

SN74ALVCH16543

16-BIT REGISTERED TRANSCEIVER WITH 3-STATE OUTPUTS

SCES025A – JULY 1995 – REVISED JULY 1996

- Member of the Texas Instruments *Widebus™* Family
- *EPIC™* (Enhanced-Performance Implanted CMOS) Submicron Process
- Bus Hold on Data Inputs Eliminates the Need for External Pullup/Pulldown Resistors
- ESD Protection Exceeds 2000 V Per MIL-STD-883C, Method 3015; Exceeds 200 V Using Machine Model (C = 200 pF, R = 0)
- Latch-Up Performance Exceeds 250 mA Per JEDEC Standard JESD-17
- 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 2.3-V to 3.6-V V_{CC} operation.

The SN74ALVCH16543 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 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 \overline{CEBA} , \overline{LEBA} , and \overline{OEBA} .

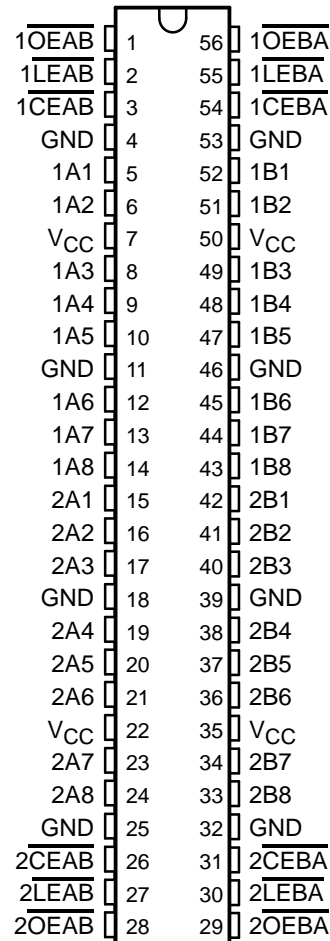
To ensure the high-impedance state during power up or power down, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sinking capability of the driver.

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

The SN74ALVCH16543 is available in TI's shrink small-outline (DL) and thin shrink small-outline (DGG) packages, which provide twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

The SN74ALVCH16543 is characterized for operation from -40°C to 85°C .

DGG OR DL PACKAGE
(TOP VIEW)



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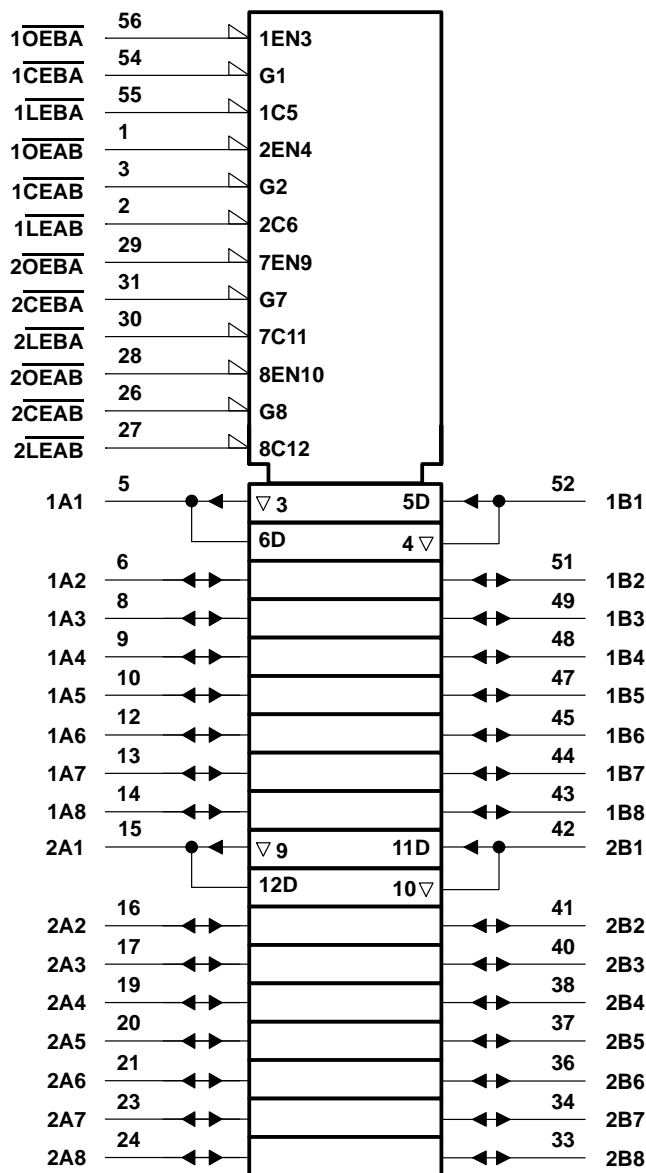
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WITH 3-STATE OUTPUTS

