

# SN74SSTL16837A

## 20-BIT SSTL\_3 INTERFACE UNIVERSAL BUS DRIVER WITH 3-STATE OUTPUTS

SCBS675G – SEPTEMBER 1996 – REVISED SEPTEMBER 1998

- Member of the Texas Instruments *Widebus™* Family
- Supports SSTL\_3 Signal Inputs and Outputs
- Flow-Through Architecture Optimizes PCB Layout
- Meets SSTL\_3 Class I and Class II Specifications
- Latch-Up Performance Exceeds 250 mA Per JESD 17
- Packaged in Plastic Thin Shrink Small-Outline Package

### description

This 20-bit universal bus driver is designed for 3-V to 3.6-V  $V_{CC}$  operation and SSTL\_3 or LVTTTL I/O levels.

Data flow from A to Y is controlled by the output-enable ( $\overline{OE}$ ) input. The device operates in the transparent mode when latch enable (LE) is high. The A data is latched if LE is low and clock (CLK) is held at a high or low logic level. If LE is low, the A data is stored in the latch/flip-flop on the low-to-high transition of CLK. When  $\overline{OE}$  is high, the outputs are in the high-impedance state.

To ensure the high-impedance state during power up or power down,  $\overline{OE}$  should be tied to  $V_{CC}$  through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

The SN74SSTL16837A is characterized for operation from 0°C to 70°C.

DGG PACKAGE  
(TOP VIEW)

|                 |    |    |          |
|-----------------|----|----|----------|
| Y1              | 1  | 64 | A1       |
| Y2              | 2  | 63 | A2       |
| GND             | 3  | 62 | GND      |
| Y3              | 4  | 61 | A3       |
| Y4              | 5  | 60 | A4       |
| $V_{DDQ}$       | 6  | 59 | $V_{CC}$ |
| Y5              | 7  | 58 | A5       |
| Y6              | 8  | 57 | A6       |
| GND             | 9  | 56 | GND      |
| Y7              | 10 | 55 | A7       |
| Y8              | 11 | 54 | A8       |
| $V_{DDQ}$       | 12 | 53 | $V_{CC}$ |
| Y9              | 13 | 52 | A9       |
| Y10             | 14 | 51 | A10      |
| GND             | 15 | 50 | GND      |
| $\overline{OE}$ | 16 | 49 | CLK      |
| $V_{REF}$       | 17 | 48 | LE       |
| GND             | 18 | 47 | GND      |
| Y11             | 19 | 46 | A11      |
| Y12             | 20 | 45 | A12      |
| $V_{DDQ}$       | 21 | 44 | $V_{CC}$ |
| Y13             | 22 | 43 | A13      |
| Y14             | 23 | 42 | A14      |
| GND             | 24 | 41 | GND      |
| Y15             | 25 | 40 | A15      |
| Y16             | 26 | 39 | A16      |
| $V_{DDQ}$       | 27 | 38 | $V_{CC}$ |
| Y17             | 28 | 37 | A17      |
| Y18             | 29 | 36 | A18      |
| GND             | 30 | 35 | GND      |
| Y19             | 31 | 34 | A19      |
| Y20             | 32 | 33 | A20      |



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| INPUTS |    |     |   | OUTPUT<br>Y |
|--------|----|-----|---|-------------|
| OE     | LE | CLK | A |             |
| L      | H  | X   | H | H           |
| L      | H  | X   | L | L           |
| L      | L  | ↑   | H | H           |
| L      | L  | ↑   | L | L           |
| L      | L  | H   | X | $Y_0^+$     |
| L      | L  | L   | X | $Y_0^+$     |
| H      | X  | X   | X | Z           |

‡ Output level before the indicated steady-state input conditions were established

[illegible]

|                                                               |                             |
|---------------------------------------------------------------|-----------------------------|
| Supply voltage range, $V_{CC}$ or $V_{DDQ}$                   | −0.5 V to 4.6 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, $I_{OK}$ ( $V_O < 0$ )                  | −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, $\theta_{JA}$ (see Note 3)         | 73°C/W                      |
| Storage temperature range, $T_{Stg}$                          | −65°C to 150°C              |

NOTES:

1. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
2. This current flows only when the output is in the high state and  $V_O > V_{DDQ}$ .
3. The package thermal impedance is calculated in accordance with JESD 51.

