



3.3V CMOS 18-BIT REGISTERED TRANSCEIVER WITH 3-STATE OUTPUTS AND 5 VOLT TOLERANT I/O

IDT74LVC16500A

FEATURES:

- Typical $t_{SK(0)}$ (Output Skew) < 250ps
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- 0.635mm pitch SSOP, 0.50mm pitch TSSOP and 0.40mm pitch TVSOP packages
- Extended commercial range of -40°C to +85°C
- $V_{CC} = 3.3V \pm 0.3V$, Normal Range
- $V_{CC} = 2.7V$ to 3.6V, Extended Range
- CMOS power levels (0.4μW typ. static)
- All inputs, outputs and I/O are 5 Volt tolerant
- Supports hot insertion

Drive Features for LVC16500A:

- High Output Drivers: $\pm 24mA$
- Reduced system switching noise

APPLICATIONS:

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

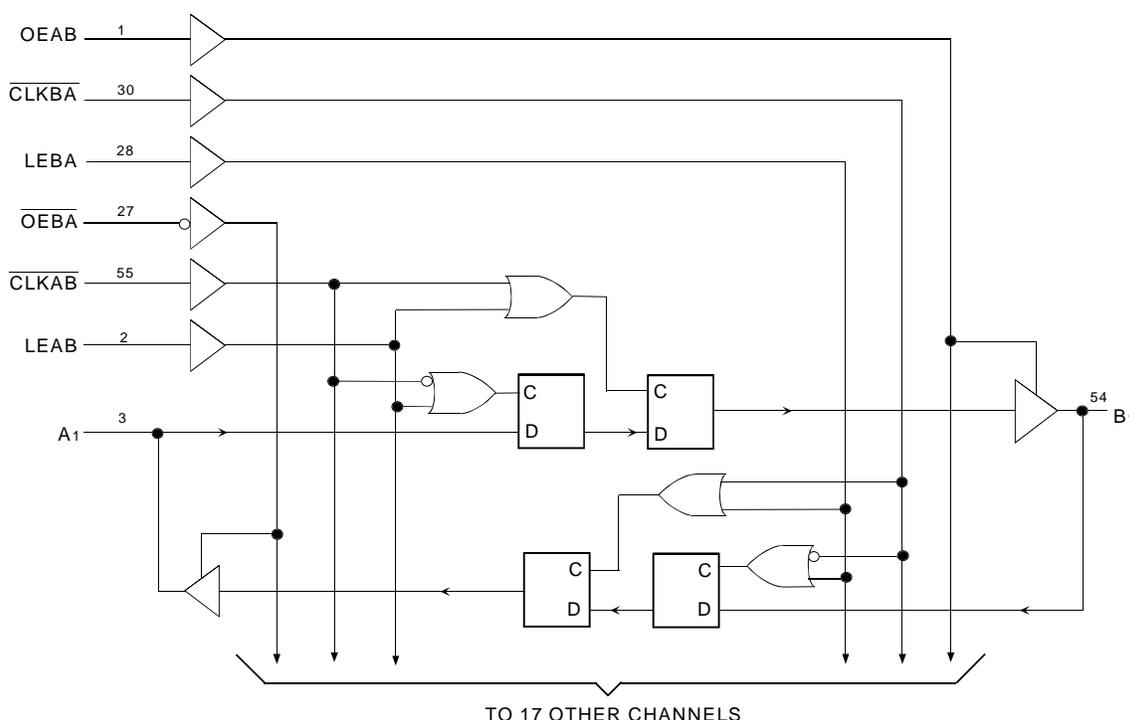
DESCRIPTION:

This 18-bit registered transceiver is built using advanced dual metal CMOS technology. This high-speed, low power 18-bit registered bus transceiver combines D-type latches and D-type flip-flops to allow data flow in transparent, latched, and clocked modes. Data flow in each direction is controlled by output-enable (OEAB and \overline{OEBA}), latch enable (LEAB and LEBA), and clock (\overline{CLKAB} and \overline{CLKBA}) inputs. For A-to-B data flow, the device operates in transparent mode when LEAB is high. When LEAB is low, the A data is latched if \overline{CLKAB} is held at a high or low logic level. If LEAB is low, the A bus data is stored in the latch/flip-flop on the low-to-high transition of \overline{CLKAB} . OEAB performs the output enable function on the B port. Data flow from B port to A port is similar but uses \overline{OEBA} , LEBA and \overline{CLKBA} . Flow-through organization of signal pins simplifies layout. All inputs are designed with hysteresis for improved noise margin.

