

## **Rochester Electronics Manufactured Components**

Rochester branded components are manufactured using either die/wafers purchased from the original suppliers or Rochester wafers recreated from the original IP. All recreations are done with the approval of the OCM.

Parts are tested using original factory test programs or Rochester developed test solutions to guarantee product meets or exceed the OCM data sheet.

## **Quality Overview**

- ISO-9001
- AS9120 certification
- Qualified Manufacturers List (QML) MIL-PRF-35835
  - Class Q Military
  - Class V Space Level
- Qualified Suppliers List of Distributors (QSLD)
  - Rochester is a critical supplier to DLA and meets all industry and DLA standards.

Rochester Electronics, LLC is committed to supplying products that satisfy customer expectations for quality and are equal to those originally supplied by industry manufacturers.

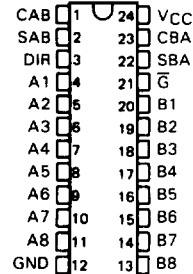
The original manufacturer's datasheet accompanying this document reflects the performance and specifications of the Rochester manufactured version of this device. Rochester Electronics guarantees the performance of its semiconductor products to the original OEM specifications. 'Typical' values are for reference purposes only. Certain minimum or maximum ratings may be based on product characterization, design, simulation, or sample testing.

**SN74ALS646, SN74ALS648, SN74AS646, SN74AS648  
SN54ALS646, SN54ALS648, SN54AS646  
OCTAL BUS TRANSCEIVERS AND REGISTERS**  
D2661, DECEMBER 1983 - REVISED OCTOBER 1991

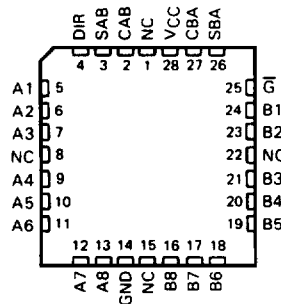
- Independent Registers for A and B Buses
- Multiplexed Real-Time and Stored Data
- Choice of True or Inverting Data Paths
- 3-State Outputs
- Package Options Include Plastic "Small Outline" Packages, Ceramic Chip Carriers, and Standard Plastic and Ceramic 300-mil DIPs

| DEVICE          | OUTPUT  | LOGIC     |
|-----------------|---------|-----------|
| 'ALS646, 'AS646 | 3-State | True      |
| 'ALS648, 'AS648 | 3-State | Inverting |

SN54ALS', SN54AS' ... JT PACKAGE  
SN74ALS', SN74AS' ... DW OR NT PACKAGE  
(TOP VIEW)



SN54ALS', SN54AS' ... FK PACKAGE  
(TOP VIEW)



NC - No internal connection

## description

These devices consist of bus transceiver circuits, with 3-state outputs, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the data bus or from the internal storage registers. Data on the A or B bus will be clocked into the registers on the low-to-high transition of the appropriate clock pin (CAB or CBA). The following examples demonstrate the four fundamental bus-management functions that can be performed with the octal bus transceivers and registers.

Enable ( $\bar{G}$ ) and direction (DIR) pins are provided to control the transceiver functions. In the transceiver mode, data present at the high-impedance port may be stored in either register or in both. The select controls (SAB and SBA) can multiplex stored and real-time (transparent mode) data. The circuitry used for select control will eliminate the typical decoding glitch which occurs in a multiplexer during the transition between stored and real-time data. The direction control determines which bus will receive data when enable  $\bar{G}$  is active (low). In the isolation mode (control  $\bar{G}$  high), A data may be stored in one register and/or B data may be stored in the other register.

When an output function is disabled, the input function is still enabled and may be used to store and transmit data. Only one of the two buses, A or B, may be driven at a time.

The -1 versions of the SN74ALS' parts are identical to the standard versions except that the recommended maximum  $I_{OL}$  is increased to 48 milliamperes.

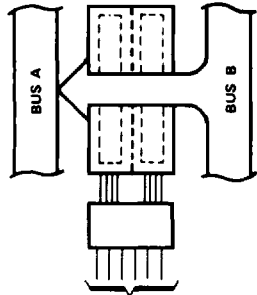
The SN54' family is characterized for operation over the full military temperature range of -55°C to 125°C. The SN74' family is characterized for operation from 0°C to 70°C.

PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



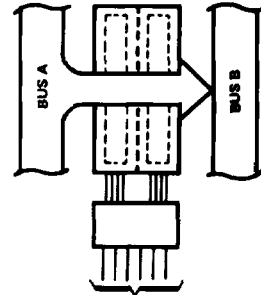
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**SN74ALS646, SN74ALS648, SN74AS646, SN74AS648**  
**SN54ALS646, SN54ALS648, SN54AS646**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS**



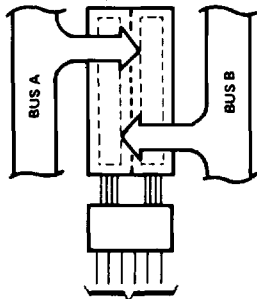
| (21)      | (3) | (1) | (23) | (2) | (22) |
|-----------|-----|-----|------|-----|------|
| $\bar{G}$ | DIR | CAB | CBA  | SAB | SBA  |
| L         | L   | X   | X    | X   | L    |

**REAL-TIME TRANSFER**  
**BUS B TO BUS A**



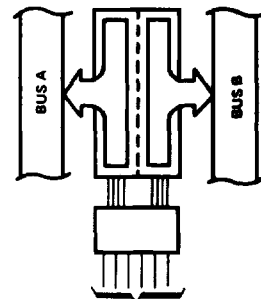
| (21)      | (3) | (1) | (23) | (2) | (22) |
|-----------|-----|-----|------|-----|------|
| $\bar{G}$ | DIR | CAB | CBA  | SAB | SBA  |
| L         | H   | X   | X    | L   | X    |

**REAL-TIME TRANSFER**  
**BUS A TO BUS B**



| (21)      | (3) | (1) | (23) | (2) | (22) |
|-----------|-----|-----|------|-----|------|
| $\bar{G}$ | DIR | CAB | CBA  | SAB | SBA  |
| X         | X   | ↑   | X    | X   | X    |
| X         | X   | X   | ↑    | X   | X    |
| H         | X   | ↑   | ↑    | X   | X    |

