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

IDT74ALVCH16652

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)**
- **Vcc = 3.3V ± 0.3V, Normal Range**
- **Vcc = 2.7V to 3.6V, Extended Range**
- **Vcc = 2.5V ± 0.2V**
- **CMOS power levels (0.4µ W typ. static)**
- **Rail-to-Rail output swing for increased noise margin**
- **Available in TSSOP package**

DRIVE FEATURES:

- **High Output Drivers: ±24mA**
- **Suitable for heavy loads**

APPLICATIONS:

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

DESCRIPTION:

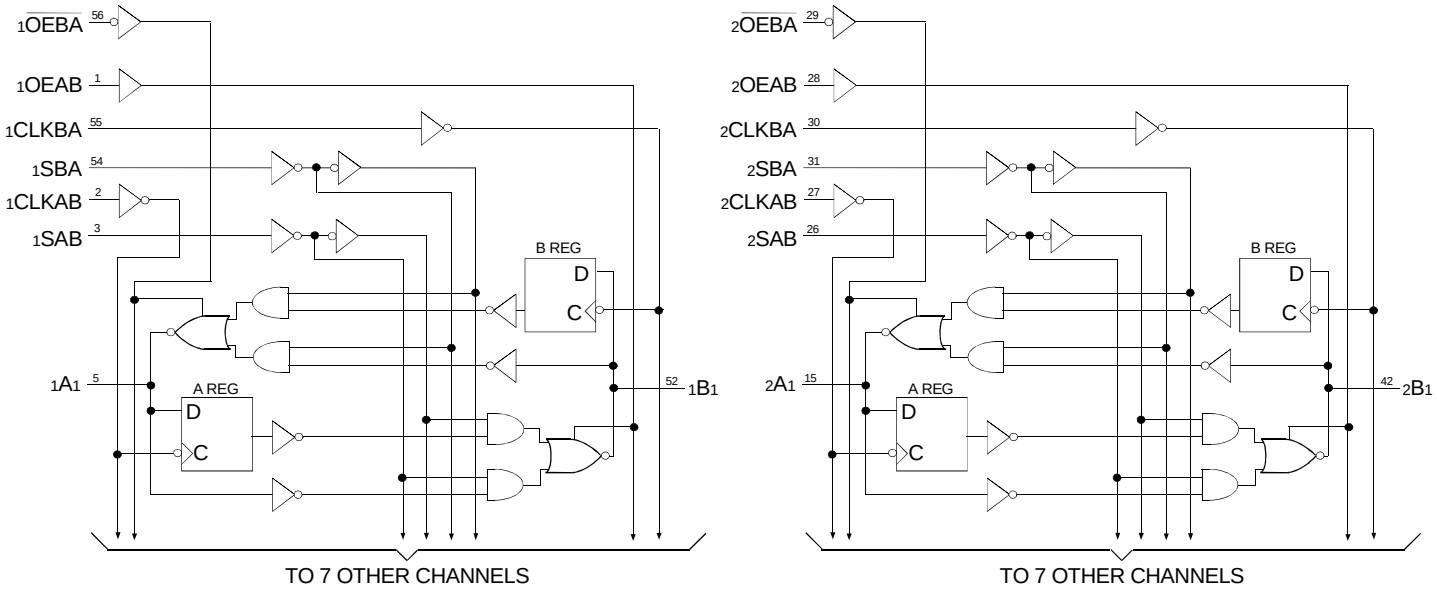
This 16-bit bus transceiver and register is built using advanced dual metal CMOS technology. The ALVCH16652 consists of D-type flip-flops and control circuitry arranged for multiplexed transmission of data directly from the data bus or from the internal storage registers. The device can be used as two 8-bit transceivers or one 16-bit transceiver.

Complementary output enable (OEAB and $\overline{OEBA}$) inputs are provided to control the transceiver functions. Select control (SAB and SBA) inputs are provided to select whether real-time or stored data is transferred. A low input level selects real-time data, and a high input level selects stored data. Circuitry used for select control eliminates the typical decoding glitch that occurs in a multiplexer during the transition between stored and real-time data. Data on the A or B bus, or both, can be stored in the internal D flip-flops by low-to-high transition at the appropriate clock (CLKAB or CLKBA) inputs regardless of the levels on the select control or output enable inputs. When SAB and SBA are in the real-time transfer mode, it also is possible to store data without using the internal D-type flip-flops by simultaneously enabling OEAB and $\overline{OEBA}$. In this configuration, each output reinforces its input. Thus, when all other data sources to the two sets of bus lines are in the high-impedance state, each set of bus lines remains at its last level configuration.