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

|                  |                                                                                     | MIN                    | NOM              | MAX                     | UNIT |
|------------------|-------------------------------------------------------------------------------------|------------------------|------------------|-------------------------|------|
| V <sub>CC</sub>  | Supply voltage                                                                      | V <sub>DDQ</sub>       |                  | 3.6                     | V    |
| V <sub>DDQ</sub> | Output supply voltage                                                               | 3                      |                  | 3.6                     | V    |
| V <sub>REF</sub> | Reference voltage (V <sub>REF</sub> = 0.45 × V <sub>DDQ</sub> )                     | 1.3                    | 1.5              | 1.7                     | V    |
| V <sub>TT</sub>  | Termination voltage (V <sub>REF</sub> = V <sub>TT</sub> = 0.45 × V <sub>DDQ</sub> ) | V <sub>REF</sub> –50mV | V <sub>REF</sub> | V <sub>REF</sub> +50mV  | V    |
| V <sub>I</sub>   | Input voltage                                                                       | 0                      |                  | V <sub>CC</sub>         | V    |
| V <sub>IH</sub>  | AC high-level input voltage                                                         | All inputs             |                  | V <sub>REF</sub> +400mV | V    |
| V <sub>IL</sub>  | AC low-level input voltage                                                          | All inputs             |                  | V <sub>REF</sub> –400mV | V    |
| V <sub>IH</sub>  | DC high-level input voltage                                                         | All inputs             |                  | V <sub>REF</sub> +200mV | V    |
| V <sub>IL</sub>  | DC low-level input voltage                                                          | All inputs             |                  | V <sub>REF</sub> –200mV | V    |
| I <sub>OH</sub>  | High-level output current                                                           |                        |                  | –20                     | mA   |
| I <sub>OL</sub>  | Low-level output current                                                            |                        |                  | 20                      |      |
| T <sub>A</sub>   | Operating free-air temperature                                                      | 0                      |                  | 70                      | °C   |

NOTE 4: 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† | MAX  | UNIT |    |
|-----------------|------------------------------|-----------------------------------|--|-----------------------------------|----------------------|------|------|------|----|
| V <sub>IK</sub> |                              | I <sub>I</sub> = −18 mA           |  | 3 V                               |                      |      | −1.2 | V    |    |
| V <sub>OH</sub> |                              | I <sub>OH</sub> = −100 μA         |  | 3 V to 3.6 V                      | V <sub>CC</sub> −0.2 |      |      | V    |    |
|                 |                              | I <sub>OH</sub> = −16 mA          |  | 3 V                               | 2.2                  |      |      |      |    |
|                 |                              | I <sub>OH</sub> = −20 mA          |  |                                   | 2.1                  |      |      |      |    |
| V <sub>OL</sub> |                              | I <sub>OL</sub> = 100 μA          |  | 3 V to 3.6 V                      |                      |      | 0.2  | V    |    |
|                 |                              | I <sub>OL</sub> = 16 mA           |  | 3 V                               |                      |      | 0.5  |      |    |
|                 |                              | I <sub>OL</sub> = 20 mA           |  |                                   |                      |      | 0.55 |      |    |
| I <sub>I</sub>  | LE                           | V <sub>I</sub> = 2.1 V or 0.9 V   |  | V <sub>REF</sub> = 1.3 V or 1.7 V | 3.6 V                |      |      | ±40  | μA |
|                 |                              | V <sub>I</sub> = 3.6 V or 0       |  |                                   |                      |      |      | ±1.2 | mA |
|                 | Data inputs, $\overline{OE}$ | V <sub>I</sub> = 2.1 V or 0.9 V   |  | V <sub>REF</sub> = 1.3 V or 1.7 V | 3.6 V                |      |      | ±5   | μA |
|                 |                              | V <sub>I</sub> = 3.6 V or 0       |  |                                   |                      |      |      | ±5   |    |
|                 | CLK                          | V <sub>I</sub> = 2.1 V or 0.9 V   |  | V <sub>REF</sub> = 1.3 V or 1.7 V | 3.6 V                |      |      | ±150 | mA |
|                 |                              | V <sub>I</sub> = 3.6 V or 0       |  |                                   |                      |      |      | ±4   |    |
|                 | V <sub>REF</sub>             | V <sub>REF</sub> = 1.3 V or 1.7 V |  |                                   | 3.6 V                |      |      | ±150 | μA |
| I <sub>OZ</sub> |                              | V <sub>O</sub> = 0.9 V or 2.1 V   |  | 3.6 V                             |                      |      | ±10  | μA   |    |
|                 |                              | V <sub>O</sub> = 0 or 3.6 V       |  |                                   |                      |      | ±10  |      |    |
| I <sub>CC</sub> |                              | V <sub>I</sub> = 2.1 V or 0.9 V   |  | 3.6 V                             |                      |      | 90   | mA   |    |
|                 |                              | V <sub>I</sub> = 3.6 V or 0       |  |                                   |                      |      | 90   |      |    |
| C <sub>i</sub>  | Control inputs               | V <sub>I</sub> = 2.1 V or 0.9 V   |  |                                   | 3.3 V                | 2.5  |      | pF   |    |
|                 | A port                       |                                   |  |                                   |                      | 2    |      |      |    |
| C <sub>O</sub>  | Y port                       | V <sub>O</sub> = 2.1 V or 0.9 V   |  |                                   | 3.3 V                | 3    |      | pF   |    |