**STORAGE FROM**  
**A, B, OR A AND B**



| (21)      | (3) | (1)  | (23) | (2) | (22) |
|-----------|-----|------|------|-----|------|
| $\bar{G}$ | DIR | CAB  | CBA  | SAB | SBA  |
| L         | L   | X    | HorL | X   | H    |
| L         | H   | HorL | X    | H   | X    |

**TRANSFER**  
**STORED DATA**  
**TO A OR B**

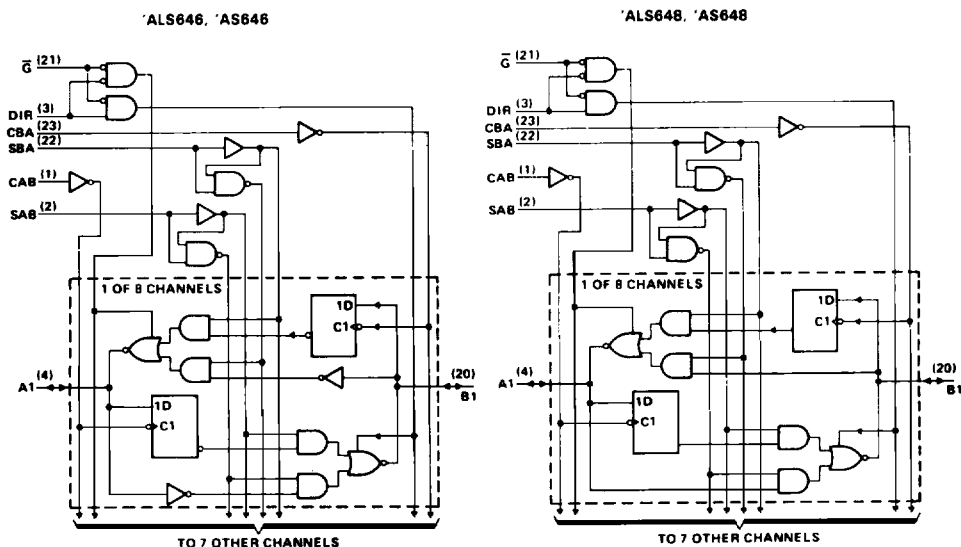
**SN74ALS646, SN74ALS648, SN74AS646, SN74AS648**  
**SN54ALS646, SN54ALS648, SN54AS646**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS**

**FUNCTION TABLE**

| INPUTS         |     |        |        |     |     | DATA I/O                 |                          | OPERATION OR FUNCTION               |                                        |
|----------------|-----|--------|--------|-----|-----|--------------------------|--------------------------|-------------------------------------|----------------------------------------|
| $\overline{G}$ | DIR | CAB    | CBA    | SAB | SBA | A1 THRU A8               | B1 THRU B8               | 'ALS646, 'AS646                     | 'ALS648, 'AS648                        |
| X              | X   | ↑      | X      | X   | X   | Input                    | Unspecified <sup>†</sup> | Store A, B unspecified <sup>†</sup> | Store A, B unspecified <sup>†</sup>    |
| X              | X   | X      | ↑      | X   | X   | Unspecified <sup>†</sup> | Input                    | Store B, A unspecified <sup>†</sup> | Store B, A unspecified <sup>†</sup>    |
| H              | X   | ↑      | ↑      | X   | X   | Input                    | Input                    | Store A and B Data                  | Store A and B Data                     |
| H              | X   | H or L | H or L | X   | X   |                          |                          | Isolation, hold storage             | Isolation, hold storage                |
| L              | L   | X      | X      | X   | L   | Output                   | Input                    | Real-Time B Data to A Bus           | Real-Time $\overline{B}$ Data to A Bus |
| L              | L   | X      | H or L | X   | H   |                          |                          | Stored B Data to A Bus              | Stored $\overline{B}$ Data to A Bus    |
| L              | H   | X      | X      | L   | X   | Input                    | Output                   | Real-Time A Data to B Bus           | Real-Time $\overline{A}$ Data to B Bus |
| L              | H   | H or L | X      | H   | X   |                          |                          | Stored A Data to B Bus              | Stored $\overline{A}$ Data to B Bus    |

<sup>†</sup>The data output functions may be enabled or disabled by various signals at the  $\overline{G}$  and DIR inputs. Data input functions are always enabled, i.e., data at the bus pins will be stored on every low-to-high transition on the clock inputs.

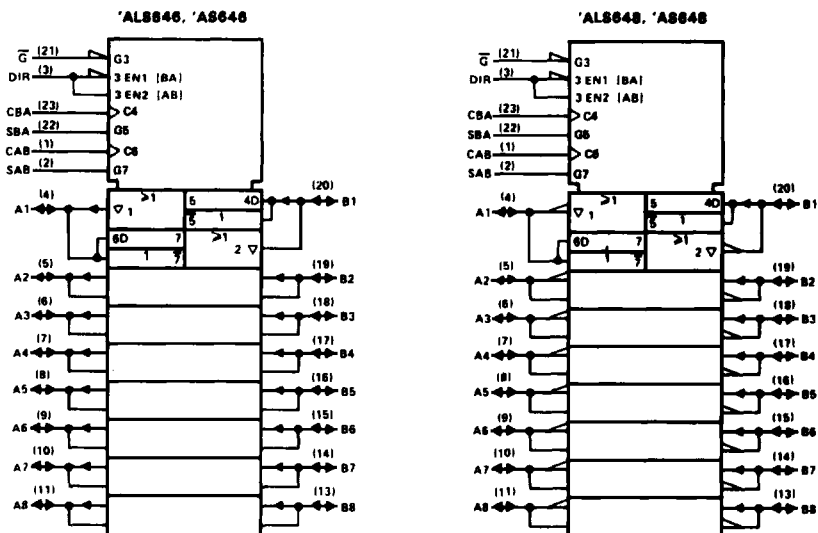
**functional block diagrams (positive logic)**



Pin numbers shown are for DW, JT, and NT packages.

