

SN74LVC16543

16-BIT REGISTERED TRANSCEIVER WITH 3-STATE OUTPUTS

SCAS317A – NOVEMBER 1993 – REVISED OCTOBER 1995

- Member of the Texas Instruments *Widebus™* Family
- *EPIC™* (Enhanced-Performance Implanted CMOS) Submicron Process
- Typical V_{OLP} (Output Ground Bounce) $< 0.8\text{ V}$ at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$
- Typical V_{OHV} (Output V_{OH} Undershoot) $> 2\text{ V}$ at $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$
- Latch-Up Performance Exceeds 250 mA Per JEDEC Standard JESD-17
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- Package Options Include Plastic 300-mil Shrink Small-Outline (DL) and Thin Shrink Small-Outline (DGG) Packages

description

This 16-bit registered transceiver is designed for low-voltage (3.3-V) V_{CC} operation.

The SN74LVC16543 can be used as two 8-bit transceivers or one 16-bit transceiver. Separate latch-enable ($\overline{LEAB}$ or $\overline{LEBA}$) and output-enable ($\overline{OEAB}$ or $\overline{OEBA}$) inputs are provided for each register to permit independent control in either direction of data flow.

The A-to-B enable ($\overline{CEAB}$) input must be low in order to enter data from A or to output data from B. If $\overline{CEAB}$ is low and $\overline{LEAB}$ is low, the A-to-B latches are transparent; a subsequent low-to-high transition of $\overline{LEAB}$ puts the A latches in the storage mode. With $\overline{CEAB}$ and $\overline{OEAB}$ both low, the 3-state B outputs are active and reflect the data present at the output of the A latches. Data flow from B to A is similar but requires using the $\overline{CEBA}$, $\overline{LEBA}$, and $\overline{OEBA}$ inputs.

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.

Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

The SN74LVC16543 is characterized for operation from -40°C to 85°C .

DGG OR DL PACKAGE
(TOP VIEW)

$\overline{1OEAB}$	1	56	$\overline{1OEBA}$
$\overline{1LEAB}$	2	55	$\overline{1LEBA}$
$\overline{1CEAB}$	3	54	$\overline{1CEBA}$
GND	4	53	GND
1A1	5	52	1B1
1A2	6	51	1B2
V_{CC}	7	50	V_{CC}
1A3	8	49	1B3
1A4	9	48	1B4
1A5	10	47	1B5
GND	11	46	GND
1A6	12	45	1B6
1A7	13	44	1B7
1A8	14	43	1B8
2A1	15	42	2B1
2A2	16	41	2B2
2A3	17	40	2B3
GND	18	39	GND
2A4	19	38	2B4
2A5	20	37	2B5
2A6	21	36	2B6
V_{CC}	22	35	V_{CC}
2A7	23	34	2B7
2A8	24	33	2B8
GND	25	32	GND
$\overline{2CEAB}$	26	31	$\overline{2CEBA}$
$\overline{2LEAB}$	27	30	$\overline{2LEBA}$
$\overline{2OEAB}$	28	29	$\overline{2OEBA}$



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FUNCTION TABLE[†]
(each 8-bit section)