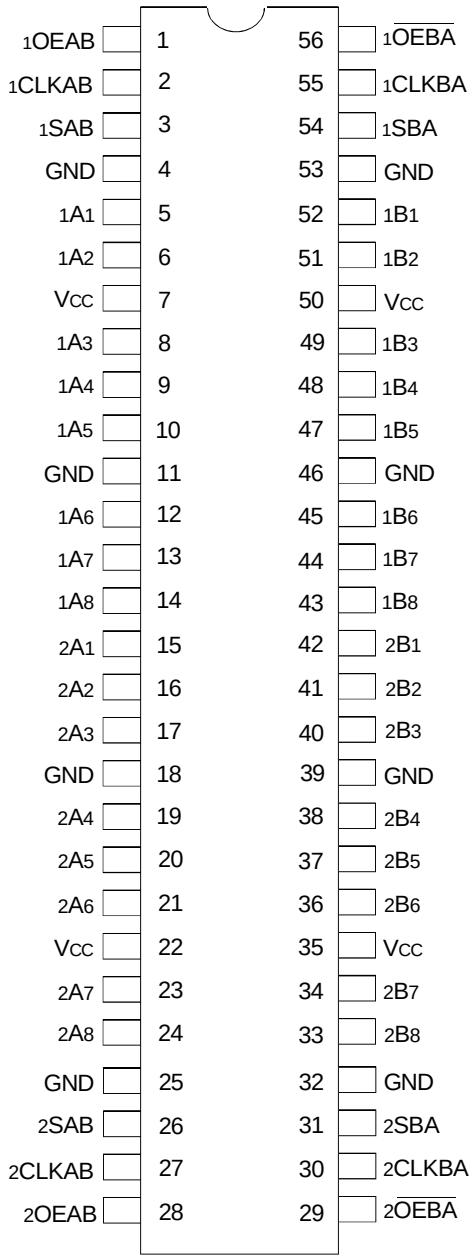
The ALVCH16652 has been designed with a ±24mA output driver. This driver is capable of driving a moderate to heavy load while maintaining speed performance.

The ALVCH16652 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



PIN CONFIGURATION



TSSOP
TOP VIEW

ABSOLUTE MAXIMUM RATINGS(1)

Symbol	Description	Max	Unit
V_{TERM}(2)	Terminal Voltage with Respect to GND	–0.5 to +4.6	V
V_{TERM}(3)	Terminal Voltage with Respect to GND	–0.5 to V_{CC}+0.5	V
T_{STG}	Storage Temperature	–65 to +150	°C
I_{OUT}	DC Output Current	–50 to +50	mA
I_{IK}	Continuous Clamp Current, V_I < 0 or V_I > V_{CC}	±50	mA
I_{OK}	Continuous Clamp Current, V_O < 0	–50	mA
I_{CC} I_{SS}	Continuous Current through each V_{CC} or GND	±100	mA

NOTES:
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.
2. V_{CC} terminals.
3. All terminals except V_{CC}.

CAPACITANCE (T_A = +25°C, F = 1.0MHz)

Symbol	Parameter(1)	Conditions	Typ.	Max.	Unit
C_{IN}	Input Capacitance	V_{IN} = 0V	5	7	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0V	7	9	pF
$C_{I/O}$	I/O Port Capacitance	V_{IN} = 0V	7	9	pF

NOTE:
1. As applicable to the device type.

PIN DESCRIPTION

Pin Names	Description
xAx	Data Register A Inputs(1) Data Register B Outputs
xBx	Data Register B Inputs(1) Data Register A Outputs
xCLKAB, xCLKBA	Clock Pulse Inputs
xSAB, xSBA	Output Data Source Select Inputs
xOEAB, x$\overline{OEBA}$	Output Enable Inputs

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

FUNCTION TABLE(1)

