

# 54AC16640, 74AC16640 16-BIT BUS TRANSCEIVERS WITH 3-STATE OUTPUTS

SCAS240A – JULY 1990 – REVISED APRIL 1996

- Members of the Texas Instruments *Widebus*™ Family
- Flow-Through Architecture Optimizes PCB Layout
- Distributed  $V_{CC}$  and GND Pin Configuration Minimizes High-Speed Switching Noise
- *EPIC*™ (Enhanced-Performance Implanted CMOS) 1- $\mu$ m Process
- 500-mA Typical Latch-Up Immunity at 125°C
- Package Options Include Plastic 300-mil Shrink Small-Outline (DL) Packages Using 25-mil Center-to-Center Pin Spacings and 380-mil Fine-Pitch Ceramic Flat (WD) Packages Using 25-mil Center-to-Center Pin Spacings

## description

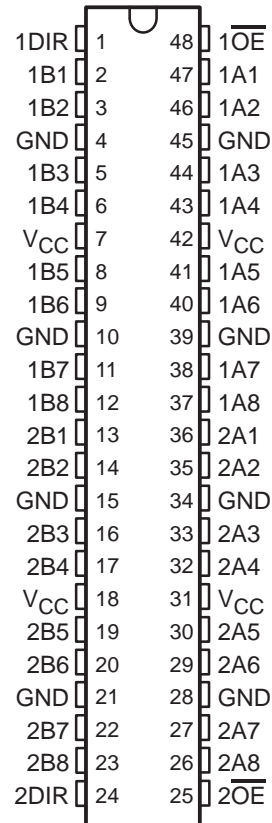
The 'AC16640 are inverting 16-bit transceivers designed for asynchronous communication between data buses.

These devices can be used as two 8-bit transceivers or one 16-bit transceiver. They allow 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 (1DIR and 2DIR) inputs. The output-enable ( $1\overline{OE}$  and  $2\overline{OE}$ ) inputs can be used to disable the device so that the buses are effectively isolated.

The 74AC16640 is packaged in TI's shrink small-outline package, which provides twice the I/O pin count and functionality of standard small-outline packages in the same printed-circuit-board area.

The 54AC16640 is characterized for operation over the full military temperature range of –55°C to 125°C. The 74AC16640 is characterized for operation from –40°C to 85°C.

54AC16640 . . . WD PACKAGE  
74AC16640 . . . DL PACKAGE  
(TOP VIEW)



FUNCTION TABLE  
(each section)

INPUTS		OPERATION
$\overline{OE}$	DIR	
L	L	$\overline{B}$ data to A bus
L	H	$\overline{A}$ data to B bus
H	X	Isolation



