

**FEATURES:**

- Typical  $t_{SK(o)}$  (Output Skew) < 250ps
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model ( $C = 200\text{pF}$ ,  $R = 0$ )
- $V_{CC} = 3.3V \pm 0.3V$ , Normal Range
- $V_{CC} = 2.7V$  to  $3.6V$ , Extended Range
- CMOS power levels ( $0.4\mu\text{W}$  typ. static)
- All inputs, outputs, and I/O are 5V tolerant
- Supports hot insertion
- Available in TSSOP package

**DRIVE FEATURES:**

- Balanced Output Drivers:  $\pm 12\text{mA}$
- Low switching noise

**APPLICATIONS:**

- 5V and 3.3V mixed voltage systems
- Data communication and telecommunication systems

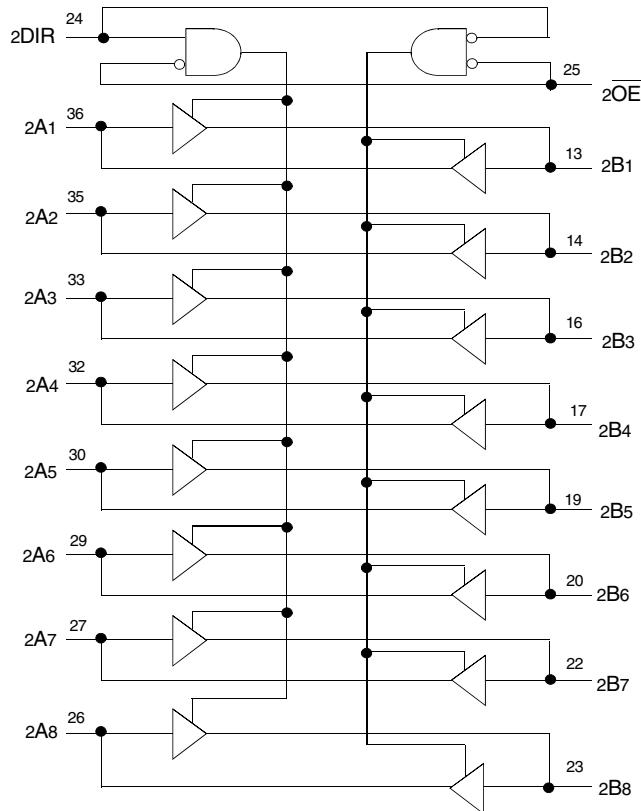
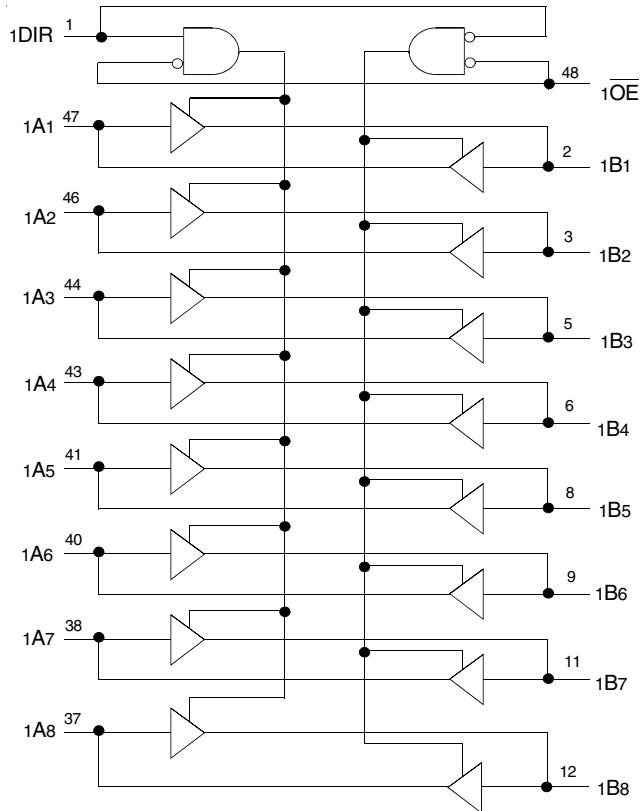
**DESCRIPTION:**

This 16-bit bus transceiver is built using advanced dual metal CMOS technology. This high-speed, low power device is ideal for asynchronous communication between two buses (A and B). The Direction and Output Enable controls are designed to operate this device as either two independent 8-bit transceivers or one 16-bit transceiver. The direction control pin (DIR) controls the direction of data flow. The output enable pin ( $\bar{OE}$ ) overrides the direction control and disables both ports. All inputs are designed with hysteresis for improved noise margin.