Inputs						Data I/O(2)		Operation or Function
xOEAB	$\overline{xOEBA}$	xCLKAB	xCLKBA	xSAB	xSBA	xAx	xBx	
L	H	H or L	H or L	X	X	Input	Input	Isolation
L	H	↑	↑	X	X	Input	Input	Store A and B Data
X	H	↑	H or L	X	X	Input	Unspecified(3)	Store A, hold B
H	H	↑	↑	X(3)	X	Input	Output	Store A in both registers
L	X	H or L	↑	X	X	Unspecified(3)	Input	Hold A, store B
L	L	↑	↑	X	X(3)	Output	Input	Store B in both registers
L	L	X	X	X	L	Output	Input	Real time B data to A bus
L	L	X	H or L	X	H	Output	Input	Stored B data to A bus
H	H	X	X	L	X	Input	Output	Real time A data to B bus
H	H	H or L	X	H	X	Input	Output	Stored A data to B bus
H	L	H or L	H or L	H	H	Input	Output	Stored A data to B Bus and Stored B data to A bus

NOTES:
1. H = HIGH Voltage Level
   L = LOW Voltage Level
   X = Don't Care
   ↑ = LOW-to-HIGH Transition
2. The data output functions may be enabled or disabled by various signals at the xOEAB or $\overline{xOEBA}$ 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.
3. Select control = L: clocks can occur simultaneously.
   Select control = H: clocks must be staggered to load both registers.

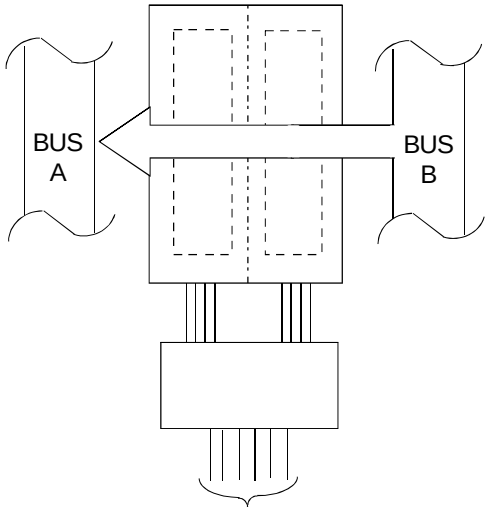
DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:
Operating Condition: T_A = –40°C to +85°C

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

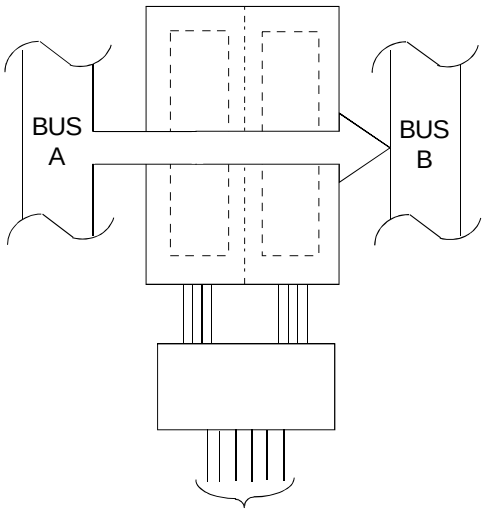
NOTE:
1. Typical values are at V_{CC} = 3.3V, +25°C ambient.

BUS MANAGEMENT FUNCTIONS



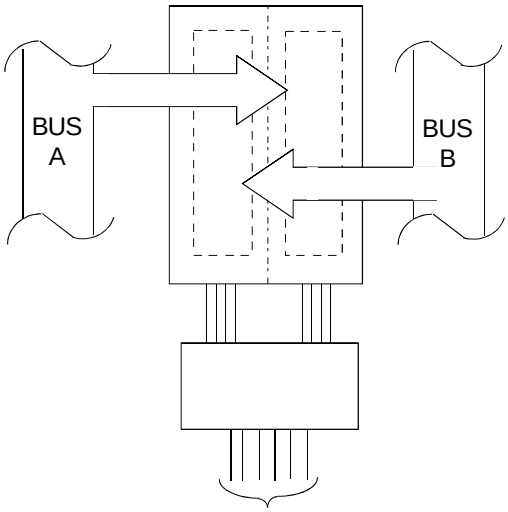
xOEAB	xOEBA	xCLKAB	xCLKBA	xSAB	xSBA
L	L	X	X	X	L