**SN74ALS646, SN74ALS648, SN74AS646, SN74AS648**  
**SN54ALS646, SN54ALS648, SN54AS646**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS**

logic symbols†



†These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.  
Pin numbers shown are for DW, JT, and NT packages.

# **SN74ALS646, SN54ALS646** **OCTAL BUS TRANSCEIVERS AND REGISTERS** **WITH 3-STATE OUTPUTS**

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

|                                                  |                |
|--------------------------------------------------|----------------|
| Supply voltage, $V_{CC}$                         | 7 V            |
| Input voltage: Control inputs                    | 7 V            |
| I/O ports                                        | 5.5 V          |
| Operating free-air temperature range: SN54ALS646 | -55°C to 125°C |
| SN74ALS646                                       | 0°C to 70°C    |
| Storage temperature range                        | -65°C to 150°C |

## **recommended operating conditions**

|             |                                                                    | SN54ALS646 |     |     | SN74ALS646 |     |                 | UNIT |
|-------------|--------------------------------------------------------------------|------------|-----|-----|------------|-----|-----------------|------|
|             |                                                                    | MIN        | NOM | MAX | MIN        | NOM | MAX             |      |
| $V_{CC}$    | Supply voltage                                                     | 4.5        | 5   | 5.5 | 4.5        | 5   | 5.5             | V    |
| $V_{IH}$    | High-level input voltage                                           | 2          |     |     | 2          |     |                 | V    |
| $V_{IL}$    | Low-level input voltage                                            |            |     | 0.7 |            |     | 0.8             | V    |
| $I_{OH}$    | High-level output current                                          |            |     | -12 |            |     | -15             | mA   |
| $I_{OL}$    | Low-level output current                                           |            |     | 12  |            |     | 24              | mA   |
|             |                                                                    |            |     |     |            |     | 48 <sup>†</sup> | mA   |
| $f_{clock}$ | Clock frequency                                                    | 0          |     | 35  | 0          |     | 40              | MHz  |
| $t_w$       | Pulse duration, clocks high or low                                 | 14.5       |     |     | 12.5       |     |                 | ns   |
| $t_{su}$    | Setup time, A before CAB <sup>†</sup> or B before CBA <sup>†</sup> | 15         |     |     | 10         |     |                 | ns   |
| $t_h$       | Hold time, A after CAB <sup>†</sup> or B after CBA <sup>†</sup>    | 1          |     |     | 0          |     |                 | ns   |
| $T_A$       | Operating free-air temperature                                     | -55        |     | 125 | 0          |     | 70              | °C   |

<sup>†</sup>The extended condition applies if  $V_{CC}$  is maintained between 4.75 V and 5.25 V.

The 48-mA limit applies for the SN74ALS646-1 only.

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

| PARAMETER |                           | TEST CONDITIONS                                                      | SN54ALS646   |                  |      | SN74ALS646   |                  |      | UNIT          |
|-----------|---------------------------|----------------------------------------------------------------------|--------------|------------------|------|--------------|------------------|------|---------------|
|           |                           |                                                                      | MIN          | TYP <sup>‡</sup> | MAX  | MIN          | TYP <sup>‡</sup> | MAX  |               |
| $V_{IK}$  |                           | $V_{CC} = 4.5 \text{ V}, I_I = -18 \text{ mA}$                       |              |                  | -1.2 |              |                  | -1.2 | V             |
| $V_{OH}$  |                           | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}, I_{OH} = -0.4 \text{ mA}$ | $V_{CC} - 2$ |                  |      | $V_{CC} - 2$ |                  |      | V             |
|           |                           | $V_{CC} = 4.5 \text{ V}, I_{OH} = -3 \text{ mA}$                     | 2.4          | 3.2              |      | 2.4          | 3.2              |      |               |
|           |                           | $V_{CC} = 4.5 \text{ V}, I_{OH} = -12 \text{ mA}$                    | 2            |                  |      |              |                  |      |               |
|           |                           | $V_{CC} = 4.5 \text{ V}, I_{OH} = -15 \text{ mA}$                    |              |                  |      | 2            |                  |      |               |
| $V_{OL}$  |                           | $V_{CC} = 4.5 \text{ V}, I_{OL} = 12 \text{ mA}$                     |              | 0.25             | 0.4  |              | 0.25             | 0.4  | V             |
|           |                           | $V_{CC} = 4.5 \text{ V}, I_{OL} = 24 \text{ mA}$                     |              |                  |      |              | 0.35             | 0.5  |               |
|           |                           | ( $I_{OL} = 48 \text{ mA}$ for -1 version)                           |              |                  |      |              |                  |      |               |
| $I_I$     | Control inputs            | $V_{CC} = 5.5 \text{ V}, V_I = 7 \text{ V}$                          |              |                  | 0.1  |              |                  | 0.1  | mA            |
|           | A or B ports              | $V_{CC} = 5.5 \text{ V}, V_I = 5.5 \text{ V}$                        |              |                  | 0.1  |              |                  | 0.1  |               |
| $I_{IH}$  | Control inputs            | $V_{CC} = 5.5 \text{ V}, V_I = 2.7 \text{ V}$                        |              |                  | 20   |              |                  | 20   | $\mu\text{A}$ |
|           | A or B ports <sup>§</sup> |                                                                      |              |                  | 20   |              |                  | 20   |               |
| $I_{IL}$  | Control inputs            | $V_{CC} = 5.5 \text{ V}, V_I = 0.4 \text{ V}$                        |              |                  | -0.2 |              |                  | -0.2 | mA            |
|           | A or B ports <sup>§</sup> |                                                                      |              |                  | -0.2 |              |                  | -0.2 |               |
| $I_{OI}$  |                           | $V_{CC} = 5.5 \text{ V}, V_O = 2.25 \text{ V}$                       | -30          |                  | -112 | -30          |                  | -112 | mA            |
| $I_{CC}$  |                           | $V_{CC} = 5.5 \text{ V}$                                             |              |                  | 47   | 76           |                  | 47   | mA            |
|           | Outputs high              |                                                                      |              |                  | 55   | 88           |                  | 55   |               |
|           | Outputs disabled          |                                                                      |              |                  | 55   | 88           |                  | 55   |               |

<sup>‡</sup>All typical values are at  $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$ .

