

- Member of the Texas Instruments Widebus+™ Family
- Output Edge-Control Circuitry Minimizes Switching Noise in an Unterminated DIMM Load
- Supports SSTL\_2 Data Inputs
- Differential Clock (CLK and  $\overline{\text{CLK}}$ ) Inputs
- Supports LVCMOS Switching Levels on the  $\overline{\text{RESET}}$  Input
- $\overline{\text{RESET}}$  Input Disables Differential Input Receivers, Resets All Registers, and Forces All Outputs Low
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

## description

This 26-bit registered buffer is designed for 2.3-V to 2.7-V  $V_{CC}$  operation.

All inputs are SSTL\_2, except the LVCMOS reset ( $\overline{\text{RESET}}$ ) input. All outputs are edge-controlled LVCMOS circuits optimized for unterminated DIMM loads.

The SN74SSTV32867 operates from a differential clock (CLK and  $\overline{\text{CLK}}$ ). Data are registered at the crossing of CLK going high and  $\overline{\text{CLK}}$  going low.

The device supports low-power standby operation. When  $\overline{\text{RESET}}$  is low, the differential input receivers are disabled, and undriven (floating) data, clock, and reference voltage ( $V_{REF}$ ) inputs are allowed. In addition, when  $\overline{\text{RESET}}$  is low, all registers are reset and all outputs are forced low. The LVCMOS  $\overline{\text{RESET}}$  always must be held at a valid logic high or low level.

To ensure defined outputs from the register before a stable clock has been supplied,  $\overline{\text{RESET}}$  must be held in the low state during power up.



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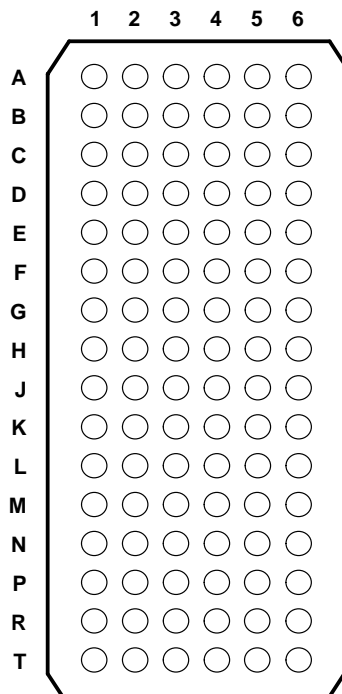
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**SN74SSTV32867**  
**26-BIT REGISTERED BUFFER**  
**WITH SSTL\_2 INPUTS AND LVCMOS OUTPUTS**

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**GKE PACKAGE**  
(TOP VIEW)



**terminal assignments**

|   | 1   | 2               | 3                | 4                | 5   | 6                |
|---|-----|-----------------|------------------|------------------|-----|------------------|
| A | D1  | V <sub>CC</sub> | GND              | V <sub>DDQ</sub> | Q1  | Q2               |
| B | D3  | D2              | V <sub>REF</sub> | GND              | Q3  | Q4               |
| C | D5  | D4              | NC               | GND              | Q5  | Q6               |
| D | D7  | D6              | GND              | V <sub>DDQ</sub> | Q7  | Q8               |
| E | D9  | D8              | V <sub>CC</sub>  | GND              | Q9  | V <sub>DDQ</sub> |
| F | D11 | D10             | GND              | V <sub>DDQ</sub> | Q10 | GND              |
| G | D13 | D12             | V <sub>CC</sub>  | V <sub>DDQ</sub> | Q12 | Q11              |
| H | D15 | D14             | GND              | GND              | GND | Q13              |
| J | CLK | NC              | GND              | GND              | GND | Q14              |
| K | CLK | RESET           | V <sub>CC</sub>  | V <sub>DDQ</sub> | Q15 | Q16              |
| L | D16 | D17             | GND              | V <sub>DDQ</sub> | Q17 | GND              |
| M | D18 | D19             | V <sub>CC</sub>  | GND              | Q18 | V <sub>DDQ</sub> |
| N | D20 | D21             | GND              | V <sub>DDQ</sub> | Q20 | Q19              |
| P | D22 | D23             | NC               | GND              | Q22 | Q21              |
| R | D24 | D25             | NC               | GND              | Q24 | Q23              |
| T | D26 | V <sub>CC</sub> | GND              | V <sub>DDQ</sub> | Q26 | Q25              |

