

# SN74GTL2006

## 13-BIT GTL-/GTL/GTL+ TO LVTTL TRANSLATOR

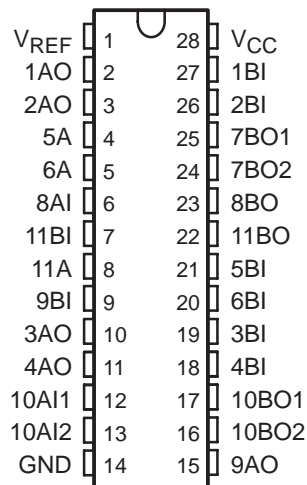
SCES619 – DECEMBER 2004

- Operates as GTL-/GTL/GTL+ to LVTTL or LVTTL to GTL-/GTL/GTL+ Translator
- Series Termination on TTL Outputs of 30  $\Omega$
- Latch-Up Testing to JEDEC Standard JESD 78 Exceeds 500 mA
- ESD Performance Tested Per JESD 22
  - 2000-V Human-Body Model (A114-B, Class II)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

### description

The SN74GTL2006 is a 13-bit translator to interface between the 3.3-V LVTTL chipset I/O and the Xeon™ processor GTL-/GTL/GTL+ I/O. The device is designed for platform health management in dual-processor applications.

PW PACKAGE  
(TOP VIEW)



### PIN DESCRIPTION

| PIN NUMBER        | SYMBOL           | NAME AND FUNCTION                   |
|-------------------|------------------|-------------------------------------|
| 1                 | V <sub>REF</sub> | GTL reference voltage               |
| 2–6, 8, 10–13, 15 | nAn              | Data inputs/outputs (LVTTL)         |
| 7, 9, 16, 17–27   | nBn              | Data inputs/outputs (GTL-/GTL/GTL+) |
| 14                | GND              | Ground (0 V)                        |
| 28                | V <sub>CC</sub>  | Positive supply voltage             |

### ORDERING INFORMATION

| T <sub>A</sub> | PACKAGE†   | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|----------------|------------|-----------------------|------------------|
| –40°C to 85°C  | TSSOP – PW | Tube                  | SN74GTL2006PW    |
|                |            | Tape and reel         | SN74GTL2006PWR   |

† 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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## 13-BIT GTL-/GTL/GTL+ TO LVTTTL TRANSLATOR

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### Function Tables

| INPUTS<br>1BI/2BI/3BI/4BI/9BI | OUTPUTS<br>1AO/2AO/3AO/4AO/9AO |
|-------------------------------|--------------------------------|
| L                             | L                              |
| H                             | H                              |

| INPUT<br>8AI | OUTPUT<br>8BO |
|--------------|---------------|
| L            | L             |
| H            | H             |

| INPUTS      |     | OUTPUTS<br>10BO1/10BO2 |
|-------------|-----|------------------------|
| 10AI1/10AI2 | 9BI |                        |
| L           | L   | L                      |
| L           | H   | L                      |
| H           | L   | L                      |
| H           | H   | H                      |

| INPUTS<br>5BI/6BI | INPUTS/OUTPUTS<br>5A/6A<br>(OPEN DRAIN) | OUTPUTS<br>7BO1/7BO2 |
|-------------------|---|----------------------|
| L                 | L                                       | H <sup>†</sup>       |
| H                 | L <sup>‡</sup>                          | L                    |
| H                 | H                                       | H                    |