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



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

|                    |                 |                          |          | $V_{CC} = 3.3\text{ V}$<br>$\pm 0.3\text{ V}$ |     | UNIT |
|--------------------|-----------------|--------------------------|----------|-----------------------------------------------|-----|------|
|                    |                 |                          |          | MIN                                           | MAX |      |
| $f_{\text{clock}}$ | Clock frequency |                          |          | 200                                           |     | MHz  |
| $t_w$              | Pulse duration  | LE high                  |          | 2.5                                           |     | ns   |
|                    |                 | CLK high or low          |          | 2.5                                           |     |      |
| $t_{\text{su}}$    | Setup time      | A before CLK $\uparrow$  | LE low   | 1.5                                           |     | ns   |
|                    |                 | A before LE $\downarrow$ | CLK high | 1.5                                           |     |      |
|                    |                 |                          | CLK low  | 2                                             |     |      |
| $t_h$              | Hold time       | A after CLK $\uparrow$   | LE low   | 1                                             |     | ns   |
|                    |                 | A after LE $\downarrow$  |          | 1                                             |     |      |

**switching characteristics over recommended operating free-air temperature range,  
Class I,  $V_{\text{REF}} = V_{\text{TT}} = V_{\text{DDQ}} \times 0.45$  and  $C_L = 10\text{ pF}$  (unless otherwise noted) (see Figure 1)**

| PARAMETER        | FROM<br>(INPUT)        | TO<br>(OUTPUT) | $V_{CC} = 3.3\text{ V}$<br>$\pm 0.3\text{ V}$ |     | UNIT |
|------------------|------------------------|----------------|-----------------------------------------------|-----|------|
|                  |                        |                | MIN                                           | MAX |      |
| $f_{\text{max}}$ |                        |                | 200                                           |     | MHz  |
| $t_{\text{pd}}$  | A                      | Y              | 1.1                                           | 4   | ns   |
|                  | LE                     |                | 1.5                                           | 4.1 |      |
|                  | CLK                    |                | 1                                             | 3   |      |
| $t_{\text{en}}$  | $\overline{\text{OE}}$ | Y              | 1.8                                           | 5.5 | ns   |
| $t_{\text{dis}}$ | $\overline{\text{OE}}$ | Y              | 1.8                                           | 6   | ns   |

**switching characteristics over recommended operating free-air temperature range,  
Class II,  $V_{\text{REF}} = V_{\text{TT}} = V_{\text{DDQ}} \times 0.45$  and  $C_L = 30\text{ pF}$  (unless otherwise noted) (see Figure 1)**

| PARAMETER        | FROM<br>(INPUT)        | TO<br>(OUTPUT) | $V_{CC} = 3.3\text{ V}$<br>$\pm 0.3\text{ V}$ |     | UNIT |
|------------------|------------------------|----------------|-----------------------------------------------|-----|------|
|                  |                        |                | MIN                                           | MAX |      |
| $f_{\text{max}}$ |                        |                | 200                                           |     | MHz  |
| $t_{\text{pd}}$  | A                      | Y              | 1.1                                           | 4.2 | ns   |
|                  | LE                     |                | 1.5                                           | 4.3 |      |
|                  | CLK                    |                | 1                                             | 3.2 |      |
| $t_{\text{en}}$  | $\overline{\text{OE}}$ | Y              | 1.8                                           | 5.5 | ns   |
| $t_{\text{dis}}$ | $\overline{\text{OE}}$ | Y              | 1.8                                           | 6   | ns   |

