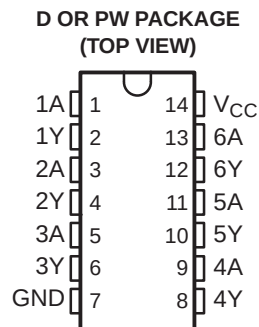


## HEX INVERTER BUFFER/DRIVER WITH OPEN-DRAIN OUTPUTS

### FEATURES

- Qualified for Automotive Applications
- Operate From 1.65 V to 3.6 V
- Inputs and Open-Drain Outputs Accept Voltages up to 5.5 V
- Max  $t_{pd}$  of 3.7 ns at 3.3 V
- $I_{off}$  Supports Partial-Power-Down Mode Operation
- Latch-Up Performance Exceeds 250 mA Per JESD 17



### DESCRIPTION/ORDERING INFORMATION

This hex inverter buffer/driver is designed for 1.65-V to 3.6-V  $V_{CC}$  operation.

The outputs of the SN74LVC06A device are open drain and can be connected to other open-drain outputs to implement active-low wired-OR or active-high wired-AND functions. The maximum sink current is 24 mA.

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.

### ORDERING INFORMATION<sup>(1)</sup>

| $T_A$          | PACKAGE <sup>(2)</sup> |              | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|------------------------|--------------|-----------------------|------------------|
| –40°C to 125°C | SOIC – D               | Reel of 2500 | SN74LVC06AQDRQ1       | LVC06AQ          |
|                | TSSOP – PW             | Reel of 2000 | SN74LVC06AQPWRQ1      | LVC06AQ          |

(1) 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 [www.ti.com](http://www.ti.com).

(2) Package drawings, thermal data, and symbolization are available at [www.ti.com/packaging](http://www.ti.com/packaging).

### FUNCTION TABLE (EACH INVERTER)

| INPUT<br>A | OUTPUT<br>Y |
|------------|-------------|
| H          | L           |
| L          | H           |

### LOGIC DIAGRAM, EACH INVERTER (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.

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

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

|                  |                                                   | MIN                | MAX  | UNIT |
|------------------|---------------------------------------------------|--------------------|------|------|
| V <sub>CC</sub>  | Supply voltage range                              | –0.5               | 6.5  | V    |
| V <sub>I</sub>   | Input voltage range <sup>(2)</sup>                | –0.5               | 6.5  | V    |
| V <sub>O</sub>   | Output voltage range                              | –0.5               | 6.5  | V    |
| I <sub>IK</sub>  | Input clamp current                               | V <sub>I</sub> < 0 | –50  | mA   |
| I <sub>OK</sub>  | Output clamp current                              | V <sub>O</sub> < 0 | –50  | mA   |
| I <sub>O</sub>   | Continuous output current                         |                    | ±50  | mA   |
|                  | Continuous current through V <sub>CC</sub> or GND |                    | ±100 | mA   |
| θ <sub>JA</sub>  | Package thermal impedance <sup>(3)</sup>          | D package          | 86   | °C/W |
|                  |                                                   | PW package         | 113  |      |
| T <sub>stg</sub> | Storage temperature range                         | –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 package thermal impedance is calculated in accordance with JESD 51-7.

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

|                 |                                | MIN                                | MAX                    | UNIT |
|-----------------|--------------------------------|------------------------------------|------------------------|------|
| V <sub>CC</sub> | Supply voltage                 | Operating                          | 1.65                   | 3.6  |
|                 |                                | Data retention only                | 1.5                    |      |
| V <sub>IH</sub> | High-level input voltage       | V <sub>CC</sub> = 1.65 V to 1.95 V | 0.65 × V <sub>CC</sub> | V    |
|                 |                                | V <sub>CC</sub> = 2.3 V to 2.7 V   | 1.7                    |      |
|                 |                                | V <sub>CC</sub> = 2.7 V to 3.6 V   | 2                      |      |
| V <sub>IL</sub> | Low-level input voltage        | V <sub>CC</sub> = 1.65 V to 1.95 V | 0.35 × V <sub>CC</sub> | V    |
|                 |                                | V <sub>CC</sub> = 2.3 V to 2.7 V   | 0.7                    |      |
|                 |                                | V <sub>CC</sub> = 2.7 V to 3.6 V   | 0.8                    |      |
| V <sub>I</sub>  | Input voltage                  | 0                                  | 5.5                    | V    |
| V <sub>O</sub>  | Output voltage                 | 0                                  | 5.5                    | V    |
| I <sub>OL</sub> | Low-level output current       | V <sub>CC</sub> = 1.65 V           | 4                      | mA   |
|                 |                                | V <sub>CC</sub> = 2.3 V            | 8                      |      |
|                 |                                | V <sub>CC</sub> = 2.7 V            | 12                     |      |
|                 |                                | V <sub>CC</sub> = 3 V              | 24                     |      |
| T <sub>A</sub>  | Operating free-air temperature | –40                                | 125                    | °C   |