SCES025A – JULY 1995 – REVISED JULY 1996

logic symbol†



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

logic diagram (positive logic)



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SCES025A – JULY 1995 – REVISED JULY 1996

FUNCTION TABLE†
(each 8-bit section)

INPUTS				OUTPUT B
$\overline{\text{CEAB}}$	$\overline{\text{LEAB}}$	$\overline{\text{OEAB}}$	A	
H	X	X	X	Z
X	X	H	X	Z
L	H	L	X	B_0^\ddagger
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 $\overline{\text{CEBA}}$, $\overline{\text{LEBA}}$, and $\overline{\text{OEBA}}$.

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

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 each 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 *ABT Advanced BiCMOS Technology Data Book*.



POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

SN74ALVCH16543
16-BIT REGISTERED TRANSCEIVER
WITH 3-STATE OUTPUTS

SCES025A – JULY 1995 – REVISED JULY 1996

recommended operating conditions (see Note 4)

			MIN	MAX	UNIT
V_{CC}	Supply voltage		2.3	3.6	V
V_{IH}	High-level input voltage	$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$	1.7		V
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$	2		
V_{IL}	Low-level input voltage	$V_{CC} = 2.3 \text{ V to } 2.7 \text{ V}$		0.7	V
		$V_{CC} = 2.7 \text{ V to } 3.6 \text{ V}$		0.8	
V_I	Input voltage		0	V_{CC}	V
V_O	Output voltage		0	V_{CC}	V
I_{OH}	High-level output current	$V_{CC} = 2.3 \text{ V}$		-12	mA
		$V_{CC} = 2.7 \text{ V}$		-12	
		$V_{CC} = 3 \text{ V}$		-24	
I_{OL}	Low-level output current	$V_{CC} = 2.3 \text{ V}$		12	mA
		$V_{CC} = 2.7 \text{ V}$		12	
		$V_{CC} = 3 \text{ V}$		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.

SN74ALVCH16543

16-BIT REGISTERED TRANSCEIVER

WITH 3-STATE OUTPUTS

SCES025A – JULY 1995 – REVISED JULY 1996

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

PARAMETER		TEST CONDITIONS	V _{CC} [†]	MIN	TYP [‡]	MAX	UNIT
V _{OH}	I _{OH} = −100 μA		MIN to MAX	V _{CC} − 0.2			V
	I _{OH} = −6 mA, V _{IH} = 1.7 V		2.3 V	2			
	I _{OH} = −12 mA	V _{IH} = 1.7 V	2.3 V	1.7			
		V _{IH} = 2 V	2.7 V	2.2			
		V _{IH} = 2 V	3 V	2.4			
	I _{OH} = −24 mA, V _{IH} = 2 V		3 V	2			
V _{OL}	I _{OL} = 100 μA		MIN to MAX	0.2			V
	I _{OL} = 6 mA, V _{IL} = 0.7 V		2.3 V	0.4			
	I _{OL} = 12 mA	V _{IL} = 0.7 V	2.3 V	0.7			
		V _{IL} = 0.8 V	2.7 V	0.4			
	I _{OL} = 24 mA, V _{IL} = 0.8 V		3 V	0.55			
I _I	V _I = V _{CC} or GND		3.6 V	±5			μA
I _I (hold)	V _I = 0.7 V		2.3 V	45			μA
	V _I = 1.7 V			−45			
	V _I = 0.8 V		3 V	75			
	V _I = 2 V			−75			
	V _I = 0 to 3.6 V [§]		3.6 V	±500			
I _{OZ} [¶]	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	750			μA
C _i	Control inputs	V _I = V _{CC} or GND	3.3 V	3.5			pF
C _{io}	A or B ports	V _O = V _{CC} or GND	3.3 V	8.5			pF

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

‡ Typical values are measured at $V_{CC} = 3.3 \text{ V}$, $T_A = 25^{\circ}\text{C}$.

§ This is the bus-hold maximum dynamic current required to switch the input from one state to another.

