

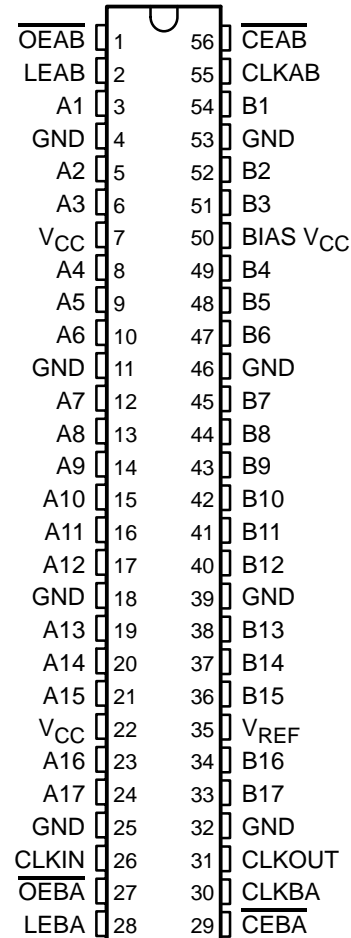
SN74GTLPH16916

17-BIT LVTTTL-TO-GTLP UNIVERSAL BUS TRANSCEIVER WITH BUFFERED CLOCK OUTPUTS

SCES347C – JANUARY 2001 – REVISED JANUARY 2002

- Member of the Texas Instruments Widebus™ Family
- UBT™ Transceiver Combines D-Type Latches and D-Type Flip-Flops for Operation in Transparent, Latched, Clocked, and Clock-Enabled Mode
- TI-OPC™ Circuitry Limits Ringing on Unevenly Loaded Backplanes
- OEC™ Circuitry Improves Signal Integrity and Reduces Electromagnetic Interference
- Bidirectional Interface Between GTLP Signal Levels and LVTTTL Logic Levels
- GTLP Buffered CLKAB Signal (CLKOUT)
- LVTTTL Interfaces Are 5-V Tolerant
- Medium-Drive GTLP Outputs (50 mA)
- LVTTTL Outputs (–24 mA/24 mA)
- GTLP Rise and Fall Times Designed for Optimal Data-Transfer Rate and Signal Integrity in Distributed Loads
- I_{off} , Power-Up 3-State, and BIAS V_{CC} Support Live Insertion
- Bus Hold on A-Port Data Inputs
- Distributed V_{CC} and GND Pins Minimize High-Speed Switching Noise
- 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)

DGG OR DGV PACKAGE
(TOP VIEW)



description

The SN74GTLPH16916 is a medium-drive, 17-bit UBT™ transceiver that provides LVTTTL-to-GTLP and GTLP-to-LVTTTL signal-level translation. It allows for transparent, latched, clocked, and clock-enabled modes of data transfer. Additionally, it provides for a copy of CLKAB at GTLP signal levels (CLKOUT) and conversion of a GTLP clock to LVTTTL logic levels (CLKIN). The device provides a high-speed interface between cards operating at LVTTTL logic levels and a backplane operating at GTLP signal levels. High-speed (about three times faster than standard TTL or LVTTTL) backplane operation is a direct result of GTLP's reduced output swing (<1 V), reduced input threshold levels, improved differential input, OEC™ circuitry, and TI-OPC™ circuitry. Improved GTLP OEC and TI-OPC circuits minimize bus-settling time and have been designed and tested using several backplane models. The medium drive allows incident-wave switching in heavily loaded backplanes with equivalent load impedance down to 19 Ω.



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SN74GTLPH16916

17-BIT LVTTTL-TO-GTLP UNIVERSAL BUS TRANSCEIVER WITH BUFFERED CLOCK OUTPUTS

SCES347C – JANUARY 2001 – REVISED JANUARY 2002

description (continued)

GTLP is the Texas Instruments derivative of the Gunning Transceiver Logic (GTL) JEDEC standard JESD 8-3. The ac specification of the SN74GTLPH16916 is given only at the preferred higher noise-margin GTLP, but the user has the flexibility of using this device at either GTL ($V_{TT} = 1.2\text{ V}$ and $V_{REF} = 0.8\text{ V}$) or GTLP ($V_{TT} = 1.5\text{ V}$ and $V_{REF} = 1\text{ V}$) signal levels.

Normally, the B port operates at GTLP signal levels. The A-port and control inputs operate at LVTTTL logic levels, but are 5-V tolerant and are compatible with TTL and 5-V CMOS inputs. V_{REF} is the B-port differential input reference voltage.