**ORDERING INFORMATION**

| T <sub>A</sub> | PACKAGE†    |               | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|-------------|---------------|-----------------------|------------------|
| 0°C to 70°C    | LFBGA – GKE | Tape and reel | SN74SSTV32867GKER     | SV867            |

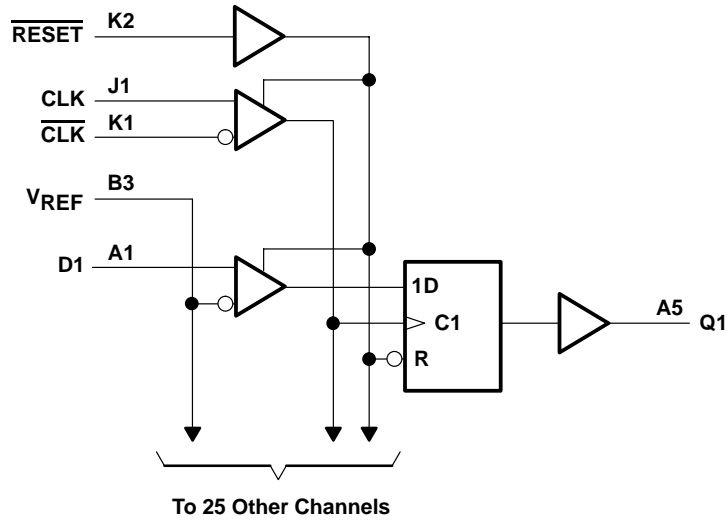
† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).

**FUNCTION TABLE**

| INPUTS |               |               |               | OUTPUT         |
|--------|---------------|---------------|---------------|----------------|
| RESET  | CLK           | CLK           | D             | Q              |
| H      | ↑             | ↓             | H             | H              |
| H      | ↑             | ↓             | L             | L              |
| H      | L or H        | L or H        | X             | Q <sub>0</sub> |
| L      | X or floating | X or floating | X or floating | L              |



**logic diagram (positive logic)**



**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†**

|   |                             |
|---|-----------------------------|
| Supply voltage range, $V_{CC}$ or $V_{DDQ}$ .....                     | -0.5 V to 3.6 V             |
| Input voltage range, $V_I$ (see Note 1) .....                         | -0.5 V to $V_{CC} + 0.5$ V  |
| Output voltage range, $V_O$ (see Notes 1 and 2) .....                 | -0.5 V to $V_{DDQ} + 0.5$ V |
| Input clamp current, $I_{IK}$ ( $V_I < 0$ ) .....                     | -50 mA                      |
| Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{DDQ}$ ) ..... | $\pm 50$ mA                 |
| Continuous output current, $I_O$ ( $V_O = 0$ to $V_{DDQ}$ ) .....     | $\pm 50$ mA                 |
| Continuous current through each $V_{CC}$ , $V_{DDQ}$ , or GND .....   | $\pm 100$ mA                |
| Package thermal impedance, $\theta_{JA}$ (see Note 3) .....           | 40°C/W                      |
| 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 negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
  2. This value is limited to 3.6 V maximum.
  3. The package thermal impedance is calculated in accordance with JESD 51-7.

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**recommended operating conditions (see Note 4)**