- (1) 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> | MIN | TYP <sup>(1)</sup> | MAX  | UNIT |
|------------------|------------------------------------------------------------------------------|-----------------|-----|--------------------|------|------|
| V <sub>OL</sub>  | I <sub>OL</sub> = 100 µA                                                     | 1.65 V to 3.6 V |     |                    | 0.2  | V    |
|                  | I <sub>OL</sub> = 4 mA                                                       | 1.65 V          |     |                    | 0.45 |      |
|                  | I <sub>OL</sub> = 8 mA                                                       | 2.3 V           |     |                    | 0.7  |      |
|                  | I <sub>OL</sub> = 12 mA                                                      | 2.7 V           |     |                    | 0.5  |      |
|                  | I <sub>OL</sub> = 24 mA                                                      | 3 V             |     |                    | 0.65 |      |
| I <sub>I</sub>   | V <sub>I</sub> = 5.5 V or GND                                                | 3.6 V           |     |                    | ±5   | µA   |
| I <sub>CC</sub>  | V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0                  | 3.6 V           |     |                    | 10   | µA   |
| 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  |     |                    | 1    | mA   |
| C <sub>i</sub>   | V <sub>I</sub> = V <sub>CC</sub> or GND                                      | 3.3 V           |     | 5                  |      | pF   |

(1) All typical values are at V<sub>CC</sub> = 3.3 V, T<sub>A</sub> = 25°C.

## Switching Characteristics

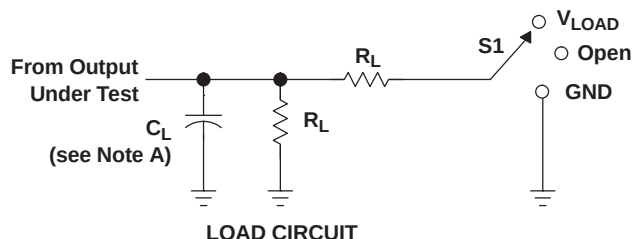
over recommended operating free-air temperature range (unless otherwise noted) (see [Figure 1](#))

| PARAMETER       | FROM<br>(INPUT) | TO<br>(OUTPUT) | V <sub>CC</sub> = 2.7 V |     | V <sub>CC</sub> = 3.3 V<br>± 0.3 V |     | UNIT |
|-----------------|-----------------|----------------|-------------------------|-----|------------------------------------|-----|------|
|                 |                 |                | MIN                     | MAX | MIN                                | MAX |      |
| t <sub>pd</sub> | A               | Y              |                         | 3.9 | 1                                  | 3.7 | ns   |

## Operating Characteristics, T<sub>A</sub> = 25°C

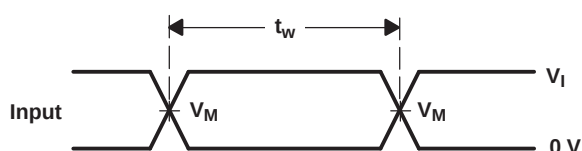
| PARAMETER                                                       | TEST CONDITIONS | V <sub>CC</sub> = 3.3 V | UNIT |
|-----------------------------------------------------------------|-----------------|-------------------------|------|
|                                                                 |                 | TYP                     |      |
| C <sub>pd</sub> Power dissipation capacitance per buffer/driver | f = 10 MHz      | 2.5                     | pF   |

## PARAMETER MEASUREMENT INFORMATION (OPEN DRAIN)

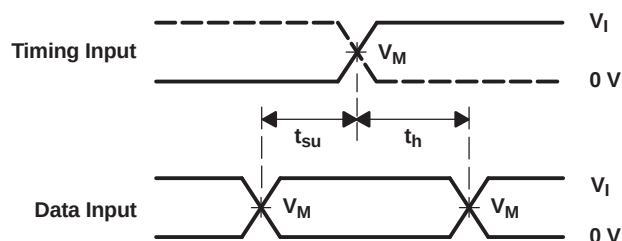


| TEST                          | S1         |
|-------------------------------|------------|
| $t_{PZL}$ (see Notes E and F) | $V_{LOAD}$ |
| $t_{PLZ}$ (see Notes E and G) | $V_{LOAD}$ |
| $t_{PHZ}/t_{PZH}$             | $V_{LOAD}$ |