<sup>§</sup>For I/O ports, the parameters  $I_{IH}$  and  $I_{IL}$  include the off-state output current.

<sup>¶</sup>The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current,  $I_{OS}$ .

**SN74ALS646, SN54ALS646**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS**  
**WITH 3-STATE OUTPUTS**

**\*ALS646 switching characteristics (see Note 1)**

| PARAMETER | FROM<br>(INPUT)                   | TO<br>(OUTPUT) | VCC = 4.5 V to 5.5 V,<br>CL = 50 pF,<br>R1 = 500 Ω,<br>R2 = 500 Ω,<br>TA = MIN to MAX |     |            |     | UNIT |
|-----------|-----------------------------------|----------------|---------------------------------------------------------------------------------------|-----|------------|-----|------|
|           |                                   |                | SN54ALS646                                                                            |     | SN74ALS646 |     |      |
|           |                                   |                | MIN                                                                                   | MAX | MIN        | MAX |      |
| tmax      |                                   |                | 35                                                                                    |     | 40         |     | MHz  |
| tPLH      | CBA or CAB                        | A or B         | 10                                                                                    | 36  | 10         | 30  | ns   |
| tPHL      |                                   |                | 5                                                                                     | 20  | 5          | 17  |      |
| tPLH      | A or B                            | B or A         | 5                                                                                     | 22  | 5          | 20  | ns   |
| tPHL      |                                   |                | 3                                                                                     | 15  | 3          | 12  |      |
| tPLH      | SBA or SAB†<br>(with A or B low)  | A or B         | 10                                                                                    | 40  | 15         | 35  | ns   |
| tPHL      |                                   |                | 5                                                                                     | 23  | 5          | 20  |      |
| tPLH      | SBA or SAB†<br>(with A or B high) | A or B         | 8                                                                                     | 30  | 8          | 25  | ns   |
| tPHL      |                                   |                | 5                                                                                     | 24  | 5          | 20  |      |
| tPZH      | G̅                                | A or B         | 3                                                                                     | 20  | 3          | 17  | ns   |
| tPZL      |                                   |                | 5                                                                                     | 22  | 5          | 20  |      |
| tPHZ      | G̅                                | A or B         | 1                                                                                     | 12  | 1          | 10  | ns   |
| tPLZ      |                                   |                | 1                                                                                     | 20  | 2          | 16  |      |
| tPZH      | DIR                               | A or B         | 5                                                                                     | 38  | 8          | 30  | ns   |
| tPZL      |                                   |                | 5                                                                                     | 30  | 5          | 25  |      |
| tPHZ      | DIR                               | A or B         | 1                                                                                     | 12  | 1          | 10  | ns   |
| tPLZ      |                                   |                | 2                                                                                     | 21  | 2          | 16  |      |

<sup>†</sup>These parameters are measured with the internal output state of the storage register opposite to that of the bus input.  
 NOTE 1: Load circuit and voltage waveforms are shown in Figure 1.

# **SN74ALS648, SN54ALS648** **OCTAL BUS TRANSCEIVERS AND REGISTERS** **WITH 3-STATE OUTPUTS**

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

|                                                  |                |
|--------------------------------------------------|----------------|
| Supply voltage, $V_{CC}$                         | 7 V            |
| Input voltage: Control inputs                    | 7 V            |
| I/O ports                                        | 5.5 V          |
| Operating free-air temperature range: SN54ALS648 | -55°C to 125°C |
| SN74ALS648                                       | 0°C to 70°C    |
| Storage temperature range                        | -65°C to 150°C |

## **recommended operating conditions**

|             |                                                               | SN54ALS648 |     |     | SN74ALS648 |     |     | UNIT |
|-------------|---------------------------------------------------------------|------------|-----|-----|------------|-----|-----|------|
|             |                                                               | MIN        | NOM | MAX | MIN        | NOM | MAX |      |
| $V_{CC}$    | Supply voltage                                                | 4.5        | 5   | 5.5 | 4.5        | 5   | 5.5 | V    |
| $V_{IH}$    | High-level input voltage                                      | 2          |     |     | 2          |     |     | V    |
| $V_{IL}$    | Low-level input voltage                                       |            |     | 0.7 |            |     | 0.8 | V    |
| $I_{OH}$    | High-level output current                                     |            |     | -12 |            |     | -15 | mA   |
| $I_{OL}$    | Low-level output current                                      |            |     | 12  |            |     | 24  | mA   |
| $f_{clock}$ | Clock frequency                                               | 0          |     | 35  | 0          |     | 40  | MHz  |
| $t_w$       | Pulse duration, clocks high or low                            | 14.5       |     |     | 12.5       |     |     | ns   |
| $t_{su}$    | Setup time, A before $CAB\uparrow$ or B before $CBA\uparrow$  | 15         |     |     | 10         |     |     | ns   |
| $t_h$       | Hold time, A after $CAB\downarrow$ or B after $CBA\downarrow$ | 0          |     |     | 0          |     |     | ns   |
| $T_A$       | Operating free-air temperature                                | -55        |     | 125 | 0          |     | 70  | °C   |