This device is fully specified for live-insertion applications using I_{off} , power-up 3-state, and BIAS V_{CC} . The I_{off} circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down. The power-up 3-state circuitry places the outputs in the high-impedance state during power up and power down, which prevents driver conflict. The BIAS V_{CC} circuitry precharges and preconditions the B-port input/output connections, preventing disturbance of active data on the backplane during card insertion or removal, and permits true live-insertion capability.

This GTLP device features TI-OPC circuitry, which actively limits the overshoot caused by improperly terminated backplanes, unevenly distributed cards, or empty slots during low-to-high signal transitions. This improves signal integrity, which allows adequate noise margin to be maintained at higher frequencies.

Active bus-hold circuitry holds unused or undriven LVTTTL data inputs at a valid logic state. Use of pullup or pulldown resistors with the bus-hold circuitry is not recommended.

When V_{CC} is between 0 and 1.5 V, the device is in the high-impedance state during power up or power down. However, to ensure the high-impedance state above 1.5 V, the output-enable (\overline{OE}) input 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.

ORDERING INFORMATION

| T_A | PACKAGE† | | ORDERABLE PART NUMBER | TOP-SIDE MARKING |
|---------------|-------------|---------------|-----------------------|------------------|
| -40°C to 85°C | TSSOP – DGG | Tape and reel | SN74GTLPH16916GR | GTLPH16916 |
| | TVSOP – DGV | Tape and reel | SN74GTLPH16916VR | GL916 |

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



SN74GTLPH16916
17-BIT LVTTTL-TO-GTLP UNIVERSAL BUS TRANSCEIVER
WITH BUFFERED CLOCK OUTPUTS

SCES347C – JANUARY 2001 – REVISED JANUARY 2002

functional description

The SN74GTLPH16916 is a medium-drive (50 mA), 17-bit UBT transceiver containing D-type latches and D-type flip-flops for data-path operation in transparent, latched, clocked, or clock-enabled modes and can replace any of the functions shown in Table 1. Data polarity is noninverting.

Table 1. SN74GTLPH16916 UBT™ Transceiver Replacement Functions

| FUNCTION | 8 BIT | 9 BIT | 10 BIT | 16 BIT | 18 BIT |
|---|------------------|-------|--------|------------------------|----------------|
| Transceiver | '245, '623, '645 | '863 | '861 | '16245, '16623 | '16863 |
| Buffer/driver | '241, '244, '541 | | '827 | '16241, '16244, '16541 | '16825 |
| Latched transceiver | '543 | | | '16543 | '16472 |
| Latch | '373, '573 | '843 | '841 | '16373 | '16843 |
| Registered transceiver | '646, '652 | | | '16646, '16652 | '16474 |
| Flip-flop | '374, '574 | | '821 | '16374 | |
| Standard UBT | | | | | '16500, '16501 |
| Universal bus driver | | | | | '16835 |
| Registered transceiver with clock enable | '2952 | | | '16470, '16952 | |
| Flip-flop with clock enable | '377 | '823 | | | '16823 |
| Standard UBT with clock enable | | | | | '16600, '16601 |
| SN74GTLPH16916 UBT transceiver replaces all above functions | | | | | |

Additionally, the SN74GTLPH16916 allows for transparent conversion of CLKAB-to-GTLP signal levels (CLKOUT) and CLKOUT-to-LVTTTL logic levels (CLKIN).

Data flow in each direction is controlled by clock enables (\overline{CEAB} and \overline{CEBA}), latch enables (LEAB and LEBA), clock (CLKAB and CLKBA), and output enables (\overline{OEAB} and \overline{OEBA}). \overline{CEAB} and \overline{CEBA} enable all 17 bits, and \overline{OEAB} and \overline{OEBA} control the 17 bits of data and the CLKOUT/CLKIN buffered clock path for the A-to-B and B-to-A directions, respectively.

For A-to-B data flow when \overline{CEAB} is low, the device operates on the low-to-high transition of CLKAB for the flip-flop and on the high-to-low transition of LEAB for the latch path, i.e., if \overline{CEAB} and LEAB are low, the A data is latched regardless of the state of CLKAB (high or low) and, if LEAB is high, the device is in transparent mode. When \overline{OEAB} is low, the outputs are active. When \overline{OEAB} is high, the outputs are in the high-impedance state.

The data flow for B to A is similar to A to B, except \overline{CEBA} , \overline{OEBA} , LEBA, and CLKBA are used.