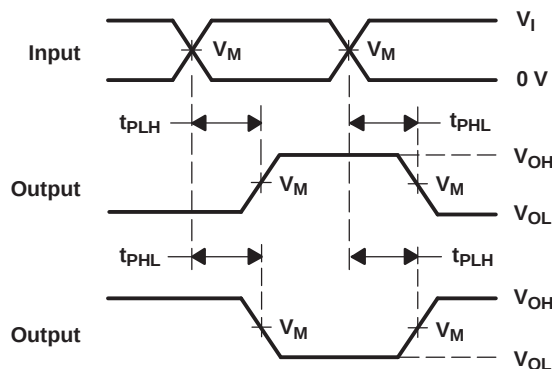
| $V_{CC}$          | INPUT |               | $V_M$ | $V_{LOAD}$ | $C_L$ | $R_L$        | $V_{\Delta}$ |
|-------------------|-------|---------------|-------|------------|-------|--------------|--------------|
|                   | $V_I$ | $t_r/t_f$     |       |            |       |              |              |
| 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        |



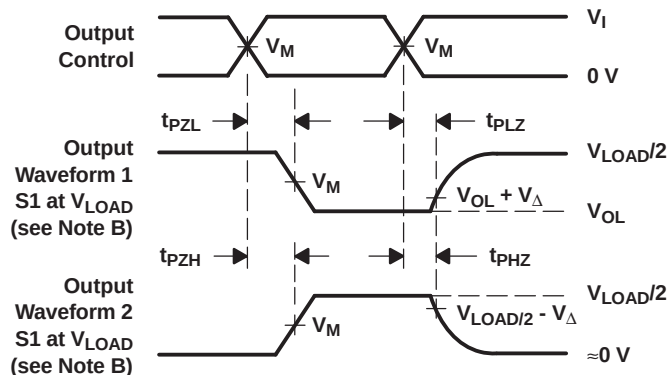
VOLTAGE WAVEFORMS  
PULSE DURATION



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.
  - Since this device has open-drain outputs,  $t_{PLZ}$  and  $t_{PZL}$  are the same as  $t_{pd}$ .
  - $t_{PZL}$  is measured at  $V_M$ .
  - $t_{PLZ}$  is measured at  $V_{OL} + V_{\Delta}$ .
  - 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/Ball Finish<br>(6) | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|--------------------|---------------|--------------|--------------------|------|----------------|----------------------------|-------------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74LVC06AQDRG4Q1  | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | LVC06AQ                 | <a href="#">Samples</a> |
| SN74LVC06AQDRQ1    | ACTIVE        | SOIC         | D                  | 14   | 2500           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | LVC06AQ                 | <a href="#">Samples</a> |
| SN74LVC06AQPWRG4Q1 | ACTIVE        | TSSOP        | PW                 | 14   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU               | Level-1-260C-UNLIM   | -40 to 125   | LVC06AQ                 | <a href="#">Samples</a> |
| SN74LVC06AQPWRQ1   | OBSOLETE      | TSSOP        | PW                 | 14   |                | TBD                        | Call TI                 | Call TI              | -40 to 125   |                         |                         |

(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) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