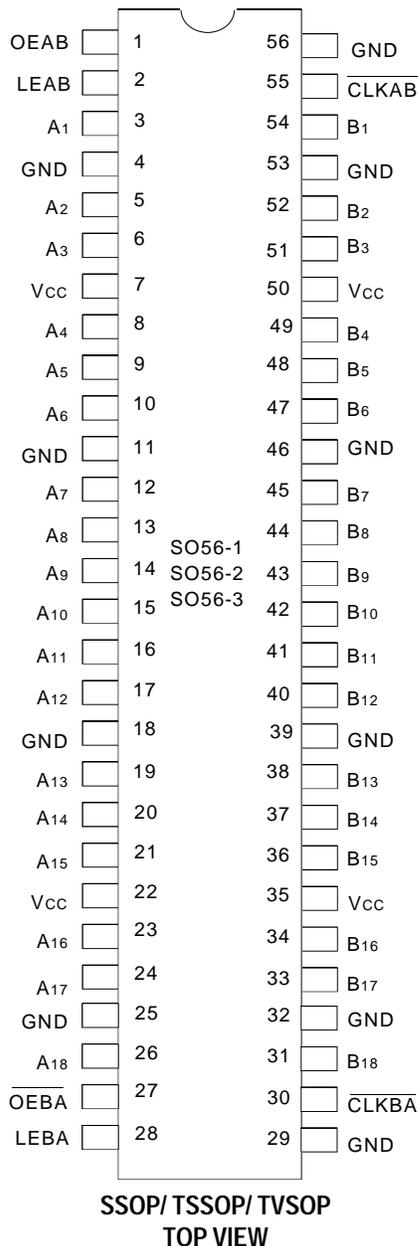
All pins of this 18-bit registered transceiver can be driven from either 3.3V or 5V devices. This feature allows the use of this device as a translator in a mixed 3.3V/5V supply system.

The LVC16500A has been designed with a $\pm 24mA$ output driver. This driver is capable of driving a moderate to heavy load while maintaining speed performance.

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION



PIN DESCRIPTION

Pin Names	Description
OEAB	A-to-B Output Enable Input
$\overline{\text{OEBA}}$	B-to-A Output Enable Input (Active LOW)
LEAB	A-to-B Latch Enable Input
LEBA	B-to-A Latch Enable Input
$\overline{\text{CLKAB}}$	A-to-B Clock Input (Active LOW)
$\overline{\text{CLKBA}}$	B-to-A Clock Input (Active LOW)
Ax	A-to-B Data Inputs or B-to-A 3-State Outputs
Bx	B-to-A Data Inputs or A-to-B 3-State Outputs

ABSOLUTE MAXIMUM RATINGS (1)

Symbol	Description	Max.	Unit
VTERM	Terminal Voltage with Respect to GND	- 0.5 to +6.5	V
TSTG	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

LVC Link

NOTE:

- 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 (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

LVC Link

NOTE:

- As applicable to the device type.

FUNCTION TABLE (1, 2)

Inputs				Outputs
OEAB	LEAB	$\overline{\text{CLKAB}}$	Ax	Bx
L	X	X	X	Z
H	H	X	L	L
H	H	X	H	H
H	L	↓	L	L
H	L	↓	H	H
H	L	H	X	B ⁽³⁾
H	L	L	X	B ⁽⁴⁾

NOTES:

- H = HIGH Voltage Level
L = LOW Voltage Level
X = Don't Care
Z = High-Impedance
↓ = HIGH-to-LOW Transition
- A-to-B data flow is shown. B-to-A data flow is similar but uses $\overline{\text{OEBA}}$, LEBA, and CLKBA.
- Output level before the indicated steady-state input conditions were established.
- Output level before the indicated steady-state input conditions were established, provided that $\overline{\text{CLKAB}}$ was LOW before LEAB went LOW.

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Operating Condition: TA = -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 ≤ 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 _{CC1} I _{CC2} I _{CC3}	Quiescent Power Supply Current	V _{CC} = 3.6V	V _{IN} = GND or V _{CC}	—	—	10	μA
			3.6 ≤ V _{IN} ≤ 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

LVC Link

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} = 3.0V		2.4	—	
		V _{CC} = 3.0V	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} = 3.0V	I _{OL} = 24mA	—	0.55	

LVC Link

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. TA = -40°C to +85°C.

