

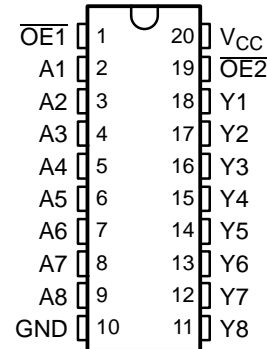
## FEATURES

- Controlled Baseline
  - One Assembly/Test Site, One Fabrication Site
- Extended Temperature Performance of  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$
- Enhanced Diminishing Manufacturing Sources (DMS) Support
- Enhanced Product-Change Notification
- Qualification Pedigree <sup>(1)</sup>
- Operates From 2 V to 3.6 V
- Inputs Accept Voltages to 5.5 V
- Max  $t_{pd}$  of 5.1 ns at 3.3 V
- Typical  $V_{OLP}$  (Output Ground Bounce)  $<0.8$  V at  $V_{CC} = 3.3$  V,  $T_A = 25^{\circ}\text{C}$
- Typical  $V_{OHV}$  (Output  $V_{OH}$  Undershoot)  $>2$  V at  $V_{CC} = 3.3$  V,  $T_A = 25^{\circ}\text{C}$

(1) Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.

- Supports Mixed-Mode Signal Operation on All Ports (5-V Input/Output Voltage With 3.3-V  $V_{CC}$ )
- $I_{off}$  Supports Partial-Power-Down Mode Operation

DW OR PW PACKAGE  
(TOP VIEW)



## DESCRIPTION/ORDERING INFORMATION

The SN74LVC541A-EP octal buffer/driver is designed for 2.7-V to 3.6-V  $V_{CC}$  operation.

The device is ideal for driving bus lines or buffering memory address registers.

This device features inputs and outputs on opposite sides of the package to facilitate printed circuit board layout.

The 3-state control gate is a 2-input AND gate with active-low inputs so that, if either output enable ( $\overline{OE1}$  or  $\overline{OE2}$ ) input is high, all eight outputs are in the high-impedance state.

Inputs can be driven from either 3.3-V or 5-V devices. This feature allows the use of this device as a translator in a mixed 3.3-V/5-V system environment.

This device is fully specified for partial-power-down applications using  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

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

| $T_A$  | PACKAGE <sup>(1)</sup> |              | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|--|------------------------|--------------|-----------------------|------------------|
| $-40^{\circ}\text{C}$ to $125^{\circ}\text{C}$ | SOIC – DW              | Reel of 2000 | SN74LVC541AQDWREP     | C541AEP          |
|  | TSSOP – PW             | Reel of 2000 | SN74LVC541AQPWREP     | C541AEP          |

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).



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# SN74LVC541A-EP

## OCTAL BUFFER/DRIVER

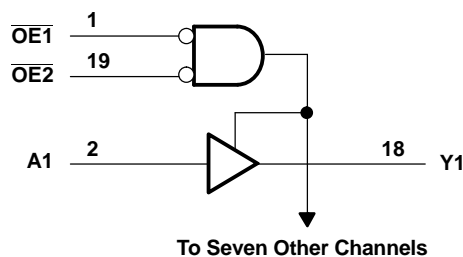
### WITH 3-STATE OUTPUTS

SCAS748A–DECEMBER 2003–REVISED AUGUST 2005

**FUNCTION TABLE**

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

**LOGIC DIAGRAM (POSITIVE LOGIC)**



### Absolute Maximum Ratings<sup>(1)</sup>

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

|               |   | MIN        | MAX            | UNIT    |
|---------------|---|------------|----------------|---------|
| $V_{CC}$      | Supply voltage range  | −0.5       | 6.5            | V       |
| $V_I$         | Input voltage range <sup>(2)</sup>  | −0.5       | 6.5            | V       |
| $V_O$         | Voltage range applied to any output in the high-impedance or power-off state <sup>(2)</sup> | −0.5       | 6.5            | V       |
| $V_O$         | Voltage range applied to any output in the high or low state <sup>(2)(3)</sup>              | −0.5       | $V_{CC} + 0.5$ | V       |
| $I_{IK}$      | Input clamp current   | $V_I < 0$  |                | −50 mA  |
| $I_{OK}$      | Output clamp current  | $V_O < 0$  |                | −50 mA  |
| $I_O$         | Continuous output current   |            |                | ±50 mA  |
|               | Continuous current through $V_{CC}$ or GND  |            |                | ±100 mA |
| $\theta_{JA}$ | Package thermal impedance <sup>(4)</sup>  | DW package |                | 58 °C/W |
|               |   | PW package |                | 83 °C/W |
| $T_{stg}$     | Storage temperature range <sup>(5)</sup>  | −65        | 150            | °C      |