All pins can be driven from either 3.3V or 5V devices. This feature allows the use of this device as a translator in a mixed 3.3V/5V supply system.

The LVCHR162245A has series resistors in the device output structure which will significantly reduce line noise when used with light loads. The driver has been designed to drive  $\pm 12\text{mA}$  at the designated threshold levels.

The LVCHR162245A has "bus-hold" which retains the inputs' last state whenever the input goes to a high impedance. This prevents floating inputs and eliminates the need for pull-up/down resistors.

**FUNCTIONAL BLOCK DIAGRAM**

**PIN CONFIGURATION**

|      |    |    |     |
|------|----|----|-----|
| 1DIR | 1  | 48 | 1OE |
| 1B1  | 2  | 47 | 1A1 |
| 1B2  | 3  | 46 | 1A2 |
| GND  | 4  | 45 | GND |
| 1B3  | 5  | 44 | 1A3 |
| 1B4  | 6  | 43 | 1A4 |
| VCC  | 7  | 42 | VCC |
| 1B5  | 8  | 41 | 1A5 |
| 1B6  | 9  | 40 | 1A6 |
| GND  | 10 | 39 | GND |
| 1B7  | 11 | 38 | 1A7 |
| 1B8  | 12 | 37 | 1A8 |
| 2B1  | 13 | 36 | 2A1 |
| 2B2  | 14 | 35 | 2A2 |
| GND  | 15 | 34 | GND |
| 2B3  | 16 | 33 | 2A3 |
| 2B4  | 17 | 32 | 2A4 |
| VCC  | 18 | 31 | VCC |
| 2B5  | 19 | 30 | 2A5 |
| 2B6  | 20 | 29 | 2A6 |
| GND  | 21 | 28 | GND |
| 2B7  | 22 | 27 | 2A7 |
| 2B8  | 23 | 26 | 2A8 |
| 2DIR | 24 | 25 | 2OE |

TSSOP  
TOP VIEW**ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>**

| Symbol          | Description  | Max          | Unit |
|-----------------|--|--------------|------|
| VTERM           | Terminal Voltage with Respect to GND                               | -0.5 to +6.5 | V    |
| TSTG            | Storage Temperature  | -65 to +150  | °C   |
| IOUT            | DC Output Current  | -50 to +50   | mA   |
| I <sub>IK</sub> | Continuous Clamp Current, V <sub>I</sub> < 0 or V <sub>O</sub> < 0 | -50          | mA   |
| I <sub>CC</sub> | Continuous Current through each VCC or GND                         | ±100         | mA   |
| I <sub>SS</sub> |  |              |      |

## NOTE:

1. Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

**CAPACITANCE** (TA = +25°C, F = 1.0MHz)

| Symbol           | Parameter <sup>(1)</sup> | Conditions            | Typ. | Max. | Unit |
|------------------|--------------------------|-----------------------|------|------|------|
| C <sub>IN</sub>  | Input Capacitance        | V <sub>IN</sub> = 0V  | 4.5  | 6    | pF   |
| C <sub>OUT</sub> | Output Capacitance       | V <sub>OUT</sub> = 0V | 6.5  | 8    | pF   |
| C <sub>I/O</sub> | I/O Port Capacitance     | V <sub>IN</sub> = 0V  | 6.5  | 8    | pF   |

## NOTE:

1. As applicable to the device type.

**PIN DESCRIPTION**

| Pin Names | Description                                     |
|-----------|---|
| xOE       | Output Enable Input (Active LOW)                |
| xDIR      | Direction Control Output                        |
| xAx       | Side A Inputs or 3-State Outputs <sup>(1)</sup> |
| xBx       | Side B Inputs or 3-State Outputs <sup>(1)</sup> |

## NOTE:

1. These pins have "Bus-Hold". All other pins are standard inputs, outputs, or I/Os.

**FUNCTION TABLE** (EACH 8-BIT SECTION)<sup>(1)</sup>

| Inputs |      | Outputs         |
|--------|------|-----------------|
| xOE    | xDIR |                 |
| L      | L    | B Data to A Bus |
| L      | H    | A Data to B Bus |
| H      | X    | High Z State    |