OPERATING CHARACTERISTICS, $V_{CC} = 3.3V \pm 0.3V$, $T_A = 25^\circ C$

Symbol	Parameter	Test Conditions	Typical	Unit
CPD	Power Dissipation Capacitance per transceiver Outputs enabled	$C_L = 0pF$, $f = 10MHz$		pF
CPD	Power Dissipation Capacitance per transceiver Outputs disabled			pF

SWITCHING CHARACTERISTICS (1)

Symbol	Parameter	$V_{CC} = 2.7V$		$V_{CC} = 3.3V \pm 0.3V$		Unit	
		Min.	Max.	Min.	Max.		
tPLH tPHL	Propagation Delay Ax to Bx or Bx to Ax	1.5	7	1.5	6	ns	
tPLH tPHL	Propagation Delay LEBA to Ax, LEAB to Bx	1.5	8	1.5	7	ns	
tPLH tPHL	Propagation Delay \overline{CLKBA} to Ax, \overline{CLKAB} to Bx	1.5	8	1.5	6.7	ns	
tPZH tPZL	Output Enable Time \overline{OEBA} to Ax, OEAB to Bx	1.5	8.2	1.5	7.2	ns	
tPHZ tPLZ	Output Disable Time \overline{OEBA} to Ax, OEAB to Bx	1.5	8	1.5	7	ns	
tSU	Set-up Time, HIGH or LOW Ax to \overline{CLKAB} , Bx to \overline{CLKBA}	3	—	3	—	ns	
tH	Hold Time, HIGH or LOW Ax to \overline{CLKAB} , Bx to \overline{CLKBA}	0	—	0	—	ns	
tSU	Set-up Time HIGH or LOW Ax to LEAB, Bx to LEBA	Clock LOW	2.5	—	2.5	—	ns
		Clock HIGH	2.5	—	2.5	—	ns
tH	Hold Time HIGH or LOW Ax to LEAB, Bx to LEBA	1.5	—	1.5	—	ns	
tw	LEAB or LEBA Pulse Width HIGH	3	—	3	—	ns	
tw	\overline{CLKAB} or \overline{CLKBA} Pulse Width HIGH or LOW	3	—	3	—	ns	
tSk(o)	Output Skew (2)	—	—	—	500	ps	

NOTES:

1. See test circuits and waveforms. $T_A = -40^\circ C$ to $+85^\circ C$.
2. Skew between any two outputs of the same package and switching in the same direction.

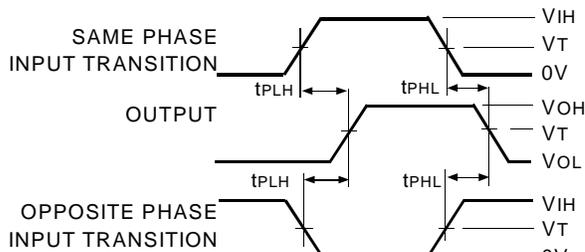
TEST CIRCUITS AND WAVEFORMS:

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 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

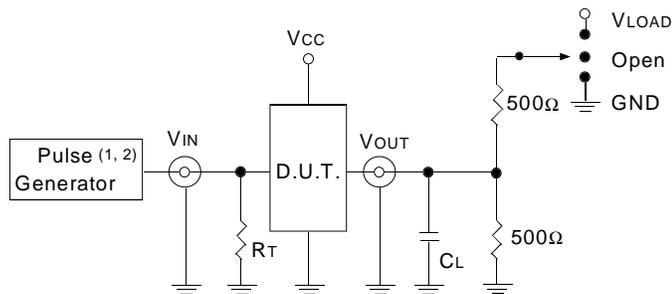
LVC Link

PROPAGATION DELAY



LVC Link

TEST CIRCUITS FOR ALL OUTPUTS



LVC Link

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:

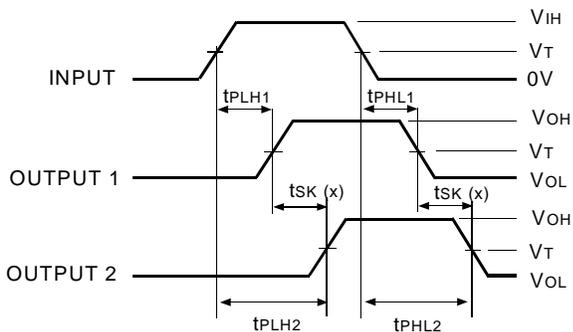
1. Pulse Generator for All Pulses: Rate ≤ 10MHz; t_F ≤ 2.5ns; t_R ≤ 2.5ns.
2. Pulse Generator for All Pulses: Rate ≤ 10MHz; t_F ≤ 2ns; t_R ≤ 2ns.