SN74GTLPH16916
17-BIT LVTTTL-TO-GTLP UNIVERSAL BUS TRANSCEIVER
WITH BUFFERED CLOCK OUTPUTS

SCES347C – JANUARY 2001 – REVISED JANUARY 2002

Function Tables

OUTPUT ENABLE†

| INPUTS | | | | | OUTPUT B | MODE |
|-------------------|-------------------|------|------------|---|----------------|---------------------------|
| \overline{CEAB} | \overline{OEAB} | LEAB | CLKAB | A | | |
| X | H | X | X | X | Z | Isolation |
| L | L | L | H | X | B_0^\ddagger | Latched storage of A data |
| L | L | L | L | X | B_0^\S | |
| X | L | H | X | L | L | True transparent |
| X | L | H | X | H | H | |
| L | L | L | \uparrow | L | L | Clocked storage of A data |
| L | L | L | \uparrow | H | H | |
| H | L | L | X | X | B_0^\S | Clock inhibit |

† A-to-B data flow is shown. B-to-A data flow is similar, but uses \overline{CEBA} , \overline{OEBA} , LEBA, and CLKBA. The condition when \overline{OEAB} and \overline{OEBA} are both low at the same time is not recommended.

‡ Output level before the indicated steady-state input conditions were established, provided that CLKAB was high before LEAB went low

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

BUFFERED CLOCK

| INPUTS | | | | OPERATION OR FUNCTION | MODE |
|-----------------|----|-------------------|-------------------|-------------------------------------|--|
| \overline{CE} | LE | \overline{OEAB} | \overline{OEBA} | | |
| X | X | H | H | Z | Isolation |
| X | X | L | H | CLKAB to CLKOUT | True delayed clock signal |
| X | X | H | L | CLKOUT to CLKIN | |
| X | X | L | L | CLKAB to CLKOUT, CLKOUT to CLKIN | True delayed clock signal with feedback path \uparrow |

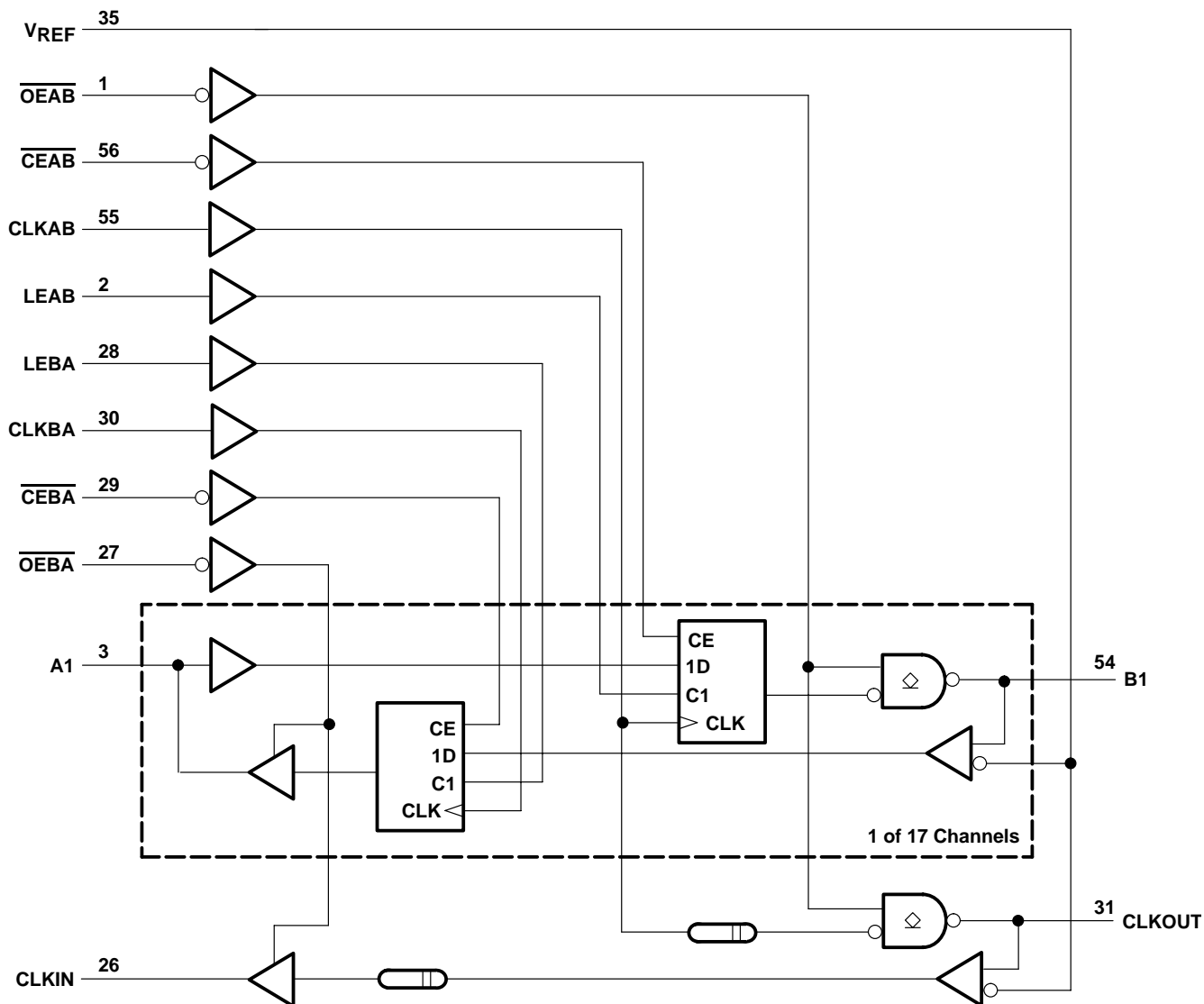
\uparrow This condition is not recommended.