## NOTE:

1. H = HIGH Voltage Level

X = Don't Care

L = LOW Voltage Level

Z = High-Impedance

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Operating Condition:  $TA = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$

| Symbol   | Parameter  | Test Conditions   |   | Min. | Typ. <sup>(1)</sup> | Max.     | Unit          |
|--|--|---|---|------|---------------------|----------|---------------|
| VIH  | Input HIGH Voltage Level                               | V <sub>CC</sub> = 2.3V to 2.7V  |   | 1.7  | —                   | —        | V             |
|  |  | V <sub>CC</sub> = 2.7V to 3.6V  |   | 2    | —                   | —        |               |
| VIL  | Input LOW Voltage Level                                | V <sub>CC</sub> = 2.3V to 2.7V  |   | —    | —                   | 0.7      | V             |
|  |  | V <sub>CC</sub> = 2.7V to 3.6V  |   | —    | —                   | 0.8      |               |
| I <sub>IH</sub><br>I <sub>IL</sub>                       | Input Leakage Current                                  | V <sub>CC</sub> = 3.6V  | V <sub>I</sub> = 0 to 5.5V                            | —    | —                   | $\pm 5$  | $\mu\text{A}$ |
| I <sub>OZH</sub><br>I <sub>OZL</sub>                     | High Impedance Output Current<br>(3-State Output pins) | V <sub>CC</sub> = 3.6V  | V <sub>O</sub> = 0 to 5.5V                            | —    | —                   | $\pm 10$ | $\mu\text{A}$ |
| I <sub>OFF</sub>   | Input/Output Power Off Leakage                         | V <sub>CC</sub> = 0V, V <sub>IN</sub> or V <sub>O</sub> $\leq$ 5.5V         |   | —    | —                   | $\pm 50$ | $\mu\text{A}$ |
| V <sub>IK</sub>  | Clamp Diode Voltage                                    | V <sub>CC</sub> = 2.3V, I <sub>IN</sub> = $-18\text{mA}$                    |   | —    | -0.7                | -1.2     | V             |
| V <sub>H</sub>   | Input Hysteresis                                       | V <sub>CC</sub> = 3.3V  |   | —    | 100                 | —        | mV            |
| I <sub>CCL</sub><br>I <sub>CCH</sub><br>I <sub>CCZ</sub> | Quiescent Power Supply Current                         | V <sub>CC</sub> = 3.6V  | V <sub>IN</sub> = GND or V <sub>CC</sub>              | —    | —                   | 10       | $\mu\text{A}$ |
|  |  |   | 3.6 $\leq$ V <sub>IN</sub> $\leq$ 5.5V <sup>(2)</sup> | —    | —                   | 10       |               |
| $\Delta I_{CC}$  | Quiescent Power Supply Current Variation               | One input at V <sub>CC</sub> - 0.6V, other inputs at V <sub>CC</sub> or GND |   | —    | —                   | 500      | $\mu\text{A}$ |

NOTES:

1. Typical values are at V<sub>CC</sub> = 3.3V,  $+25^{\circ}\text{C}$  ambient.
2. This applies in the disabled state only.

## BUS-HOLD CHARACTERISTICS

| Symbol                                 | Parameter <sup>(1)</sup>         | Test Conditions        |                            | Min. | Typ. <sup>(2)</sup> | Max.      | Unit          |
|--|----------------------------------|------------------------|----------------------------|------|---------------------|-----------|---------------|
| I <sub>BHH</sub><br>I <sub>BHL</sub>   | Bus-Hold Input Sustain Current   | V <sub>CC</sub> = 3V   | V <sub>I</sub> = 2V        | -75  | —                   | —         | $\mu\text{A}$ |
|  |                                  |                        | V <sub>I</sub> = 0.8V      | 75   | —                   | —         |               |
| I <sub>BHH</sub><br>I <sub>BHL</sub>   | Bus-Hold Input Sustain Current   | V <sub>CC</sub> = 2.3V | V <sub>I</sub> = 1.7V      | —    | —                   | —         | $\mu\text{A}$ |
|  |                                  |                        | V <sub>I</sub> = 0.7V      | —    | —                   | —         |               |
| I <sub>BHHO</sub><br>I <sub>BHLO</sub> | Bus-Hold Input Overdrive Current | V <sub>CC</sub> = 3.6V | V <sub>I</sub> = 0 to 3.6V | —    | —                   | $\pm 500$ | $\mu\text{A}$ |

NOTES:

1. Pins with Bus-Hold are identified in the pin description.
2. Typical values are at V<sub>CC</sub> = 3.3V,  $+25^{\circ}\text{C}$  ambient.