Real-Time Transfer Bus B to Bus A



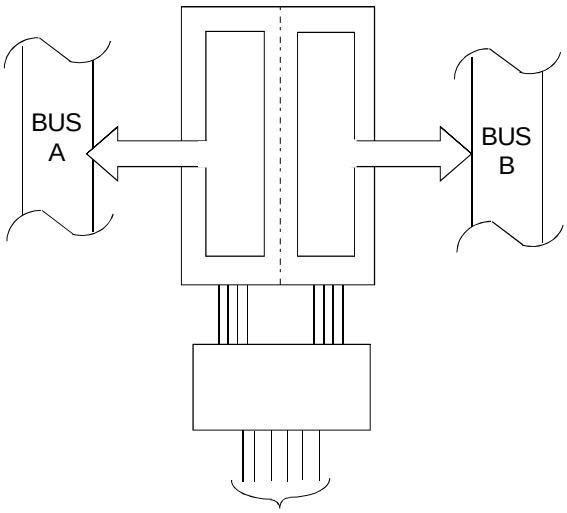
xOEAB	xOEBA	xCLKAB	xCLKBA	xSAB	xSBA
H	H	X	X	L	X

Real-Time Transfer Bus A to Bus B



xOEAB	xOEBA	xCLKAB	xCLKBA	xSAB	xSBA
X	H	↑	X	X	X
L	X	X	↑	X	X
L	H	↑	↑	X	X

Storage from A and/or B



xOEAB	xOEBA	xCLKAB	xCLKBA	xSAB	xSBA
H	L	H or L	H or L	H	X

Transfer Stored Data to A and/or B

BUS-HOLD CHARACTERISTICS

Symbol	Parameter[1]	Test Conditions		Min.	Typ.[2]	Max.	Unit
I_{BHH}	Bus-Hold Input Sustain Current	V_{CC} = 3V	V_I = 2V	–75	—	—	µA
I_{BHL}			V_I = 0.8V	75	—	—	
I_{BHH}	Bus-Hold Input Sustain Current	V_{CC} = 2.3V	V_I = 1.7V	–45	—	—	µA
I_{BHL}			V_I = 0.7V	45	—	—	
I_{BHHO}	Bus-Hold Input Overdrive Current	V_{CC} = 3.6V	V_I = 0 to 3.6V	—	—	±500	µA
I_{BHLO}							

NOTES:
1. Pins with Bus-Hold are identified in the pin description.
2. Typical values are at V_{CC} = 3.3V, +25°C ambient.

OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions[1]		Min.	Max.	Unit
V_{OH}	Output HIGH Voltage	V_{CC} = 2.3V to 3.6V	I_{OH} = – 0.1mA	V_{CC} – 0.2	—	V
		V_{CC} = 2.3V	I_{OH} = – 6mA	2	—	
		V_{CC} = 2.3V	I_{OH} = – 12mA	1.7	—	
		V_{CC} = 2.7V		2.2	—	
		V_{CC} = 3V		2.4	—	
		V_{CC} = 3V	I_{OH} = – 24mA	2	—	
V_{OL}	Output LOW Voltage	V_{CC} = 2.3V to 3.6V	I_{OL} = 0.1mA	—	0.2	V
		V_{CC} = 2.3V	I_{OL} = 6mA	—	0.4	
			I_{OL} = 12mA	—	0.7	
		V_{CC} = 2.7V	I_{OL} = 12mA	—	0.4	
		V_{CC} = 3V	I_{OL} = 24mA	—	0.55	

NOTE:
1. V_{IH} and V_{IL} must be within the min. or max. range shown in the DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE table for the appropriate V_{CC} range. T_A = – 40°C to + 85°C.

OPERATING CHARACTERISTICS, T_A = 25°C

Symbol	Parameter	Test Conditions	V_{CC} = 2.5V ± 0.2V Typical	V_{CC} = 3.3V ± 0.3V Typical	Unit
C_{PD}	Power Dissipation Capacitance Outputs enabled	C_L = 0pF, f = 10Mhz			pF
C_{PD}	Power Dissipation Capacitance Outputs disabled				

SWITCHING CHARACTERISTICS(1)