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

| PARAMETER                   |                           | TEST CONDITIONS                                             | SN54ALS648          |                      | SN74ALS648          |                      | UNIT |
|-----------------------------|---------------------------|-------------------------------------------------------------|---------------------|----------------------|---------------------|----------------------|------|
|                             |                           |                                                             | MIN                 | TYP <sup>‡</sup> MAX | MIN                 | TYP <sup>‡</sup> MAX |      |
| V <sub>IK</sub>             |                           | V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = -18 mA            | -1.2                |                      | -1.2                |                      | V    |
| V <sub>OH</sub>             |                           | V <sub>CC</sub> = 4.5 V to 5.5 V, I <sub>OH</sub> = -0.4 mA | V <sub>CC</sub> - 2 |                      | V <sub>CC</sub> - 2 |                      | V    |
|                             |                           | V <sub>CC</sub> = 4.5 V, I <sub>OH</sub> = -3 mA            | 2.4 3.2             |                      | 2.4 3.2             |                      |      |
|                             |                           | V <sub>CC</sub> = 4.5 V, I <sub>OH</sub> = -12 mA           | 2                   |                      |                     |                      |      |
|                             |                           | V <sub>CC</sub> = 4.5 V, I <sub>OH</sub> = -15 mA           |                     |                      | 2                   |                      |      |
| V <sub>OL</sub>             |                           | V <sub>CC</sub> = 4.5 V, I <sub>OL</sub> = 12 mA            | 0.25 0.4            |                      | 0.25 0.4            |                      | V    |
|                             |                           | V <sub>CC</sub> = 4.5 V, I <sub>OL</sub> = 24 mA            |                     |                      | 0.35 0.5            |                      |      |
|                             |                           | (I <sub>OL</sub> = 48 mA for -1 version)                    |                     |                      |                     |                      |      |
| I <sub>I</sub>              | Control inputs            | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 7 V               | 0.1                 |                      | 0.1                 |                      | mA   |
|                             | A or B ports              | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 5.5 V             | 0.1                 |                      | 0.1                 |                      |      |
| I <sub>IH</sub>             | Control inputs            | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 2.7 V             | 20                  |                      | 20                  |                      | μA   |
|                             | A or B ports <sup>§</sup> |                                                             | 20                  |                      | 20                  |                      |      |
| I <sub>IL</sub>             | Control inputs            | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 0.4 V             | -0.2                |                      | -0.2                |                      | mA   |
|                             | A or B ports <sup>§</sup> |                                                             | -0.2                |                      | -0.2                |                      |      |
| I <sub>O</sub> <sup>¶</sup> |                           | V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.25 v            | -30                 | -112                 | -30                 | -112                 | mA   |
| I <sub>CC</sub>             |                           | V <sub>CC</sub> = 5.5 V                                     | Outputs high        |                      | 47 76               |                      | mA   |
|                             |                           |                                                             | Outputs low         |                      | 57 88               |                      |      |
|                             |                           |                                                             | Outputs disabled    |                      | 57 88               |                      |      |

<sup>‡</sup>All typical values are at  $V_{CC} = 5 \text{ V}, T_A = 25^\circ\text{C}$

<sup>§</sup>For I/O ports, the parameters  $I_{IH}$  and  $I_{IL}$  include the off-state output current.

<sup>¶</sup>The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current,  $I_{OS}$ .

**SN74ALS648, SN54ALS648**  
**OCTAL BUS TRANSCEIVERS AND REGISTERS**  
**WITH 3-STATE OUTPUTS**

'ALS648 switching characteristics (see Note 1)

| PARAMETER | FROM<br>(INPUT)                   | TO<br>(OUTPUT) | VCC = 4.5 V to 5.5 V,<br>CL = 50 pF,<br>R1 = 500 Ω,<br>R2 = 500 Ω,<br>TA = MIN to MAX |     |            |     | UNIT |
|-----------|-----------------------------------|----------------|---------------------------------------------------------------------------------------|-----|------------|-----|------|
|           |                                   |                | SN54ALS648                                                                            |     | SN74ALS648 |     |      |
|           |                                   |                | MIN                                                                                   | MAX | MIN        | MAX |      |
| fmax      |                                   |                | 35                                                                                    |     | 40         |     | MHz  |
| tPLH      | CBA or CAB                        | A or B         | 8                                                                                     | 39  | 8          | 33  | ns   |
| tPHL      |                                   |                | 5                                                                                     | 23  | 5          | 20  |      |
| tPLH      | A or B                            | B or A         | 3                                                                                     | 20  | 3          | 17  | ns   |
| tPHL      |                                   |                | 2                                                                                     | 12  | 2          | 10  |      |
| tPLH      | SBA or SAB†<br>(with A or B low)  | A or B         | 5                                                                                     | 44  | 5          | 39  | ns   |
| tPHL      |                                   |                | 4                                                                                     | 26  | 4          | 22  |      |
| tPLH      | SBA or SAB†<br>(with A or B high) | A or B         | 6                                                                                     | 30  | 6          | 25  | ns   |
| tPHL      |                                   |                | 6                                                                                     | 25  | 6          | 21  |      |
| tPZH      | G                                 | A or B         | 4                                                                                     | 25  | 4          | 22  | ns   |
| tPZL      |                                   |                | 4                                                                                     | 25  | 4          | 22  |      |
| tPHZ      | G                                 | A or B         | 1                                                                                     | 12  | 1          | 10  | ns   |
| tPLZ      |                                   |                | 2                                                                                     | 21  | 2          | 15  |      |
| tPZH      | DIR                               | A or B         | 4                                                                                     | 35  | 4          | 27  | ns   |
| tPZL      |                                   |                | 3                                                                                     | 25  | 3          | 19  |      |
| tPHZ      | DIR                               | A or B         | 1                                                                                     | 17  | 1          | 14  | ns   |
| tPLZ      |                                   |                | 2                                                                                     | 22  | 2          | 15  |      |

<sup>†</sup>These parameters are measured with the internal output state of the storage register opposite to that of the bus input.

NOTE 1: Load circuit and voltage waveforms are shown in Figure 1.