## OUTPUT DRIVE CHARACTERISTICS

| Symbol | Parameter           | Test Conditions <sup>(1)</sup> |               | Min.      | Max. | Unit |
|--------|---------------------|--------------------------------|---------------|-----------|------|------|
| VOH    | Output HIGH Voltage | Vcc = 2.3V to 3.6V             | IOH = - 0.1mA | Vcc - 0.2 | —    | V    |
|        |                     | Vcc = 2.3V                     | IOH = - 4mA   | 1.9       | —    |      |
|        |                     |                                | IOH = - 6mA   | 1.7       | —    |      |
|        |                     | Vcc = 2.7V                     | IOH = - 4mA   | 2.2       | —    |      |
|        |                     |                                | IOH = - 8mA   | 2         | —    |      |
|        |                     | Vcc = 3V                       | IOH = - 6mA   | 2.4       | —    |      |
|        |                     |                                | IOH = - 12mA  | 2         | —    |      |
| VOL    | Output LOW Voltage  | Vcc = 2.3V to 3.6V             | IOL = 0.1mA   | —         | 0.2  | V    |
|        |                     | Vcc = 2.3V                     | IOL = 4mA     | —         | 0.4  |      |
|        |                     |                                | IOL = 6mA     | —         | 0.55 |      |
|        |                     | Vcc = 2.7V                     | IOL = 4mA     | —         | 0.4  |      |
|        |                     |                                | IOL = 8mA     | —         | 0.6  |      |
|        |                     | Vcc = 3V                       | IOL = 6mA     | —         | 0.55 |      |
|        |                     |                                | IOL = 12mA    | —         | 0.8  |      |

## NOTE:

1. VIH and Vil must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate Vcc range.  
TA = - 40°C to + 85°C.

## OPERATING CHARACTERISTICS, Vcc = 3.3V ± 0.3V, TA = 25°C

| Symbol | Parameter  | Test Conditions     | Typical | Unit |
|--------|--|---------------------|---------|------|
| CPD    | Power Dissipation Capacitance per Transceiver Outputs enabled  | CL = 0pF, f = 10Mhz | 39      | pF   |
| CPD    | Power Dissipation Capacitance per Transceiver Outputs disabled |                     | 4       |      |

## SWITCHING CHARACTERISTICS<sup>(1)</sup>

| Symbol           | Parameter  | Vcc = 2.7V |      | Vcc = 3.3V ± 0.3V |      | Unit |
|------------------|--|------------|------|-------------------|------|------|
|                  |  | Min.       | Max. | Min.              | Max. |      |
| t <sub>PLH</sub> | Propagation Delay<br>xAx to xBx or xBx to xAx        | —          | 5.7  | 1.5               | 4.8  | ns   |
| t <sub>PHL</sub> |  | —          | —    | —                 | —    | ns   |
| t <sub>PZH</sub> | Output Enable Time<br>x <sub>OE</sub> to xAx or xBx  | —          | 7.9  | 1.5               | 6.3  | ns   |
| t <sub>PZL</sub> |  | —          | —    | —                 | —    | ns   |
| t <sub>PHZ</sub> | Output Disable Time<br>x <sub>OE</sub> to xAx or xBx | —          | 8.3  | 2.2               | 7.4  | ns   |
| t <sub>PZL</sub> |  | —          | —    | —                 | —    | ns   |
| tsk(o)           | Output Skew <sup>(2)</sup>                           | —          | —    | —                 | 500  | ps   |

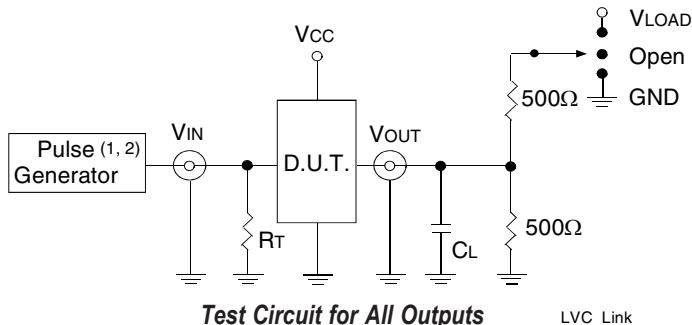
## NOTES:

1. See TEST CIRCUITS AND WAVEFORMS. TA = - 40°C to + 85°C.  
2. Skew between any two outputs of the same package and switching in the same direction.

