3.3V CMOS 16-BIT REGISTERED TRANSCEIVER WITH 3-STATE OUTPUTS, 5 VOLT TOLERANT I/O

IDT74LVC16952A

FEATURES:

- **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**
- **CMOS power levels (0.4µ W typ. static)**
- **All inputs, outputs, and I/O are 5V tolerant**
- **Supports hot insertion**
- **Available in SSOP, TSSOP, and TVSOP packages**

DRIVE FEATURES:

- **High Output Drivers: ±24mA**
- **Reduced system switching noise**

APPLICATIONS:

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

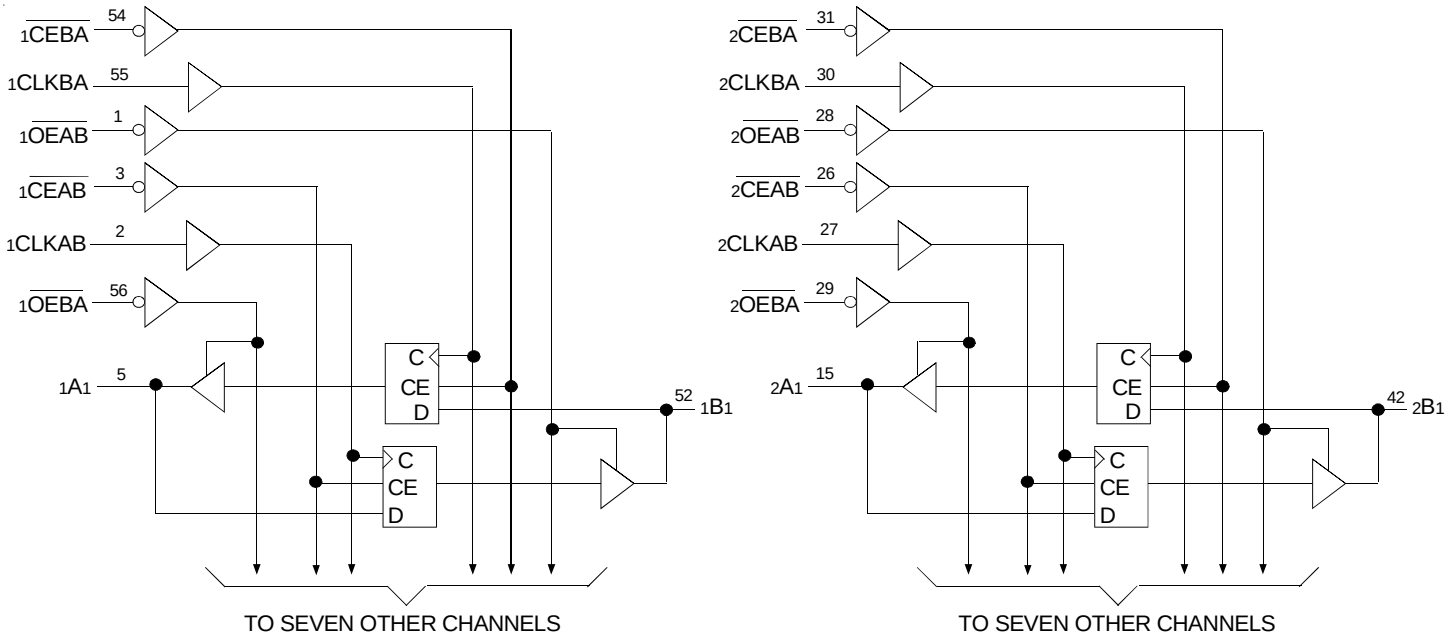
DESCRIPTION:

This 16-bit registered transceiver is built using advanced dual metal CMOS technology. This high-speed, low power device is organized as two independent 8-bit D-type registered transceivers with separate input and output control for independent control of data flow in either direction. For example, the A-to-B Enable ($\overline{CEAB}$) must be LOW to enter data from the A port. CLKAB controls the clocking function. When CLKAB toggles from LOW-to-HIGH, the data present on the A port will be clocked into the register. $\overline{OEAB}$ performs the output enable function on the B port. Data flow from the B port to A port is similar but requires using $\overline{CEBA}$, CLKBA, and $\overline{OEBA}$ inputs. Full 16-bit operation is achieved by tying the control pins of the independent transceivers together.