- (1) 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.
- (2) The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The value of  $V_{CC}$  is provided in the recommended operating conditions table.
- (4) The package thermal impedance is calculated in accordance with JESD 51-7.
- (5) Long-term high-temperature storage and/or extended use at maximum recommended operating conditions may result in a reduction of overall device life. See [http://www.ti.com/ep\\_quality](http://www.ti.com/ep_quality) for additional information on enhanced plastic packaging.

## Recommended Operating Conditions<sup>(1)</sup>

|          |                                |   | MIN | MAX      | UNIT |
|----------|--------------------------------|---|-----|----------|------|
| $V_{CC}$ | Supply voltage                 | Operating                               | 2   | 3.6      | V    |
|          |                                | Data retention only                     | 1.5 |          |      |
| $V_{IH}$ | High-level input voltage       | $V_{CC} = 2.7\text{ V to }3.6\text{ V}$ | 2   |          | V    |
| $V_{IL}$ | Low-level input voltage        | $V_{CC} = 2.7\text{ V to }3.6\text{ V}$ |     | 0.8      | V    |
| $V_I$    | Input voltage                  |   | 0   | 5.5      | V    |
| $V_O$    | Output voltage                 | High or low state                       | 0   | $V_{CC}$ | V    |
|          |                                | 3-state                                 | 0   | 5.5      |      |
| $I_{OH}$ | High-level output current      | $V_{CC} = 2.7\text{ V}$                 |     | –12      | mA   |
|          |                                | $V_{CC} = 3\text{ V}$                   |     | –24      |      |
| $I_{OL}$ | Low-level output current       | $V_{CC} = 2.7\text{ V}$                 |     | 12       | mA   |
|          |                                | $V_{CC} = 3\text{ V}$                   |     | 24       |      |
| $T_A$    | Operating free-air temperature |   | –40 | 125      | °C   |

(1) All unused inputs of the device must be held at  $V_{CC}$  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> | MIN                   | TYP <sup>(1)</sup> | MAX  | UNIT |
|------------------|--|--|-----------------|-----------------------|--------------------|------|------|
| V <sub>OH</sub>  | I <sub>OH</sub> = −100 μA  |  | 2.7 V to 3.6 V  | V <sub>CC</sub> − 0.2 |                    |      | V    |
|                  | I <sub>OH</sub> = −12 mA   |  | 2.7 V           | 2.2                   |                    |      |      |
|                  |  |  | 3 V             | 2.4                   |                    |      |      |
|                  | I <sub>OH</sub> = −24 mA   |  | 3 V             | 2.2                   |                    |      |      |
| V <sub>OL</sub>  | I <sub>OL</sub> = 100 μA   |  | 2.7 V to 3.6 V  |                       |                    | 0.2  | V    |
|                  | I <sub>OL</sub> = 12 mA  |  | 2.7 V           |                       |                    | 0.4  |      |
|                  | I <sub>OL</sub> = 24 mA  |  | 3 V             |                       |                    | 0.55 |      |
| I <sub>I</sub>   | V <sub>I</sub> = 0 to 5.5 V  |  | 3.6 V           |                       |                    | ±5   | μA   |
| I <sub>OZ</sub>  | V <sub>O</sub> = 0 to 5.5 V  |  | 3.6 V           |                       |                    | ±15  | μA   |
| I <sub>CC</sub>  | V <sub>I</sub> = V <sub>CC</sub> or GND                                      |  | 3.6 V           |                       |                    | 10   | μA   |
|                  | 3.6 V ≤ V <sub>I</sub> ≤ 5.5 V <sup>(2)</sup>                                |  |                 |                       |                    | 10   |      |
| ΔI <sub>CC</sub> | One input at V <sub>CC</sub> − 0.6 V, Other inputs at V <sub>CC</sub> or GND |  | 2.7 V to 3.6 V  |                       |                    | 500  | μA   |
| C <sub>i</sub>   | V <sub>I</sub> = V <sub>CC</sub> or GND                                      |  | 3.3 V           |                       |                    | 4    | pF   |
| C <sub>o</sub>   | V <sub>O</sub> = V <sub>CC</sub> or GND                                      |  | 3.3 V           |                       |                    | 5.5  | pF   |