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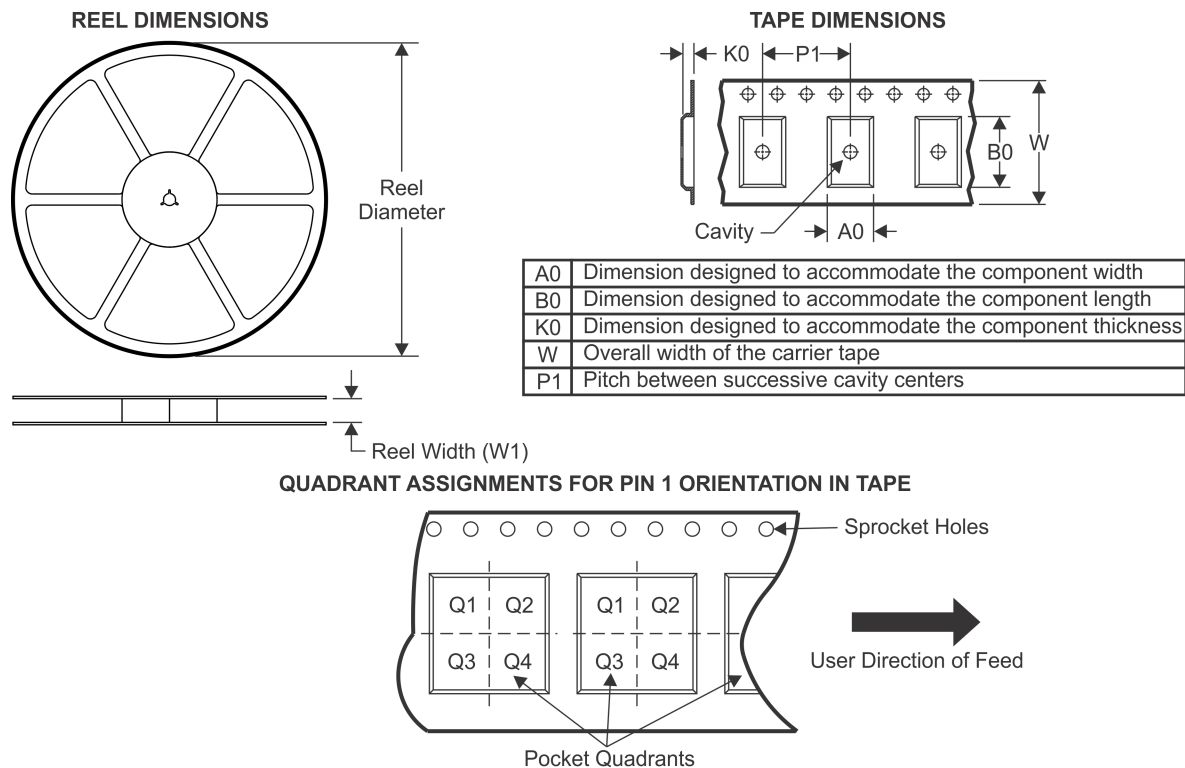
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**OTHER QUALIFIED VERSIONS OF SN74LVC06A-Q1 :**

- Catalog: [SN74LVC06A](#)
- Enhanced Product: [SN74LVC06A-EP](#)

NOTE: Qualified Version Definitions:

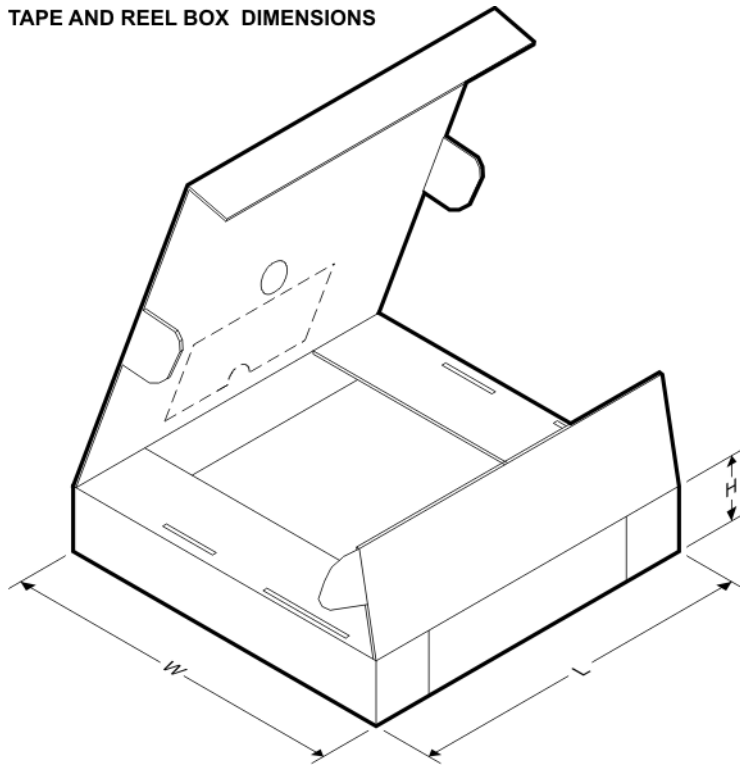
- Catalog - TI's standard catalog product
- Enhanced Product - Supports Defense, Aerospace and Medical Applications

**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 |
|------------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74LVC06AQPWRG4Q<br>1 | TSSOP        | PW              | 14   | 2000 | 330.0              | 12.4               | 6.9     | 5.6     | 1.6     | 8.0     | 12.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