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 LVC16952A has been designed with a ±24mA output driver. This driver is capable of driving a moderate to heavy load while maintaining speed performance

FUNCTIONAL BLOCK DIAGRAM



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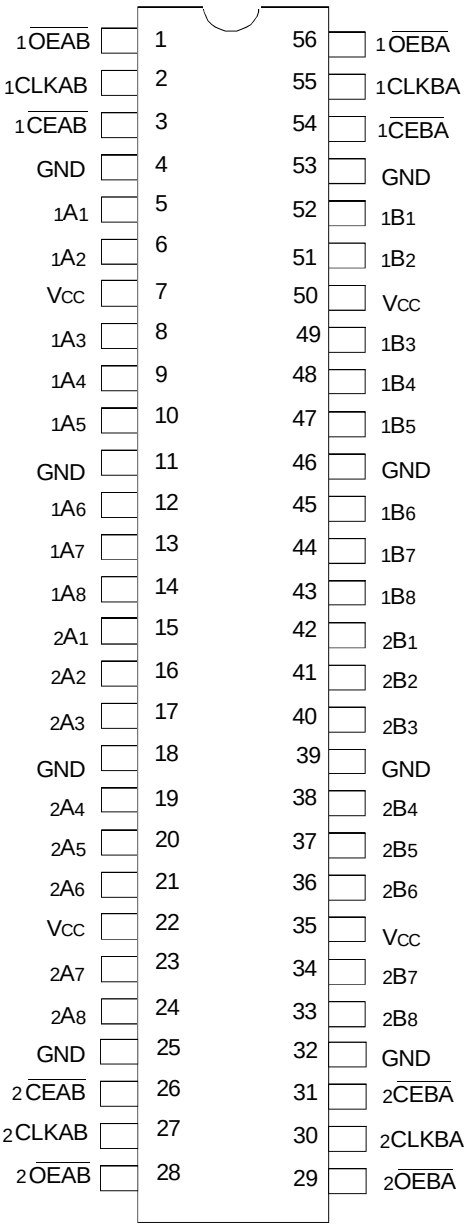
PIN CONFIGURATION



SSOP/ TSSOP/ TVSOP
TOP VIEW

CAPACITANCE (T_A = +25°C, F = 1.0MHz)

Symbol	Parameter[1]	Conditions	Typ.	Max.	Unit
C_{IN}	Input Capacitance	V_{IN} = 0V	4.5	6	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0V	6.5	8	pF
$C_{I/O}$	I/O Port Capacitance	V_{IN} = 0V	6.5	8	pF

NOTE:
1. As applicable to the device type.

ABSOLUTE MAXIMUM RATINGS[1]

Symbol	Description	Max	Unit
V_{TERM}	Terminal Voltage with Respect to GND	–0.5 to +6.5	V
T_{STG}	Storage Temperature	–65 to +150	°C
I_{OUT}	DC Output Current	–50 to +50	mA
I_{IK} I_{OK}	Continuous Clamp Current, V_I < 0 or V_O < 0	–50	mA
I_{CC} I_{SS}	Continuous Current through each V_{CC} or GND	±100	mA

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.

PIN DESCRIPTION

Pin Names	Description
x$\overline{OEAB}$	A-to-B Output Enable Inputs (Active LOW)
x$\overline{OEBA}$	B-to-A Output Enable Inputs (Active LOW)
x$\overline{CEAB}$	A-to-B Clock Enable Inputs (Active LOW)
x$\overline{CEBA}$	B-to-A Clock Enable Inputs (Active LOW)
xCLKAB	A-to-B Clock Inputs
xCLKBA	B-to-A Clock Inputs
xAx	A-to-B Data Inputs or B-to-A 3-State Outputs
xBx	B-to-A Data Inputs or A-to-B 3-State Outputs

FUNCTION TABLE[1,2]

Inputs				Outputs
x$\overline{CEAB}$	xCLKAB	x$\overline{OEAB}$	xAx	xBx
H	X	L	X	B[3]
X	L	L	X	B[3]
L	↑	L	L	L
L	↑	L	H	H
X	X	H	X	Z

NOTES:
1. A-to-B data flow is shown: B-to-A data flow is similar but uses x$\overline{CEBA}$, xCLKBA, and x$\overline{OEBA}$.
2. H = HIGH Voltage Level
   L = LOW Voltage Level
   X = Don't Care
   Z = High Impedance
   ↑ = LOW-to-HIGH Transition
3. Output level of B before the indicated steady-state input conditions were established.

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} I_{IL}	Input Leakage Current	V_{CC} = 3.6V	V_I = 0 to 5.5V	—	—	±5	µA
I_{OZH} I_{OZL}	High Impedance Output Current (3-State Output pins)	V_{CC} = 3.6V	V_O = 0 to 5.5V	—	—	±10	µA
I_{OFF}	Input/Output Power Off Leakage	V_{CC} = 0V, V_{IN} or $V_O \leq$ 5.5V		—	—	±50	µA
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}	Quiescent Power Supply Current	V_{CC} = 3.6V	V_{IN} = GND or V_{CC}	—	—	10	µA
I_{CCZ}			$3.6 \leq V_{IN} \leq 5.5V$(2)	—	—	10	
ΔI_{CC}	Quiescent Power Supply Current Variation	One input at V_{CC} - 0.6V, other inputs at V_{CC} or GND		—	—	500	µA

NOTES:
1. Typical values are at V_{CC} = 3.3V, +25°C ambient.
2. This applies in the disabled state only.

