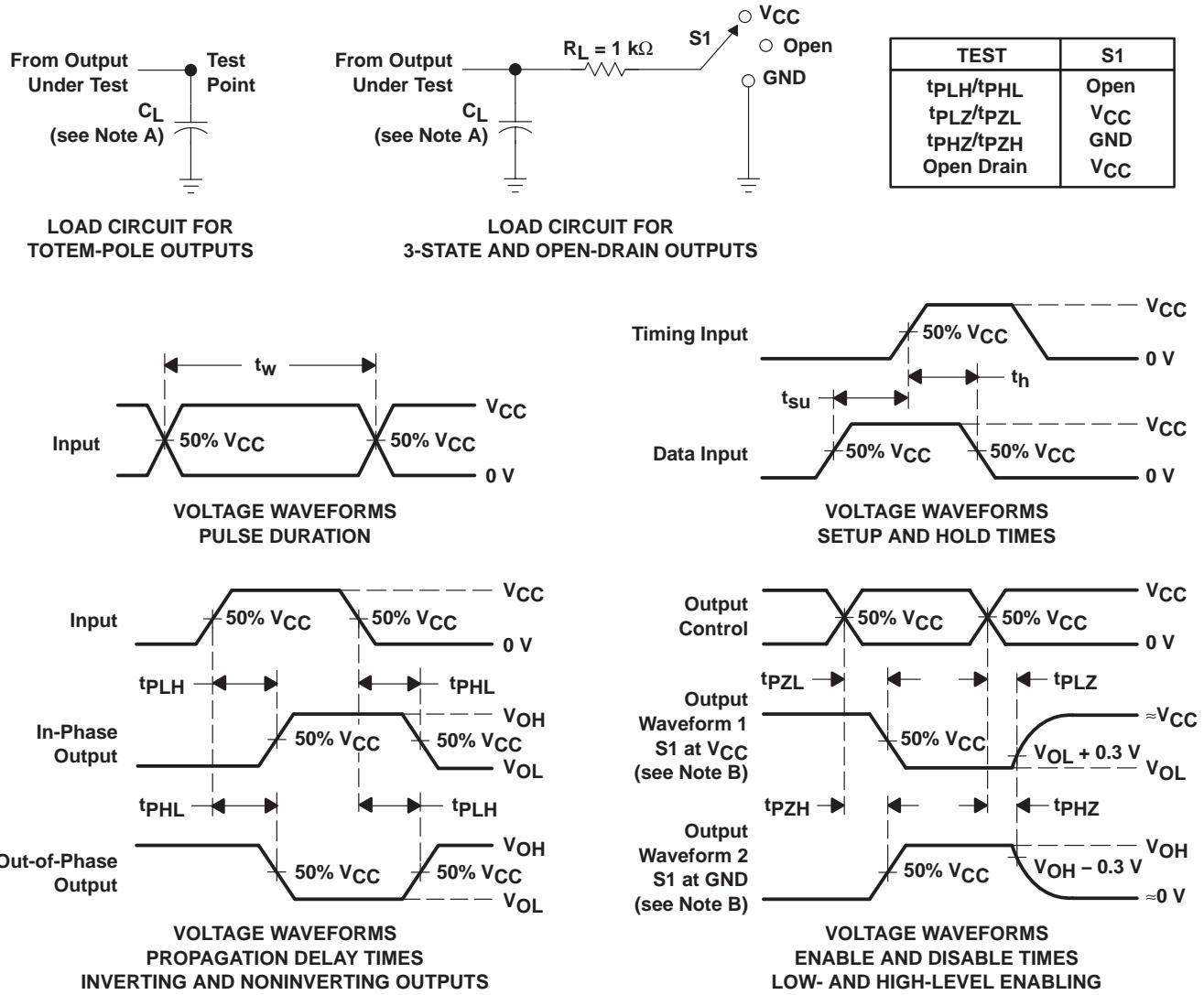
| PARAMETER          |   | MIN | MAX  | UNIT |
|--------------------|---|-----|------|------|
| V <sub>OL(P)</sub> | Quiet output, maximum dynamic V <sub>OL</sub> |     | 0.8  | V    |
| V <sub>OL(V)</sub> | Quiet output, minimum dynamic V <sub>OL</sub> |     | -0.8 | V    |
| V <sub>OH(V)</sub> | Quiet output, minimum dynamic V <sub>OH</sub> | 4.7 |      | V    |
| V <sub>IH(D)</sub> | High-level dynamic input voltage              | 3.5 |      | V    |
| V <sub>IL(D)</sub> | Low-level dynamic input voltage               | 1.5 |      | V    |

