



## 3.3V CMOS 16-BIT BUS TRANSCEIVER WITH 3-STATE OUTPUTS AND BUS-HOLD

**IDT74ALVCHR162245**

### FEATURES:

- 0.5 MICRON CMOS Technology
- Typical  $t_{SK(O)}$  (Output Skew) < 250ps
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- $V_{CC} = 3.3V \pm 0.3V$ , Normal Range
- $V_{CC} = 2.7V$  to  $3.6V$ , Extended Range
- $V_{CC} = 2.5V \pm 0.2V$
- CMOS power levels (0.4μ W typ. static)
- Rail-to-Rail output swing for increased noise margin
- Available in SSOP, TSSOP, and TVSOP packages

### DRIVE FEATURES:

- Balanced Output Drivers:  $\pm 12mA$
- Low Switching Noise

### APPLICATIONS:

- 3.3V high speed systems
- 3.3V and lower voltage computing systems

### DESCRIPTION:

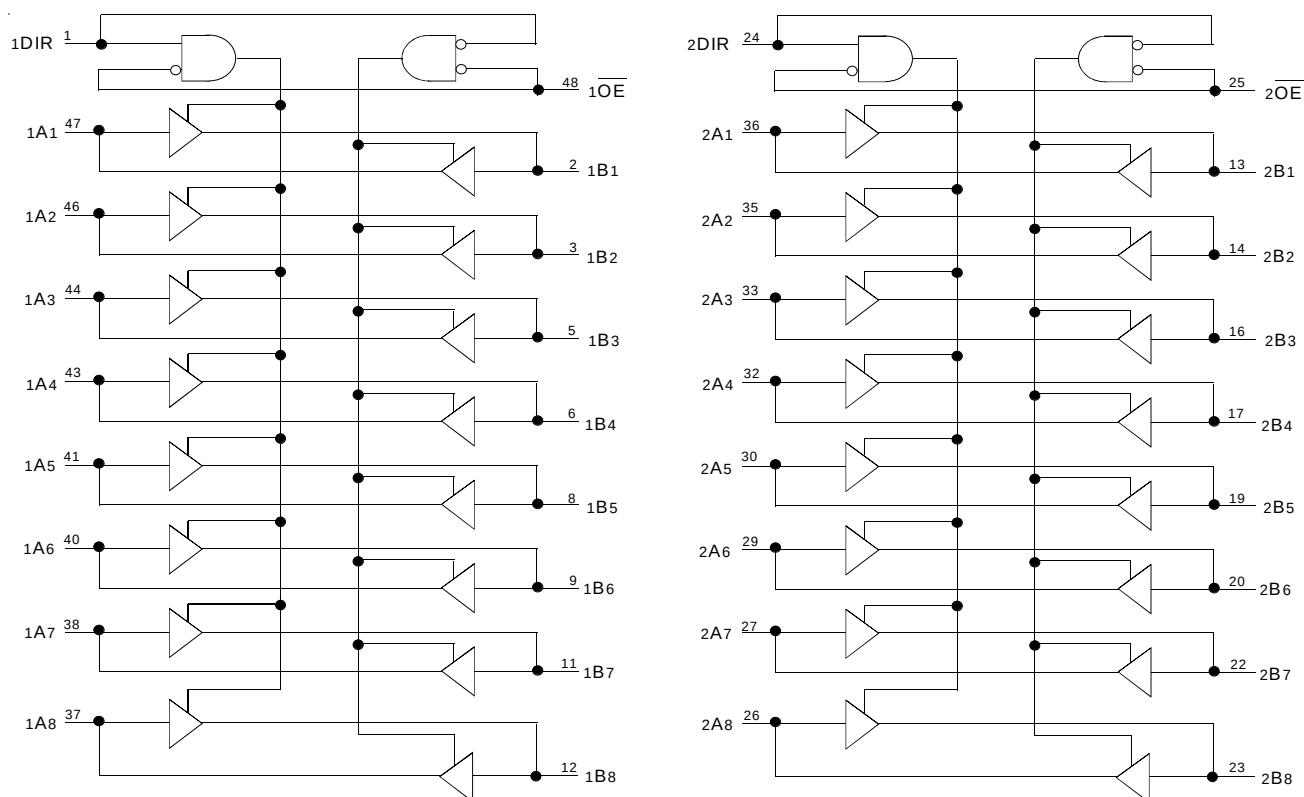
This 16-bit bus transceiver is built using advanced dual metal CMOS technology. The ALVCHR162245 device is designed for asynchronous communication between data buses. The control-function implementation minimizes external timing requirements.