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	2.2	—	
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, V_{CC} = 3.3V ± 0.3V, T_A = 25°C

Symbol	Parameter	Test Conditions	Typical	Unit
C_{PD}	Power Dissipation Capacitance per Latch Outputs enabled	C_L = 0pF, f = 10Mhz	87	pF
C_{PD}	Power Dissipation Capacitance per Latch Outputs disabled		43	

SWITCHING CHARACTERISTICS(1)

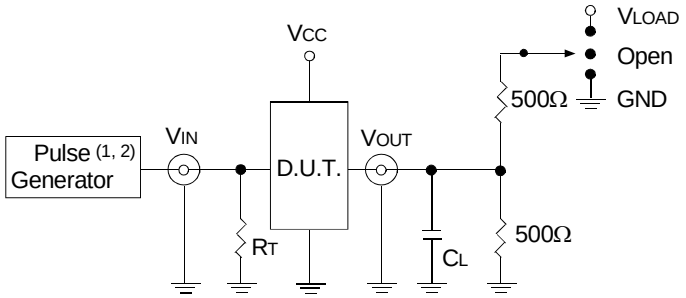
Symbol	Parameter	Vcc = 2.7V		Vcc = 3.3V ± 0.3V		Unit
		Min.	Max.	Min.	Max.	
t_{PLH} t_{PHL}	Propagation Delay xCLKAB, xCLKBA to xBx, xAx	—	7.6	1.6	6.6	ns
t_{PZH} t_{PZL}	Output Enable Time x$\overline{OEBA}$, x$\overline{OEAB}$ to xAx, xBx	—	8	1.1	6.6	ns
t_{PHZ} t_{PLZ}	Output Disable Time x$\overline{OEBA}$, x$\overline{OEAB}$ to xAx, xBx	—	7.1	1.9	6.7	ns
t_{SU}	Set-up Time, HIGH or LOW xAx, xBx before xCLKAB↑, xCLKBA↑	3.4	—	2.8	—	ns
t_H	Hold Time, HIGH or LOW xAx, xBx after xCLKAB↑, xCLKBA↑	0.5	—	0.5	—	ns
t_{SU}	Set-up Time, HIGH or LOW x$\overline{CEAB}$, x$\overline{CEBA}$ before xCLKAB↑, xCLKBA↑	1.8	—	1.4	—	ns
t_H	Hold Time, HIGH or LOW x$\overline{CEAB}$, x$\overline{CEBA}$ after xCLKAB↑, xCLKBA↑	1.1	—	1.9	—	ns
t_W	xLE Pulse Width HIGH or LOW, xCLKAB or xCLKBA	3.3	—	3.3	—	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:

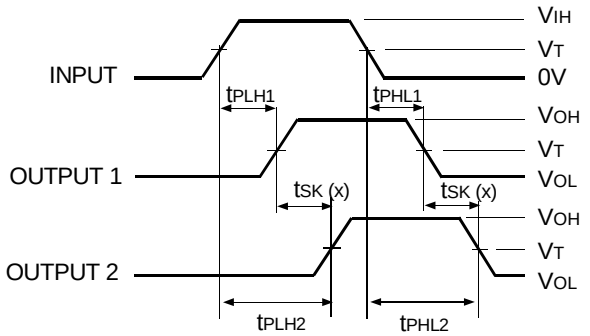
C_L = Load capacitance: includes jig and probe capacitance.
R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.

NOTES:

1. Pulse Generator for All Pulses: Rate ≤ 10MHz; t_F ≤ 2.5ns; t_R ≤ 2.5ns.
2. Pulse Generator for All Pulses: Rate ≤ 10MHz; 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