INPUTS				OUTPUT B
<u>CEAB</u>	<u>LEAB</u>	<u>OEAB</u>	A	
H	X	X	X	Z
X	X	H	X	Z
L	H	L	X	B ₀ [‡]
L	L	L	L	L
L	L	L	H	H

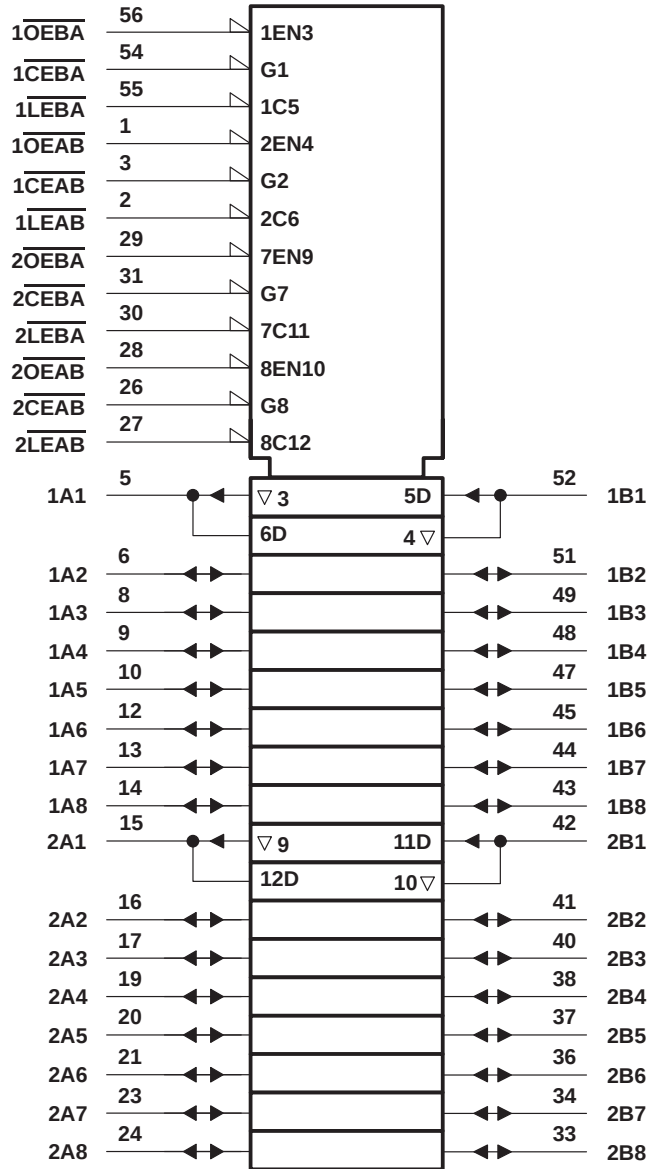
[†] A-to-B data flow is shown; B-to-A flow control is the same except that it uses CEBA, LEBA, and OEBA.

[‡] Output level before the indicated steady-state input conditions were established

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logic symbol[†]