# **SN74AS646, SN74AS648, SN54AS646** **OCTAL BUS TRANSCEIVERS AND REGISTERS** **WITH 3-STATE OUTPUTS**

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

|                                                 |                |
|-------------------------------------------------|----------------|
| Supply voltage, $V_{CC}$                        | 7 V            |
| Input voltage: Control inputs                   | 7 V            |
| I/O ports                                       | 5.5 V          |
| Operating free-air temperature range: SN54AS646 | -55°C to 125°C |
| SN74AS646, SN74AS648                            | 0°C to 70°C    |
| Storage temperature range                       | -65°C to 150°C |

## **recommended operating conditions**

|                    |                                            |            | SN54AS646 |     |     | SN74AS646 |     |     | UNIT |
|--------------------|--------------------------------------------|------------|-----------|-----|-----|-----------|-----|-----|------|
|                    |                                            |            | MIN       | NOM | MAX | MIN       | NOM | MAX |      |
| V <sub>CC</sub>    | Supply voltage                             |            | 4.5       | 5   | 5.5 | 4.5       | 5   | 5.5 | V    |
| V <sub>IH</sub>    | High-level input voltage                   |            | 2         |     |     | 2         |     |     | V    |
| V <sub>IL</sub>    | Low-level input voltage                    |            |           |     | 0.8 |           |     | 0.8 | V    |
| I <sub>OH</sub>    | High-level output current                  |            |           |     | -12 |           |     | -15 | mA   |
| I <sub>OL</sub>    | Low-level output current                   |            |           |     | 32  |           |     | 48  | mA   |
| f <sub>clock</sub> | Clock frequency                            |            | 0         |     | 75  | 0         |     | 90  | MHz  |
| t <sub>w</sub>     | Pulse duration                             | Clock high | 6         |     |     | 5         |     |     | ns   |
|                    |                                            | Clock low  | 7         |     |     | 6         |     |     |      |
| t <sub>su</sub>    | Setup time, A before CAB↑ or B before CBA↑ |            | 7         |     |     | 6         |     |     | ns   |
| t <sub>h</sub>     | Hold time, A after CAB↑ or B after CBA↑    |            | 0         |     |     | 0         |     |     | ns   |
| T <sub>A</sub>     | Operating free-air temperature             |            | -55       |     | 125 | 0         |     | 70  | °C   |

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

| PARAMETER  |                           | TEST CONDITIONS                                                       |                  | SN54AS646  |                  |       | SN74AS646  |                  |       | UNIT          |
|------------|---------------------------|-----------------------------------------------------------------------|------------------|------------|------------------|-------|------------|------------------|-------|---------------|
|            |                           |                                                                       |                  | MIN        | TYP <sup>†</sup> | MAX   | MIN        | TYP <sup>†</sup> | MAX   |               |
| $V_{IK}$   |                           | $V_{CC} = 4.5 \text{ V}$ , $I_I = -18 \text{ mA}$                     |                  |            |                  | -1.2  |            |                  | -1.2  | V             |
| $V_{OH}$   |                           | $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$ , $I_{OH} = -2 \text{ mA}$ |                  | $V_{CC}-2$ |                  |       | $V_{CC}-2$ |                  |       | V             |
|            |                           | $V_{CC} = 4.5 \text{ V}$ , $I_{OH} = -3 \text{ mA}$                   |                  | 2.4        | 3.2              |       | 2.4        | 3.2              |       |               |
|            |                           | $V_{CC} = 4.5 \text{ V}$ , $I_{OH} = -12 \text{ mA}$                  |                  | 2          |                  |       |            |                  |       |               |
|            |                           | $V_{CC} = 4.5 \text{ V}$ , $I_{OH} = -15 \text{ mA}$                  |                  |            |                  |       | 2          |                  |       |               |
| $V_{OL}$   |                           | $V_{CC} = 4.5 \text{ V}$ , $I_{OL} = 32 \text{ mA}$                   |                  |            | 0.25             | 0.50  |            |                  |       | V             |
|            |                           | $V_{CC} = 4.5 \text{ V}$ , $I_{OL} = 48 \text{ mA}$                   |                  |            |                  |       | 0.35       | 0.50             |       |               |
| $I_I$      | Control inputs            | $V_{CC} = 5.5 \text{ V}$ , $V_I = 7 \text{ V}$                        |                  |            |                  | 0.1   |            |                  | 0.1   | mA            |
|            | A or B ports              | $V_{CC} = 5.5 \text{ V}$ , $V_I = 5.5 \text{ V}$                      |                  |            |                  | 0.1   |            |                  | 0.1   |               |
| $I_{IH}$   | Control inputs            | $V_{CC} = 5.5 \text{ V}$ , $V_I = 2.7 \text{ V}$                      |                  |            |                  | 20    |            |                  | 20    | $\mu\text{A}$ |
|            | A or B ports <sup>‡</sup> | $V_{CC} = 5.5 \text{ V}$ , $V_I = 2.7 \text{ V}$                      |                  |            |                  | 70    |            |                  | 70    |               |
| $I_{IL}$   | Control inputs            | $V_{CC} = 5.5 \text{ V}$ , $V_I = 0.4 \text{ V}$                      |                  |            |                  | -0.5  |            |                  | -0.5  | mA            |
|            | A or B ports <sup>‡</sup> | $V_{CC} = 5.5 \text{ V}$ , $V_I = 0.4 \text{ V}$                      |                  |            |                  | -0.75 |            |                  | -0.75 |               |
| $I_O^{\S}$ |                           | $V_{CC} = 5.5 \text{ V}$ , $V_O = 2.25 \text{ V}$                     |                  | -30        |                  | -112  | -30        |                  | -112  | mA            |
| $I_{CC}$   | 'AS646                    | $V_{CC} = 5.5 \text{ V}$                                              | Outputs high     |            | 120              | 196   |            | 120              | 195   | mA            |
|            |                           |                                                                       | Outputs low      |            | 130              | 211   |            | 130              | 211   |               |
|            |                           |                                                                       | Outputs disabled |            | 130              | 211   |            | 130              | 211   |               |

<sup>†</sup>All typical values are at  $V_{CC} = 5 \text{ V}$ ,  $T_A = 25^\circ\text{C}$ .

<sup>‡</sup>For I/O ports, the parameters  $I_{IH}$  and  $I_{IL}$  include the off-state output current.

<sup>§</sup>The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current,  $I_{OS}$ .