NOTE 4: Characteristics are for surface-mount packages only.

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

| PARAMETER                                     | TEST CONDITIONS    | TYP | UNIT |
|---|--------------------|-----|------|
| C <sub>pd</sub> Power dissipation capacitance | No load, f = 1 MHz | 12  | pF   |

PARAMETER MEASUREMENT INFORMATION



NOTES:

- $C_L$  includes probe and jig capacitance.
- 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.
- All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 3 \text{ ns}$ ,  $t_f \leq 3 \text{ ns}$ .
- The outputs are measured one at a time, with one input transition per measurement.
- All parameters and waveforms are not applicable to all devices.

Figure 1. Load Circuit and Voltage Waveforms

**PACKAGING INFORMATION**

| Orderable Device   | Status<br>(1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan<br>(2) | Lead finish/<br>Ball material<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples   |
|--------------------|---------------|--------------|-----------------|------|-------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|---|
| SN74AHC541QPWRG4Q1 | ACTIVE        | TSSOP        | PW              | 20   | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | AHC541Q                 | <span style="background-color: red; color: white; padding: 2px;">Samples</span> |
| SN74AHC541QPWRQ1   | ACTIVE        | TSSOP        | PW              | 20   | 2000        | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | AHC541Q                 | <span style="background-color: red; color: white; padding: 2px;">Samples</span> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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**OTHER QUALIFIED VERSIONS OF SN74AHC541-Q1 :**

- Catalog: [SN74AHC541](#)
- Military: [SN54AHC541](#)

NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications

**TAPE AND REEL INFORMATION**
**REEL DIMENSIONS**

**TAPE DIMENSIONS**


|    |   |
|----|---|
| A0 | Dimension designed to accommodate the component width     |
| B0 | Dimension designed to accommodate the component length    |
| K0 | Dimension designed to accommodate the component thickness |
| W  | Overall width of the carrier tape                         |
| P1 | Pitch between successive cavity centers                   |

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*All dimensions are nominal

| Device             | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|--------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74AHC541QPWRG4Q1 | TSSOP        | PW              | 20   | 2000 | 330.0              | 16.4               | 6.95    | 7.1     | 1.6     | 8.0     | 16.0   | Q1            |
| SN74AHC541QPWRQ1   | TSSOP        | PW              | 20   | 2000 | 330.0              | 16.4               | 6.95    | 7.1     | 1.6     | 8.0     | 16.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**

\*All dimensions are nominal

| Device             | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74AHC541QPWRG4Q1 | TSSOP        | PW              | 20   | 2000 | 853.0       | 449.0      | 35.0        |
| SN74AHC541QPWRQ1   | TSSOP        | PW              | 20   | 2000 | 853.0       | 449.0      | 35.0        |