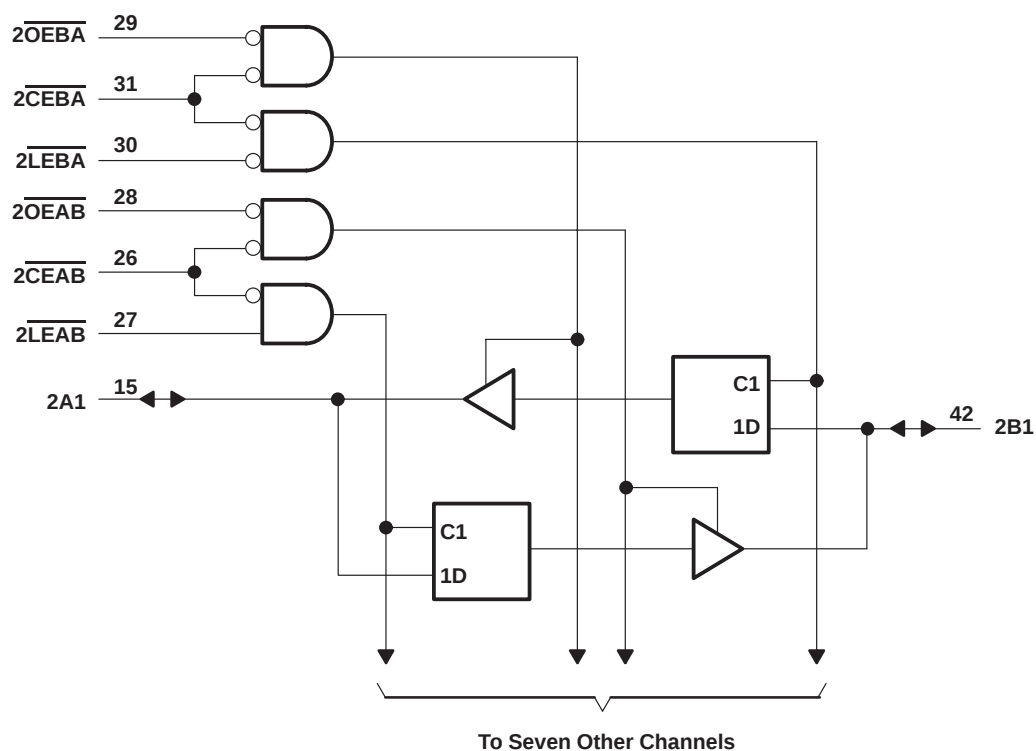
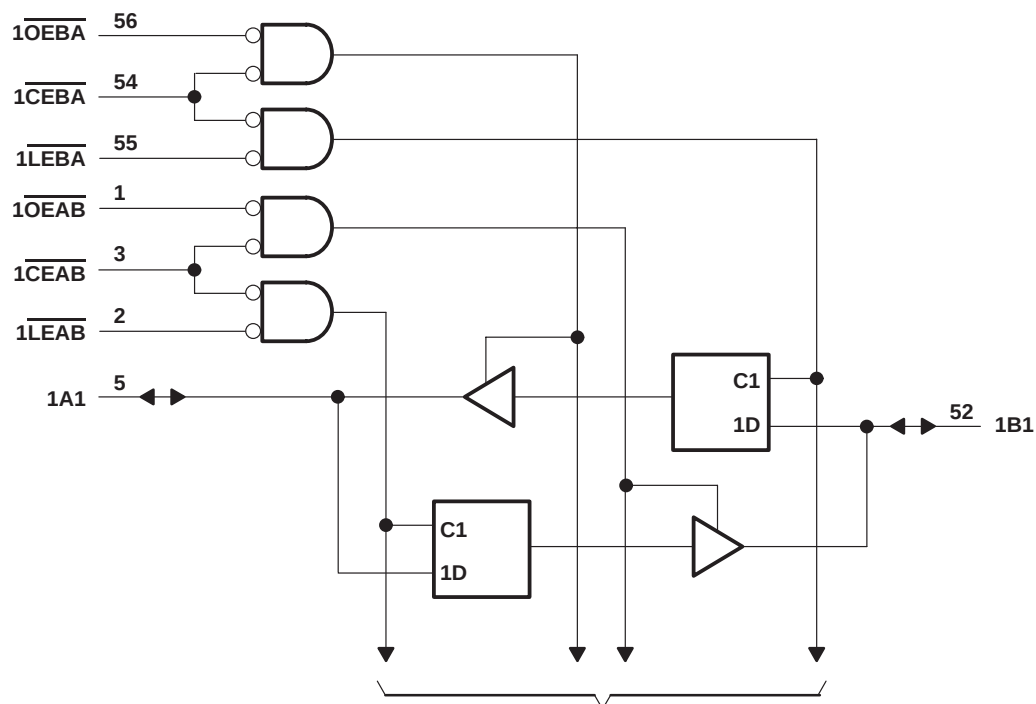
[†] This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

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logic diagram (positive logic)



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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage range, V_{CC}	–0.5 V to 4.6 V
Input voltage range, V_I : Except I/O ports (see Note 1)	–0.5 V to 4.6 V
I/O ports (see Notes 1 and 2)	–0.5 V to $V_{CC} + 0.5$ V
Output voltage range, V_O (see Notes 1 and 2)	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, I_{IK} ($V_I < 0$)	–50 mA
Output clamp current, I_{OK} ($V_O < 0$ or $V_O > V_{CC}$)	±50 mA
Continuous output current, I_O ($V_O = 0$ to V_{CC})	±50 mA
Continuous current through V_{CC} or GND	±100 mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air) (see Note 3): DGG package	1 W
DL package	1.4 W
Storage temperature range, T_{stg}	–65°C to 150°C

[†] Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES:
1. The input and output negative-voltage ratings may be exceeded if the input and output clamp-current ratings are observed.
 2. This value is limited to 4.6 V maximum.
 3. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils. For more information, refer to the *Package Thermal Considerations* application note in the 1994 *ABT Advanced BiCMOS Technology Data Book*, literature number SCBD002B.

recommended operating conditions (see Note 4)