This device can be used as two 8-bit transceivers or one 16-bit transceiver. It allows data transmission from the A bus to the B bus or from the B bus to the A bus, depending on the logic level at the direction control (DIR) input. The output-enable ( $\overline{OE}$ ) input can be used to disable the device so that the buses are effectively isolated.

The ALVCHR162245 has series resistors in the device output structure which will significantly reduce line noise when used with light loads. This driver has been designed to drive  $\pm 12mA$  at the designated threshold levels.

The ALVCHR162245 has "bus-hold" which retains the inputs' last state whenever the input bus goes to a high impedance. This prevents floating inputs and eliminates the need for pull-up/down resistors.

### FUNCTIONAL BLOCK DIAGRAM

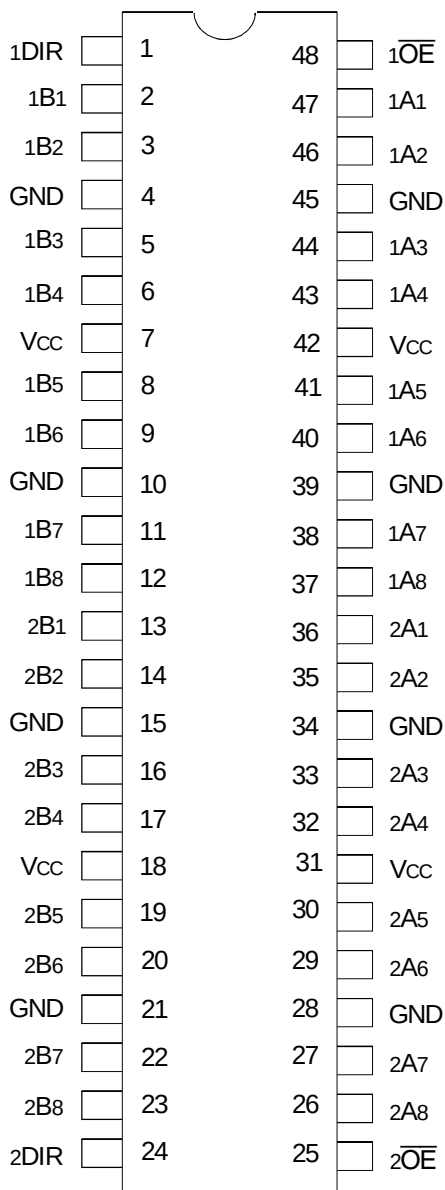


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**INDUSTRIAL TEMPERATURE RANGE**

**MARCH 1999**

## PIN CONFIGURATION



SSOP/ TSSOP/ TVSOP  
TOP VIEW

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

| Symbol               | Description                                  | Max             | Unit |
|----------------------|----------------------------------------------|-----------------|------|
| VTERM <sup>(2)</sup> | Terminal Voltage with Respect to GND         | -0.5 to +4.6    | V    |
| VTERM <sup>(3)</sup> | Terminal Voltage with Respect to GND         | -0.5 to Vcc+0.5 | V    |
| TSTG                 | Storage Temperature                          | -65 to +150     | °C   |
| IOUT                 | DC Output Current                            | -50 to +50      | mA   |
| IIK                  | Continuous Clamp Current, Vi < 0 or Vi > Vcc | ±50             | mA   |
| IOK                  | Continuous Clamp Current, Vo < 0             | -50             | mA   |
| ICC<br>ISS           | Continuous Current through each Vcc or GND   | ±100            | mA   |

### NOTES:

- 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.
- Vcc terminals.
- All terminals except Vcc.

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

| Symbol | Parameter <sup>(1)</sup> | Conditions | Typ. | Max. | Unit |
|--------|--------------------------|------------|------|------|------|
| CIN    | Input Capacitance        | VIN = 0V   | 5    | 7    | pF   |
| COUT   | Output Capacitance       | VOUT = 0V  | 7    | 9    | pF   |
| CII/O  | I/O Port Capacitance     | VIN = 0V   | 7    | 9    | pF   |

### NOTE:

- As applicable to the device type.