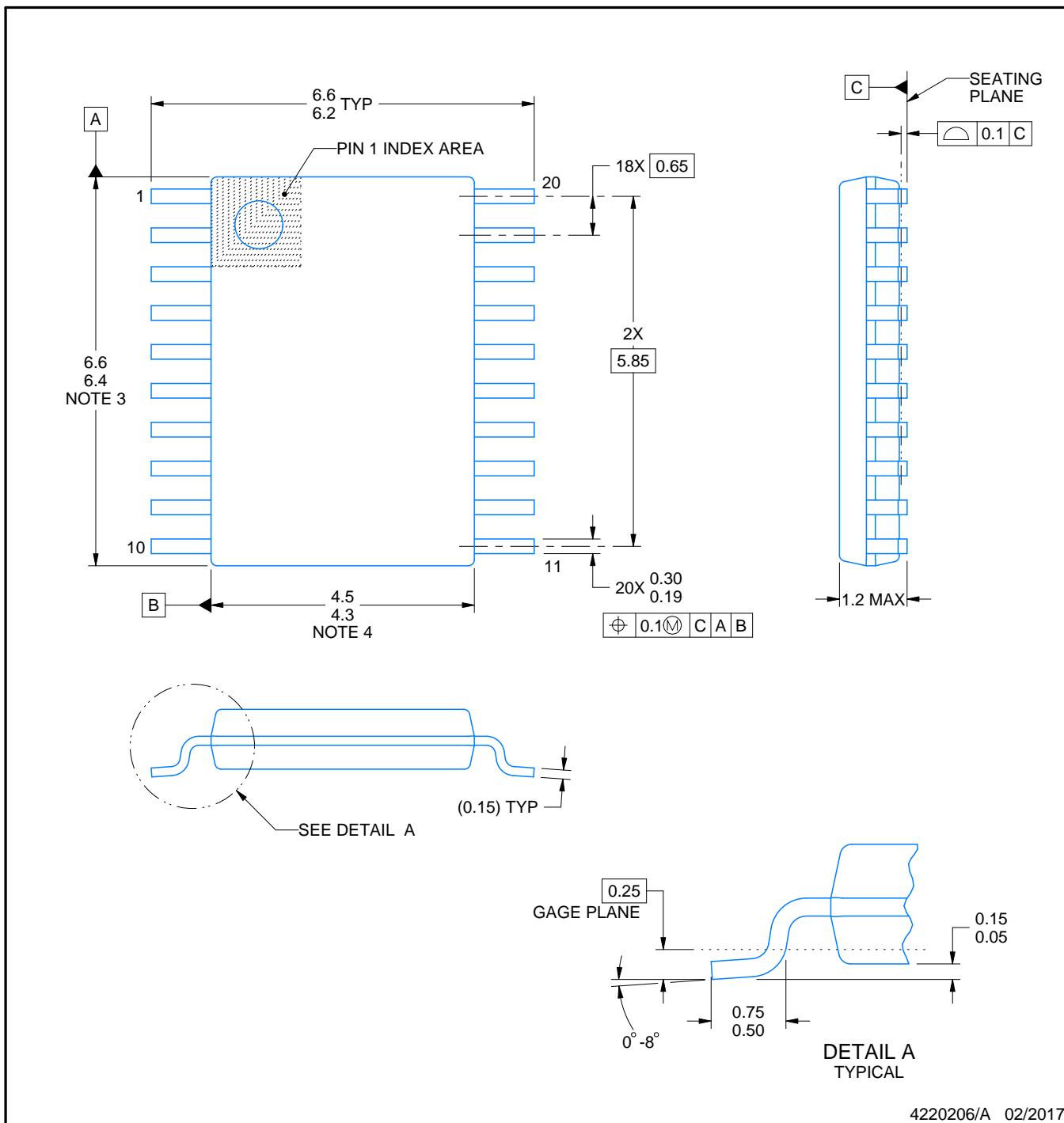
## PACKAGE OUTLINE

**PW0020A**



## **TSSOP - 1.2 mm max height**

## SMALL OUTLINE PACKAGE



## NOTES:

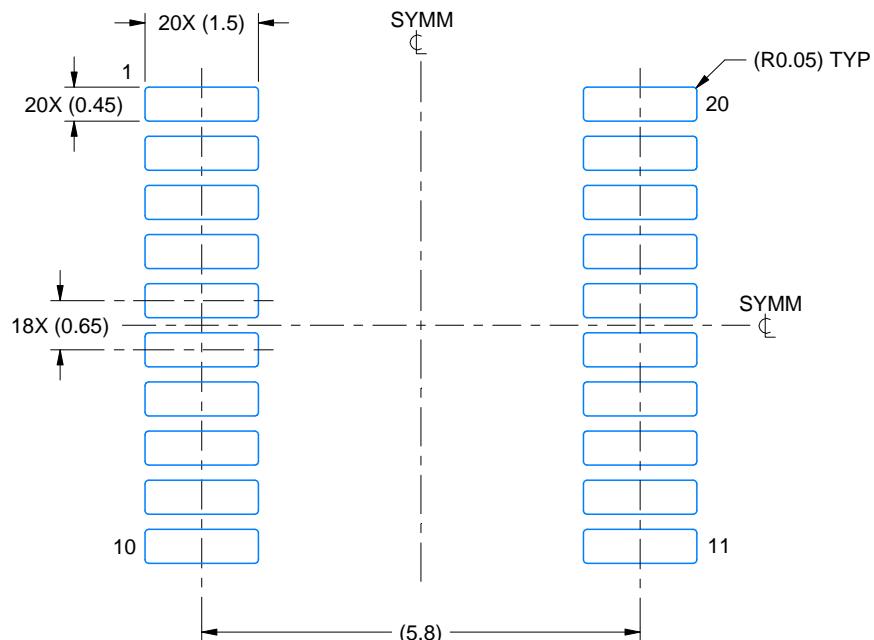
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-153.

## EXAMPLE BOARD LAYOUT

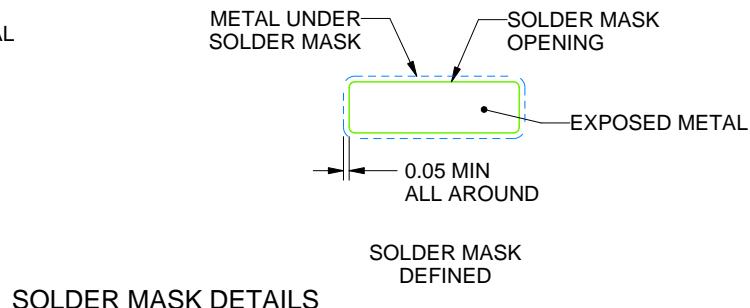