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**TEXAS  
INSTRUMENTS**

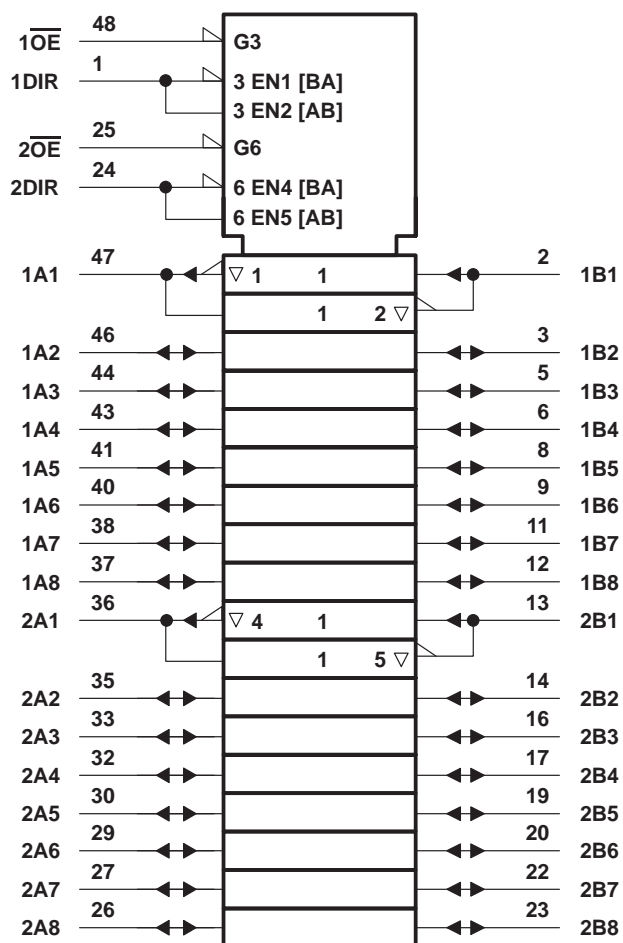
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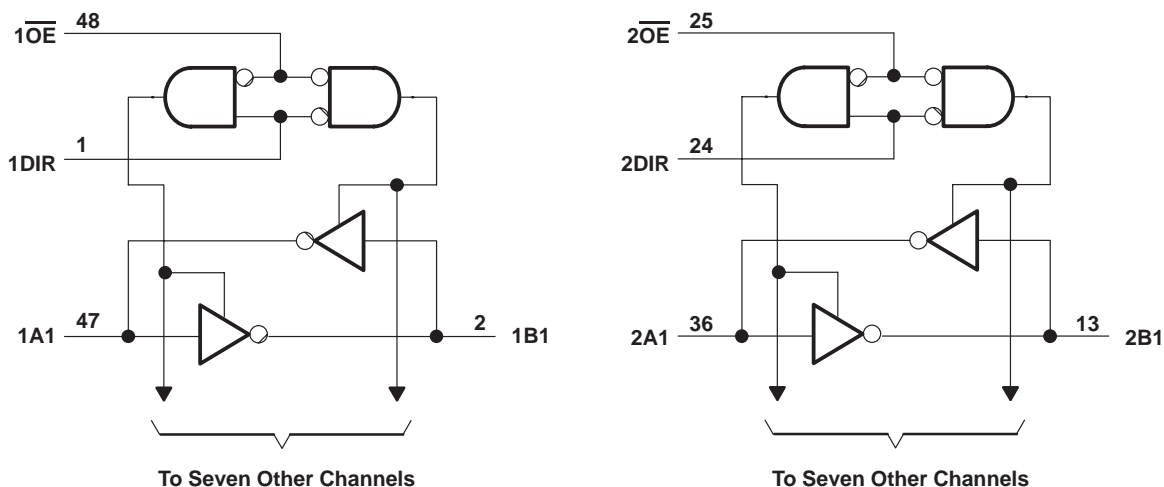
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## logic symbol†



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

## logic diagram (positive logic)



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

Supply voltage range, $V_{CC}$	–0.5 V to 7 V
Input voltage range, $V_I$ (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Output voltage range, $V_O$ (see Note 1)	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, $I_{IK}$ ( $V_I < 0$ or $V_I > V_{CC}$ )	±20 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	±400 mA
Maximum power dissipation at $T_A = 55^\circ\text{C}$ (in still air)(see Note 2): DL package	1.2 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 voltage ratings may be exceeded if the input and output current ratings are observed.  
2. The maximum package power dissipation is calculated using a junction temperature of 150°C and a board trace length of 750 mils.

**recommended operating conditions (see Note 3)**

			54AC16640			74AC16640			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
$V_{CC}$	Supply voltage		3	5	5.5	3	5	5.5	V
$V_{IH}$	High-level input voltage	$V_{CC} = 3$ V	2.1			2.1			V
		$V_{CC} = 4.5$ V	3.15			3.15			
		$V_{CC} = 5.5$ V	3.85			3.85			
$V_{IL}$	Low-level input voltage	$V_{CC} = 3$ V			0.9			0.9	V
		$V_{CC} = 4.5$ V			1.35			1.35	
		$V_{CC} = 5.5$ V			1.65			1.65	
$V_I$	Input voltage		0		$V_{CC}$	0		$V_{CC}$	V
$V_O$	Output voltage		0		$V_{CC}$	0		$V_{CC}$	V
$I_{OH}$	High-level output current	$V_{CC} = 3$ V			–4			–4	mA
		$V_{CC} = 4.5$ V			–24			–24	
		$V_{CC} = 5.5$ V			–24			–24	
$I_{OL}$	Low-level output current	$V_{CC} = 3$ V			12			12	mA
		$V_{CC} = 4.5$ V			24			24	
		$V_{CC} = 5.5$ V			24			24	
$\Delta t/\Delta v$	Input transition rise or fall rate		0		10	0		10	ns/V
$T_A$	Operating free-air temperature		–55		125	–40		85	°C

NOTE 3: Unused inputs must be held high or low to prevent them from floating.