## PIN DESCRIPTION

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

### NOTE:

- 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    | Bus B data to A bus |
| L      | H    | Bus A data to B bus |
| H      | X    | High Z State        |

### NOTE:

- H = HIGH Voltage Level  
L = LOW Voltage Level  
X = Don't Care  
Z = High-Impedance

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

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

| Symbol                              | Parameter                                              | Test Conditions                                                                |                    | Min. | Typ. <sup>(1)</sup> | Max.     | Unit          |
|-------------------------------------|--------------------------------------------------------|--------------------------------------------------------------------------------|--------------------|------|---------------------|----------|---------------|
| $V_{IH}$                            | Input HIGH Voltage Level                               | $V_{CC} = 2.3\text{V}$ to $2.7\text{V}$                                        |                    | 1.7  | —                   | —        | V             |
|                                     |                                                        | $V_{CC} = 2.7\text{V}$ to $3.6\text{V}$                                        |                    | 2    | —                   | —        |               |
| $V_{IL}$                            | Input LOW Voltage Level                                | $V_{CC} = 2.3\text{V}$ to $2.7\text{V}$                                        |                    | —    | —                   | 0.7      | V             |
|                                     |                                                        | $V_{CC} = 2.7\text{V}$ to $3.6\text{V}$                                        |                    | —    | —                   | 0.8      |               |
| $I_{IH}$                            | Input HIGH Current                                     | $V_{CC} = 3.6\text{V}$                                                         | $V_I = V_{CC}$     | —    | —                   | $\pm 5$  | $\mu\text{A}$ |
| $I_{IL}$                            | Input LOW Current                                      | $V_{CC} = 3.6\text{V}$                                                         | $V_I = \text{GND}$ | —    | —                   | $\pm 5$  | $\mu\text{A}$ |
| $I_{OZH}$                           | High Impedance Output Current<br>(3-State Output pins) | $V_{CC} = 3.6\text{V}$                                                         | $V_O = V_{CC}$     | —    | —                   | $\pm 10$ | $\mu\text{A}$ |
| $I_{OZL}$                           |                                                        |                                                                                | $V_O = \text{GND}$ | —    | —                   | $\pm 10$ |               |
| $V_{IK}$                            | Clamp Diode Voltage                                    | $V_{CC} = 2.3\text{V}$ , $I_{IN} = -18\text{mA}$                               |                    | —    | -0.7                | -1.2     | V             |
| $V_H$                               | Input Hysteresis                                       | $V_{CC} = 3.3\text{V}$                                                         |                    | —    | 100                 | —        | mV            |
| $I_{CCL}$<br>$I_{CCH}$<br>$I_{CCZ}$ | Quiescent Power Supply Current                         | $V_{CC} = 3.6\text{V}$<br>$V_{IN} = \text{GND}$ or $V_{CC}$                    |                    | —    | 0.1                 | 40       | $\mu\text{A}$ |
| $\Delta I_{CC}$                     | Quiescent Power Supply Current Variation               | One input at $V_{CC} - 0.6\text{V}$ , other inputs at $V_{CC}$ or $\text{GND}$ |                    | —    | —                   | 750      | $\mu\text{A}$ |

### NOTE:

1. Typical values are at  $V_{CC} = 3.3\text{V}$ ,  $+25^{\circ}\text{C}$  ambient.

## BUS-HOLD CHARACTERISTICS

| Symbol                   | Parameter <sup>(1)</sup>         | Test Conditions        |                            | Min. | Typ. <sup>(2)</sup> | Max.      | Unit          |
|--------------------------|----------------------------------|------------------------|----------------------------|------|---------------------|-----------|---------------|
| $I_{BHH}$<br>$I_{BHL}$   | Bus-Hold Input Sustain Current   | $V_{CC} = 3\text{V}$   | $V_I = 2\text{V}$          | -75  | —                   | —         | $\mu\text{A}$ |
|                          |                                  |                        | $V_I = 0.8\text{V}$        | 75   | —                   | —         |               |
| $I_{BHH}$<br>$I_{BHL}$   | Bus-Hold Input Sustain Current   | $V_{CC} = 2.3\text{V}$ | $V_I = 1.7\text{V}$        | -45  | —                   | —         | $\mu\text{A}$ |
|                          |                                  |                        | $V_I = 0.7\text{V}$        | 45   | —                   | —         |               |
| $I_{BHNO}$<br>$I_{BHL0}$ | Bus-Hold Input Overdrive Current | $V_{CC} = 3.6\text{V}$ | $V_I = 0$ to $3.6\text{V}$ | —    | —                   | $\pm 500$ | $\mu\text{A}$ |