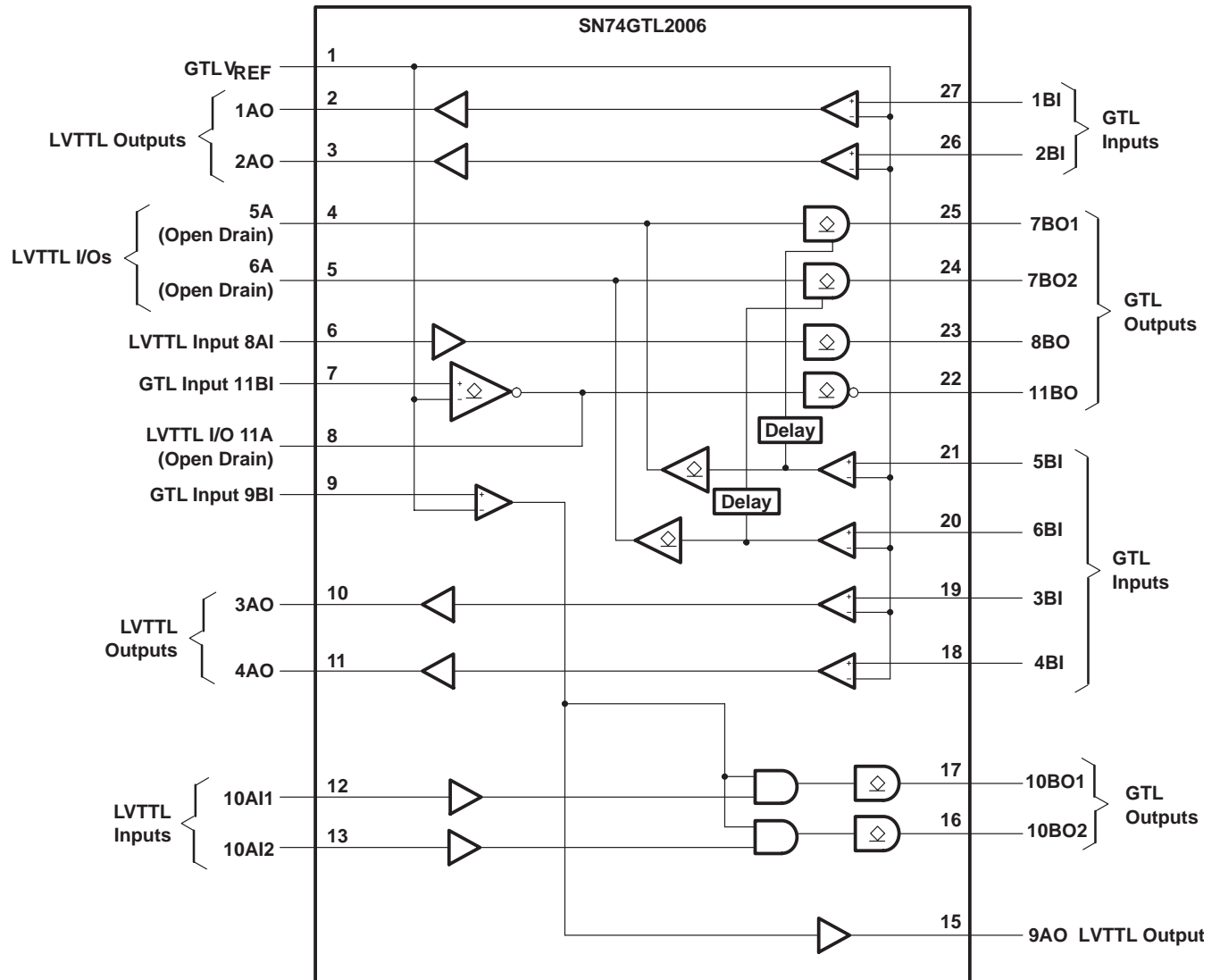
<sup>†</sup> The enable on 7BO1/7BO2 includes a delay that prevents a transient condition (when 5BI/6BI goes from low to high, and the low to high on 5A/6A lags up to 100 ns) from causing a low glitch on the 7BO1/7BO2 outputs.

<sup>‡</sup> Open-drain input/output terminal is driven to a logic-low state by an external driver.

| INPUT<br>11BI | INPUT/OUTPUT<br>11A<br>(OPEN DRAIN) | OUTPUT<br>11BO |
|---------------|-------------------------------------|----------------|
| L             | H                                   | L              |
| L             | L <sup>‡</sup>                      | H              |
| H             | L                                   | H              |

<sup>‡</sup> Open-drain input/output terminal is driven to a logic-low state by an external driver.

**logic symbol**



NOTE A: The enable on 7BO1/7BO2 includes a delay that prevents a transient condition (where 5BI/6BI go from low to high, and the low to high on 5A/6A lags up to 100 ns) from causing a low glitch on the 7BO1/7BO2 outputs.

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## 13-BIT GTL-/GTL/GTL+ TO LVTTTL TRANSLATOR

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### absolute maximum ratings over operating free-air temperature (unless otherwise noted)<sup>†‡</sup>

|   |               |
|---|---------------|
| Supply voltage range, $V_{CC}$  | –0.5 to 4.6 V |
| Input voltage range, $V_I$ (see Note 2): A port (LVTTTL)                      | –0.5 to 4.6 V |
| B port (GTL)  | –0.5 to 4.6 V |
| Output voltage range, $V_O$ (output in OFF or HIGH state)(see Note 2): A port | –0.5 to 4.6 V |
| B port  | –0.5 to 4.6 V |
| Input diode current, $I_{IK}$ ( $V_I < 0$ )                                   | –50 mA        |
| Output diode current, $I_{OK}$ ( $V_O < 0$ )                                  | –50 mA        |
| Current into any output in the LOW state: A port                              | 32 mA         |
| B port  | 30 mA         |
| Current into any output in the HIGH state, A port                             | –32 mA        |
| Storage temperature range, $T_{stg}$  | –60 to 150°C  |

<sup>†</sup> 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.