$^{\parallel}$ For I/O ports, the parameter I_{OZ} includes the input leakage current.

timing requirements over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)

			$V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$		$V_{CC} = 2.7 \text{ V}$		$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
t_w	Pulse duration, \overline{LE} or \overline{CE} low		3.3		3.3		3.3		ns
t_{su}	Setup time	Data before $\overline{LE}\uparrow$ or $\overline{CE}\uparrow$	1.2		1.5		1.2		ns
t_h	Hold time	Data after $\overline{LE}\uparrow$ or $\overline{CE}\uparrow$	1.2		0.8		1.3		ns

SN74ALVCH16543
16-BIT REGISTERED TRANSCEIVER
WITH 3-STATE OUTPUTS

SCES025A – JULY 1995 – REVISED JULY 1996

switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figures 1 and 2)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$		$V_{CC} = 2.7\text{ V}$		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
t_{pd}	A or B	B or A	1	5.7	4.8		1	4.3	ns
	\overline{LE}	A or B	1.1	7.1	6.2		1.1	5	
t_{en}	\overline{CE}	A or B	1	7.7	6.9		1	5.6	ns
t_{dis}	\overline{CE}	A or B	2	6.3	6.2		1.5	5.1	ns
t_{en}	\overline{OE}	A or B	1	7.3	6.3		1	5.3	ns
t_{dis}	\overline{OE}	A or B	1.6	5.9	4.8		1.1	4.6	ns

operating characteristics, $T_A = 25^\circ\text{C}$

PARAMETER			TEST CONDITIONS	$V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$	$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$	UNIT
				TYP	TYP	
C_{pd}	Power dissipation capacitance	Outputs enabled	$C_L = 50\text{ pF}, f = 10\text{ MHz}$	54	64	pF
		Outputs disabled		6	7	



SN74ALVCH16543

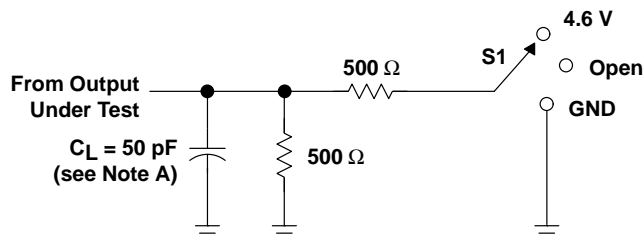
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WITH 3-STATE OUTPUTS

SCES025A – JULY 1995 – REVISED JULY 1996

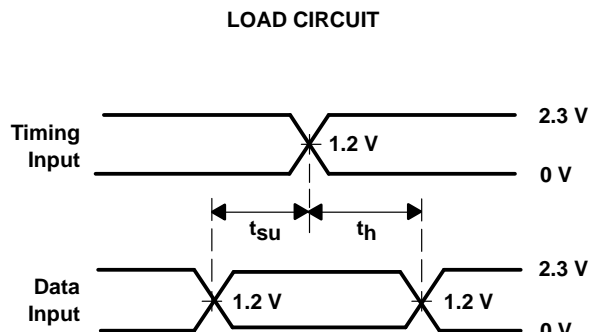
PARAMETER MEASUREMENT INFORMATION

$$V_{CC} = 2.5 \text{ V} \pm 0.2 \text{ V}$$

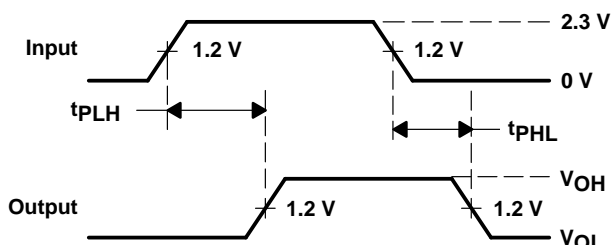


LOAD CIRCUIT

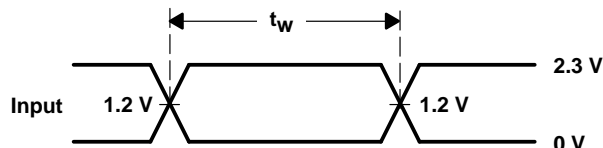
TEST	S1
t_{pd}	Open
t_{PLZ}/t_{PZL}	4.6 V
t_{PHZ}/t_{PZH}	GND



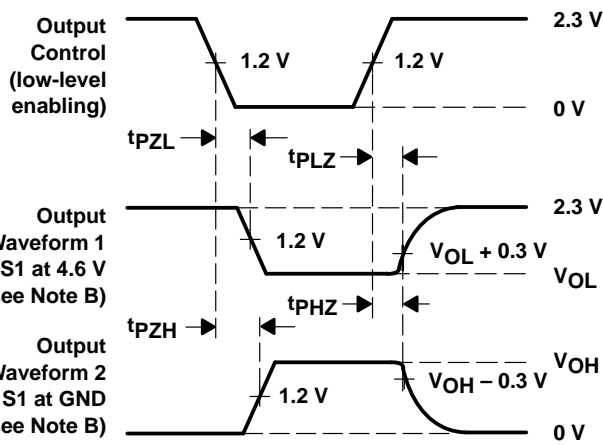
VOLTAGE WAVEFORMS
SETUP AND HOLD TIMES



VOLTAGE WAVEFORMS
PROPAGATION DELAY TIMES



VOLTAGE WAVEFORMS
PULSE DURATION

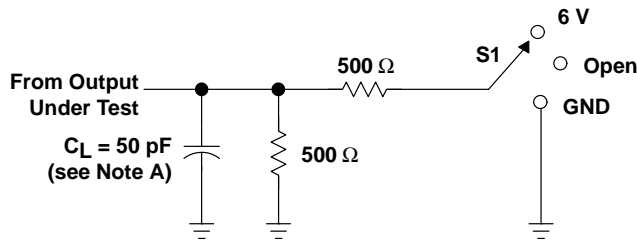


VOLTAGE WAVEFORMS
ENABLE AND DISABLE TIMES

- 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} .