|                    |  | MIN                          | NOM                     | MAX                     | UNIT |
|--------------------|--|------------------------------|-------------------------|-------------------------|------|
| V <sub>CC</sub>    | Supply voltage   | V <sub>DDQ</sub>             |                         | 2.7                     | V    |
| V <sub>DDQ</sub>   | Output supply voltage                                      | 2.3                          |                         | 2.7                     | V    |
| V <sub>REF</sub>   | Reference voltage (V <sub>REF</sub> = V <sub>DDQ</sub> /2) | 1.15                         | 1.25                    | 1.35                    | V    |
| V <sub>TT</sub>    | Termination voltage  | V <sub>REF</sub> -40mV       | V <sub>REF</sub>        | V <sub>REF</sub> +40mV  | V    |
| V <sub>I</sub>     | Input voltage  | 0                            |                         | V <sub>CC</sub>         | V    |
| V <sub>IH</sub>    | AC high-level input voltage                                | Data input                   | V <sub>REF</sub> +310mV |                         | V    |
| V <sub>IL</sub>    | AC low-level input voltage                                 | Data input                   |                         | V <sub>REF</sub> -310mV | V    |
| V <sub>IH</sub>    | DC high-level input voltage                                | Data input                   | V <sub>REF</sub> +150mV |                         | V    |
| V <sub>IL</sub>    | DC low-level input voltage                                 | Data input                   |                         | V <sub>REF</sub> -150mV | V    |
| V <sub>IH</sub>    | High-level input voltage                                   | $\overline{\text{RESET}}$    | 1.7                     |                         | V    |
| V <sub>IL</sub>    | Low-level input voltage                                    | $\overline{\text{RESET}}$    |                         | 0.7                     | V    |
| V <sub>ICR</sub>   | Common-mode input voltage range                            | CLK, $\overline{\text{CLK}}$ | 0.97                    | 1.53                    | V    |
| V <sub>I(PP)</sub> | Peak-to-peak input voltage                                 | CLK, $\overline{\text{CLK}}$ | 360                     |                         | mV   |
| I <sub>OH</sub>    | High-level output current                                  |                              |                         | -8                      | mA   |
| I <sub>OL</sub>    | Low-level output current                                   |                              |                         | 8                       | mA   |
| T <sub>A</sub>     | Operating free-air temperature                             | 0                            |                         | 70                      | °C   |

NOTE 4: The  $\overline{\text{RESET}}$  input of the device must be held at V<sub>CC</sub> or GND to ensure proper device operation. The differential inputs must not be floating unless RESET is low. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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

| PARAMETER        |   | TEST CONDITIONS  | V <sub>CC</sub> | MIN                   | TYP† | MAX  | UNIT       |
|------------------|---|--|-----------------|-----------------------|------|------|------------|
| V <sub>IK</sub>  |   | I <sub>I</sub> = -18 mA  | 2.3 V           |                       |      | -1.2 | V          |
| V <sub>OH</sub>  |   | I <sub>OH</sub> = -100 μA  | 2.3 V to 2.7 V  | V <sub>DDQ</sub> -0.2 |      |      | V          |
|                  |   | I <sub>OH</sub> = -8 mA  | 2.3 V           | 1.7                   |      |      |            |
| V <sub>OL</sub>  |   | I <sub>OL</sub> = 100 μA   | 2.3 V to 2.7 V  |                       |      | 0.2  | V          |
|                  |   | I <sub>OL</sub> = 8 mA   | 2.3 V           |                       |      | 0.4  |            |
| I <sub>I</sub>   | All inputs                              | V <sub>I</sub> = V <sub>CC</sub> or GND  | 2.7 V           |                       |      | ±5   | μA         |
| I <sub>CC</sub>  | Static standby                          | RESET = GND  | 2.7 V           |                       |      | 40   | μA         |
|                  | Static operating                        | RESET = V <sub>CC</sub> ,<br>V <sub>I</sub> = V <sub>IH(AC)</sub> or V <sub>IL(AC)</sub>   |                 | I <sub>O</sub> = 0    |      | 95   |            |
| I <sub>CCD</sub> | Dynamic operating – clock only          | RESET = V <sub>CC</sub> ,<br>V <sub>I</sub> = V <sub>IH(AC)</sub> or V <sub>IL(AC)</sub> ,<br>CLK and CLK switching<br>50% duty cycle  | 2.5 V           |                       |      | 44   | μA/<br>MHz |
|                  | Dynamic operating – per each data input | RESET = V <sub>CC</sub> ,<br>V <sub>I</sub> = V <sub>IH(AC)</sub> or V <sub>IL(AC)</sub> ,<br>CLK and CLK switching<br>50% duty cycle,<br>One data input switching at<br>one-half clock frequency,<br>50% duty cycle |                 | I <sub>O</sub> = 0    |      | 5    |            |
| C <sub>i</sub> ‡ | Data inputs                             | V <sub>I</sub> = V <sub>REF</sub> ± 310 mV   | 2.5 V           | 2.5                   | 3.5  | 4.5  | pF         |
|                  | CLK, CLK                                | V <sub>ICR</sub> = 1.25 V, V <sub>I(PP)</sub> = 360 mV   |                 | 4                     | 4.5  | 5    |            |
|                  | RESET                                   | V <sub>I</sub> = V <sub>CC</sub> or GND  |                 | 3.9                   | 5    | 5.5  |            |