<sup>‡</sup> Voltages are referenced to GND (ground = 0 V).

- NOTES: 1. The performance capability of a high-performance integrated circuit, in conjunction with its thermal environment, can create junction temperatures that are detrimental to reliability. The maximum junction temperature of this integrated circuit should not exceed 150°C.
2. The input and output negative voltage ratings may be exceeded if the input and output clamp current ratings are observed.

### recommended operating conditions

|           |                                      | MIN                       | NOM                       | MAX  | UNIT |
|-----------|--------------------------------------|---------------------------|---------------------------|------|------|
| $V_{CC}$  | Supply voltage                       | 3                         | 3.3                       | 3.6  | V    |
| $V_{TT}$  | Termination voltage                  | 0.85                      | 0.9                       | 0.95 | V    |
|           | GTL–                                 | 1.14                      | 1.2                       | 1.26 |      |
|           | GTL+                                 | 1.35                      | 1.5                       | 1.65 |      |
| $V_{REF}$ | Reference voltage                    | 0.5                       | $2/3 V_{TT}$              | 1.8  | V    |
|           | GTL–                                 | 0.5                       | 0.6                       | 0.63 |      |
|           | GTL                                  | 0.76                      | 0.8                       | 0.84 |      |
|           | GTL+                                 | 0.87                      | 1                         | 1.1  |      |
| $V_I$     | Input voltage                        | 0                         | 3.3                       | 3.6  | V    |
|           | B port                               | 0                         | $V_{TT}$                  | 3.6  |      |
| $V_{IH}$  | High-level input voltage             | 2                         |                           |      | V    |
|           | B port                               | $V_{REF} + 50 \text{ mV}$ |                           |      |      |
| $V_{IL}$  | Low-level input voltage              |                           | 0.8                       |      | V    |
|           | B port                               |                           | $V_{REF} - 50 \text{ mV}$ |      |      |
| $I_{OH}$  | High-level output current            |                           |                           | –16  | mA   |
| $I_{OL}$  | Low-level output current             |                           |                           | 16   | mA   |
|           | B port                               |                           |                           | 15   |      |
| $T_A$     | Operating free-air temperature range | –40                       |                           | 85   | °C   |



**electrical characteristics over recommended operating conditions**

| PARAMETER |                          | TEST CONDITIONS                      |                               | –40°C TO 85°C |      |     | UNIT |    |
|-----------|--------------------------|--------------------------------------|-------------------------------|---------------|------|-----|------|----|
|           |                          |                                      |                               | MIN           | TYP† | MAX |      |    |
| VOH‡      | A port                   | VCC = 3 V to 3.6 V, IOH = –100 µA    |                               | VCC – 0.2     |      |     | V    |    |
|           |                          | VCC = 3 V, IOH = –16 mA              |                               | 2.1           |      |     |      |    |
| VOL‡      | A port                   | VCC = 3 V, IOL = 16 mA               |                               | 0.8           |      |     | V    |    |
|           | B port                   | VCC = 3 V, IOL = 15 mA               |                               | 0.4           |      |     |      |    |
| II        | A port                   | VCC = 3.6 V                          | VI = VCC                      | ±1            |      |     | µA   |    |
|           |                          |                                      | VI = 0 V                      | ±1            |      |     |      |    |
|           | B port                   | VCC = 3.6 V, VI = VTT or GND         |                               | ±1            |      |     |      |    |
| ICC       | A or B port              | VCC = 3.6 V, VI = VCC or GND, IO = 0 |                               | 12            |      |     | mA   |    |
| ΔICC§     | A port or control inputs |                                      | VCC = 3.6 V, VI = VCC – 0.6 V |               | 500  |     |      | µA |
| CIO       | A port                   | VO = 3 V or 0, VO = 3 V or 0         |                               | 5             |      |     | pF   |    |
|           | B port                   | VO = VTT or 0, VO = VTT or 0         |                               | 4             |      |     |      |    |

† All typical values are measured at  $V_{CC} = 3.3\text{ V}$  and  $T_A = 25^\circ\text{C}$ .

‡ The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

§ This is the increase in supply current for each input that is at the specified LVTTTL voltage, rather than  $V_{CC}$  or GND.