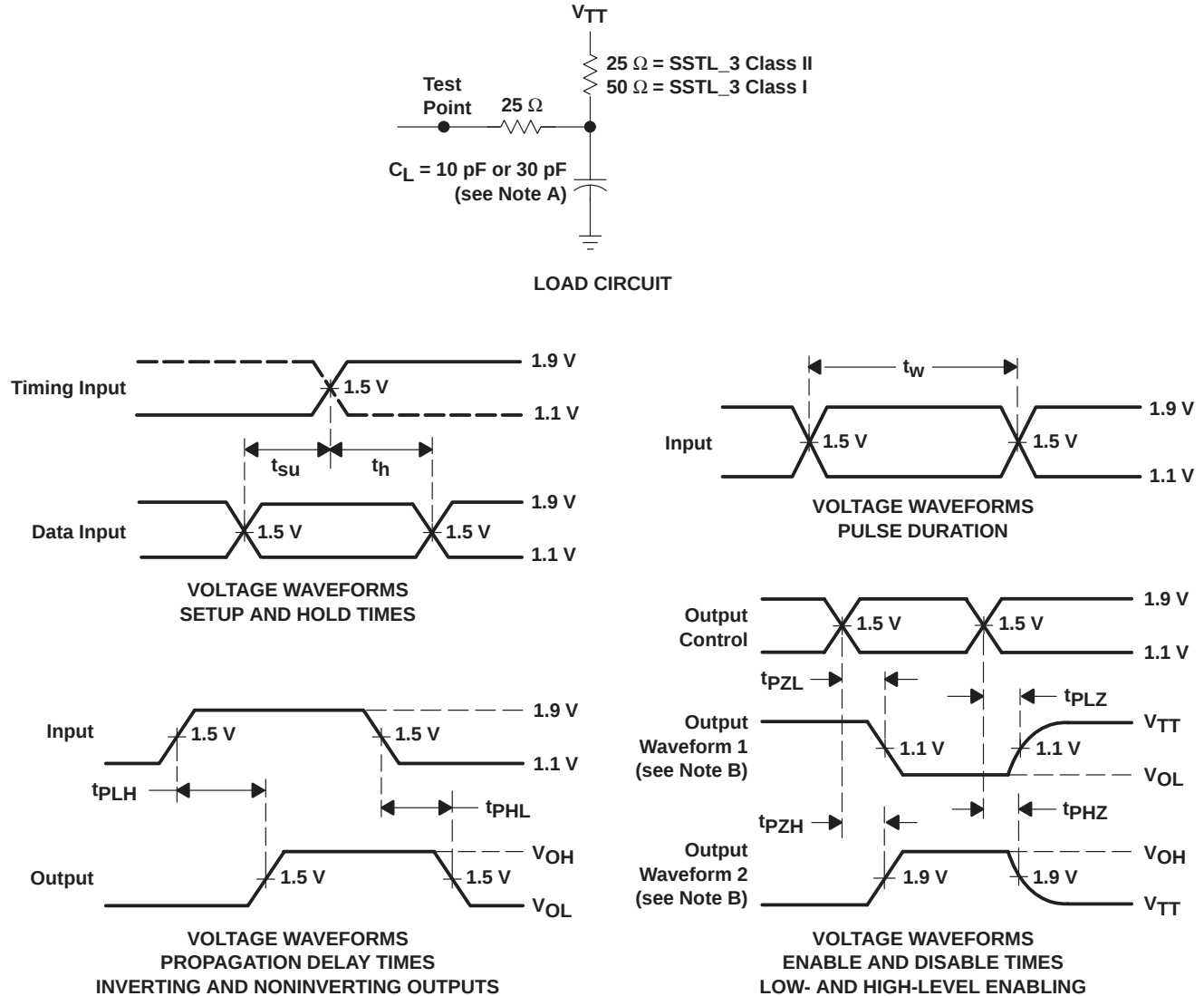
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#### PARAMETER MEASUREMENT INFORMATION



- NOTES:
- A.  $C_L$  includes probe and jig capacitance.
  - B. 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.
  - C. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r \leq 1 \text{ ns}$ ,  $t_f \leq 1 \text{ ns}$ .
  - D. The outputs are measured one at a time with one transition per measurement.
  - E.  $V_{TT} = V_{REF} = V_{CC} \times 0.45$
  - F.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$ .
  - G.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$ .
  - H.  $t_{PHL}$  and  $t_{PLH}$  are the same as  $t_{pd}$ .

Figure 1. Load Circuit and Voltage Waveforms

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