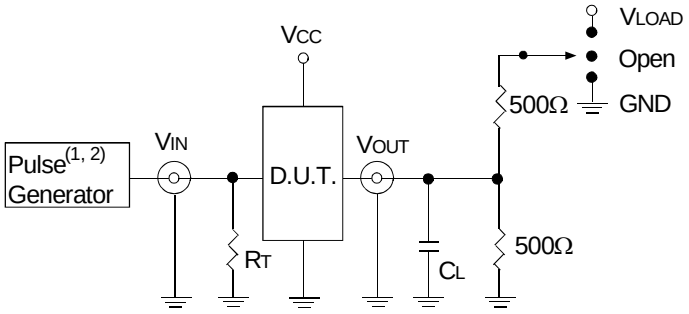
Symbol	Parameter	Vcc = 2.5V ± 0.2V		Vcc = 2.7V		Vcc = 3.3V ± 0.3V		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
t_{PLH} t_{PHL}	Propagation Delay xAx to xBx or xBx to xAx	—	—	—	5.7	1.4	5.2	ns
t_{PLH} t_{PHL}	Propagation Delay xCLKAB to xBx or xCLKBA to xAx	—	—	—	7.3	2.4	6.6	ns
t_{PLH} t_{PHL}	Propagation Delay xSBA or xAx or xSAB to xBx	—	—	—	7.4	1.9	6.7	ns
t_{PZH} t_{PZL}	Output Enable Time x$\overline{OEBA}$ to xAx	—	—	—	5	1.6	4.5	ns
t_{PZH} t_{PZL}	Output Enable Time xOEAB to xBx	—	—	—	5	1.6	4.5	ns
t_{PHZ} t_{PLZ}	Output Disable Time x$\overline{OEBA}$ to xAx	—	—	—	5.3	1.2	4.8	ns
t_{PHZ} t_{PLZ}	Output Disable Time xOEAB to xBx	—	—	—	5.3	1.2	4.8	ns
t_{SU}	Set-up Time, xAx before xCLKAB↑ or xBx before xCLKBA↑	—	—	1.3	—	0.9	—	ns
t_H	Hold Time, xAx after xCLKAB↑ or xBx after xCLKBA↑	—	—	1.3	—	0.9	—	ns
t_W	Pulse Duration, CLKAB or CLKBA HIGH or LOW	—	—	3.3	—	2.5	—	ns
$t_{SK}(o)$	Output Skew(2)	—	—	—	—	—	500	ps

NOTES:
1. See TEST CIRCUITS AND WAVEFORMS. T_A = – 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±0.3V	$V_{CC}^{(1)}$=2.7V	$V_{CC}^{(2)}$=2.5V±0.2V	Unit
V_{LOAD}	6	6	2 x Vcc	V
V_{IH}	2.7	2.7	Vcc	V
V_T	1.5	1.5	Vcc / 2	V
V_{LZ}	300	300	150	mV
V_{HZ}	300	300	150	mV
C_L	50	50	30	pF



Test Circuit for All Outputs

DEFINITIONS:

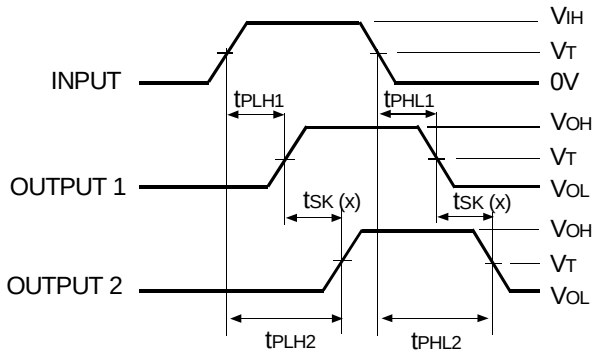
C_L = Load capacitance: includes jig and probe capacitance.
R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

NOTES:

1. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t_F ≤ 2.5ns; t_R ≤ 2.5ns.
2. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t_F ≤ 2ns; t_R ≤ 2ns.

SWITCH POSITION

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

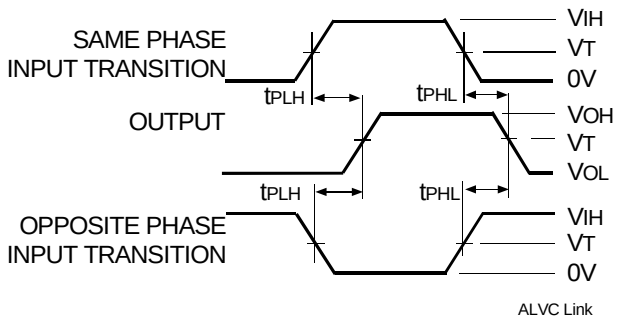


$t_{SK(x)} = |t_{PLH2} - t_{PLH1}|$ or $|t_{PHL2} - t_{PHL1}|$

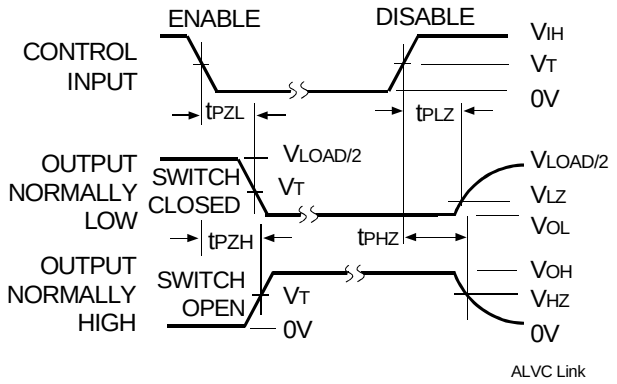
Output Skew - $t_{SK(x)}$

NOTES:

1. For t_{SK}(o) OUTPUT1 and OUTPUT2 are any two outputs.
2. For t_{SK}(b) OUTPUT1 and OUTPUT2 are in the same bank.



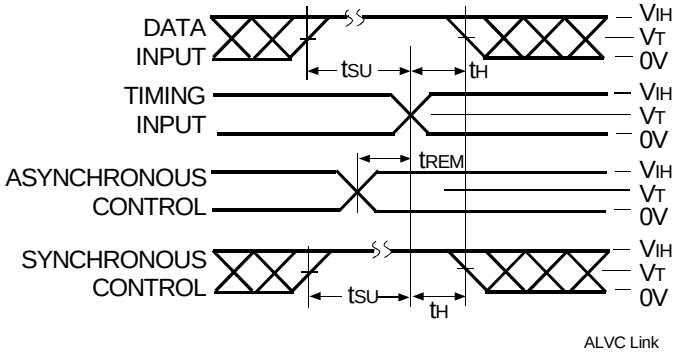
Propagation Delay



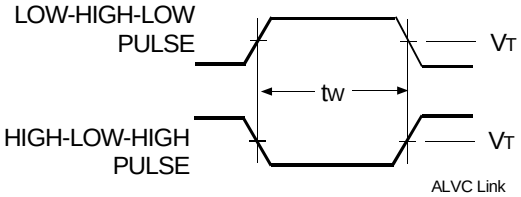
Enable and Disable Times

NOTE:

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

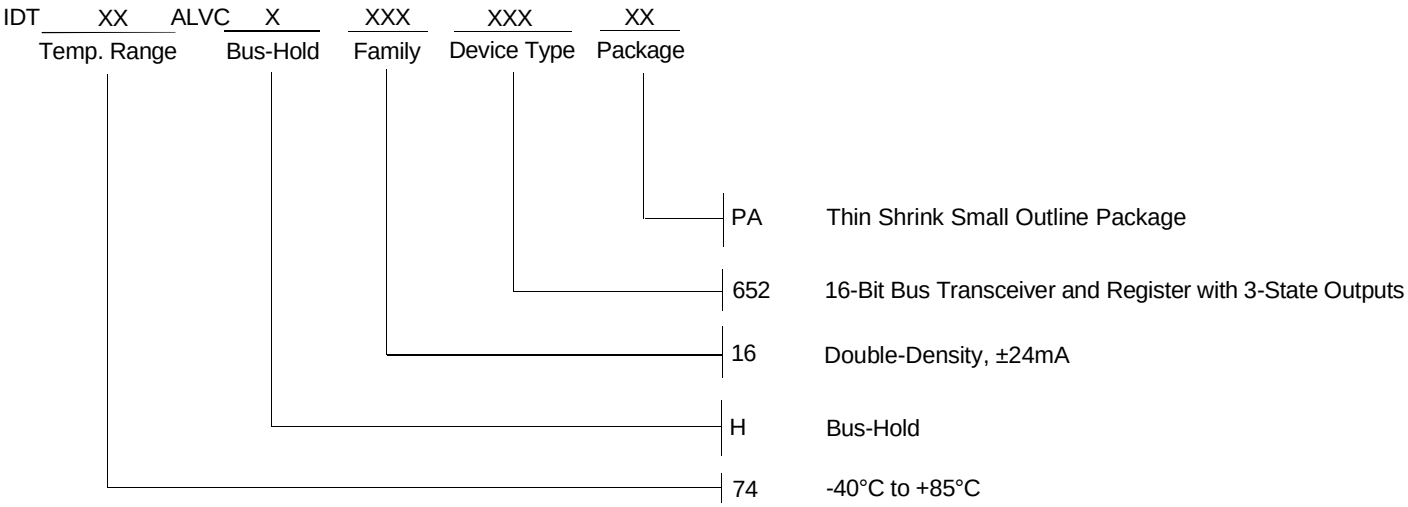


Set-up, Hold, and Release Times



Pulse Width

ORDERING INFORMATION



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