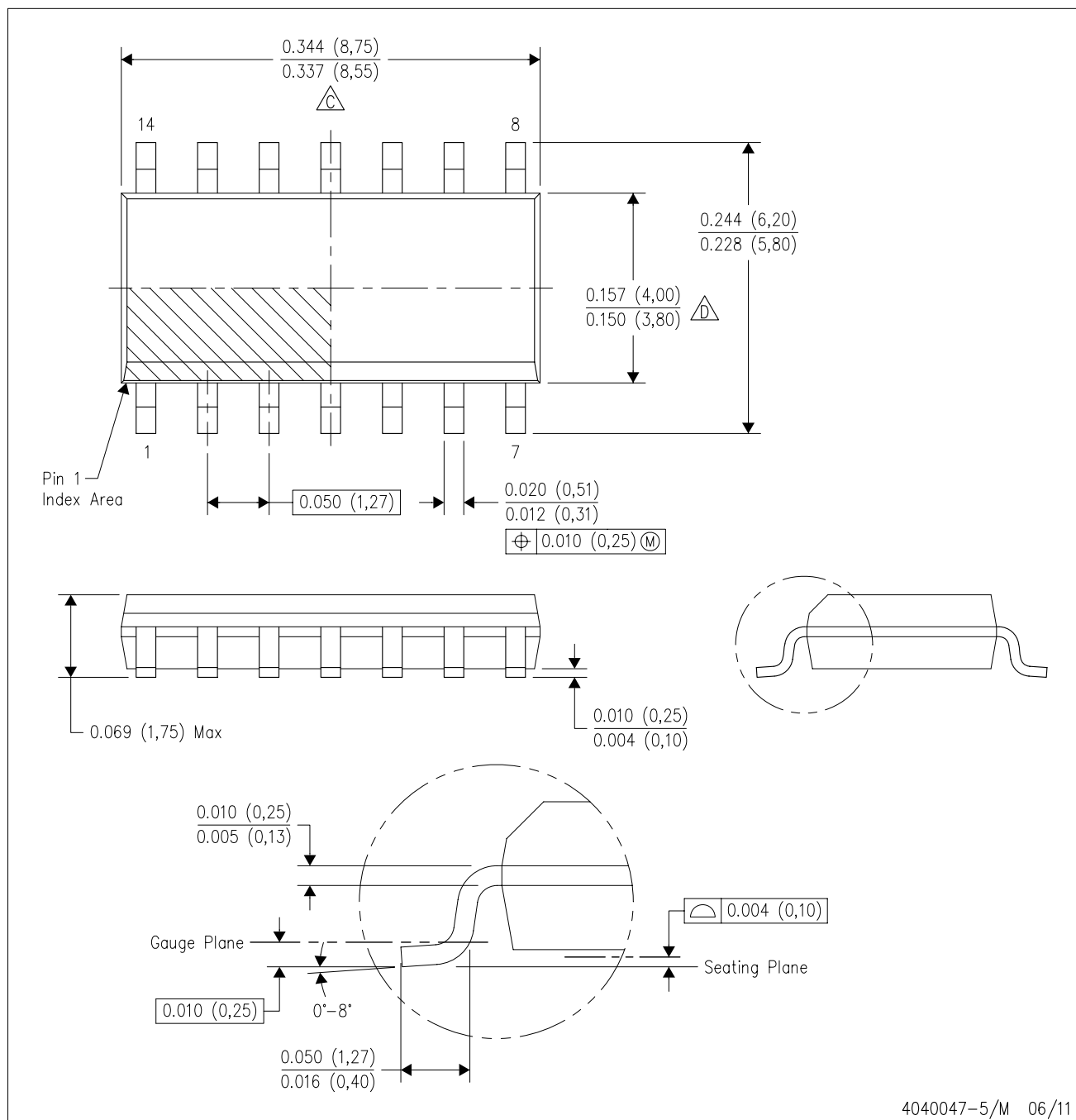
\*All dimensions are nominal

| Device             | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|--------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74LVC06AQPWRG4Q1 | TSSOP        | PW              | 14   | 2000 | 367.0       | 367.0      | 35.0        |



