RENESAS

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

IDT74LVC162245A

FEATURES:

- 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 ± 0.3V, Normal Range
- V_{CC} = 2.7V to 3.6V, Extended Range
- CMOS power levels (0.4μ W typ. static)
- All inputs, outputs, and I/O are 5V tolerant
- Available in SSOP and TSSOP packages

DRIVE FEATURES:

- Balanced Output Drivers: ±12mA (A port)
- High Output Drivers: ±24mA (B port)

APPLICATIONS:

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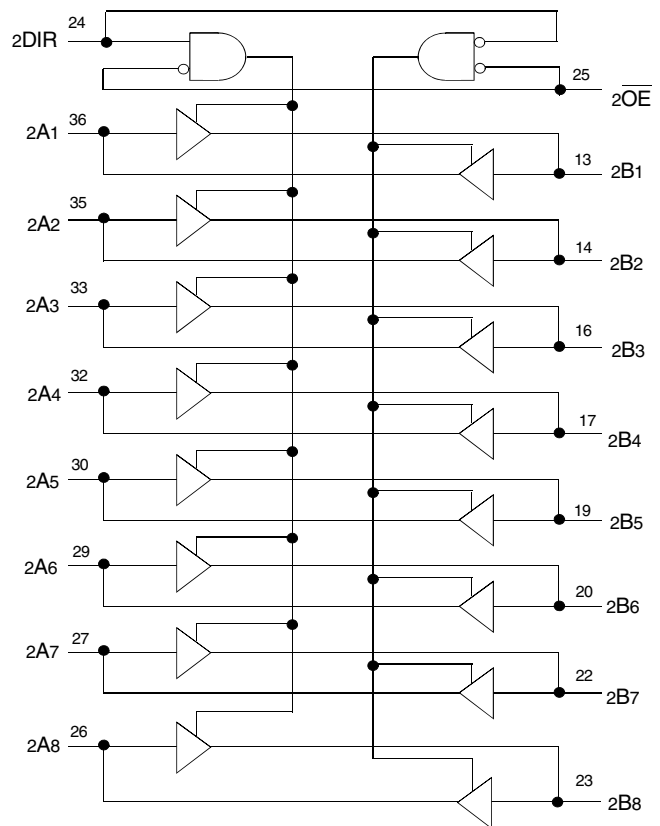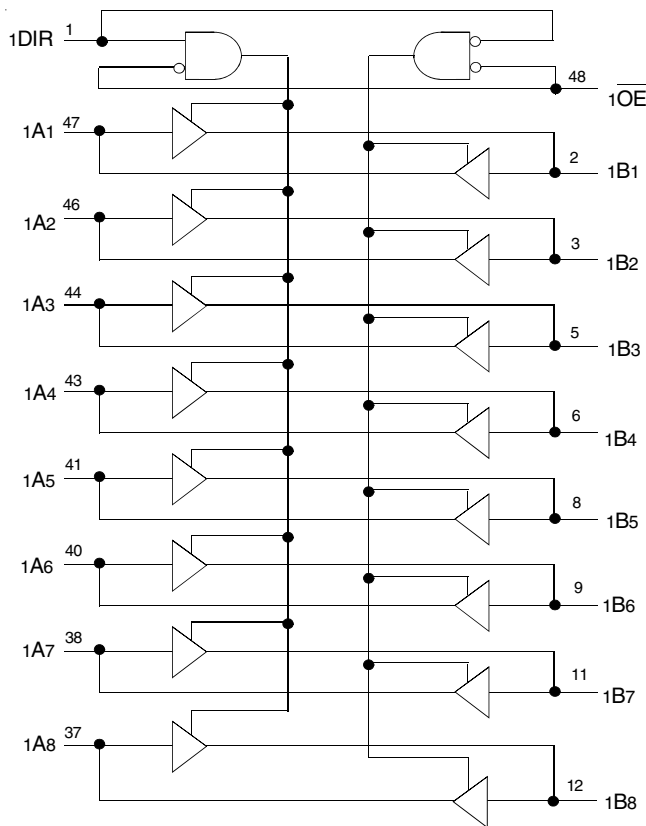- Data communication and telecommunication systems

DESCRIPTION:

This 16-bit transceiver is built using advanced dual metal CMOS technology. The LVC162245A 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. To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.
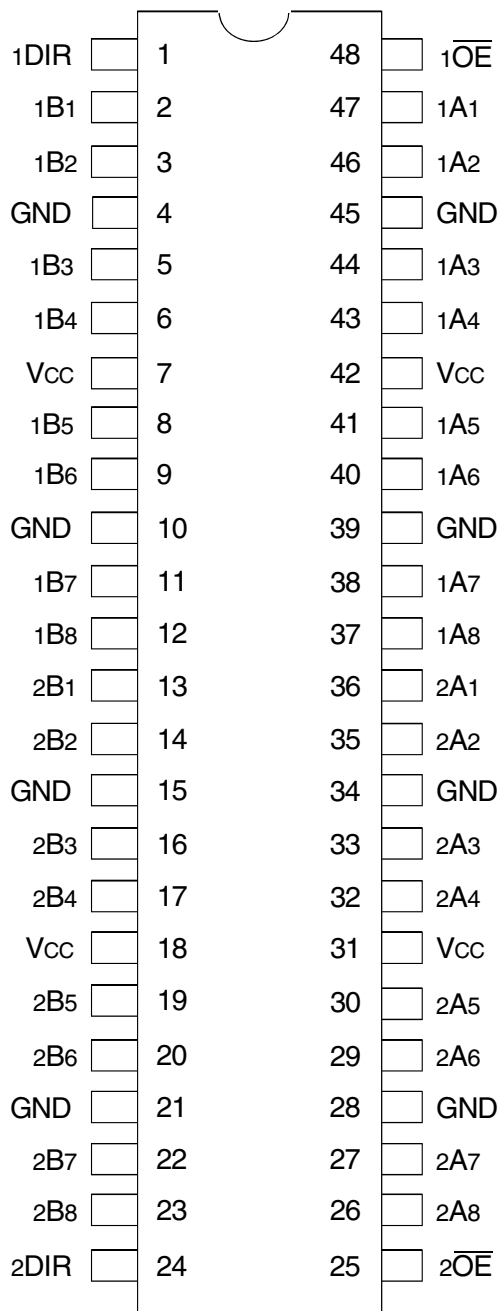
All pins can be driven from either 3.3V or 5V devices. This feature allows the use of this device as a translator in a mixed 3.3V/5V supply system.

The LVC162245A has series resistors in the device output structure of the "A" port which will significantly reduce line noise when used with light loads. The driver has been designed to drive ±12mA at the designated threshold levels. The "B" port has a ±24mA driver.

FUNCTIONAL BLOCK DIAGRAM

INDUSTRIAL TEMPERATURE RANGE

AUGUST 2015

DSC-4483/5

PIN CONFIGURATION

1DIR	1		48	1$\overline{OE}$
1B1	2		47	1A1
1B2	3		46	1A2
GND	4		45	GND
1B3	5		44	1A3
1B4	6		43	1A4
V$_{CC}$	7		42	V$_{CC}$
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
V$_{CC}$	18		31	V$_{CC}$
2B5	19		30	2A5
2B6	20		29	2A6
GND	21		28	GND
2B7	22		27	2A7
2B8	23		26	2A8
2DIR	24		25	2$\overline{OE}$

SSOP / TSSOP
TOP VIEW

ABSOLUTE MAXIMUM RATINGS[1]

Symbol	Description	Max	Unit
V$_{TERM}$[2]	Terminal Voltage with Respect to GND	–0.5 to +6.5	V
V$_{TERM}$[3]	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

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	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.

PIN DESCRIPTION

Pin Names	Description
x$\overline{OE}$	Output Enable Input (Active LOW)
xDIR	Direction Control Output
xAx	Side A Inputs or 3-State Outputs
xBx	Side B Inputs or 3-State Outputs

FUNCTION TABLE (EACH 8-BIT SECTION)[1]

Inputs		Outputs
x$\overline{OE}$	xDIR	Outputs
L	L	B Data to A Bus
L	H	A Data to B Bus
H	X	Isolation

NOTE:
1. H = HIGH Voltage Level
   X = Don't Care
   L = LOW Voltage Level

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 ≤ 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} I_{CCZ}	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

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

OUTPUT DRIVE CHARACTERISTICS (A PORT)

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} = – 4mA	1.9	—	
			I_{OH} = – 6mA	1.7	—	
		V_{CC} = 2.7V	I_{OH} = – 4mA	2.2	—	
			I_{OH} = – 8mA	2	—	
		V_{CC} = 3V	I_{OH} = – 6mA	2.4	—	
			I_{OH} = – 12mA	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} = 4mA	—	0.4	
			I_{OL} = 6mA	—	0.55	
		V_{CC} = 2.7V	I_{OL} = 4mA	—	0.4	
			I_{OL} = 8mA	—	0.6	
		V_{CC} = 3V	I_{OL} = 6mA	—	0.55	
			I_{OL} = 12mA	—	0.8	

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.

OUTPUT DRIVE CHARACTERISTICS (B PORT)

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, V_{CC} = 3.3V ± 0.3V, T_A = 25°C

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

SWITCHING CHARACTERISTICS (A PORT)[1]

Symbol	Parameter	V_{CC} = 2.7V		V_{CC} = 3.3V ± 0.3V		Unit
		Min.	Max.	Min.	Max.	
t_{PLH} t_{PHL}	Propagation Delay xBx to xAx	1.5	5.7	1.5	4.8	ns
t_{PZH} t_{PZL}	Output Enable Time x$\overline{OE}$ to xAx	1.5	7.9	1.5	6.3	ns
t_{PHZ} t_{PLZ}	Output Disable Time x$\overline{OE}$ to xAx	1.5	8.3	2.2	7.4	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.