SN74GTLPH16916
17-BIT LVTTTL-TO-GTLP UNIVERSAL BUS TRANSCEIVER
WITH BUFFERED CLOCK OUTPUTS

SCES347C – JANUARY 2001 – REVISED JANUARY 2002

logic diagram (positive logic)



SN74GTLPH16916
17-BIT LVTTTL-TO-GTLP UNIVERSAL BUS TRANSCEIVER
WITH BUFFERED CLOCK OUTPUTS

SCES347C – JANUARY 2001 – REVISED JANUARY 2002

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

| | |
|---|-----------------|
| Supply voltage range, V_{CC} and BIAS V_{CC} | –0.5 V to 4.6 V |
| Input voltage range, V_I (see Note 1): A port and control inputs | –0.5 V to 7 V |
| B port and V_{REF} | –0.5 V to 4.6 V |
| Voltage range applied to any output in the high-impedance or power-off state, V_O (see Note 1): A port | –0.5 V to 7 V |
| B port | –0.5 V to 4.6 V |
| Current into any output in the low state, I_O : A port | 48 mA |
| B port | 100 mA |
| Current into any A port output in the high state, I_O (see Note 2) | 48 mA |
| Continuous current through each V_{CC} or GND | ± 100 mA |
| Input clamp current, I_{IK} ($V_I < 0$) | –50 mA |
| Output clamp current, I_{OK} ($V_O < 0$) | –50 mA |
| Package thermal impedance, θ_{JA} (see Note 3): DGG package | 64°C/W |
| DGV package | 48°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 current flows only when the output is in the high state and $V_O > V_{CC}$.
3. The package thermal impedance is calculated in accordance with JESD 51-7.



SN74GTLPH16916
17-BIT LVTTTL-TO-GTLP UNIVERSAL BUS TRANSCEIVER
WITH BUFFERED CLOCK OUTPUTS

SCES347C – JANUARY 2001 – REVISED JANUARY 2002

recommended operating conditions (see Notes 4 through 7)

| | | MIN | NOM | MAX | UNIT | |
|-----------------------------|------------------------------------|-----------------|----------------|------|-----------|--------------|
| V_{CC} , BIAS V_{CC} | Supply voltage | 3.15 | 3.3 | 3.45 | V | |
| V_{TT} | Termination voltage | GTLP | 1.14 | 1.2 | 1.26 | V |
| | | GTL | 1.35 | 1.5 | 1.65 | |
| V_{REF} | Reference voltage | GTLP | 0.74 | 0.8 | 0.87 | V |
| | | GTL | 0.87 | 1 | 1.1 | |
| V_I | Input voltage | B port | V_{TT} | | V | |
| | | Except B port | V_{CC} 5.5 | | | |
| V_{IH} | High-level input voltage | B port | $V_{REF}+0.05$ | | V | |
| | | Except B port | 2 | | | |
| V_{IL} | Low-level input voltage | B port | $V_{REF}-0.05$ | | V | |
| | | Except B port | 0.8 | | | |
| I_{IK} | Input clamp current | | | | -18 | mA |
| I_{OH} | High-level output current | A port | | | -24 | mA |
| I_{OL} | Low-level output current | A port | | | 24 | mA |
| | | B port | | | 50 | |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | Outputs enabled | | 10 | ns/V | |
| $\Delta t/\Delta V_{CC}$ | Power-up ramp rate | 20 | | | μ s/V | |
| T_A | Operating free-air temperature | -40 | | | 85 | $^{\circ}$ C |

- NOTES: 4. All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.
5. Proper connection sequence for use of the B-port I/O precharge feature is GND and BIAS $V_{CC} = 3.3$ V first, I/O second, and $V_{CC} = 3.3$ V last, because the BIAS V_{CC} precharge circuitry is disabled when any V_{CC} pin is connected. The control and V_{REF} inputs can be connected anytime, but normally are connected during the I/O stage. If B-port precharge is not required, any connection sequence is acceptable, but generally, GND is connected first.
6. V_{TT} and R_{TT} can be adjusted to accommodate backplane impedances if the dc recommended I_{OL} ratings are not exceeded.
7. V_{REF} can be adjusted to optimize noise margins, but normally is two-thirds V_{TT} . TI-OPC circuitry is enabled in the A-to-B direction and is activated when $V_{TT} > 0.7$ V above V_{REF} . If operated in the A-to-B direction, V_{REF} should be set to within 0.6 V of V_{TT} to minimize current drain.