(1) All typical values are at  $V_{CC} = 3.3\text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

(2) This applies in the disabled state only.

# SN74LVC541A-EP

## OCTAL BUFFER/DRIVER

### WITH 3-STATE OUTPUTS

SCAS748A–DECEMBER 2003–REVISED AUGUST 2005

## Switching Characteristics

over recommended operating free-air temperature range (unless otherwise noted) (see [Figure 1](#))

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | $V_{CC} = 2.7\text{ V}$ |     | $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ |     | UNIT |
|-----------|-----------------|----------------|-------------------------|-----|--|-----|------|
|           |                 |                | MIN                     | MAX | MIN                                      | MAX |      |
| $t_{pd}$  | A               | Y              |                         | 5.6 | 1  | 5.1 | ns   |
| $t_{en}$  | $\overline{OE}$ | Y              |                         | 7.5 | 1  | 7   | ns   |
| $t_{dis}$ | $\overline{OE}$ | Y              |                         | 7.7 | 1  | 7   | ns   |

## Operating Characteristics

$T_A = 25^\circ\text{C}$

| PARAMETER |   |                  | TEST<br>CONDITIONS  | $V_{CC} = 2.5\text{ V}$ | $V_{CC} = 3.3\text{ V}$ | UNIT |
|-----------|---|------------------|---------------------|-------------------------|-------------------------|------|
|           |   |                  |                     | TYP                     | TYP                     |      |
| $C_{pd}$  | Power dissipation capacitance per buffer/driver | Outputs enabled  | $f = 10\text{ MHz}$ | 58                      | 33                      | pF   |
|           |   | Outputs disabled |                     | 2                       | 2                       |      |

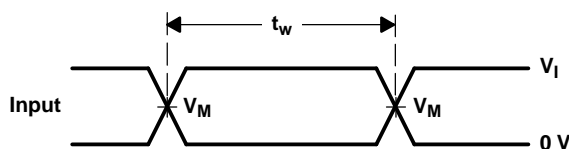
## PARAMETER MEASUREMENT INFORMATION



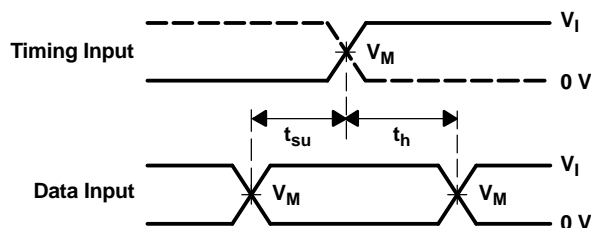
LOAD CIRCUIT

| TEST              | S1         |
|-------------------|------------|
| $t_{PLH}/t_{PHL}$ | Open       |
| $t_{PLZ}/t_{PZL}$ | $V_{LOAD}$ |
| $t_{PHZ}/t_{PZH}$ | GND        |

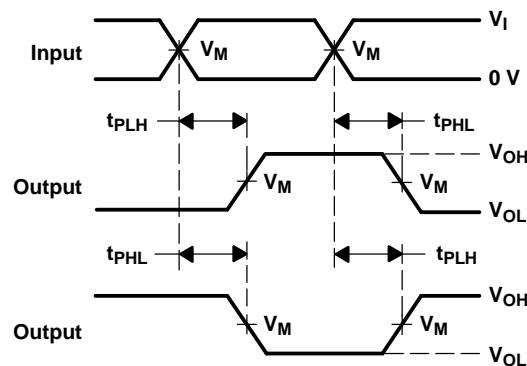
| $V_{CC}$          | INPUTS |               | $V_M$ | $V_{LOAD}$ | $C_L$ | $R_L$        | $V_{\Delta}$ |
|-------------------|--------|---------------|-------|------------|-------|--------------|--------------|
|                   | $V_I$  | $t_r/t_f$     |       |            |       |              |              |
| 2.7 V             | 2.7 V  | $\leq 2.5$ ns | 1.5 V | 6 V        | 50 pF | 500 $\Omega$ | 0.3 V        |
| 3.3 V $\pm$ 0.3 V | 2.7 V  | $\leq 2.5$ ns | 1.5 V | 6 V        | 50 pF | 500 $\Omega$ | 0.3 V        |