† All typical values are at V<sub>CC</sub> = 2.5 V, T<sub>A</sub> = 25°C.

‡ Measured with 50-MHz input frequency

**timing requirements over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)**

|                    |  |                                    | V <sub>CC</sub> = 2.5 V<br>± 0.2 V |     | UNIT                   |
|--------------------|--|------------------------------------|------------------------------------|-----|------------------------|
|                    |  |                                    | MIN                                | MAX |                        |
| f <sub>clock</sub> | Clock frequency                                |                                    | 200                                |     | MHz                    |
| t <sub>w</sub>     | Pulse duration                                 |                                    | 2.5                                |     | ns                     |
|                    |  |                                    |                                    |     | CLK, CLK high or low   |
| t <sub>act</sub>   | Differential inputs active time (see Note 5)   |                                    | 22                                 |     | ns                     |
| t <sub>inact</sub> | Differential inputs inactive time (see Note 6) |                                    | 22                                 |     | ns                     |
| t <sub>su</sub>    | Setup time                                     | Fast slew rate (see Notes 7 and 9) | 0.75                               |     | ns                     |
|                    |  | Slow slew rate (see Notes 8 and 9) | 0.9                                |     |                        |
| t <sub>h</sub>     | Hold time                                      | Fast slew rate (see Notes 7 and 9) | 0.75                               |     | ns                     |
|                    |  | Slow slew rate (see Notes 8 and 9) | 0.9                                |     |                        |
|                    |  |                                    |                                    |     | Data before CLK↑, CLK↓ |
|                    |  |                                    |                                    |     | Data after CLK↑, CLK↓  |

NOTES: 5. Data inputs must be low a minimum time of t<sub>act</sub> min, after RESET is taken high.

6. Data and clock inputs must be held at valid levels (not floating) a minimum time of t<sub>inact</sub> min, after RESET is taken low.

