

- Member of the Texas Instruments Widebus+™ Family
- Supports SSTL_2 Data Inputs
- Outputs Meet SSTL_2 Class II Specifications
- Differential Clock Inputs (CLK and $\overline{\text{CLK}}$)
- 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
- Flow-through Architecture Optimizes PCB Layout
- 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 SSTL_2, Class II compatible.

The SN74SSTV32877 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 $\overline{\text{RESET}}$ input always must be held at a valid logic high or low level. When $\overline{\text{OE}}$ and $\overline{\text{RESET}}$ are high, the outputs are in the high-impedance state.

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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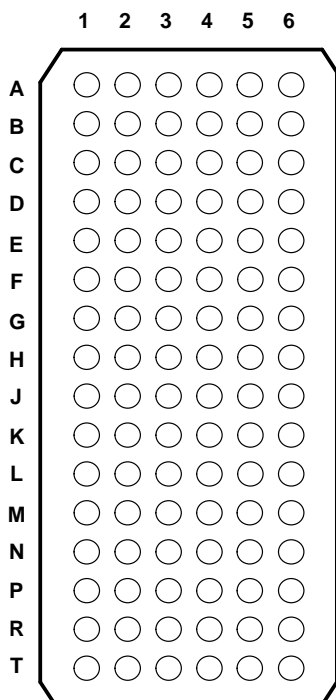
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SN74SSTV32877
26-BIT REGISTERED BUFFER
WITH SSTL_2 INPUTS AND OUTPUTS

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GKE PACKAGE
(TOP VIEW)



terminal assignments

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

ORDERING INFORMATION

| T _A | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|-------------|---------------|-----------------------|------------------|
| 0°C to 70°C | LFBGA – GKE | Tape and reel | SN74SSTV32877GKER | SV877 |

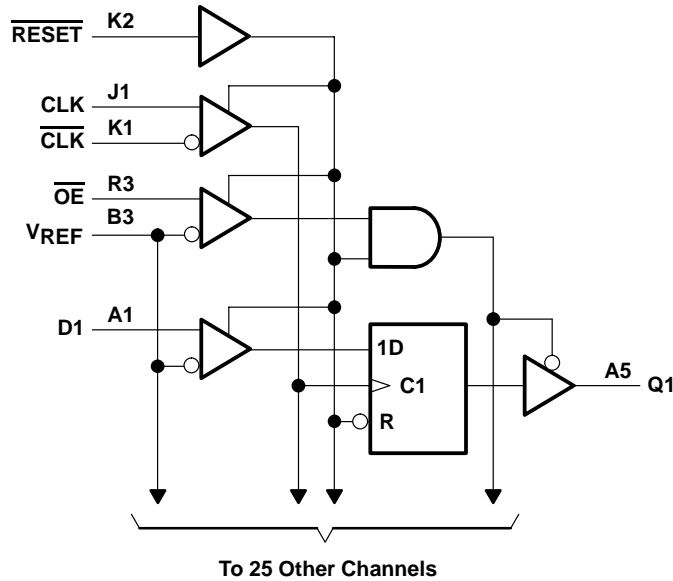
† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