SWITCH POSITION

Test	Switch
Open Drain Disable Low Enable Low	V _{LOAD}
Disable High Enable High	GND
All Other tests	Open

LVC Link

OUTPUT SKEW - t_{SK}(x)



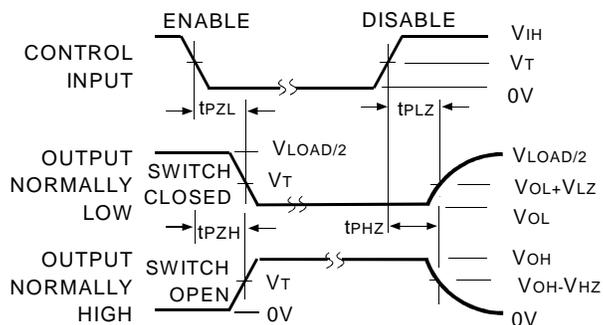
$$t_{SK}(x) = |t_{PLH2} - t_{PLH1}| \text{ or } |t_{PHL2} - t_{PHL1}|$$

LVC Link

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.

ENABLE AND DISABLE TIMES

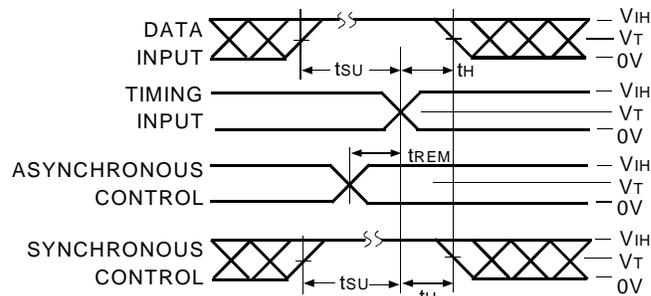


LVC Link

NOTE:

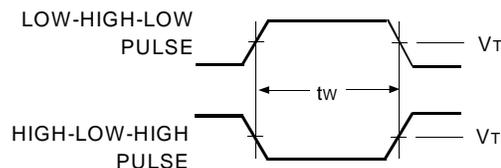
1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.

SET-UP, HOLD, AND RELEASE TIMES



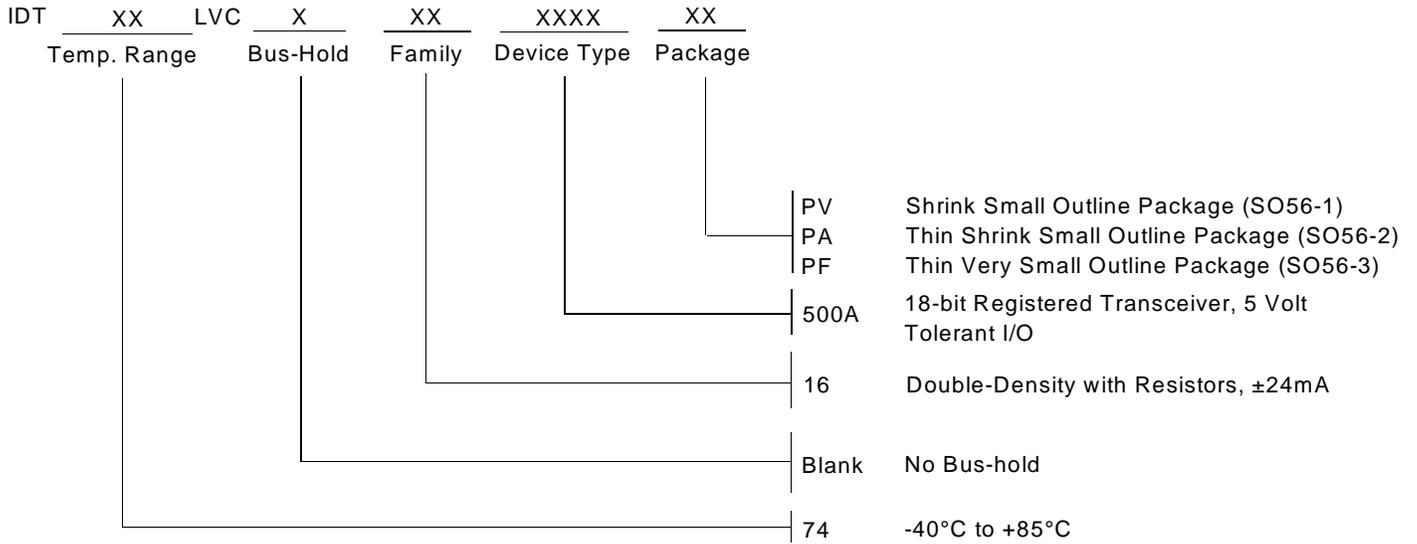
LVC Link

PULSE WIDTH



LVC Link

ORDERING INFORMATION



CORPORATE HEADQUARTERS
 2975 Stender Way
 Santa Clara, CA 95054

for SALES:
 800-345-7015 or 408-727-6116
 fax: 408-492-8674
www.idt.com*

*To search for sales office near you, please click the sales button found on our home page or dial the 800# above and press 2.
 The IDT logo is a registered trademark of Integrated Device Technology, Inc.