7. Data signal input slew rate ≥ 1 V/ns

8. Data signal input slew rate ≥ 0.5 V/ns and < 1 V/ns

9. CLK, CLK input slew rates are ≥ 1 V/ns.

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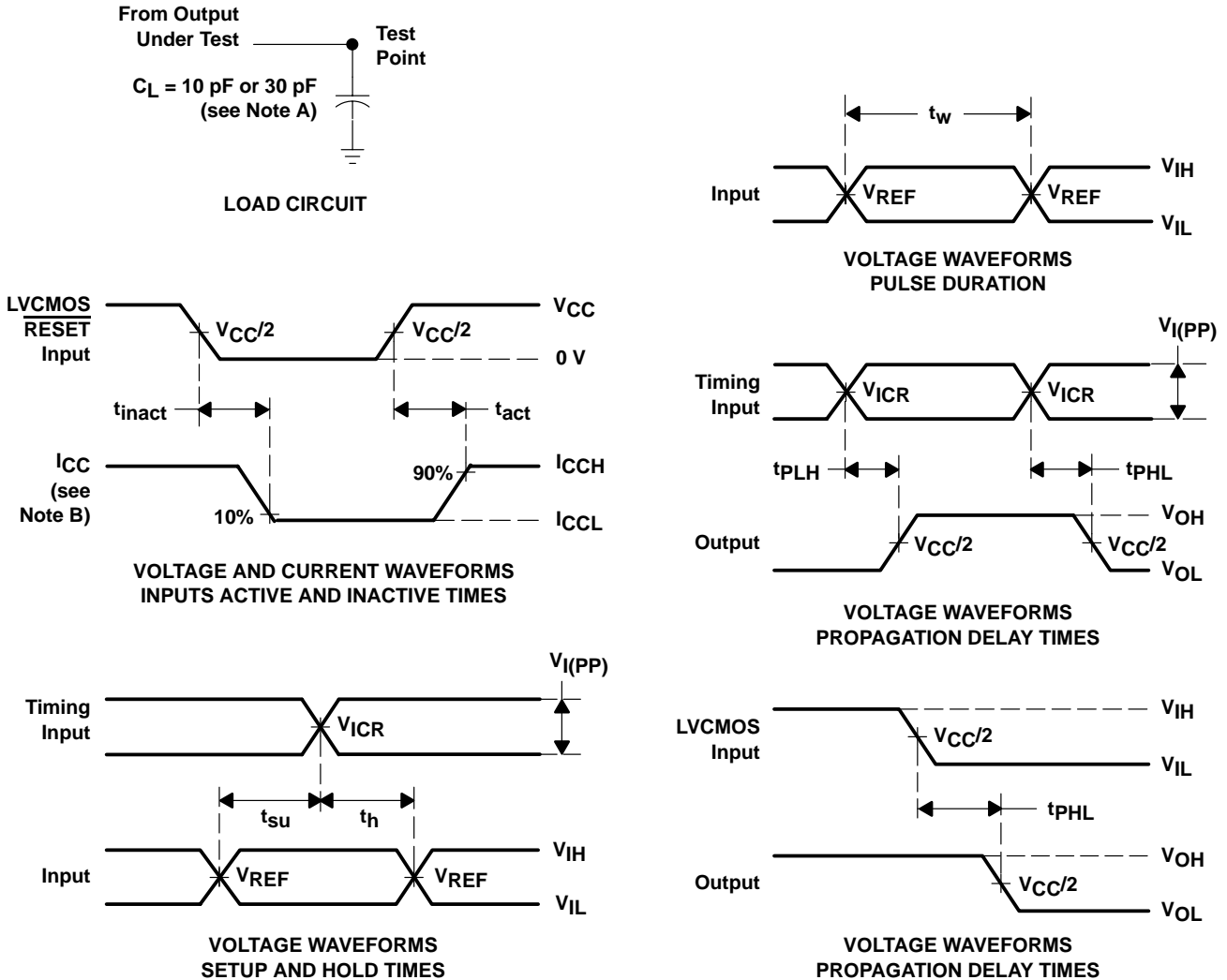
switching characteristics over recommended operating free-air temperature range,  
 $V_{REF} = V_{DDQ}/2$  and  $C_L = 10$  pF (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM<br>(INPUT)          | TO<br>(OUTPUT) | $V_{CC} = 2.5$ V<br>$\pm 0.2$ V |     | UNIT |
|-----------|--------------------------|----------------|---------------------------------|-----|------|
|           |                          |                | MIN                             | MAX |      |
| $f_{max}$ |                          |                | 200                             |     | MHz  |
| $t_{pd}$  | CLK and $\overline{CLK}$ | Q              | 1.1                             | 2.8 | ns   |
| $t_{PHL}$ | $\overline{RESET}$       | Q              |                                 | 5   | ns   |

switching characteristics over recommended operating free-air temperature range,  
 $V_{REF} = V_{DDQ}/2$  and  $C_L = 30$  pF (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM<br>(INPUT)          | TO<br>(OUTPUT) | $V_{CC} = 2.5$ V<br>$\pm 0.2$ V |     | UNIT |
|-----------|--------------------------|----------------|---------------------------------|-----|------|
|           |                          |                | MIN                             | MAX |      |
| $f_{max}$ |                          |                | 200                             |     | MHz  |
| $t_{pd}$  | CLK and $\overline{CLK}$ | Q              | 1.1                             | 3.8 | ns   |
| $t_{PHL}$ | $\overline{RESET}$       | Q              |                                 | 5   | ns   |