## TEST CIRCUITS AND WAVEFORMS

## TEST CONDITIONS

| Symbol     | $V_{CC}^{(1)} = 3.3V \pm 0.3V$ | $V_{CC}^{(1)} = 2.7V$ | $V_{CC}^{(2)} = 2.5V \pm 0.2V$ | Unit |
|------------|--------------------------------|-----------------------|--------------------------------|------|
| $V_{LOAD}$ | 6                              | 6                     | $2 \times V_{CC}$              | V    |
| $V_{IH}$   | 2.7                            | 2.7                   | $V_{CC}$                       | V    |
| $V_T$      | 1.5                            | 1.5                   | $V_{CC} / 2$                   | V    |
| $V_{LZ}$   | 300                            | 300                   | 150                            | mV   |
| $V_{HZ}$   | 300                            | 300                   | 150                            | mV   |
| $C_L$      | 50                             | 50                    | 30                             | pF   |



## DEFINITIONS:

$C_L$  = Load capacitance: includes jig and probe capacitance.

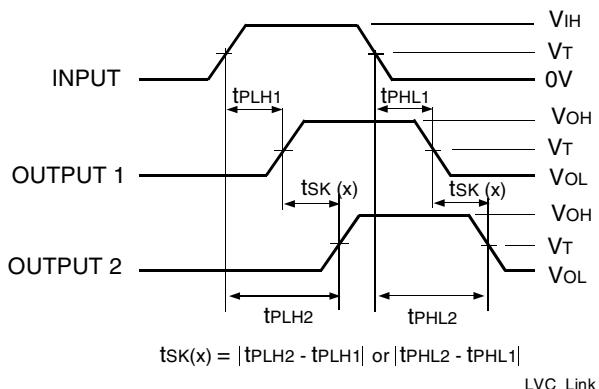
$R_T$  = Termination resistance; should be equal to  $Z_{out}$  of the Pulse Generator.

## NOTES:

1. Pulse Generator for All Pulses: Rate  $\leq$  10MHz;  $tf \leq 2.5\text{ns}$ ;  $tr \leq 2.5\text{ns}$ .
2. Pulse Generator for All Pulses: Rate  $\leq$  10MHz;  $tf \leq 2\text{ns}$ ;  $tr \leq 2\text{ns}$ .

## SWITCH POSITION

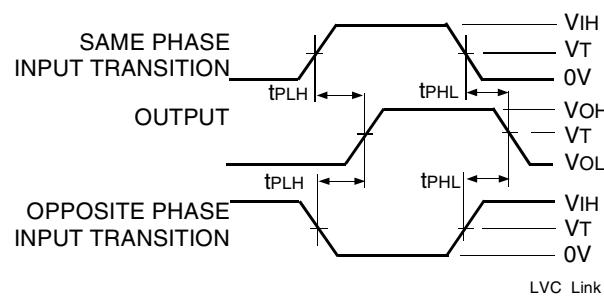
| Test            | Switch     |
|-----------------|------------|
| Open Drain      |            |
| Disable Low     | $V_{LOAD}$ |
| Enable Low      |            |
| Disable High    | GND        |
| Enable High     |            |
| All Other Tests | Open       |