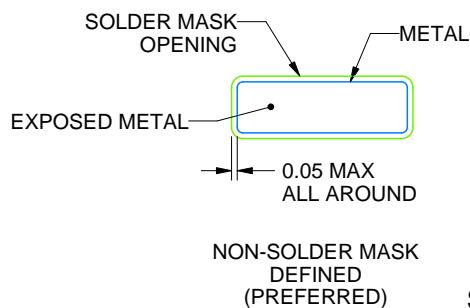
**PW0020A**

## **TSSOP - 1.2 mm max height**

## SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 10X



4220206/A 02/2017

#### NOTES: (continued)

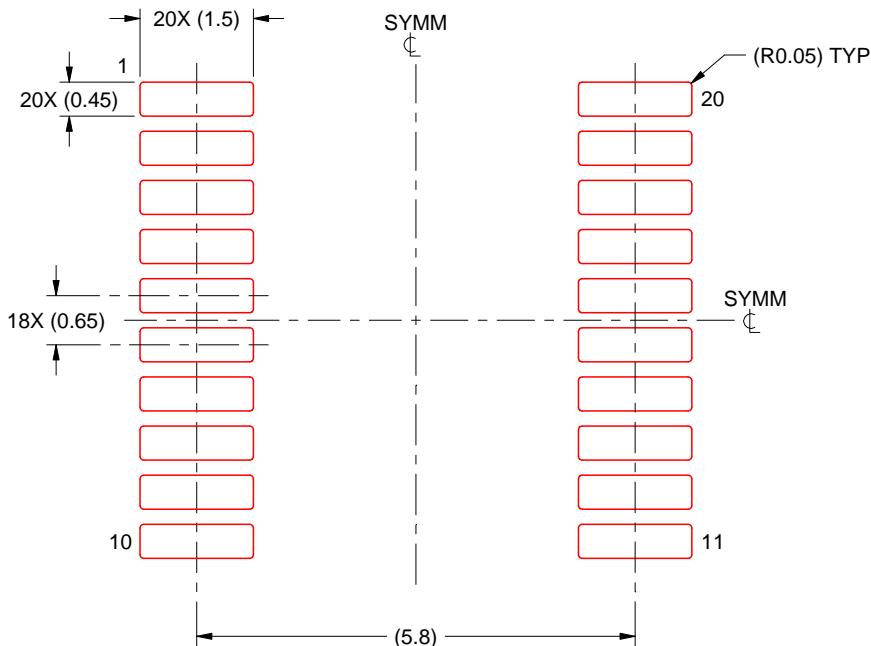
6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