**PARAMETER MEASUREMENT INFORMATION**



- NOTES:
- A.  $C_L$  includes probe and jig capacitance.
  - B.  $I_{CC}$  tested with clock and data inputs held at  $V_{CC}$  or GND, and  $I_O = 0 \text{ mA}$ .
  - C. All input pulses are supplied by generators having the following characteristics: PRR  $\leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ , input slew rate =  $1 \text{ V/ns} \pm 20\%$  (unless otherwise noted).
  - D. The outputs are measured one at a time with one transition per measurement.
  - E.  $V_{REF} = V_{DDQ}/2$
  - F.  $V_{IH} = V_{REF} + 310 \text{ mV}$  (ac voltage levels) for differential inputs.  $V_{IH} = V_{CC}$  for LVCMOS input.
  - G.  $V_{IL} = V_{REF} - 310 \text{ mV}$  (ac voltage levels) for differential inputs.  $V_{IL} = \text{GND}$  for LVCMOS input.
  - H.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pD}$ .

**Figure 1. Load Circuit and Voltage Waveforms**

**PACKAGING INFORMATION**

| Orderable Device  | Status <sup>(1)</sup> | Package Type | Package Drawing | Pins | Package Qty | Eco Plan <sup>(2)</sup> | Lead/Ball Finish | MSL Peak Temp <sup>(3)</sup> |
|-------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN74SSTV32867GKER | ACTIVE                | LFBGA        | GKE             | 96   | 1000        | TBD                     | SNPB             | Level-3-220C-168 HR          |

<sup>(1)</sup> 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.

<sup>(2)</sup> 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)

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

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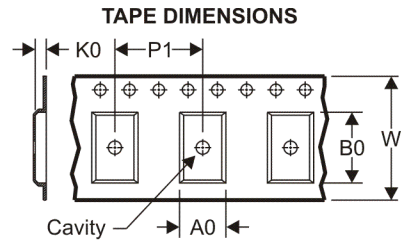
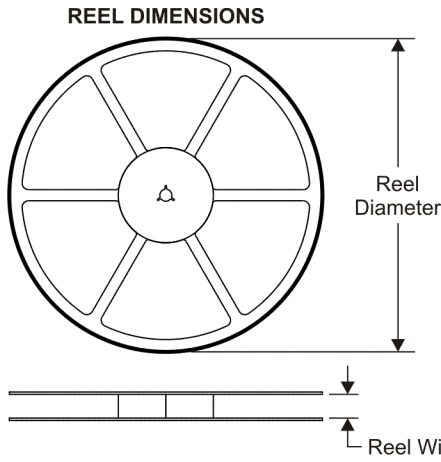
- Enhanced Product: [SN74SSTV32867-EP](#)

NOTE: Qualified Version Definitions:

- Enhanced Product - Supports Defense, Aerospace and Medical Applications

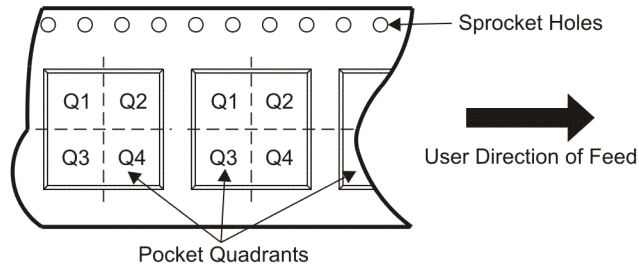


**TAPE AND REEL INFORMATION**



|    |   |
|----|---|
| 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 |
|-------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74SSTV32867GKER | LFBGA        | GKE             | 96   | 1000 | 330.0              | 24.4               | 5.7     | 13.7    | 2.0     | 8.0     | 24.0   | Q1            |