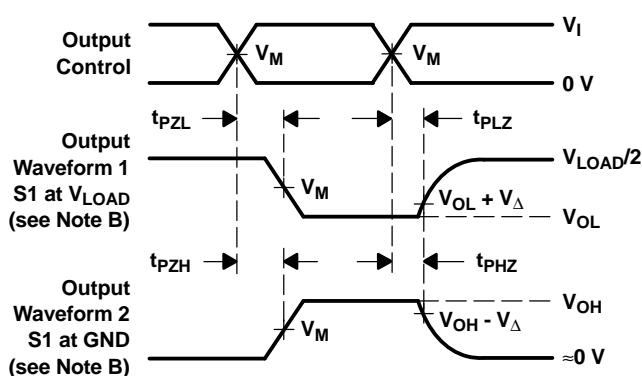
VOLTAGE WAVEFORMS  
PULSE DURATION



VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES  
INVERTING AND NONINVERTING OUTPUTS



VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES  
LOW- AND HIGH-LEVEL ENABLING

- 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:  $PRR \leq 10$  MHz,  $Z_O = 50 \Omega$ .
  - The outputs are measured one at a time, with one transition per measurement.
  - $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$ .
  - 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<br>Drawing | Pins | Package<br>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                 |
|-------------------|---------------|--------------|--------------------|------|----------------|-----------------|--------------------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74LVC541AQDWREP | ACTIVE        | SOIC         | DW                 | 20   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | C541AEP                 | <a href="#">Samples</a> |
| SN74LVC541AQPWREP | ACTIVE        | TSSOP        | PW                 | 20   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | C541AEP                 | <a href="#">Samples</a> |
| V62/04666-01XE    | ACTIVE        | SOIC         | DW                 | 20   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | C541AEP                 | <a href="#">Samples</a> |
| V62/04666-01YE    | ACTIVE        | TSSOP        | PW                 | 20   | 2000           | RoHS & Green    | NIPDAU                               | Level-1-260C-UNLIM   | -40 to 125   | C541AEP                 | <a href="#">Samples</a> |

(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.

**OBSELETE:** 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 SN74LVC541A-EP :**

- Catalog: [SN74LVC541A](#)
- Automotive: [SN74LVC541A-Q1](#)
- Military: [SN54LVC541A](#)

**NOTE: Qualified Version Definitions:**

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects
- Military - QML certified for Military and Defense Applications

**TAPE AND REEL INFORMATION**


\*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 |
|-------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LVC541AQPWREP | 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) |
|-------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LVC541AQPWREP | TSSOP        | PW              | 20   | 2000 | 853.0       | 449.0      | 35.0        |

PW (R-PDSO-G20)