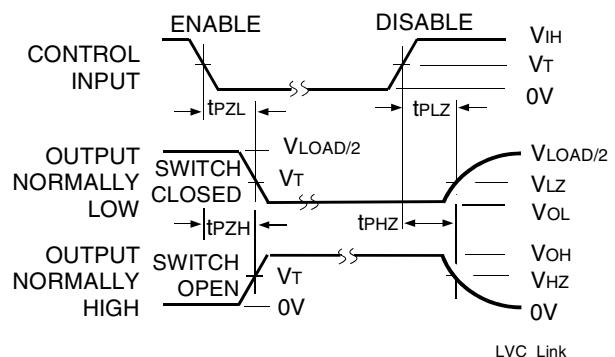
### *Output Skew - $tsk(x)$*

## NOTES:

1. For tsk(o) OUTPUT1 and OUTPUT2 are any two outputs.
2. For tsk(b) OUTPUT1 and OUTPUT2 are in the same bank.



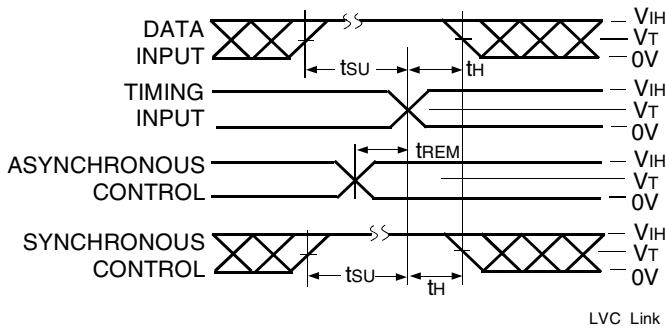
## *Propagation Delay*



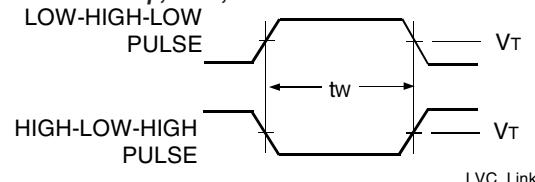
## ***Enable and Disable Times***

**NOTE:**

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.

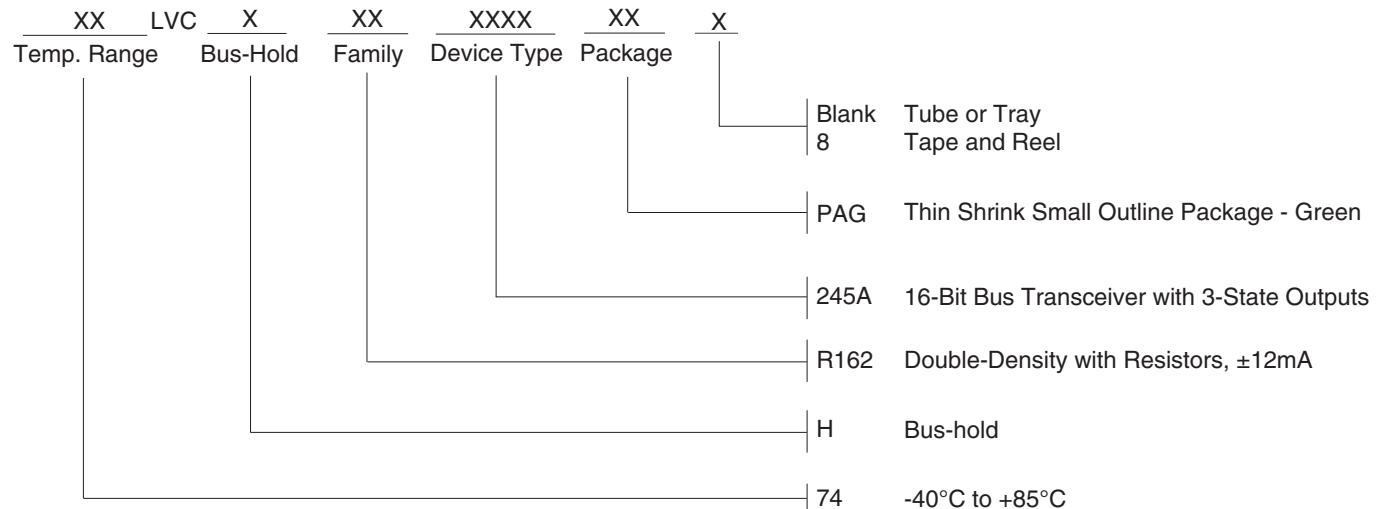


### **Set-up, Hold, and Release Times**



### **Pulse Width**

## ORDERING INFORMATION



## DATASHEET DOCUMENT HISTORY

10/06/2015 Pg. 6 Updated the ordering information by removing non RoHS part and adding Tape and Reel information.

## IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES ("RENESAS") PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD-PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers who are designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only to develop an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third-party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising from your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Disclaimer Rev.1.01)

### Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,  
Koto-ku, Tokyo 135-0061, Japan  
[www.renesas.com](http://www.renesas.com)

### Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.

### Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit [www.renesas.com/contact-us/](http://www.renesas.com/contact-us/).