**SN74AS646, SN54AS646**  
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**'AS646 switching characteristics (see Note 1)**

| PARAMETER | FROM<br>(INPUT) | TO<br>(OUTPUT) | VCC = 4.5 V to 5.5 V,<br>CL = 50 pF,<br>R1 = 500 $\Omega$ ,<br>R2 = 500 $\Omega$ ,<br>TA = MIN to MAX |      |           |     | UNIT |
|-----------|-----------------|----------------|-------------------------------------------------------------------------------------------------------|------|-----------|-----|------|
|           |                 |                | SN54AS646                                                                                             |      | SN74AS646 |     |      |
|           |                 |                | MIN                                                                                                   | MAX  | MIN       | MAX |      |
|           |                 |                |                                                                                                       |      |           |     |      |
| tmax      |                 |                | 75                                                                                                    |      | 90        |     | MHz  |
| tPLH      | CBA or CAB      | A or B         | 2                                                                                                     | 9.5  | 2         | 8.5 | ns   |
| tPHL      |                 |                | 2                                                                                                     | 10   | 2         | 9   |      |
| tPLH      | A or B          | B or A         | 2                                                                                                     | 11.5 | 2         | 9   | ns   |
| tPHL      |                 |                | 1                                                                                                     | 8    | 1         | 7   |      |
| tPLH      | SBA or SAB†     | A or B         | 2                                                                                                     | 13.5 | 2         | 11  | ns   |
| tPHL      |                 |                | 2                                                                                                     | 11   | 2         | 9   |      |
| tPZH      | $\bar{G}$       | A or B         | 2                                                                                                     | 11   | 2         | 9   | ns   |
| tPZL      |                 |                | 3                                                                                                     | 15   | 3         | 14  |      |
| tPHZ      | $\bar{G}$       | A or B         | 2                                                                                                     | 11   | 2         | 9   | ns   |
| tPLZ      |                 |                | 2                                                                                                     | 11   | 2         | 9   |      |
| tPZH      | DIR             | A or B         | 3                                                                                                     | 21   | 3         | 16  | ns   |
| tPZL      |                 |                | 3                                                                                                     | 24   | 3         | 18  |      |
| tPHZ      | DIR             | A or B         | 2                                                                                                     | 12   | 2         | 10  | ns   |
| tPLZ      |                 |                | 2                                                                                                     | 12   | 2         | 10  |      |

# **SN74AS648** **OCTAL BUS TRANSCEIVERS AND REGISTERS** **WITH 3-STATE OUTPUTS**

## **recommended operating conditions**

|                    |                                                                    |            | SN74AS648 |     |     | UNIT |
|--------------------|--------------------------------------------------------------------|------------|-----------|-----|-----|------|
|                    |                                                                    |            | MIN       | NOM | MAX |      |
| V <sub>CC</sub>    | Supply voltage                                                     |            | 4.5       | 5   | 5.5 | V    |
| V <sub>IH</sub>    | High-level input voltage                                           |            | 2         |     |     | V    |
| V <sub>IL</sub>    | Low-level input voltage                                            |            |           |     | 0.8 | V    |
| I <sub>QH</sub>    | High-level output current                                          |            |           |     | -15 | mA   |
| I <sub>OL</sub>    | Low-level output current                                           |            |           |     | 48  | mA   |
| f <sub>clock</sub> | Clock frequency                                                    |            | 0         |     | 90  | MHz  |
| t <sub>w</sub>     | Pulse duration                                                     | Clock high | 5         |     |     | ns   |
|                    |                                                                    | Clock low  | 6         |     |     |      |
| t <sub>su</sub>    | Setup time, A before CAB <sub>i</sub> or B before CBA <sub>i</sub> |            | 6         |     |     | ns   |
| t <sub>h</sub>     | Hold time, A after CAB <sub>i</sub> or B after CBA <sub>i</sub>    |            | 0         |     |     | ns   |
| T <sub>A</sub>     | Operating free-air temperature                                     |            | 0         |     | 70  | °C   |

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

| PARAMETER                   |                           | TEST CONDITIONS                                           | SN74AS648           |                  |       | UNIT |
|-----------------------------|---------------------------|-----------------------------------------------------------|---------------------|------------------|-------|------|
|                             |                           |                                                           | MIN                 | TYP <sup>†</sup> | MAX   |      |
| V <sub>IK</sub>             |                           | V <sub>CC</sub> = 4.5 V, I <sub>I</sub> = -18 mA          |                     |                  | -1.2  | V    |
| V <sub>OH</sub>             |                           | V <sub>CC</sub> = 4.5 V to 5.5 V, I <sub>QH</sub> = -2 mA | V <sub>CC</sub> - 2 |                  |       | V    |
|                             |                           | V <sub>CC</sub> = 4.5 V, I <sub>QH</sub> = -3 mA          | 2.4                 | 3.2              |       |      |
|                             |                           | V <sub>CC</sub> = 4.5 V, I <sub>QH</sub> = -12 mA         |                     |                  |       |      |
|                             |                           | V <sub>CC</sub> = 4.5 V, I <sub>QH</sub> = -15 mA         | 2                   |                  |       |      |
| V <sub>OL</sub>             |                           | V <sub>CC</sub> = 4.5 V, I <sub>QL</sub> = 32 mA          |                     |                  |       | V    |
|                             |                           | V <sub>CC</sub> = 4.5 V, I <sub>QL</sub> = 48 mA          |                     | 0.35             | 0.50  |      |
| I <sub>I</sub>              | Control inputs            | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 7 V             |                     |                  | 0.1   | mA   |
|                             | A or B ports              | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 5.5 V           |                     |                  | 0.1   |      |
| I <sub>IH</sub>             | Control inputs            | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 2.7 V           |                     |                  | 20    | μA   |
|                             | A or B ports <sup>‡</sup> |                                                           |                     |                  | 70    |      |
| I <sub>IL</sub>             | Control inputs            | V <sub>CC</sub> = 5.5 V, V <sub>I</sub> = 0.4 V           |                     |                  | -0.5  | mA   |
|                             | A or B ports <sup>‡</sup> |                                                           |                     |                  | -0.75 |      |
| I <sub>O</sub> <sup>§</sup> |                           | V <sub>CC</sub> = 5.5 V, V <sub>O</sub> = 2.25 V          | -30                 |                  | -112  | mA   |
| I <sub>CC</sub>             |                           | V <sub>CC</sub> = 5.5 V                                   | Outputs high        | 110              | 185   | mA   |
|                             |                           |                                                           | Outputs low         | 120              | 195   |      |
|                             |                           |                                                           | Outputs disabled    | 120              | 195   |      |

<sup>†</sup> All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

<sup>‡</sup> For I/O ports, the parameters I<sub>IH</sub> and I<sub>IL</sub> include the off-state output current.