SN74GTLPH16916

17-BIT LVTTTL-TO-GTLP UNIVERSAL BUS TRANSCEIVER

WITH BUFFERED CLOCK OUTPUTS

SCES347C – JANUARY 2001 – REVISED JANUARY 2002

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

| PARAMETER | | TEST CONDITIONS | | MIN | TYP† | MAX | UNIT |
|---|---------------------------|---|--|---------------------------------------|------|------|------|
| V _{IK} | | V _{CC} = 3.15 V, I _I = -18 mA | | | | -1.2 | V |
| V _{OH} | A port | V _{CC} = 3.15 V to 3.45 V, I _{OH} = -100 μA | | V _{CC} -0.2 | | | V |
| | | V _{CC} = 3.15 V, I _{OH} = -12 mA | | 2.4 | | | |
| | | V _{CC} = 3.15 V, I _{OH} = -24 mA | | 2 | | | |
| V _{OL} | A port | V _{CC} = 3.15 V to 3.45 V, I _{OL} = 100 μA | | | | 0.2 | V |
| | | V _{CC} = 3.15 V, I _{OL} = 12 mA | | | | 0.4 | |
| | | V _{CC} = 3.15 V, I _{OL} = 24 mA | | | | 0.5 | |
| | B port | V _{CC} = 3.15 V to 3.45 V, I _{OL} = 100 μA | | | | 0.2 | |
| | | V _{CC} = 3.15 V, I _{OL} = 10 mA | | | | 0.2 | |
| | | V _{CC} = 3.15 V, I _{OL} = 40 mA | | | | 0.4 | |
| V _{CC} = 3.15 V, I _{OL} = 50 mA | | | | 0.55 | | | |
| I _{I‡} | A-port and control inputs | V _{CC} = 3.45 V | | V _I = 0 or V _{CC} | | ±10 | μA |
| | B port | | | V _I = 5.5 V | | ±20 | |
| | | | | V _I = 0 to 1.5 V | | ±10 | |
| I _{BHL} § | A port | V _{CC} = 3.15 V, V _I = 0.8 V | | 75 | | μA | |
| I _{BHH} ¶ | A port | V _{CC} = 3.15 V, V _I = 2 V | | -75 | | μA | |
| I _{BHLO} # | A port | V _{CC} = 3.45 V, V _I = 0 to V _{CC} | | 500 | | μA | |
| I _{BHHO} | A port | V _{CC} = 3.45 V, V _I = 0 to V _{CC} | | -500 | | μA | |
| I _{CC} | A or B port | V _{CC} = 3.45 V, I _O = 0, V _I (A port or control input) = V _{CC} or GND, V _I (B port) = V _{TT} or GND | | Outputs high | | 50 | mA |
| | | | | Outputs low | | 50 | |
| | | | | Outputs disabled | | 50 | |
| ΔI _{CC} * | | V _{CC} = 3.45 V, One A-port or control input at V _{CC} - 0.6 V, Other A-port or control inputs at V _{CC} or GND | | | | 1.5 | mA |
| C _i | Control inputs | V _I = 3.15 V or 0 | | | 4 | 5.5 | pF |
| C _{io} | A port | V _O = 3.15 V or 0 | | | 7 | 8.5 | pF |
| | B port or CLKOUT | V _O = 1.5 V or 0 | | | 8.5 | 9.5 | |
| C _O | CLKIN | V _O = 3.15 V or 0 | | | 6 | 6.5 | pF |

† All typical values are at V_{CC} = 3.3 V, T_A = 25°C.

‡ For I/O ports, the parameter I_I includes the off-state output leakage current.

§ The bus-hold circuit can sink at least the minimum low sustaining current at V_{IL}max. I_{BHL} should be measured after lowering V_{IN} to GND and then raising it to V_{IL}max.

¶ The bus-hold circuit can source at least the minimum high sustaining current at V_{IH}min. I_{BHH} should be measured after raising V_{IN} to V_{CC} and then lowering it to V_{IH}min.

An external driver must source at least I_{BHLO} to switch this node from low to high.

|| An external driver must sink at least I_{BHHO} to switch this node from high to low.