			MIN	MAX	UNIT
V_{CC}	Supply voltage		2.7	3.6	V
V_{IH}	High-level input voltage	$V_{CC} = 2.7$ V to 3.6 V	2		V
V_{IL}	Low-level input voltage	$V_{CC} = 2.7$ V to 3.6 V		0.8	V
V_I	Input voltage		0	V_{CC}	V
V_O	Output voltage		0	V_{CC}	V
I_{OH}	High-level output current	$V_{CC} = 2.7$ V		–12	mA
		$V_{CC} = 3$ V		–24	
I_{OL}	Low-level output current	$V_{CC} = 2.7$ V		12	mA
		$V_{CC} = 3$ V		24	
$\Delta t/\Delta v$	Input transition rise or fall rate		0	10	ns/V
T_A	Operating free-air temperature		–40	85	°C

NOTE 4: Unused control inputs must be held high or low to prevent them from floating.

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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	$V_{CC}^{\dagger}$	MIN	TYP [‡]	MAX	UNIT
V_{OH}		$I_{OH} = -100\ \mu A$	MIN to MAX	$V_{CC} - 0.2$			V
		$I_{OH} = -12\ mA$	2.7 V	2.2			
			3 V	2.4			
		$I_{OH} = -24\ mA$	3 V	2			
V_{OL}		$I_{OL} = 100\ \mu A$	MIN to MAX	0.2			V
		$I_{OL} = 12\ mA$	2.7 V	0.4			
		$I_{OL} = 24\ mA$	3 V	0.55			
I_I	Control inputs	$V_I = V_{CC}$ or GND	3.6 V	± 5			μA
$I_I(\text{hold})$	A or B ports	$V_I = 0.8\ V$	3 V	75			μA
		$V_I = 2\ V$		-75			
$I_{OZ}^{\S}$		$V_O = V_{CC}$ or GND	3.6 V	± 10			μA
I_{CC}		$V_I = V_{CC}$ or GND, $I_O = 0$	3.6 V	40			μA
ΔI_{CC}		One input at $V_{CC} - 0.6\ V$, Other inputs at V_{CC} or GND	3 V to 3.6 V	500			μA
C_i	Control inputs	$V_I = V_{CC}$ or GND	3.3 V	3			pF
C_{iO}	A or B ports	$V_O = V_{CC}$ or GND	3.3 V	7			pF

[†] For conditions shown as MIN or MAX, use the appropriate values under recommended operating conditions.

[‡] All typical values are at $V_{CC} = 3.3\ V$, $T_A = 25^{\circ}C$.

[§] For I/O ports, the parameter I_{OZ} includes the input leakage current.

timing requirements over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)

		$V_{CC} = 3.3\ V \pm 0.3\ V$		$V_{CC} = 2.7\ V$		UNIT
		MIN	MAX	MIN	MAX	
t_w	Pulse duration, $\overline{LE}$ or $\overline{CE}$ low	4		4		ns
t_{su}	Setup time, Data before $\overline{LE}$, $\overline{CE}$	2		2		ns
t_h	Hold time, Data after $\overline{LE}$, $\overline{CE}$	2		2		ns

switching characteristics over recommended operating free-air temperature range, $C_L = 50\ pF$ (unless otherwise noted) (see Figure 1)

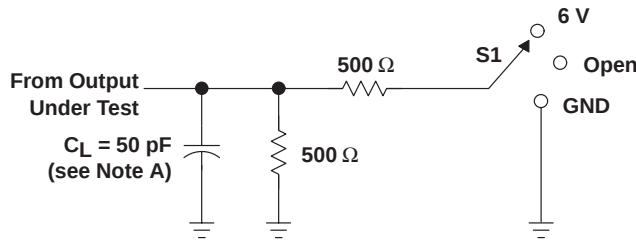
PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 3.3\ V \pm 0.3\ V$		$V_{CC} = 2.7\ V$		UNIT
			MIN	MAX	MIN	MAX	
t_{pd}	A or B	B or A	1.5	8	1.5	9	ns
t_{pd}	$\overline{LE}$	A or B	1.5	9	1.5	10	ns
t_{en}	$\overline{CE}$	A or B	1.5	9	1.5	10	ns
t_{dis}	$\overline{CE}$	A or B	1.5	9	1.5	10	ns
t_{en}	$\overline{OE}$	A or B	1.5	8.5	1.5	9.5	ns
t_{dis}	$\overline{OE}$	A or B	1.5	8.5	1.5	9.5	ns