**switching characteristics over recommended operating free-air temperature range**

| PARAMETER |                | WAVEFORM | GTL–                                 |      |     | GTL                                  |      |     | GTL+                               |      |     | UNIT |
|-----------|----------------|----------|--------------------------------------|------|-----|--------------------------------------|------|-----|------------------------------------|------|-----|------|
|           |                |          | VCC = 3.3 V ± 0.3 V,<br>VREF = 0.6 V |      |     | VCC = 3.3 V ± 0.3 V,<br>VREF = 0.8 V |      |     | VCC = 3.3 V ± 0.3 V,<br>VREF = 1 V |      |     |      |
|           |                |          | MIN                                  | TYP† | MAX | MIN                                  | TYP† | MAX | MIN                                | TYP† | MAX |      |
| tPLH      | An to Bn       | 1        | 2                                    | 4    | 8   | 2                                    | 4    | 8   | 2                                  | 4    | 8   | ns   |
| tPHL      |                |          | 2                                    | 5.5  | 10  | 2                                    | 5.5  | 10  | 2                                  | 5.5  | 10  |      |
| tPLH      | Bn to An       | 2        | 2                                    | 5.5  | 10  | 2                                    | 5.5  | 10  | 2                                  | 5.5  | 10  | ns   |
| tPHL      |                |          | 2                                    | 5.5  | 10  | 2                                    | 5.5  | 10  | 2                                  | 5.5  | 10  |      |
| tPLH      | 9BI to 10BOn   | 3        | 2                                    | 6    | 11  | 2                                    | 6    | 11  | 2                                  | 6    | 11  | ns   |
| tPHL      |                |          | 2                                    | 6    | 11  | 2                                    | 6    | 11  | 2                                  | 6    | 11  |      |
| tPLH      | 11BI to 11BO   | 3        | 2                                    | 8    | 13  | 2                                    | 8    | 13  | 2                                  | 8    | 13  | ns   |
| tPHL†     |                |          | 2                                    | 14   | 21  | 2                                    | 14   | 21  | 2                                  | 14   | 21  |      |
| tPLH      | Bn to Bn       | 3        | 4                                    | 7    | 11  | 4                                    | 7    | 11  | 4                                  | 7    | 11  | ns   |
| tPHL      |                |          | 120                                  | 205  | 350 | 120                                  | 205  | 350 | 120                                | 205  | 350 |      |
| tPLZ      | Bn to An (I/O) | 4        | 2                                    | 5    | 10  | 2                                    | 5    | 10  | 2                                  | 5    | 10  | ns   |
| tPZL      |                |          | 2                                    | 5    | 10  | 2                                    | 5    | 10  | 2                                  | 5    | 10  |      |

† All typical values are measured at  $V_{CC} = 3.3\text{ V}$  and  $T_A = 25^\circ\text{C}$ .

¶ Includes ~7.6-ns RC rise time of test-load pullup on 11-A, 1.5-k $\Omega$  pullup, and 21-pF load on 11 A has approximately 23-ns RC rise time.

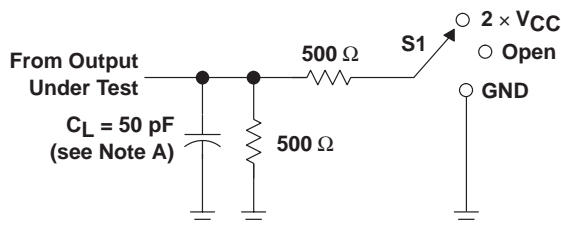
# SN74GTL2006

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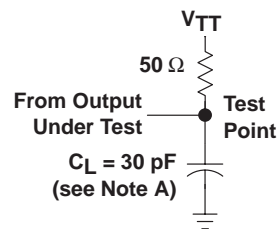
### PARAMETER MEASUREMENT INFORMATION

$V_{TT} = 1.2 \text{ V}$ ,  $V_{REF} = 0.8 \text{ V}$  FOR GTL AND  $V_{TT} = 1.5 \text{ V}$ ,  $V_{REF} = 1 \text{ V}$  FOR GTL+

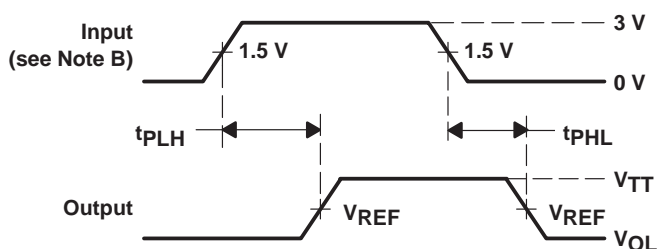


LOAD CIRCUIT FOR A OUTPUTS

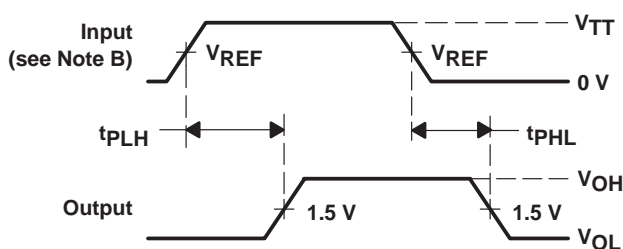
| TEST              | S1                |
|-------------------|-------------------|
| $t_{PLH}/t_{PHL}$ | Open              |
| $t_{PLZ}/t_{PZL}$ | $2 \times V_{CC}$ |