* This is the increase in supply current for each input that is at the specified TTL voltage level rather than V_{CC} or GND.

hot-insertion specifications for A port over recommended operating free-air temperature range

| PARAMETER | TEST CONDITIONS | | | MIN | MAX | UNIT |
|-------------------|-------------------------------|--------------------------------|---|-----|-----|------|
| I _{off} | V _{CC} = 0, | BIAS V _{CC} = 0, | V _I or V _O = 0 to 5.5 V | | 10 | μA |
| I _{OZPU} | V _{CC} = 0 to 1.5 V, | V _O = 0.5 V to 3 V, | $\overline{OE} = 0$ | | ±30 | μA |
| I _{OZPD} | V _{CC} = 1.5 V to 0, | V _O = 0.5 V to 3 V, | $\overline{OE} = 0$ | | ±30 | μA |



SN74GTLPH16916
17-BIT LVTTTL-TO-GTLP UNIVERSAL BUS TRANSCEIVER
WITH BUFFERED CLOCK OUTPUTS

SCES347C – JANUARY 2001 – REVISED JANUARY 2002

live-insertion specifications for B port over recommended operating free-air temperature range

| PARAMETER | TEST CONDITIONS | | MIN | MAX | UNIT |
|---------------------------|-----------------------------|--|------|----------|---------|
| I_{off} | $V_{CC} = 0,$ | BIAS $V_{CC} = 0,$ V_I or $V_O = 0$ to 1.5 V | | 10 | μA |
| I_{OZPU} | $V_{CC} = 0$ to 1.5 V, | BIAS $V_{CC} = 0,$ $V_O = 0.5$ V to 1.5 V, $\overline{OE} = 0$ | | ± 30 | μA |
| I_{OZPD} | $V_{CC} = 1.5$ V to 0, | BIAS $V_{CC} = 0,$ $V_O = 0.5$ V to 1.5 V, $\overline{OE} = 0$ | | ± 30 | μA |
| I_{CC} (BIAS V_{CC}) | $V_{CC} = 0$ to 3.15 V | BIAS $V_{CC} = 3.15$ V to 3.45 V, V_O (B port) = 0 to 1.5 V | | 5 | mA |
| | $V_{CC} = 3.15$ V to 3.45 V | | | 10 | μA |
| V_O | $V_{CC} = 0,$ | BIAS $V_{CC} = 3.3$ V, $I_O = 0$ | 0.95 | 1.05 | V |
| I_O | $V_{CC} = 0,$ | BIAS $V_{CC} = 3.15$ V to 3.45 V, V_O (B port) = 0.6 V | -1 | | μA |

timing requirements over recommended ranges of supply voltage and operating free-air temperature, $V_{TT} = 1.5$ V and $V_{REF} = 1$ V for GTLP (unless otherwise noted)

| | | MIN | MAX | UNIT | |
|-------------|-----------------|---|-------------|------|-----|
| f_{clock} | Clock frequency | | 175 | MHz | |
| t_w | Pulse duration | CLKAB to B or CLKBA to A | | ns | |
| | | LEAB or LEBA high | 2.8 | | |
| t_{su} | Setup time | CLKAB to B or CLKBA to A | High or low | ns | |
| | | A before CLKAB \uparrow | | | 1.8 |
| | | B before CLKBA \uparrow | | | 1.5 |
| | | A before LEAB \downarrow | | | 1 |
| | | B before LEBA \downarrow | | | 2 |
| | | \overline{CEAB} before CLKAB \uparrow | | | 1.5 |
| | | \overline{CEBA} before CLKBA \uparrow | | | 1.4 |
| t_h | Hold time | A after CLKAB \uparrow | | ns | |
| | | B after CLKBA \uparrow | | | 0.4 |
| | | A after LEAB \downarrow | | | 1.1 |
| | | B after LEBA \downarrow | | | 0.4 |
| | | \overline{CEAB} after CLKAB \uparrow | | | 1 |
| | | \overline{CEBA} after CLKBA \uparrow | | | 1 |