FUNCTION TABLE

| INPUTS | | | | | OUTPUT |
|---------------------------|------------------------|---------------|-------------------------|---------------|----------------|
| $\overline{\text{RESET}}$ | $\overline{\text{OE}}$ | CLK | $\overline{\text{CLK}}$ | D | Q |
| H | L | ↑ | ↓ | H | H |
| H | L | ↑ | ↓ | L | L |
| H | L | L or H | L or H | X | Q ₀ |
| H | H | X | X | X | Z |
| L | X or floating | 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 $V_O > V_{DDQ}$) | ± 50 mA |
| Continuous output current, I_O ($V_O = 0$ to V_{DDQ}) | ± 50 mA |
| Continuous current through each V_{CC} , V_{DDQ} , or GND | ± 100 mA |
| Package thermal impedance, θ_{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 _{CC} | Supply voltage | V _{DDQ} | | 2.7 | V | |
| V _{DDQ} | Output supply voltage | 2.3 | | 2.7 | V | |
| V _{REF} | Reference voltage (V _{REF} = V _{DDQ} /2) | 1.15 | 1.25 | 1.35 | V | |
| V _{TT} | Termination voltage | V _{REF} -40mV | V _{REF} | V _{REF} +40mV | V | |
| V _I | Input voltage | 0 | | V _{CC} | V | |
| V _{IH} | AC high-level input voltage | OE, data inputs | | V _{REF} +310mV | V | |
| V _{IL} | AC low-level input voltage | OE, data inputs | | V _{REF} -310mV | V | |
| V _{IH} | DC high-level input voltage | OE, data inputs | | V _{REF} +150mV | V | |
| V _{IL} | DC low-level input voltage | OE, data inputs | | V _{REF} -150mV | V | |
| V _{IH} | High-level input voltage | RESET | | 1.7 | V | |
| V _{IL} | Low-level input voltage | RESET | | 0.7 | V | |
| V _{ICR} | Common-mode input voltage range | CLK, CLK | | 0.97 | 1.53 | V |
| V _{I(PP)} | Peak-to-peak input voltage | CLK, CLK | | 360 | mV | |
| I _{OH} | High-level output current | | | -20 | mA | |
| I _{OL} | Low-level output current | | | 20 | | |
| T _A | Operating free-air temperature | 0 | | 70 | °C | |

NOTE 4: The RESET input of the device must be held at V_{CC} 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.

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

| PARAMETER | | TEST CONDITIONS | V _{CC} | MIN | TYP† | MAX | UNIT | | |
|-------------------|---|---|-----------------|----------------------|------|------|--------|--------------------|----|
| V _{IK} | | I _I = -18 mA | 2.3 V | | | -1.2 | V | | |
| V _{OH} | | I _{OH} = -100 μA | 2.3 V to 2.7 V | V _{CC} -0.2 | | | V | | |
| | | I _{OH} = -16 mA | 2.3 V | 1.95 | | | | | |
| V _{OL} | | I _{OL} = 100 μA | 2.3 V to 2.7 V | | | 0.2 | V | | |
| | | I _{OL} = 16 mA | 2.3 V | | | 0.35 | | | |
| I _I | All inputs | V _I = V _{CC} or GND | 2.7 V | | | ±5 | μA | | |
| I _{CC} | Static standby | RESET = GND | 2.7 V | | | 40 | μA | | |
| | Static operating | RESET = V _{CC} , V _I = V _{IH} (AC) or V _{IL} (AC) | | | | | | I _O = 0 | 95 |
| I _{CCD} | Dynamic operating – clock only | RESET = V _{CC} , V _I = V _{IH} (AC) or V _{IL} (AC), CLK and CLK switching 50% duty cycle | 2.5 V | | | 44 | μA/MHz | | |
| | Dynamic operating – per each data input | RESET = V _{CC} , V _I = V _{IH} (AC) or V _{IL} (AC), CLK and CLK switching 50% duty cycle, One data input switching at one-half clock frequency, 50% duty cycle | | | | | | I _O = 0 | 5 |
| I _{OZ} | Outputs | V _O = V _{CC} or GND, V _I (OE) = V _{CC} | 2.7 V | | | ±10 | μA | | |
| r _{OH} | Output high | I _{OH} = -20 mA | 2.3 V to 2.7 V | 7 | 20 | | Ω | | |
| r _{OL} | Output low | I _{OL} = 20 mA | 2.3 V to 2.7 V | 7 | 20 | | Ω | | |
| r _{O(Δ)} | r _{OH} - r _{OL} | I _O = 20 mA, T _A = 25°C | 2.5 V | | | 6 | Ω | | |
| C _i ‡ | Data inputs and OE | V _I = V _{REF} ± 310 mV | 2.5 V | | | 2.5 | 3.3 | 4 | pF |
| | CLK, CLK | V _{ICR} = 1.25 V, V _I (PP) = 360 mV | | | | 3 | 3.5 | 4 | |
| | RESET | V _I = V _{CC} or GND | | | | 3 | 4 | 4.5 | |
| C _o ‡ | Outputs | V _O = 1.7 V or 0.8 V | 2.5 V | 6.5 | 7.6 | 9 | pF | | |

† All typical values are at V_{CC} = 2.5 V, T_A = 25°C.