SWITCHING CHARACTERISTICS (B PORT)[1]

Symbol	Parameter	V_{CC} = 2.7V		V_{CC} = 3.3V ± 0.3V		Unit
		Min.	Max.	Min.	Max.	
t_{PLH} t_{PHL}	Propagation Delay xAx to xBx	1.5	4.7	1	4	ns
t_{PZH} t_{PZL}	Output Enable Time x$\overline{OE}$ to xBx	1.5	6.7	1.5	5.5	ns
t_{PHZ} t_{PLZ}	Output Disable Time x$\overline{OE}$ to xBx	1.5	7.1	1.5	6.6	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
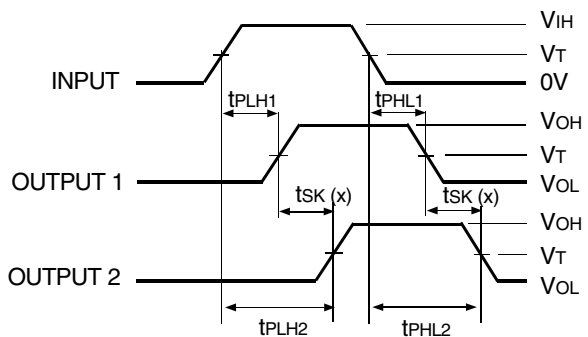
$t_{SK}(x) = |t_{PLH2} - t_{PLH1}|$ or $|t_{PHL2} - t_{PHL1}|$

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

$\underline{\text{XX}}$ LVC $\underline{\text{X}}$ $\underline{\text{XX}}$ $\underline{\text{XXXX}}$ $\underline{\text{XX}}$ $\underline{\text{X}}$
Temp. Range Bus-Hold Family Device Type Package

Blank	Tube or Tray
8	Tape and Reel
PVG	Shrink Small Outline Package - Green
PAG	Thin Shrink Small Outline Package - Green
245A	16-Bit Bus Transceiver
162	Double-Density 3.3Volt with Resistors, ±12mA (A Port)
	±24mA (B Port)
Blank	No Bus-hold
74	-40°C to +85°C
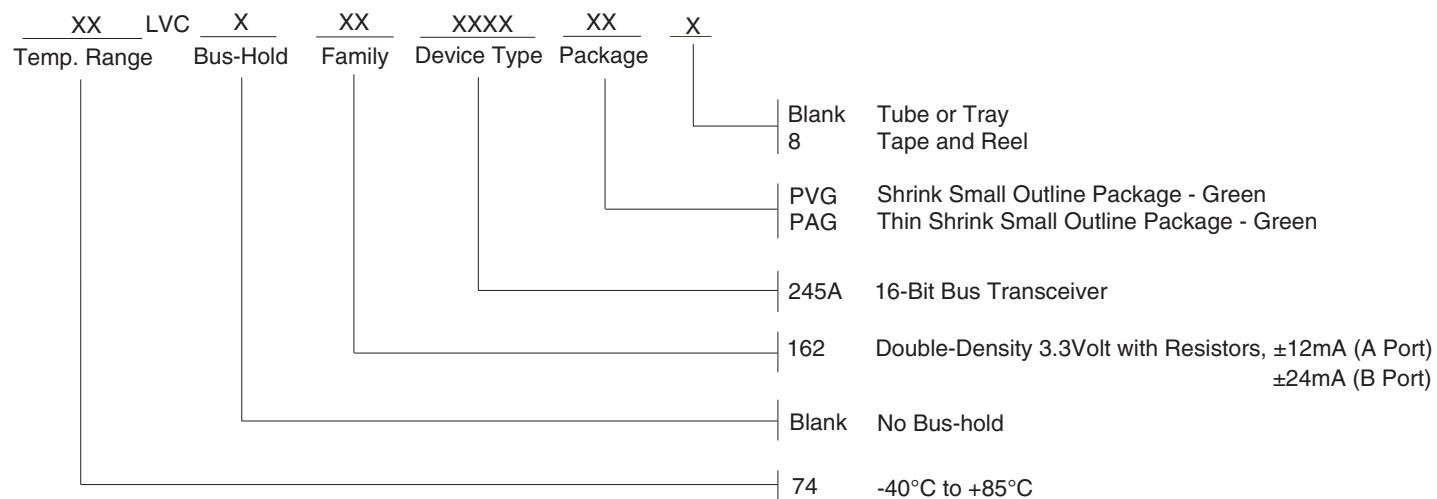
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