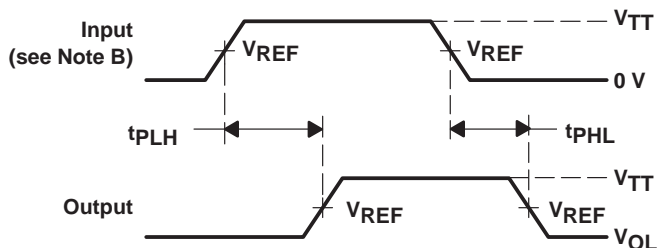
LOAD CIRCUIT FOR B OUTPUTS



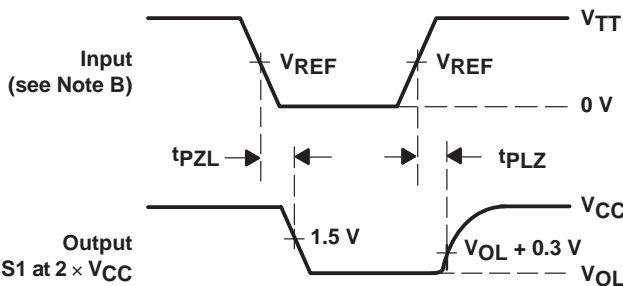
VOLTAGE WAVEFORM 1  
PROPAGATION DELAY TIMES  
(A port to B port)<sup>†</sup>



VOLTAGE WAVEFORM 2  
PROPAGATION DELAY TIMES  
(B port to A port)<sup>†</sup>



VOLTAGE WAVEFORM 3  
PROPAGATION DELAY TIMES  
(B port to B port)<sup>†</sup>



VOLTAGE WAVEFORM 4  
PROPAGATION DELAY TIMES  
(B port to A (I/O) port)<sup>†</sup>

<sup>†</sup> All control inputs are LVTTTL levels.

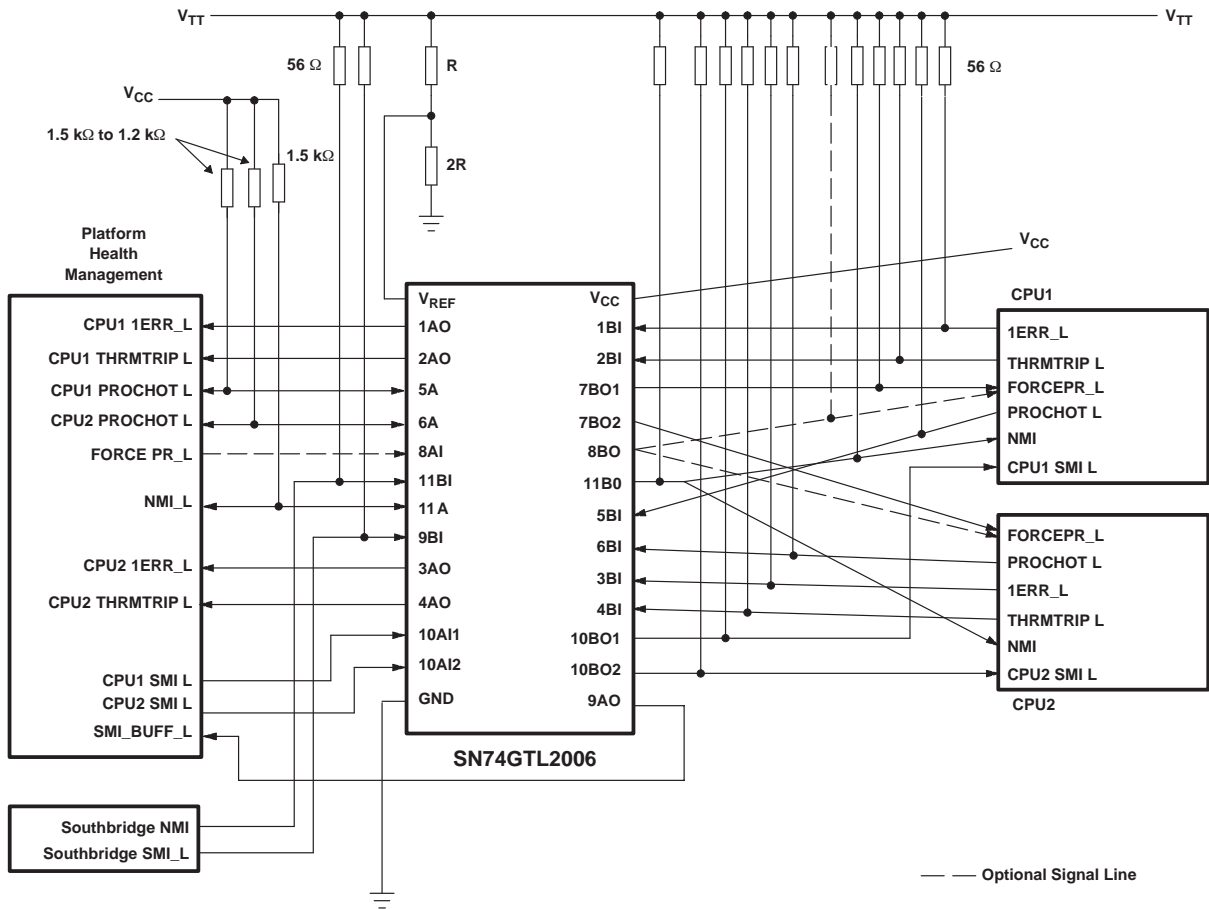
NOTES: A.  $C_L$  includes probe and jig capacitance.