‡ Measured with 50-MHz input frequency

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

| | | | V _{CC} = 2.5 V ± 0.2 V | | UNIT |
|--------------------|--|------------------------------------|--|-----|------|
| | | | MIN | MAX | |
| f _{clock} | Clock frequency | | 200 | | MHz |
| t _w | Pulse duration, CLK, $\overline{\text{CLK}}$ high or low | | 2.5 | | ns |
| t _{act} | Differential inputs active time (see Note 5) | | 22 | | ns |
| t _{inact} | Differential inputs inactive time (see Note 6) | | 22 | | ns |
| t _{su} | Setup time | Fast slew rate (see Notes 7 and 9) | Data before CLK \uparrow , $\overline{\text{CLK}}\downarrow$ | | ns |
| | | Slow slew rate (see Notes 8 and 9) | | | |
| t _h | Hold time | Fast slew rate (see Notes 7 and 9) | Data after CLK \uparrow , $\overline{\text{CLK}}\downarrow$ | | ns |
| | | Slow slew rate (see Notes 8 and 9) | | | |

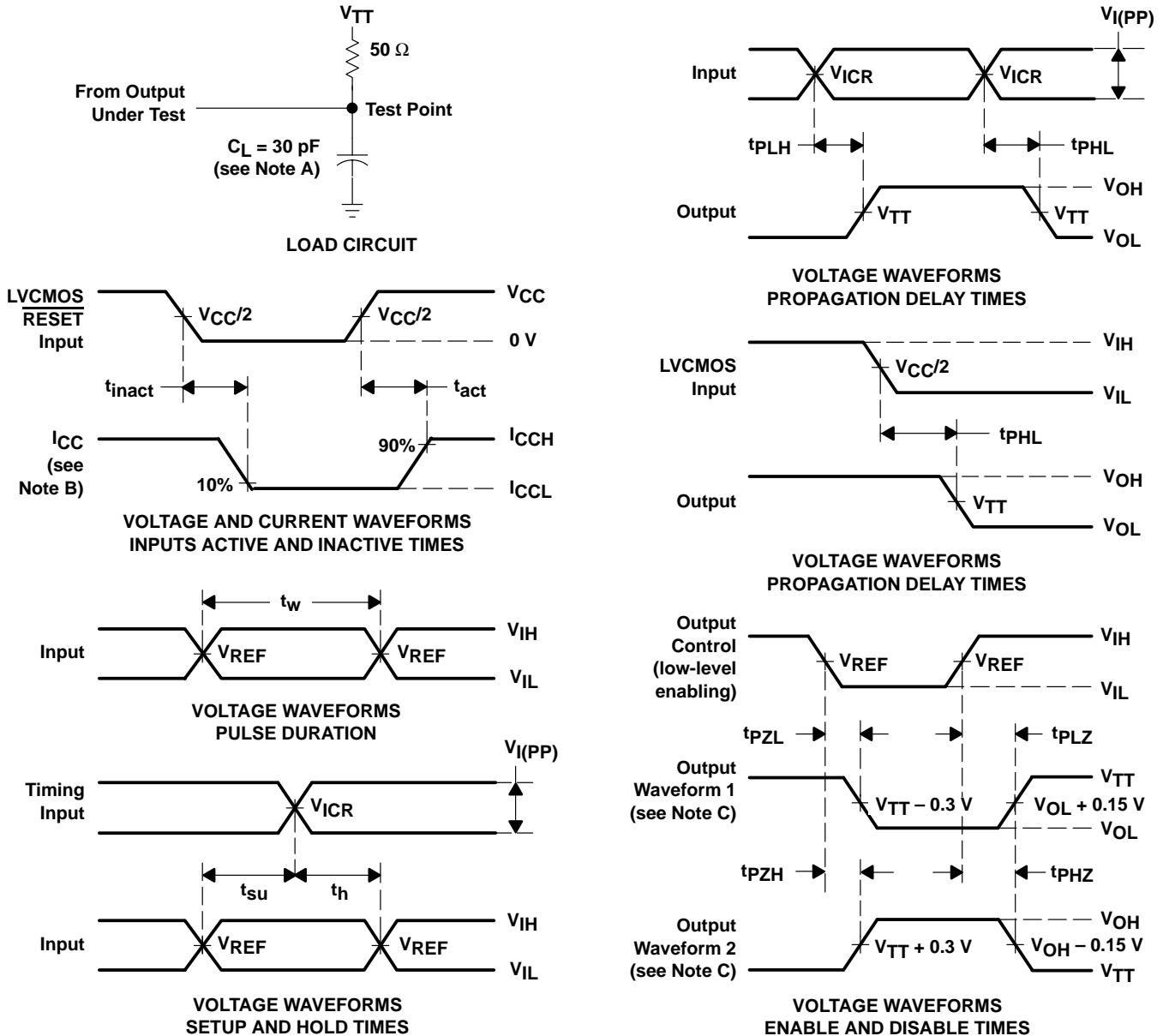
- NOTES: 5. Data inputs must be low a minimum time of t_{act} min, after $\overline{\text{RESET}}$ is taken high.
6. Data and clock inputs must be held at valid levels (not floating) a minimum time of t_{inact} min, after $\overline{\text{RESET}}$ is taken low.
7. Data signal input slew rate ≥ 1 V/ns
8. Data signal input slew rate ≥ 0.5 V/ns and < 1 V/ns
9. CLK, $\overline{\text{CLK}}$ input slew rates are ≥ 1 V/ns.

switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | V _{CC} = 2.5 V ± 0.2 V | | UNIT |
|------------------|---------------------------------|----------------|------------------------------------|-----|------|
| | | | MIN | MAX | |
| f _{max} | | | 200 | | MHz |
| t _{pd} | CLK and $\overline{\text{CLK}}$ | Q | 1.1 | 2.8 | ns |
| t _{PHL} | $\overline{\text{RESET}}$ | Q | 5 | | ns |
| t _{en} | $\overline{\text{OE}}$ | Q | 5 | | ns |
| t _{dis} | $\overline{\text{OE}}$ | Q | 6.3 | | 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 $I_O = 0$ mA.
 - C. 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.
 - D. All input pulses are supplied by generators having the following characteristics: PRR ≤ 10 MHz, $Z_O = 50 \Omega$, input slew rate = 1 V/ns $\pm 20\%$ (unless otherwise noted).
 - E. The outputs are measured one at a time with one transition per measurement.
 - F. $V_{TT} = V_{REF} = V_{DDQ}/2$
 - G. $V_{IH} = V_{REF} + 310$ mV (ac voltage levels) for differential inputs. $V_{IH} = V_{CC}$ for LVC MOS input.
 - H. $V_{IL} = V_{REF} - 310$ mV (ac voltage levels) for differential inputs. $V_{IL} = \text{GND}$ for LVC MOS input.
 - I. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - J. t_{PZL} and t_{PZH} are the same as t_{en} .
 - K. t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 1. Load Circuit and Voltage Waveforms

PACKAGING INFORMATION

| Orderable Device | Status ⁽¹⁾ | Package Type | Package Drawing | Pins | Package Qty | Eco Plan ⁽²⁾ | Lead/Ball Finish | MSL Peak Temp ⁽³⁾ |
|-------------------|-----------------------|--------------|-----------------|------|-------------|-------------------------|------------------|------------------------------|
| SN74SSTV32877GKER | ACTIVE | LFBGA | GKE | 96 | 1000 | TBD | SNPB | Level-3-220C-168 HR |

⁽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.