<sup>§</sup> The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I<sub>OS</sub>.

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switching characteristics (see Note 1)

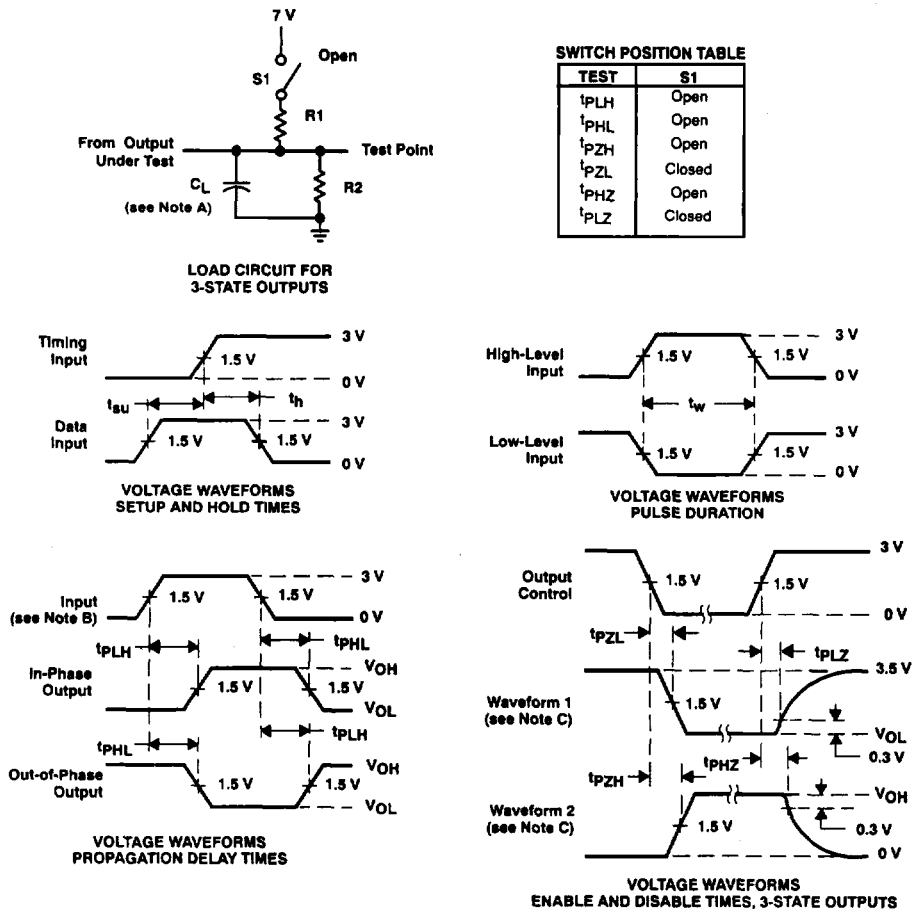
| PARAMETER        | FROM<br>(INPUT) | TO<br>(OUTPUT) | V <sub>CC</sub> = 4.5 V to 5.5 V,<br>C <sub>L</sub> = 50 pF,<br>R <sub>1</sub> = 500 Ω,<br>R <sub>2</sub> = 500 Ω,<br>T <sub>A</sub> = MIN to MAX<br>SN74AS648 |     | UNIT |
|------------------|-----------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|
|                  |                 |                | MIN                                                                                                                                                            | MAX |      |
|                  |                 |                |                                                                                                                                                                |     |      |
| f <sub>max</sub> |                 |                | 90                                                                                                                                                             |     | MHz  |
| t <sub>PLH</sub> | CBA or CAB      | A or B         | 2                                                                                                                                                              | 8.5 | ns   |
| t <sub>PHL</sub> |                 |                | 2                                                                                                                                                              | 9   |      |
| t <sub>PLH</sub> |                 |                | 2                                                                                                                                                              | 8   |      |
| t <sub>PHL</sub> | A or B          | B or A         | 1                                                                                                                                                              | 7   | ns   |
| t <sub>PLH</sub> |                 |                | 2                                                                                                                                                              | 11  |      |
| t <sub>PHL</sub> |                 |                | 2                                                                                                                                                              | 9   |      |
| t <sub>PZH</sub> | 0               | A or B         | 2                                                                                                                                                              | 9   | ns   |
| t <sub>PZL</sub> |                 |                | 3                                                                                                                                                              | 15  |      |
| t <sub>PHZ</sub> |                 |                | 2                                                                                                                                                              | 9   |      |
| t <sub>PLZ</sub> | 0               | A or B         | 2                                                                                                                                                              | 9   | ns   |
| t <sub>PZH</sub> |                 |                | 3                                                                                                                                                              | 15  |      |
| t <sub>PZL</sub> |                 |                | 3                                                                                                                                                              | 18  |      |
| t <sub>PHZ</sub> | DIR             | A or B         | 2                                                                                                                                                              | 10  | ns   |
| t <sub>PLZ</sub> |                 |                | 2                                                                                                                                                              | 10  |      |
| t <sub>PLZ</sub> |                 |                | 2                                                                                                                                                              | 10  |      |

†These parameters are measured with the internal output state of the storage register opposite of that of the bus input.

NOTE 1: Load circuit and voltage waveforms are shown in Figure 1.

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SN54ALS646, SN54ALS648, SN54AS646  
OCTAL BUS TRANSCEIVERS AND REGISTERS**

**PARAMETER MEASUREMENT INFORMATION**



- Notes: A.  $C_L$  includes probe and jig capacitance.  
 B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1 \text{ MHz}$ ,  $Z_0 = 50 \Omega$ ,  $t_r \leq 2 \text{ ns}$ ,  $t_f \leq 2 \text{ ns}$ .  
 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. The outputs are measured one at a time with one transition per measurement.

Figure 1. Load Circuit and Voltage Waveforms