B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5 \text{ ns}$ ,  $t_f \leq 2.5 \text{ ns}$ .

C. The outputs are measured one at a time, with one transition per measurement.

Figure 1. Load Circuits and Voltage Waveforms

## APPLICATION INFORMATION



### frequently asked questions

**Question 1:** On SN74GTL2006 LVTTTL inputs, specifically 10AI1 and 10AI2, when the device is powered down, these inputs may be pulled up to 3.3 V, and we want to ensure that there is no leakage path to the power rail under this condition. Are the LVTTTL inputs high impedance when the device is powered down, and will there be any leakage?

**Answer 1:** When the device is powered down, the LVTTTL inputs are in a high-impedance state and do not leak to  $V_{DD}$  if they are pulled high while the device is powered down.

**Question 2:** Do all the LVTTTL inputs have the same powered-down characteristic?

**Answer 2:** Yes

**Question 3:** What is the condition of the other GTL I/O and LVTTTL output pins when the device is powered down?

**Answer 3:** The open-drain outputs, both GTL and LVTTTL, do not leak to the power supply if they are pulled high while the device is powered down. The GTL inputs also do not leak to the power supply under the same conditions. The LVTTTL totem-pole outputs, however, are not open-drain type outputs, and there will be current flow on these pins if they are pulled high when  $V_{DD}$  is at ground.

## PACKAGING INFORMATION

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|------------------|----------------------|--------------|-------------------------|-------------------------|
| SN74GTL2006PWE4  | ACTIVE        | TSSOP        | PW                 | 28   |                | TBD                        | Call TI          | Call TI              | -40 to 85    | GK2006                  | <a href="#">Samples</a> |
| SN74GTL2006PWG4  | OBSOLETE      | TSSOP        | PW                 | 28   |                | TBD                        | Call TI          | Call TI              | -40 to 85    | GK2006                  |                         |
| SN74GTL2006PWR   | ACTIVE        | TSSOP        | PW                 | 28   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | GK2006                  | <a href="#">Samples</a> |
| SN74GTL2006PWRE4 | ACTIVE        | TSSOP        | PW                 | 28   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | GK2006                  | <a href="#">Samples</a> |
| SN74GTL2006PWRG4 | ACTIVE        | TSSOP        | PW                 | 28   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-1-260C-UNLIM   | -40 to 85    | GK2006                  | <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.

**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.

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**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 |
|----------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| SN74GTL2006PWR | TSSOP        | PW              | 28   | 2000 | 330.0              | 16.4               | 6.9     | 10.2    | 1.8     | 12.0    | 16.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS

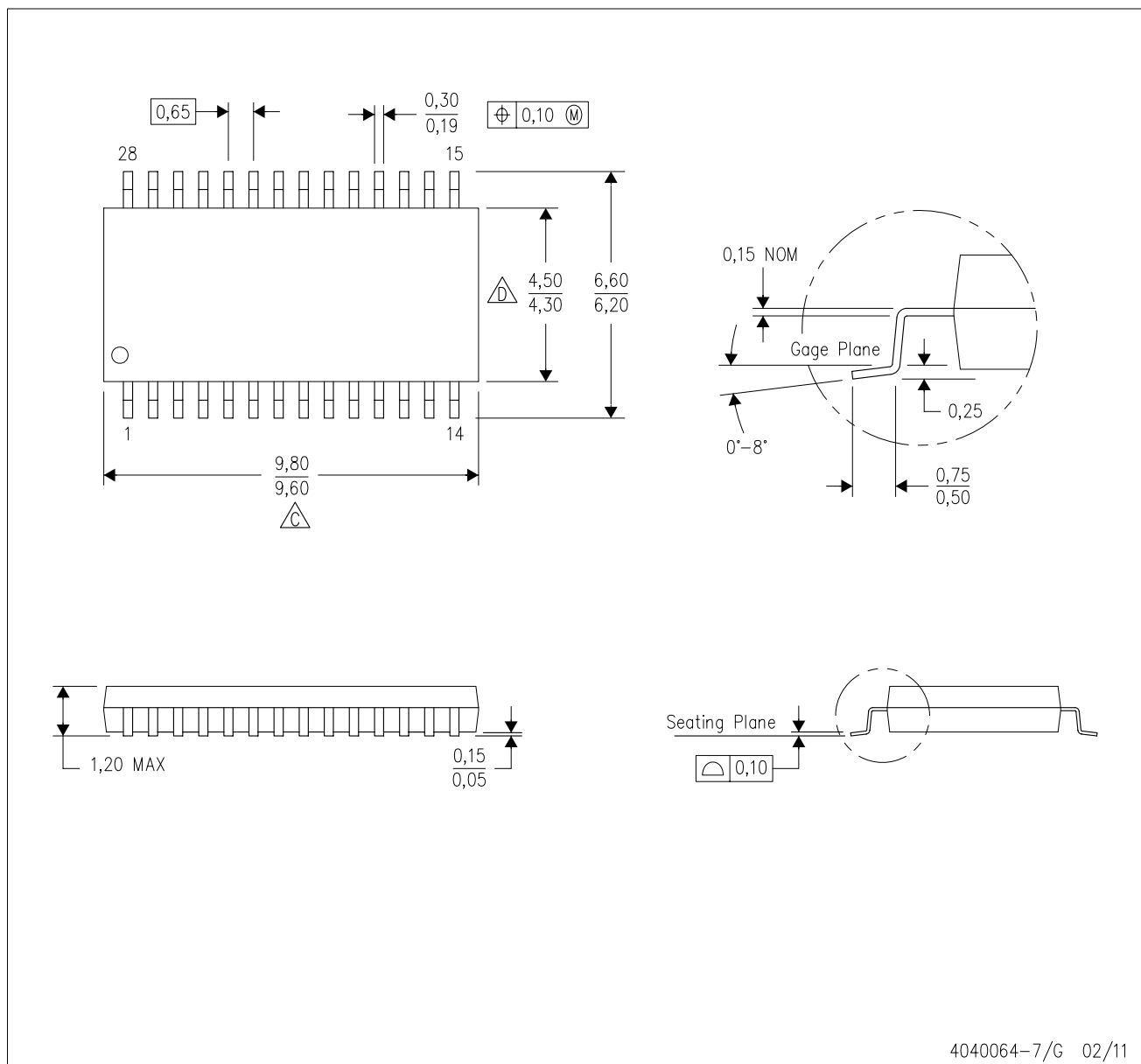


\*All dimensions are nominal

| Device         | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|----------------|--------------|-----------------|------|------|-------------|------------|-------------|
| SN74GTL2006PWR | TSSOP        | PW              | 28   | 2000 | 367.0       | 367.0      | 38.0        |

PW (R-PDSO-G28)

PLASTIC SMALL OUTLINE

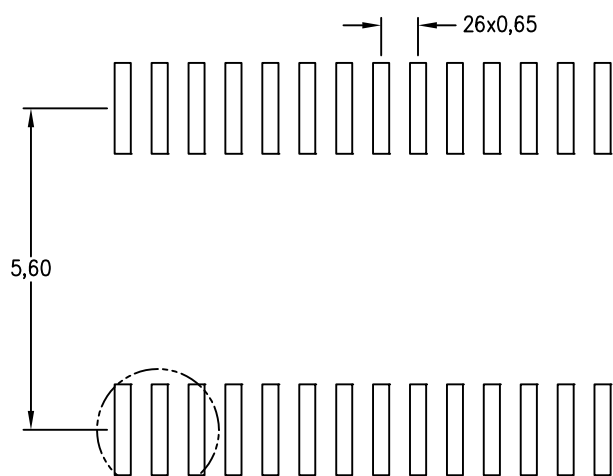


- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 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

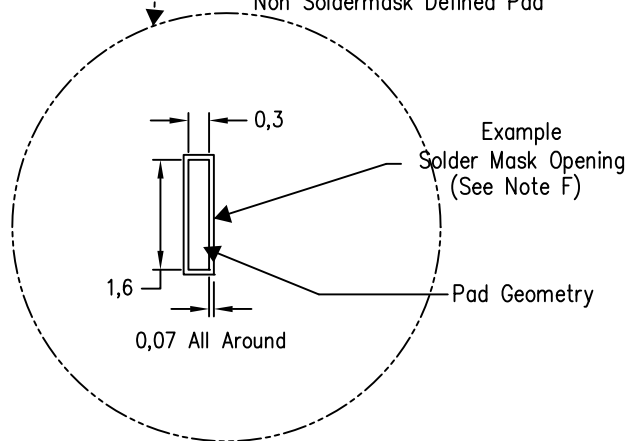
PW (R-PDSO-G28)