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TAPE AND REEL INFORMATION



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 |
|-------------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74SSTV32877GKER | LFBGA | GKE | 96 | 1000 | 330.0 | 24.4 | 5.7 | 13.7 | 2.0 | 8.0 | 24.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS

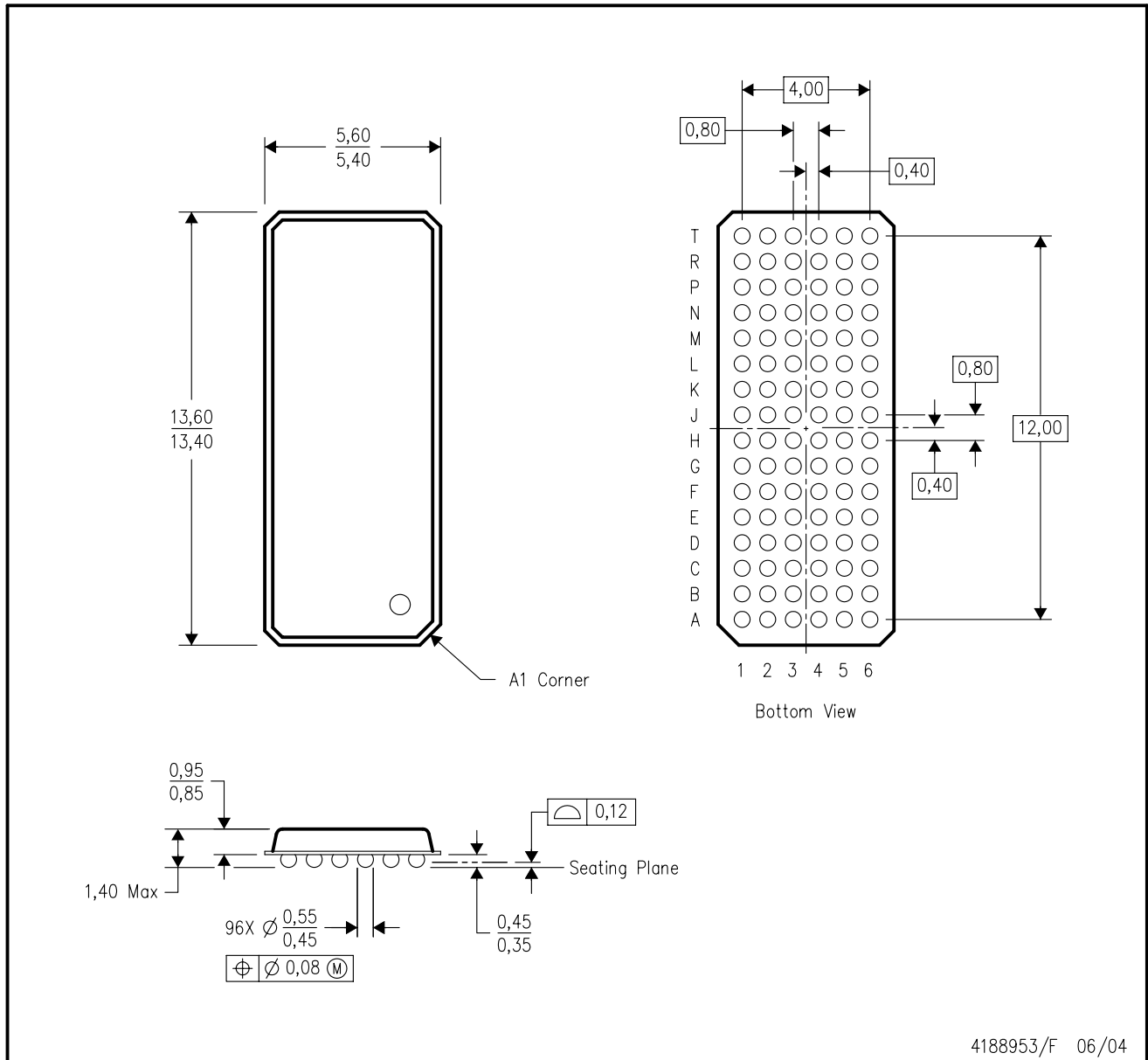


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-------------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74SSTV32877GKER | LFBGA | GKE | 96 | 1000 | 346.0 | 346.0 | 41.0 |

GKE (R-PBGA-N96)

PLASTIC BALL GRID ARRAY



- 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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