D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



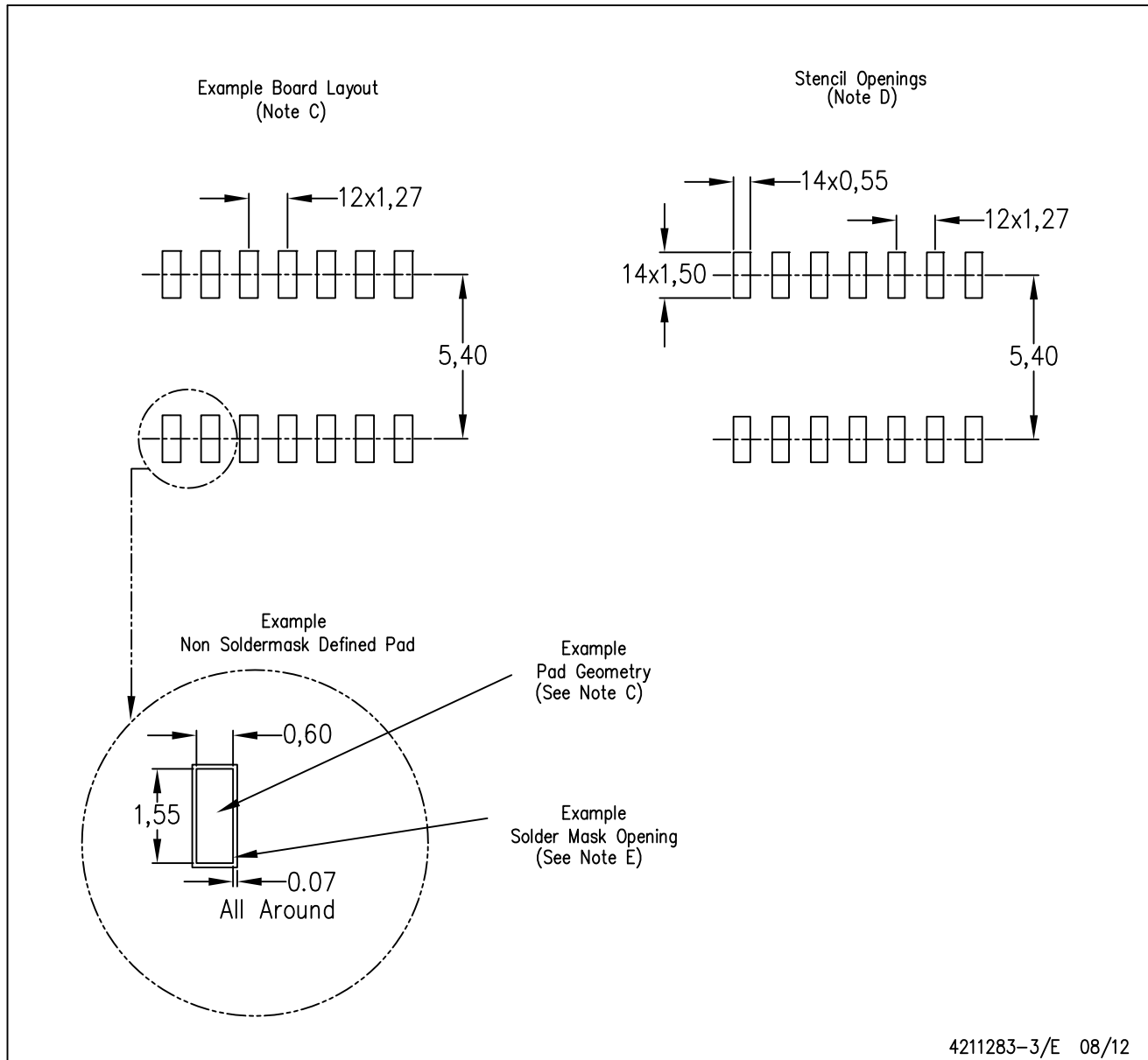
4040047-5/M 06/11

NOTES:

- A. All linear dimensions are in inches (millimeters).
- 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 0.006 (0,15) each side.
- D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
- E. Reference JEDEC MS-012 variation AB.

D (R-PDSO-G14)