SN74GTLPH16916
17-BIT LVTTTL-TO-GTLP UNIVERSAL BUS TRANSCEIVER
WITH BUFFERED CLOCK OUTPUTS

SCES347C – JANUARY 2001 – REVISED JANUARY 2002

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, $V_{TT} = 1.5\text{ V}$ and $V_{REF} = 1\text{ V}$ for GTLP (see Figure 1)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | MIN | TYP† | MAX | UNIT |
|-----------|-----------------------------------|-------------|-----|------|-----|------|
| f_{max} | CLKAB or CLKBA | B or A | 175 | | | MHz |
| t_{PLH} | A | B | 2.1 | | 6 | ns |
| t_{PHL} | | | 2.1 | | 6 | |
| t_{PLH} | LEAB | B | 2.2 | | 6.3 | ns |
| t_{PHL} | | | 2.2 | | 6.3 | |
| t_{PLH} | CLKAB | B | 2.2 | | 6.3 | ns |
| t_{PHL} | | | 2.2 | | 6.3 | |
| t_{PLH} | CLKAB | CLKOUT | 3.2 | | 8 | ns |
| t_{PHL} | | | 3.2 | | 8 | |
| t_{en} | \overline{OEAB} | B or CLKOUT | 2.6 | | 6.5 | ns |
| t_{dis} | | | 2.6 | | 6.1 | |
| t_r | Rise time, B outputs (20% to 80%) | | | 2.4 | | ns |
| t_f | Fall time, B outputs (80% to 20%) | | | 2 | | ns |
| t_{PLH} | B | A | 1.8 | | 5.8 | ns |
| t_{PHL} | | | 1.8 | | 5.8 | |
| t_{PLH} | LEBA | A | 1.7 | | 5.3 | ns |
| t_{PHL} | | | 1.7 | | 5.3 | |
| t_{PLH} | CLKBA | A | 1.8 | | 5.7 | ns |
| t_{PHL} | | | 1.8 | | 5.7 | |
| t_{PLH} | CLKOUT | CLKIN | 2.5 | | 6.5 | ns |
| t_{PHL} | | | 2.5 | | 6.5 | |
| t_{en} | \overline{OEBA} | A or CLKIN | 1.5 | | 6.2 | ns |
| t_{dis} | | | 1.5 | | 5.9 | |

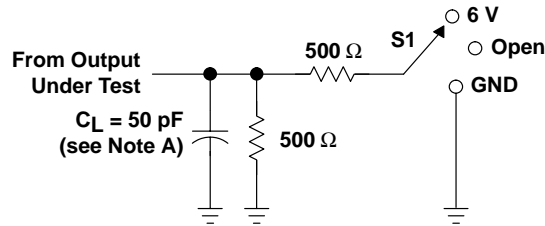
† All typical values are at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$.



SN74GTLPH16916 17-BIT LVTTL-TO-GTLP UNIVERSAL BUS TRANSCEIVER WITH BUFFERED CLOCK OUTPUTS

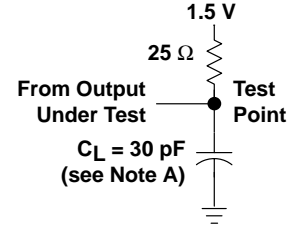
SCES347C – JANUARY 2001 – REVISED JANUARY 2002

PARAMETER MEASUREMENT INFORMATION

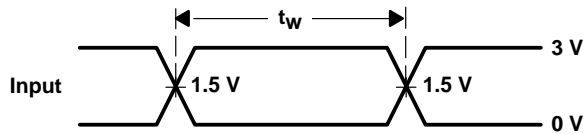


LOAD CIRCUIT FOR A OUTPUTS

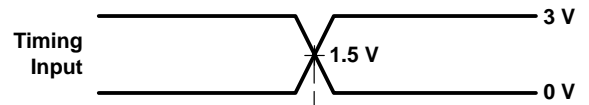
| TEST | S1 |
|-------------------|------|
| t_{PLH}/t_{PHL} | Open |
| t_{PLZ}/t_{PZL} | 6 V |
| t_{PHZ}/t_{PZH} | GND |