PLASTIC SMALL OUTLINE



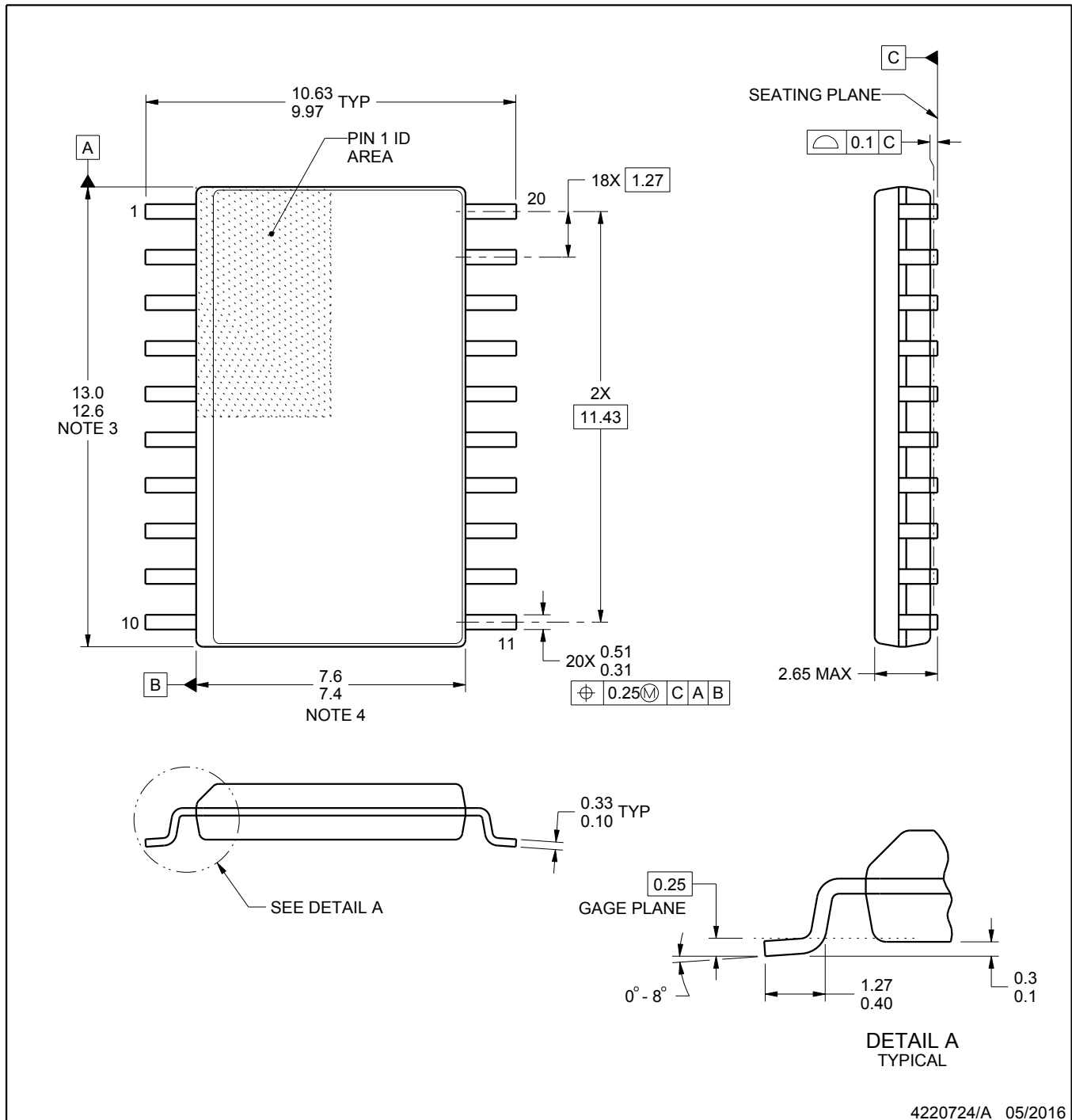
- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

PW (R-PDSO-G20)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate design.
  - D. 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.
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



4220724/A 05/2016

## NOTES:

1. All linear dimensions are in millimeters. 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 0.43 mm per side.
5. Reference JEDEC registration MS-013.

# EXAMPLE BOARD LAYOUT

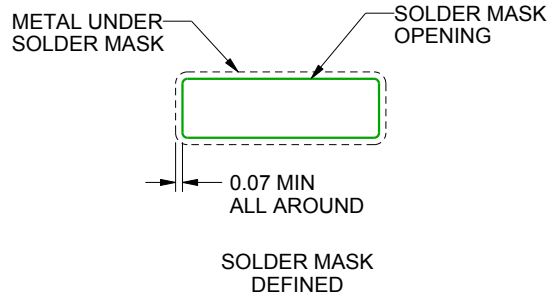
DW0020A

SOIC - 2.65 mm max height

SOIC



LAND PATTERN EXAMPLE  
SCALE:6X



SOLDER MASK DETAILS

4220724/A 05/2016

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

DW0020A

SOIC - 2.65 mm max height

SOIC



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:6X

4220724/A 05/2016

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.

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