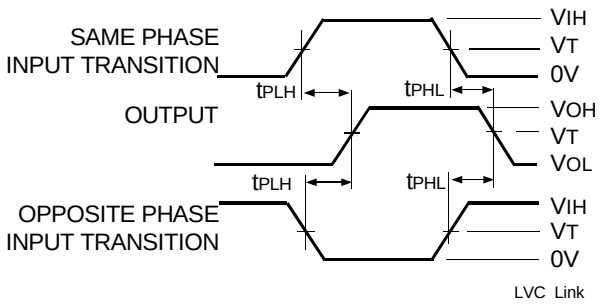


$t_{SK(x)} = |t_{PLH2} - t_{PLH1}|$ or $|t_{PHL2} - t_{PHL1}|$

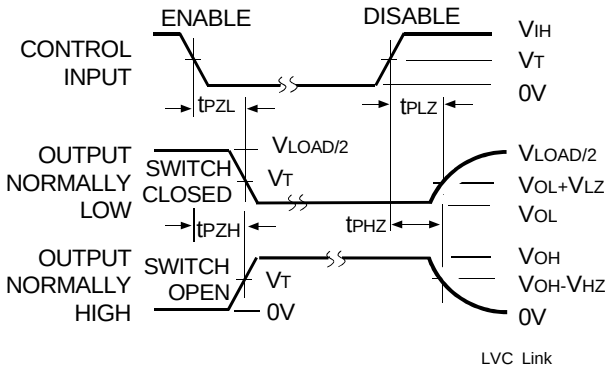
Output Skew - $t_{SK(x)}$

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.



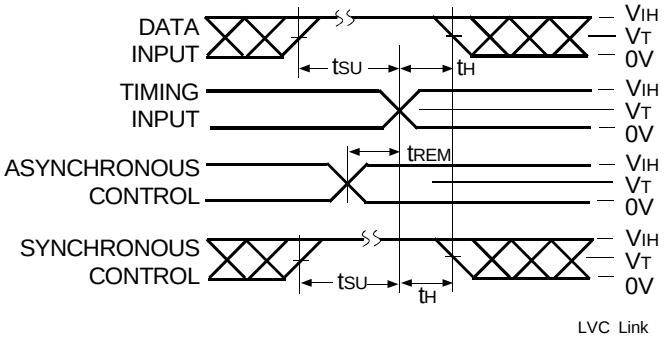
Propagation Delay



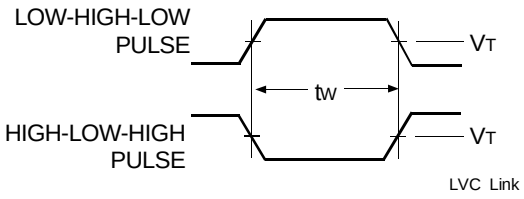
Enable and Disable Times

NOTE:

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

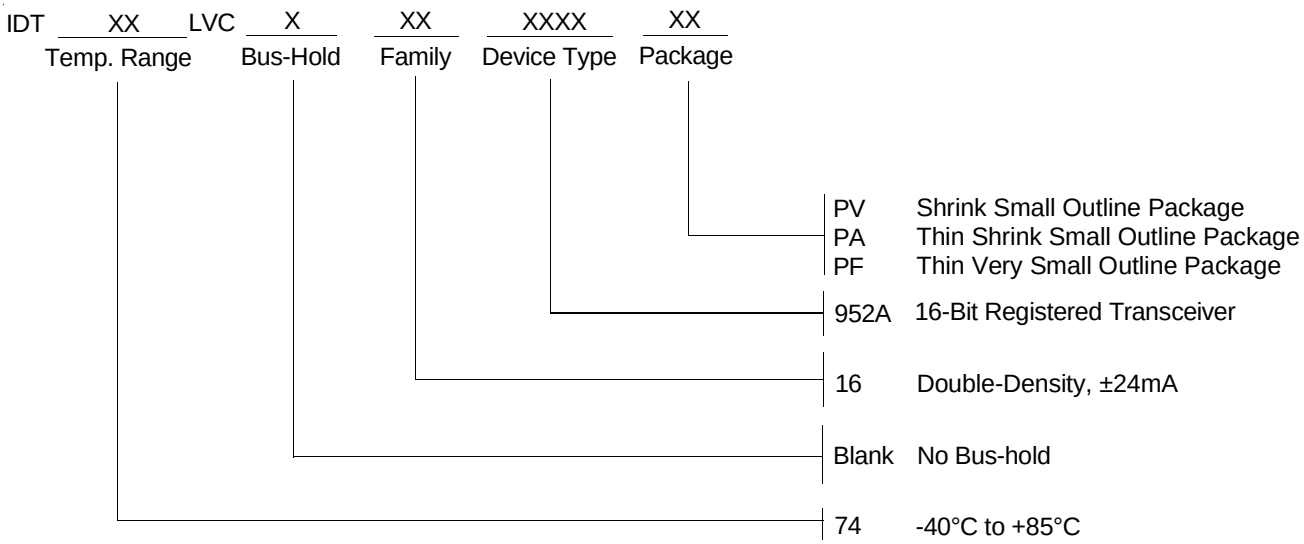


Set-up, Hold, and Release Times



Pulse Width

ORDERING INFORMATION



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