**TAPE AND REEL BOX DIMENSIONS**

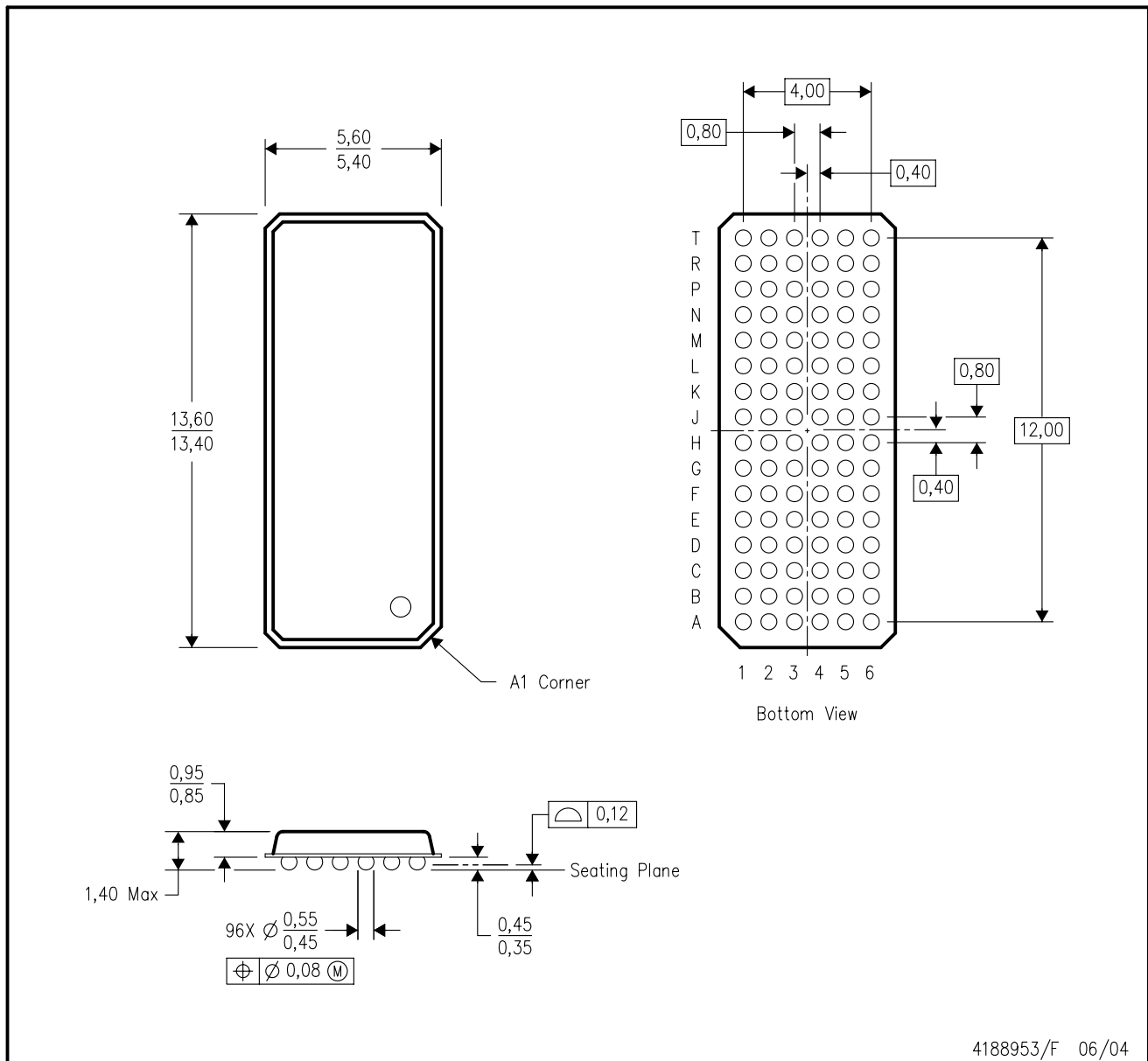


\*All dimensions are nominal

| Device            | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|-------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74SSTV32867GKER | LFBGA        | GKE             | 96   | 1000 | 346.0       | 346.0      | 41.0        |

GKE (R-PBGA-N96)

PLASTIC BALL GRID ARRAY



4188953/F 06/04

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Falls within JEDEC MO-205 variation CC.
  - D. This package is tin-lead (SnPb). Refer to the 96 ZKE package (drawing 4204493) for lead-free.

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| Data Converters             | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>     |
| DSP                         | <a href="http://dsp.ti.com">dsp.ti.com</a>                         |
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| Logic                       | <a href="http://logic.ti.com">logic.ti.com</a>                     |
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| Microcontrollers            | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a> |
| RFID                        | <a href="http://www.ti-rfid.com">www.ti-rfid.com</a>               |
| RF/IF and ZigBee® Solutions | <a href="http://www.ti.com/lprf">www.ti.com/lprf</a>               |

### Applications

|                    |  |
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