### NOTES:

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

| Symbol | Parameter                                      | Test Conditions     | VCC = 2.5V ± 0.2V | VCC = 3.3V ± 0.3V | Unit |
|--------|------------------------------------------------|---------------------|-------------------|-------------------|------|
|        |                                                |                     | Typical           | Typical           |      |
| CPD    | Power Dissipation Capacitance Outputs enabled  | CL = 0pF, f = 10Mhz | 24                | 32                | pF   |
| CPD    | Power Dissipation Capacitance Outputs disabled |                     | 4                 | 5                 |      |

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

| Symbol | Parameter                  | VCC = 2.5V ± 0.2V |      | VCC = 2.7V |      | VCC = 3.3V ± 0.3V |      | Unit |
|--------|----------------------------|-------------------|------|------------|------|-------------------|------|------|
|        |                            | Min.              | Max. | Min.       | Max. | Min.              | Max. |      |
| tPLH   | Propagation Delay          | 1                 | 4.9  | —          | 4.7  | 1                 | 4.2  | ns   |
| tPHL   | xAx to xBx or xBx to xAx   |                   |      |            |      |                   |      |      |
| tPZH   | Output Enable Time         | 1                 | 6.8  | —          | 6.7  | 1                 | 5.6  | ns   |
| tPZL   | xOE to xAx or xBx          |                   |      |            |      |                   |      |      |
| tPHZ   | Output Disable Time        | 1                 | 6.3  | —          | 5.7  | 1                 | 5.5  | ns   |
| tPLZ   | xOE to xAx or xBx          |                   |      |            |      |                   |      |      |
| tsk(0) | Output Skew <sup>(2)</sup> | —                 | —    | —          | —    | —                 | 500  | ps   |

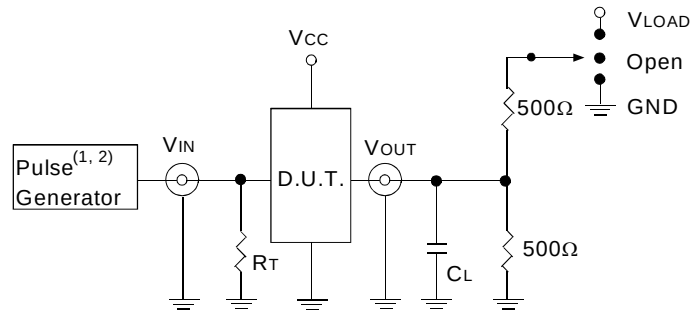
### NOTES:

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 <sub>CC</sub> <sup>(1)</sup> =3.3V±0.3V | V <sub>CC</sub> <sup>(1)</sup> =2.7V | V <sub>CC</sub> <sup>(2)</sup> =2.5V±0.2V | Unit |
|-------------------|-------------------------------------------|--------------------------------------|-------------------------------------------|------|
| V <sub>LOAD</sub> | 6                                         | 6                                    | 2 x V <sub>CC</sub>                       | V    |
| V <sub>IH</sub>   | 2.7                                       | 2.7                                  | V <sub>CC</sub>                           | V    |
| V <sub>T</sub>    | 1.5                                       | 1.5                                  | V <sub>CC</sub> / 2                       | V    |
| V <sub>LZ</sub>   | 300                                       | 300                                  | 150                                       | mV   |
| V <sub>HZ</sub>   | 300                                       | 300                                  | 150                                       | mV   |
| C <sub>L</sub>    | 50                                        | 50                                   | 30                                        | pF   |



Test Circuit for All Outputs

#### DEFINITIONS:

C<sub>L</sub> = Load capacitance: includes jig and probe capacitance.

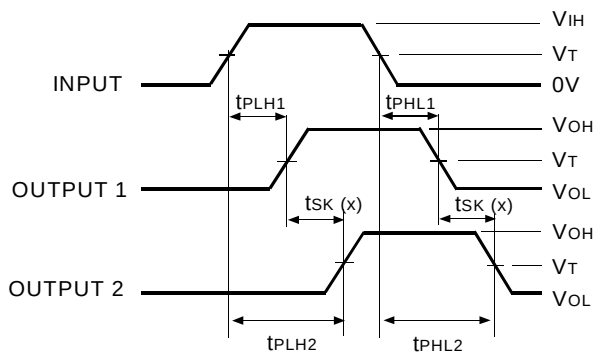
R<sub>T</sub> = Termination resistance: should be equal to Z<sub>OUT</sub> of the Pulse Generator.

#### NOTES:

1. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t<sub>r</sub> ≤ 2.5ns; t<sub>r</sub> ≤ 2.5ns.
2. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t<sub>r</sub> ≤ 2ns; t<sub>r</sub> ≤ 2ns.