**54AC16640, 74AC16640**  
**16-BIT BUS TRANSCEIVERS**  
**WITH 3-STATE OUTPUTS**

SCAS240A – JULY 1990 – REVISED APRIL 1996

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

PARAMETER	TEST CONDITIONS	V <sub>CC</sub>	T <sub>A</sub> = 25°C			54AC16640		74AC16640		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V <sub>OH</sub>	I <sub>OH</sub> = -50 µA	3 V	2.9			2.9		2.9		V
		4.5 V	4.4			4.4		4.4		
		5.5 V	5.4			5.4		5.4		
	I <sub>OH</sub> = -4 mA	3 V	2.58			2.48		2.48		
		4.5 V	3.94			3.8		3.8		
		5.5 V	4.94			4.8		4.8		
	I <sub>OH</sub> = -75 mA†	5.5 V				3.85		3.85		
V <sub>OL</sub>	I <sub>OL</sub> = 50 µA	3 V			0.1		0.1		0.1	V
		4.5 V			0.1		0.1		0.1	
		5.5 V			0.1		0.1		0.1	
	I <sub>OL</sub> = 12 mA	3 V			0.36		0.44		0.44	
		4.5 V			0.36		0.44		0.44	
	I <sub>OL</sub> = 24 mA	4.5 V			0.36		0.44		0.44	
		5.5 V			0.36		0.44		0.44	
	I <sub>OL</sub> = 75 mA†	5.5 V				1.65		1.65		
I <sub>I</sub>	Control inputs	V <sub>I</sub> = V <sub>CC</sub> or GND	5.5 V		±0.1		±1		±1	µA
I <sub>OZ</sub> ‡	A or B ports	V <sub>O</sub> = V <sub>CC</sub> or GND	5.5 V		±0.5		±5		±5	µA
I <sub>CC</sub>		V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	5.5 V		8		80		80	µA
C <sub>i</sub>	Control inputs	V <sub>I</sub> = V <sub>CC</sub> or GND	5 V		4.5					pF
C <sub>io</sub>	A or B ports	V <sub>O</sub> = V <sub>CC</sub> or GND	5 V		16					pF

† Not more than one output should be tested at a time, and the duration of the test should not exceed 10 ms.

‡ For I/O ports, the parameter I<sub>OZ</sub> includes the input leakage current.

**switching characteristics over recommended operating free-air temperature range,**  
**V<sub>CC</sub> = 3.3 V ± 0.3 V (unless otherwise noted) (see Figure 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	T <sub>A</sub> = 25°C			54AC16640		74AC16640		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t <sub>PLH</sub>	A or B	B or A	2.2	6.9	9.1	2.2	10	2.2	10	ns
t <sub>PHL</sub>			3	8.5	11	3	11.9	3	11.9	
t <sub>PZH</sub>	$\overline{\text{OE}}$	A or B	3	8.2	11	3	12.3	3	12.3	ns
t <sub>PZL</sub>			3.9	10.9	14	3.9	15.5	3.9	15.5	
t <sub>PHZ</sub>	$\overline{\text{OE}}$	A or B	5.1	8.3	10.6	5.1	11.2	5.1	11.2	ns
t <sub>PLZ</sub>			4.3	7.8	10.1	4.3	10.6	4.3	10.6	

**switching characteristics over recommended operating free-air temperature range,**  
**V<sub>CC</sub> = 5 V ± 0.5 V (unless otherwise noted) (see Figure 1)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	T <sub>A</sub> = 25°C			54AC16640		74AC16640		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t <sub>PLH</sub>	A or B	B or A	1.8	4.7		1.8	7.3	1.8	7.3	ns
t <sub>PHL</sub>			2.6	5.7		2.6	8.6	2.6	8.6	
t <sub>PZH</sub>	$\overline{\text{OE}}$	A or B	2.4	5.6		2.4	8	2.4	8	ns
t <sub>PZL</sub>			3	6.6		3	9.9	3	9.9	
t <sub>PHZ</sub>	$\overline{\text{OE}}$	A or B	5	7.5		5	9.9	5	9.9	ns
t <sub>PLZ</sub>			4.1	6.5		4.1	9	4.1	9	