PLASTIC SMALL OUTLINE

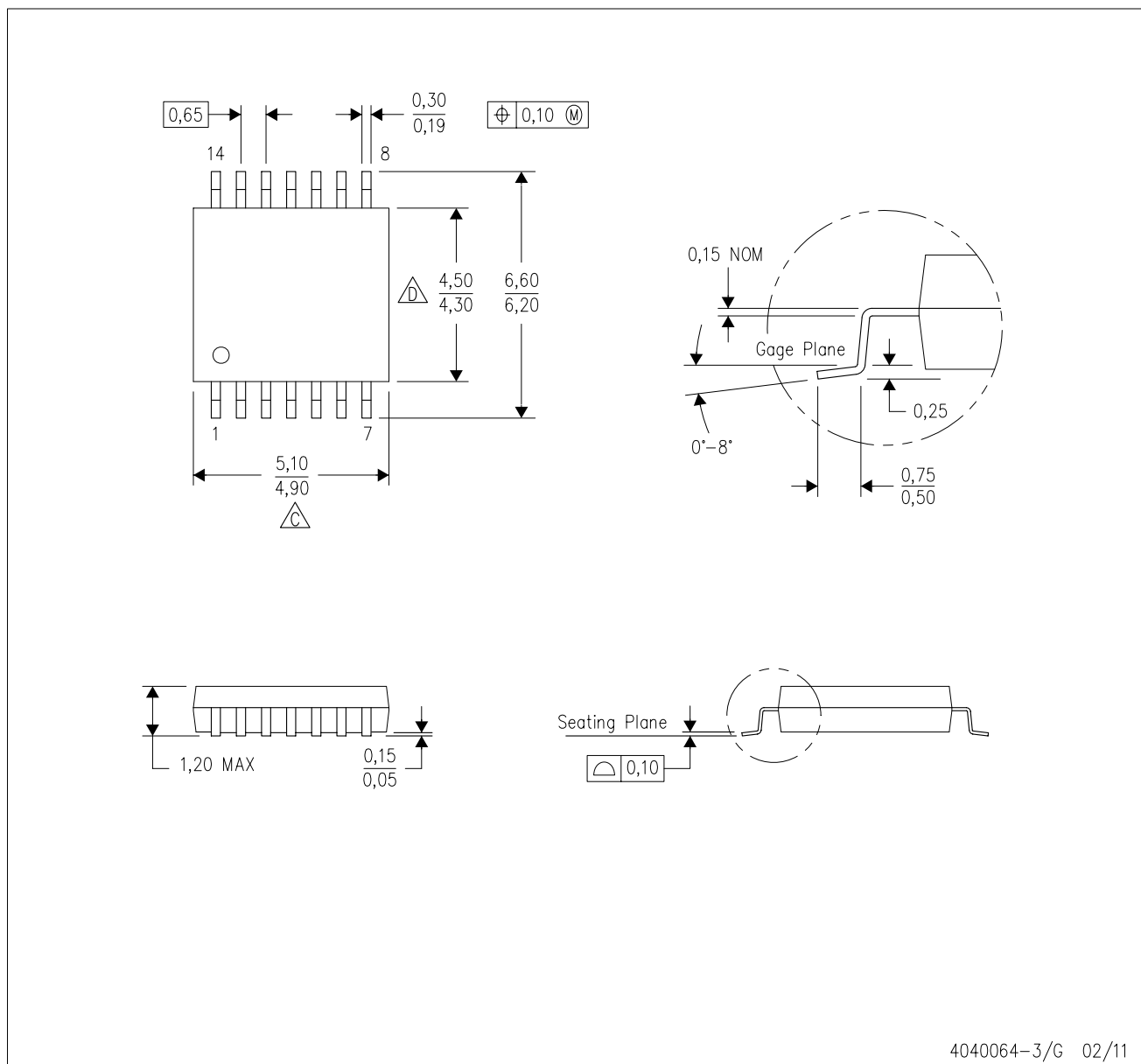


4211283-3/E 08/12

- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - 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.