# EXAMPLE STENCIL DESIGN

PW0020A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE: 10X

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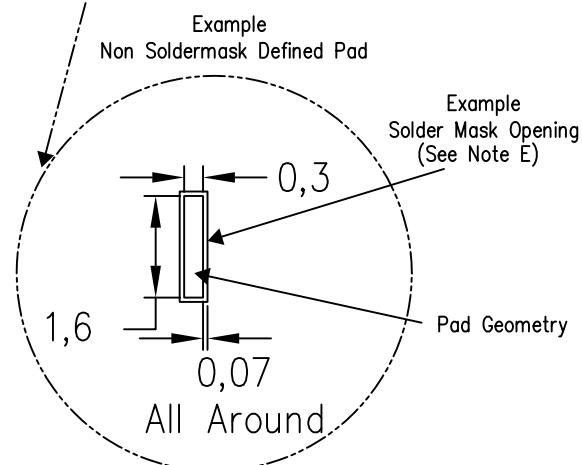
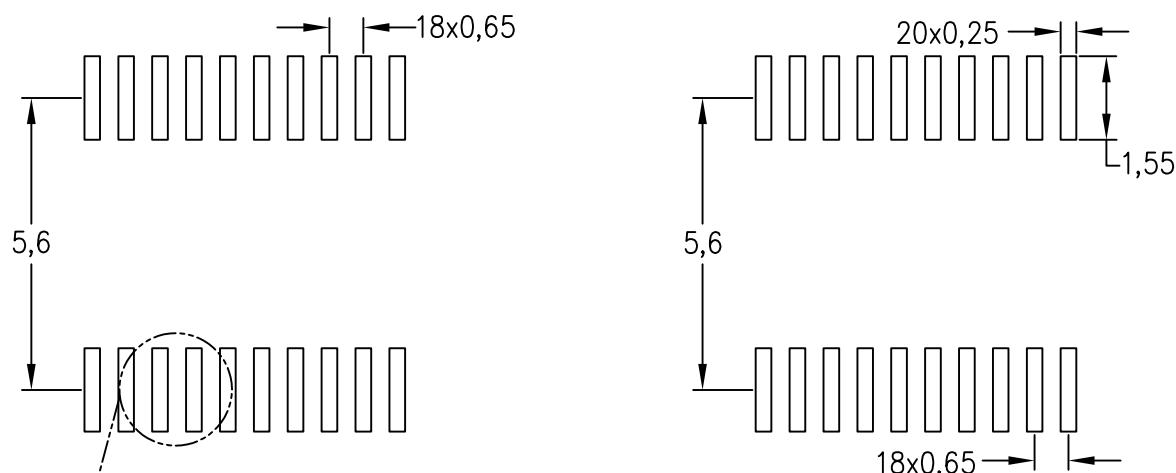
NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

PW (R-PDSO-G20)

PLASTIC SMALL OUTLINE

## Example Board Layout

Based on a stencil thickness  
of .127mm (.005inch).

4211284-5/G 08/15

NOTES:

- All linear dimensions are in millimeters.
- This drawing is subject to change without notice.
- Publication IPC-7351 is recommended for alternate design.
- Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
- Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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