### SWITCH POSITION

| Test                                    | Switch            |
|-----------------------------------------|-------------------|
| Open Drain<br>Disable Low<br>Enable Low | V <sub>LOAD</sub> |
| Disable High<br>Enable High             | GND               |
| All Other Tests                         | Open              |

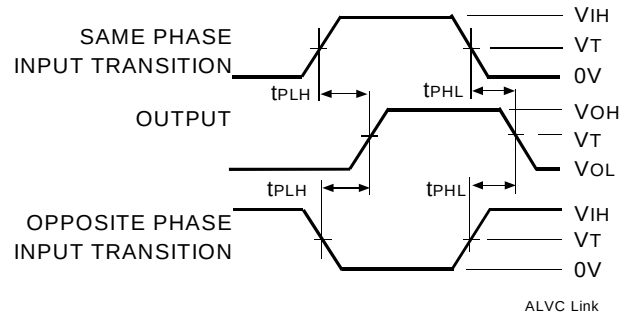


$$t_{SK}(x) = |t_{PLH2} - t_{PLH1}| \text{ or } |t_{PHL2} - t_{PHL1}|$$

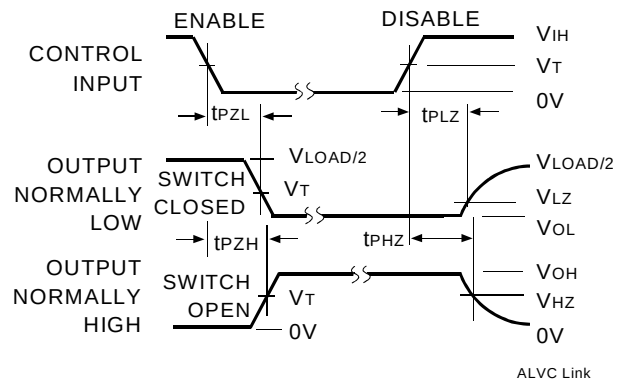
Output Skew - t<sub>SK</sub>(x)

#### NOTES:

1. For t<sub>SK</sub>(a) OUTPUT1 and OUTPUT2 are any two outputs.
2. For t<sub>SK</sub>(b) OUTPUT1 and OUTPUT2 are in the same bank.



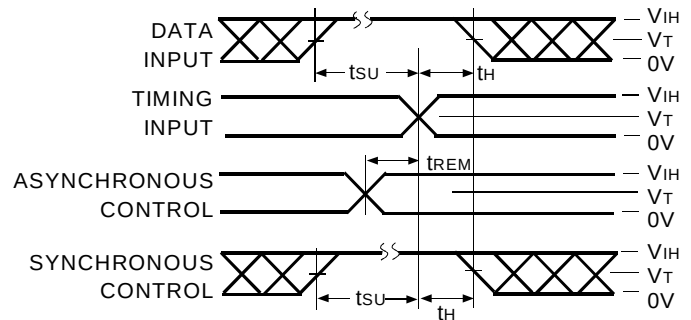
Propagation Delay



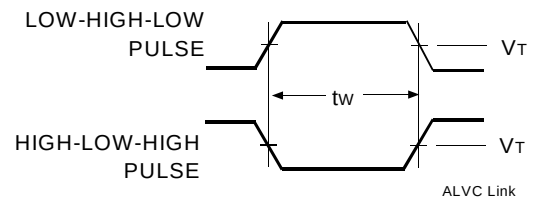
Enable and Disable Times

#### NOTE:

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



Set-up, Hold, and Release Times



Pulse Width

## ORDERING INFORMATION

| IDT         | XX | ALVC | X        | XX     | XXX         | XX      |                                                  |
|-------------|----|------|----------|--------|-------------|---------|--------------------------------------------------|
| Temp. Range |    |      | Bus-Hold | Family | Device Type | Package |                                                  |
|             |    |      |          |        |             | PV      | Shrink Small Outline Package                     |
|             |    |      |          |        |             | PA      | Thin Shrink Small Outline Package                |
|             |    |      |          |        |             | PF      | Thin Very Small Outline Package                  |
|             |    |      |          |        |             | 245     | 16-Bit Bus Transceiver with 3-State Outputs      |
|             |    |      |          |        |             | R162    | Double-Density with Resistors, $\pm 12\text{mA}$ |
|             |    |      |          |        |             | H       | Bus-hold                                         |
|             |    |      |          |        |             | 74      | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$   |



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