PLASTIC SMALL OUTLINE

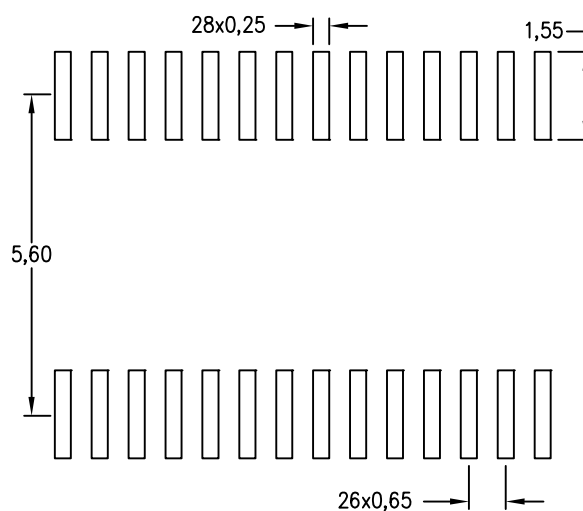
Example Board Layout



Example  
Non Soldermask Defined Pad



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



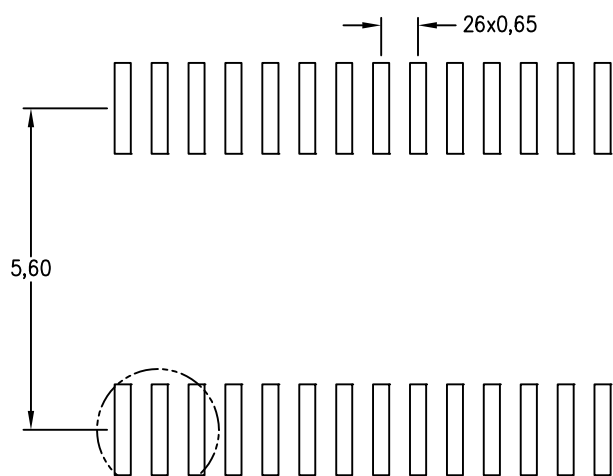
4211284-6/F 12/12

- 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.

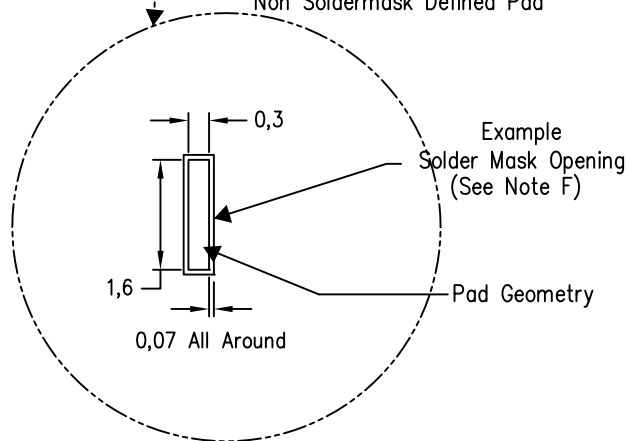
PW (R-PDSO-G28)

PLASTIC SMALL OUTLINE

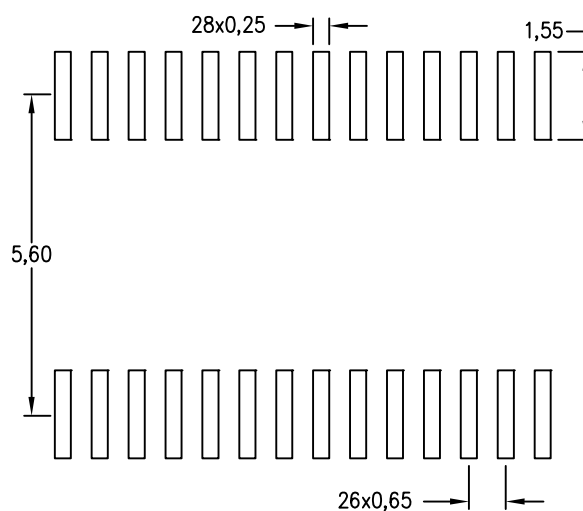
Example Board Layout



Example  
Non Soldermask Defined Pad



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



4211284-6/F 12/12

- 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.

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