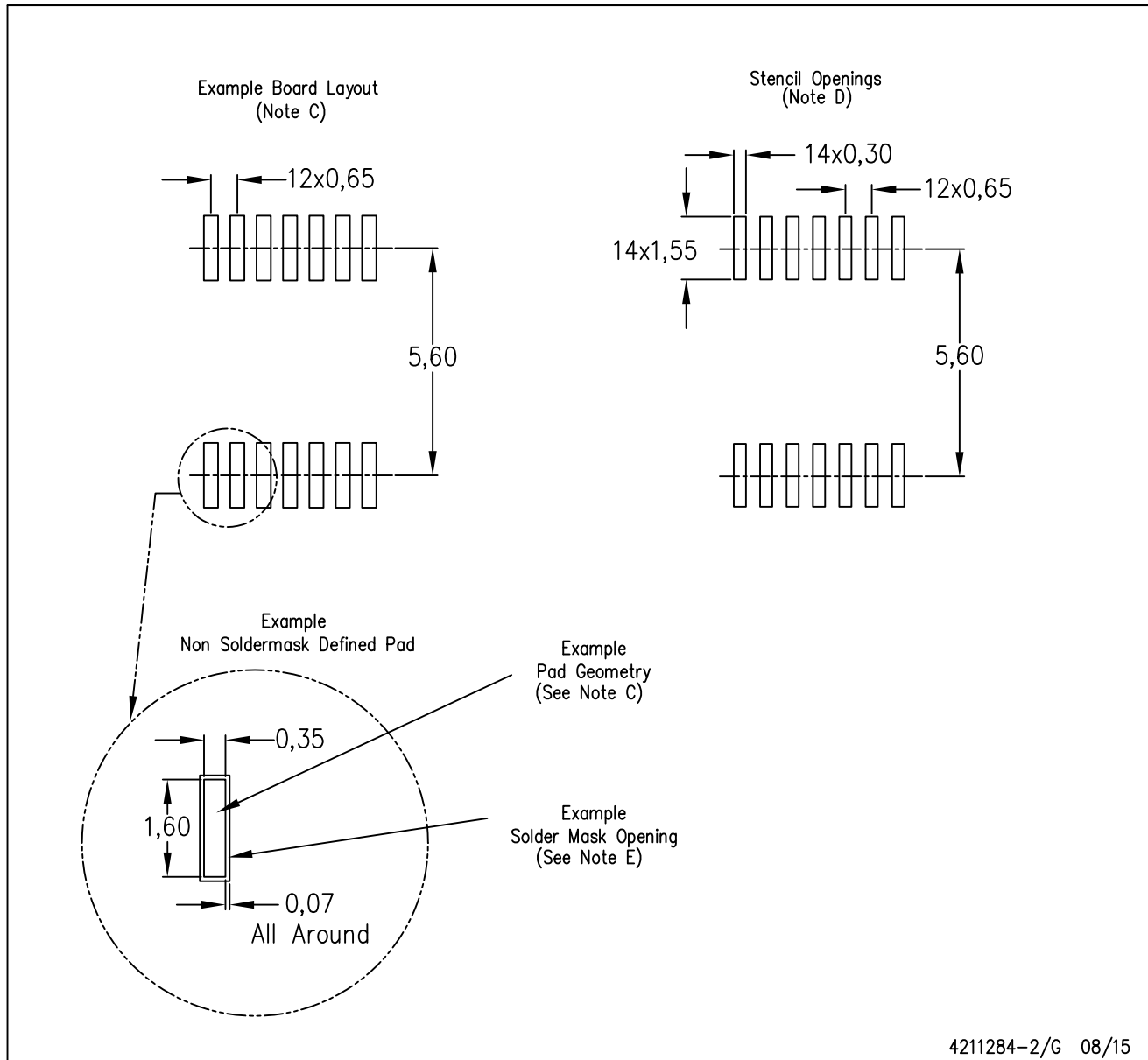
PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - 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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|                              |                                                                                      |
|------------------------------|--------------------------------------------------------------------------------------|
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| Amplifiers                   | <a href="http://amplifier.ti.com">amplifier.ti.com</a>                               |
| Data Converters              | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>                       |
| DLP® Products                | <a href="http://www.dlp.com">www.dlp.com</a>                                         |
| DSP                          | <a href="http://dsp.ti.com">dsp.ti.com</a>                                           |
| Clocks and Timers            | <a href="http://www.ti.com/clocks">www.ti.com/clocks</a>                             |
| Interface                    | <a href="http://interface.ti.com">interface.ti.com</a>                               |
| Logic                        | <a href="http://logic.ti.com">logic.ti.com</a>                                       |
| Power Mgmt                   | <a href="http://power.ti.com">power.ti.com</a>                                       |
| Microcontrollers             | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a>                   |
| RFID                         | <a href="http://www.ti-rfid.com">www.ti-rfid.com</a>                                 |
| OMAP Applications Processors | <a href="http://www.ti.com/omap">www.ti.com/omap</a>                                 |
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### Applications

|                               |                                                                                          |
|-------------------------------|------------------------------------------------------------------------------------------|
| Automotive and Transportation | <a href="http://www.ti.com/automotive">www.ti.com/automotive</a>                         |
| Communications and Telecom    | <a href="http://www.ti.com/communications">www.ti.com/communications</a>                 |
| Computers and Peripherals     | <a href="http://www.ti.com/computers">www.ti.com/computers</a>                           |
| Consumer Electronics          | <a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>                   |
| Energy and Lighting           | <a href="http://www.ti.com/energy">www.ti.com/energy</a>                                 |
| Industrial                    | <a href="http://www.ti.com/industrial">www.ti.com/industrial</a>                         |
| Medical                       | <a href="http://www.ti.com/medical">www.ti.com/medical</a>                               |
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