operating characteristics, $V_{CC} = 3.3\text{ V}$, $T_A = 25^\circ\text{C}$

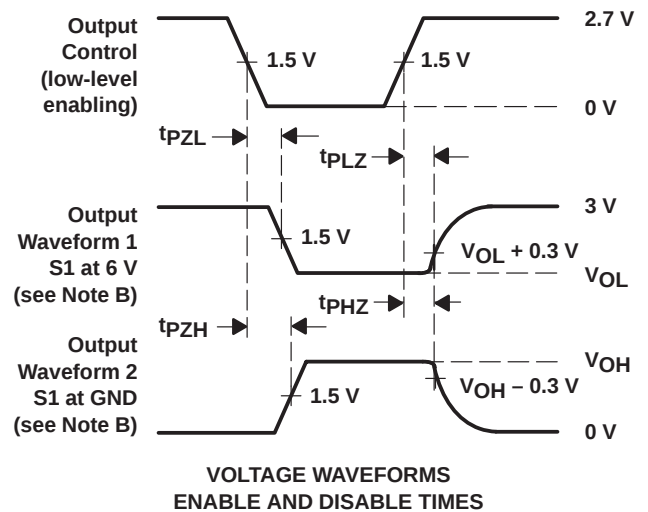
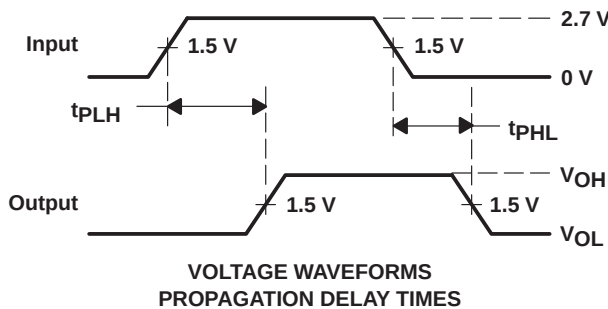
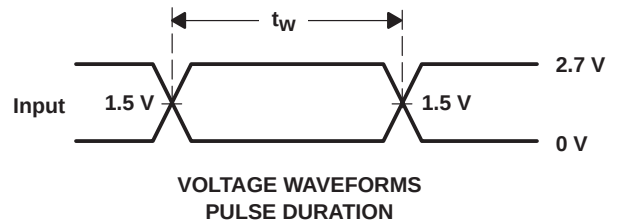
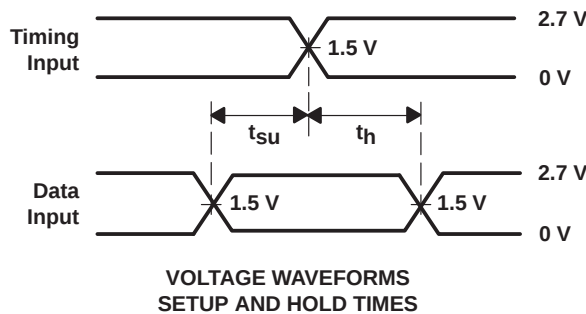
PARAMETER		TEST CONDITIONS	TYP	UNIT
C_{pd}	Power dissipation capacitance per transceiver	Outputs enabled	21	pF
		Outputs disabled	3.5	

PARAMETER MEASUREMENT INFORMATION



LOAD CIRCUIT

TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	6 V
t_{PHZ}/t_{PZH}	GND



- NOTES:
- C_L includes probe and jig capacitance.
 - Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
 - All input pulses are supplied by generators having the following characteristics: $PRR \leq 10\text{ MHz}$, $Z_O = 50\ \Omega$, $t_r \leq 2.5\text{ ns}$, $t_f \leq 2.5\text{ ns}$.
 - The outputs are measured one at a time with one transition per measurement.
 - t_{PLZ} and t_{PHZ} are the same as t_{dis} .
 - t_{PZL} and t_{PZH} are the same as t_{en} .
 - t_{PLH} and t_{PHL} are the same as t_{pd} .

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