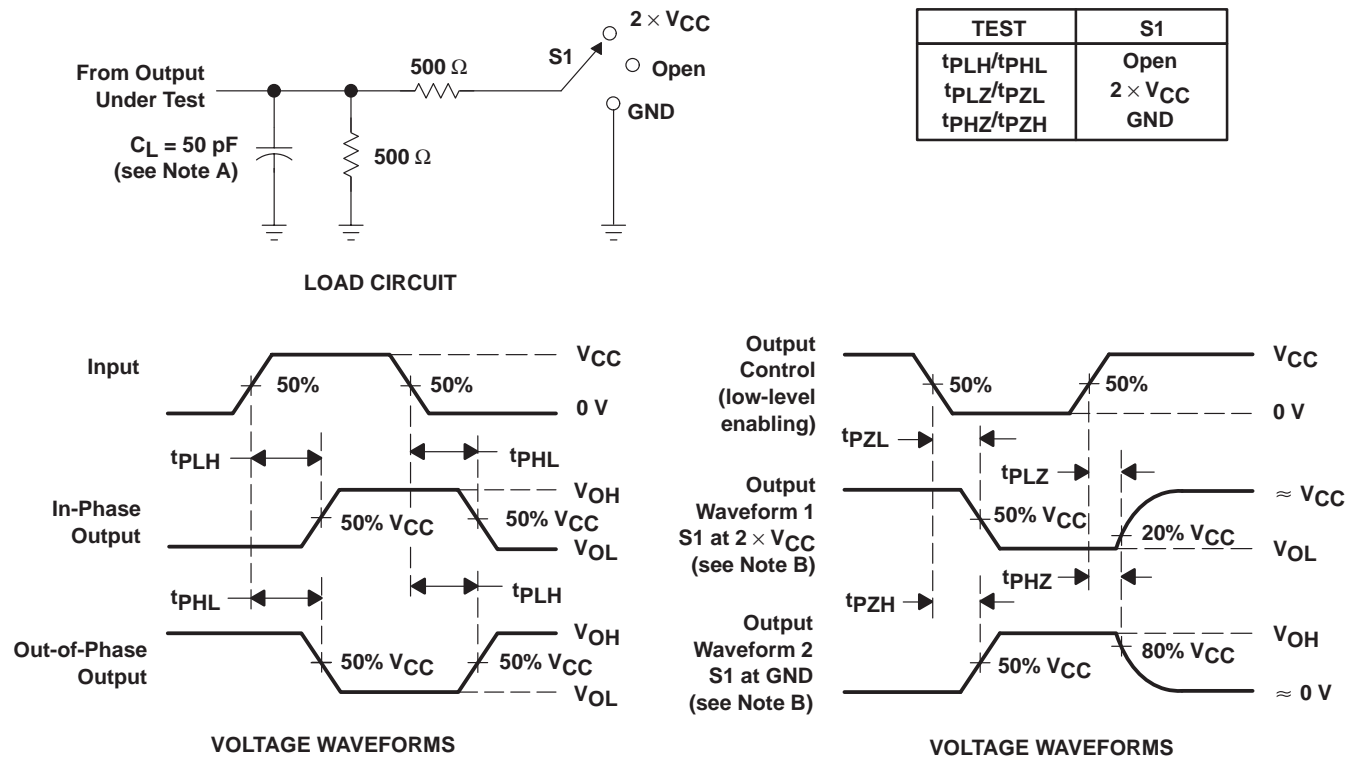
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operating characteristics,  $V_{CC} = 5\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	TYP	UNIT
$C_{pd}$	Power dissipation capacitance per transceiver	Outputs enabled	55	pF
		Outputs disabled	8	

## PARAMETER MEASUREMENT INFORMATION



- 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:  $PRR \leq 1\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r = 3\text{ ns}$ ,  $t_f = 3\text{ ns}$ .
  - D. The outputs are measured one at a time with one input transition per measurement.

Figure 1. Load Circuit and Voltage Waveform

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