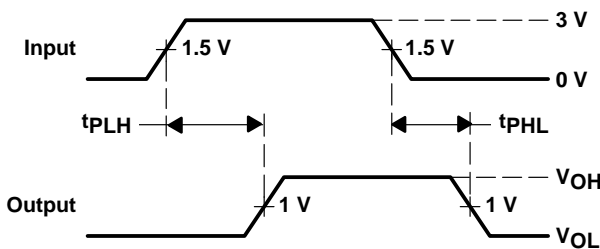
LOAD CIRCUIT FOR B OUTPUTS



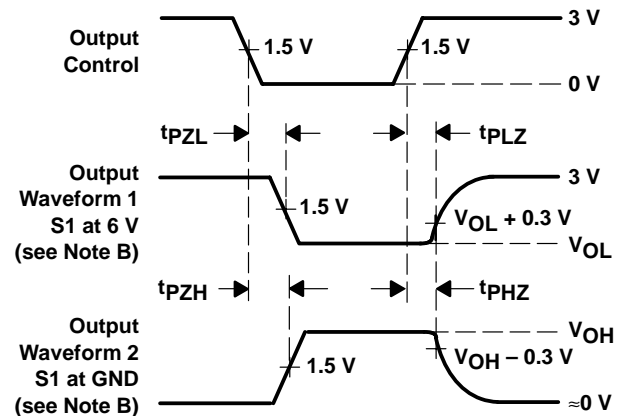
VOLTAGE WAVEFORMS
PULSE DURATION



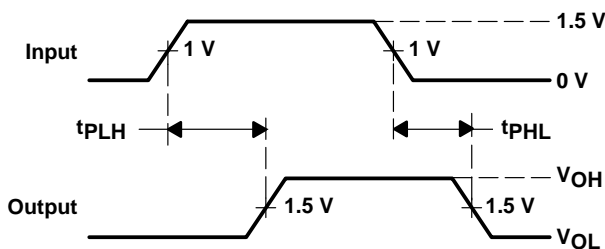
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES
($V_M = 1.5$ V for A port and 1 V for B port)
($V_{OH} = 3$ V for A port and 1.5 V for B port)



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
(A port to B port)



VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES
(A port)



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES
(B port to A port)

- 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 \approx 10 MHz, $Z_O = 50 \Omega$, $t_r \approx 2$ ns, $t_f \approx 2$ ns.
 D. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuits and Voltage Waveforms

SN74GTLPH16916 17-BIT LVTTTL-TO-GTLP UNIVERSAL BUS TRANSCEIVER WITH BUFFERED CLOCK OUTPUTS

SCES347C – JANUARY 2001 – REVISED JANUARY 2002

DISTRIBUTED-LOAD BACKPLANE SWITCHING CHARACTERISTICS

The preceding switching characteristics table shows the switching characteristics of the device into a lumped load (Figure 1). However, the designer's backplane application probably is a distributed load. The physical representation is shown in Figure 2. This backplane, or distributed load, can be approximated closely to a resistor inductance capacitance (RLC) circuit, as shown in Figure 3. This device has been designed for optimum performance in this RLC circuit. The following switching characteristics table shows the switching characteristics of the device into the RLC load, to help the designer better understand the performance of the GTLP device in this typical backplane. See www.ti.com/sc/gtlp for more information.

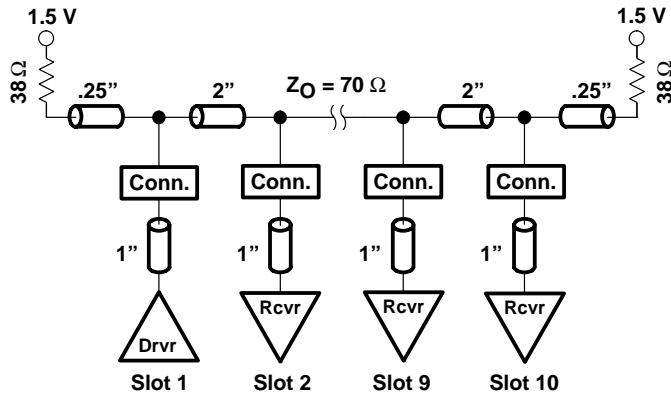


Figure 2. Medium-Drive Test Backplane

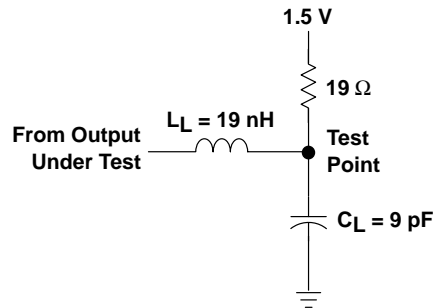


Figure 3. Medium-Drive RLC Network

switching characteristics over recommended ranges of supply voltage and operating free-air temperature, $V_{TT} = 1.5\text{ V}$ and $V_{REF} = 1\text{ V}$ for GTLP (see Figure 3)

| PARAMETER | FROM (INPUT) | TO (OUTPUT) | TYP† | UNIT |
|-----------|-----------------------------------|-------------|------|------|
| t_{PLH} | A | B | 4.5 | ns |
| t_{PHL} | | | 4.5 | |
| t_{PLH} | LEAB | B | 4.7 | ns |
| t_{PHL} | | | 4.7 | |
| t_{PLH} | CLKAB | B | 4.7 | ns |
| t_{PHL} | | | 4.7 | |
| t_{PLH} | CLKAB | CLKOUT | 6 | ns |
| t_{PHL} | | | 6 | |
| t_{en} | \overline{OEAB} | B or CLKOUT | 4.8 | ns |
| t_{dis} | | | 4.4 | |
| t_r | Rise time, B outputs (20% to 80%) | | 1.2 | ns |
| t_f | Fall time, B outputs (80% to 20%) | | 2.5 | ns |

† All typical values are at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$. All values are derived from TI-SPIICE models.

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15 per side.
 D. Falls within JEDEC: 24/48 Pins – MO-153
 14/16/20/56 Pins – MO-194

DGG (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

48 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-153

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