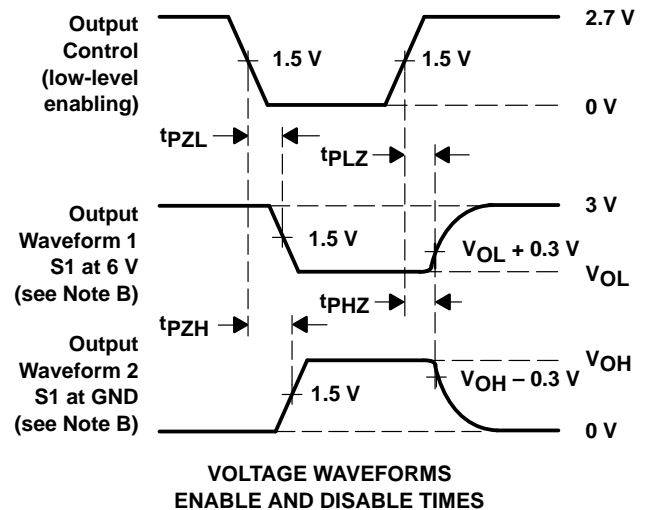
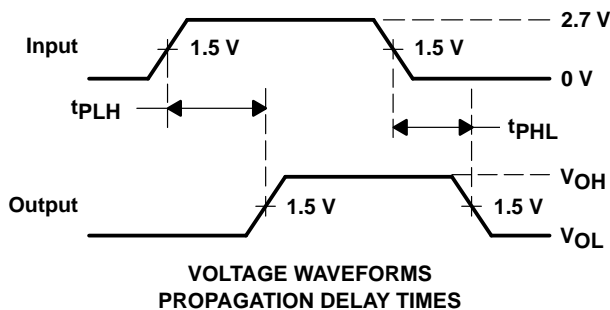
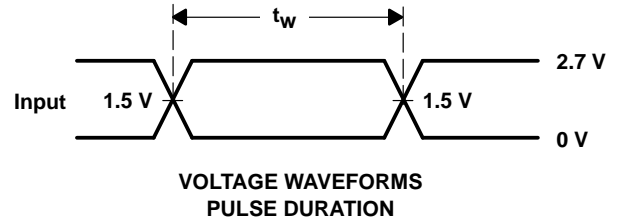
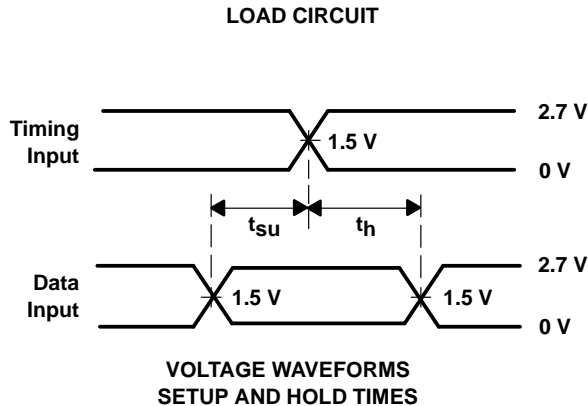
Figure 1. Load Circuit and Voltage Waveforms

PARAMETER MEASUREMENT INFORMATION
 $V_{CC} = 2.7\text{ V AND } 3.3\text{ V} \pm 0.3\text{ V}$



LOAD CIRCUIT

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



- NOTES: A. C_L includes probe and jig capacitance.
B. 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.
C. All input pulses are supplied by generators having the following characteristics: $PRR \leq 10\text{ MHz}$, $Z_O = 50\text{ }\Omega$, $t_r \leq 2.5\text{ ns}$, $t_f \leq 2.5\text{ ns}$.
D. The outputs are measured one at a time with one transition per measurement.
E. t_{PLZ} and t_{PHZ} are the same as t_{dis} .
F. t_{PZL} and t_{PZH} are the same as t_{en} .
G. t_{PLH} and t_{PHL} are the same as t_{pd} .

Figure 2. Load Circuit and Voltage Waveforms

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