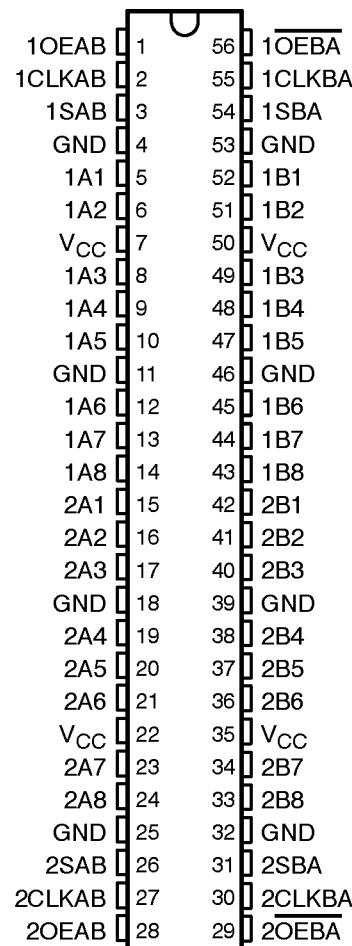- Members of the Texas Instruments *Widebus*™ Family
- Inputs Are TTL-Voltage Compatible
- Inverting Data Paths
- Independent Registers and Enables for A and B Buses
- Multiplexed Real-Time and Stored Data
- Flow-Through Architecture Optimizes PCB Layout
- Distributed V_{CC} and GND Pin Configurations Minimize High-Speed Switching Noise
- *EPIC*™ (Enhanced-Performance Implanted CMOS) 1-μm Process
- 500-mA Typical Latch-Up Immunity at 125°C
- Packaged in Plastic 300-mil Shrink Small-Outline (DL) Packages and 380-mil Fine-Pitch Ceramic Flat (WD) Packages Using 25-mil Center-to-Center Pin Spacings

54ACT16651 . . . WD PACKAGE
74ACT16651 . . . DL PACKAGE
(TOP VIEW)

1OEAB	1		56	1OEBA
1CLKAB	2		55	1CLKBA
1SAB	3		54	1SBA
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
2SAB	26		31	2SBA
2CLKAB	27		30	2CLKBA
2OEAB	28		29	2OEBA

description

The 'ACT16651 are 16-bit bus transceivers that consist of D-type flip-flops and control circuitry arranged for multiplexed transmission of data directly from the data bus or from the internal storage registers. These devices can be used as two 8-bit transceivers or one 16-bit transceiver.

Complementary output-enable (OEAB and OEBA) inputs are provided to control the transceiver functions. Select-control (SAB and SBA) inputs are provided to select whether real-time or stored data is transferred. A low input level selects real-time data, and a high input level selects stored data. The circuitry used for select control eliminates the typical decoding glitch that occurs in a multiplexer during the transition between stored and real-time data. Figure 1 illustrates the four fundamental bus-management functions that can be performed with the 'ACT16651.

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

EPIC and Widebus are trademarks of Texas Instruments Incorporated.

TEXAS INSTRUMENTS

description (continued)

Data on the A or B bus, or both, can be stored in the internal D flip-flops by low-to-high transitions at the appropriate clock (CLKAB or CLKBA) inputs regardless of the levels on the select-control or output-enable inputs. When SAB and SBA are in the real-time transfer mode, it is also possible to store data without using the internal D-type flip-flops by simultaneously enabling OEAB and $\overline{\text{OEBA}}$. In this configuration, each output reinforces its input. Thus, when all other data sources to the two sets of bus lines are at high impedance, each set of bus lines remains at its last state.

The 74ACT16651 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 54ACT16651 is characterized for operation over the full military temperature range of –55°C to 125°C. The 74ACT16651 is characterized for operation from –40°C to 85°C.

FUNCTION TABLE

INPUTS						DATA I/O[†]		OPERATION OR FUNCTION
OEAB	$\overline{\text{OEBA}}$	CLKAB	CLKBA	SAB	SBA	A1–A8	B1–B8	
L	H	L	L	X	X	Input	Input	Isolation
L	H	↑	↑	X	X	Input	Input	Store A and B data
X	H	↑	L	X	X	Input	Unspecified[‡]	Store A, hold B
H	H	↑	↑	X[‡]	X	Input	Output	Store A in both registers
L	X	L	↑	X	X	Unspecified[‡]	Input	Hold A, store B
L	L	↑	↑	X	X[‡]	Output	Input	Store B in both registers
L	L	X	X	X	L	Output	Input	Real-time $\overline{\text{B}}$ data to A bus
L	L	X	L	X	H	Output	Input	Stored $\overline{\text{B}}$ data to A bus
H	H	X	X	L	X	Input	Output	Real-time $\overline{\text{A}}$ data to B bus
H	H	L	X	H	X	Input	Output	Stored $\overline{\text{A}}$ data to B bus
H	L	L	L	H	H	Output	Output	Stored $\overline{\text{A}}$ data to B bus and stored $\overline{\text{B}}$ data to A bus

† The data-output functions may be enabled or disabled by a variety of level combinations at OEAB or $\overline{\text{OEBA}}$. Data-input functions are always enabled; i.e., data at the bus terminals is stored on every low-to-high transition of the clock inputs.
‡ Select control = L; clocks can occur simultaneously.
   Select control = H; clocks must be staggered to load both registers.

OEAB	OEBA	CLKAB	CLKBA	SAB	SBA
L	L	X	X	X	L

**REAL-TIME TRANSFER
BUS B TO BUS A**

OEAB	OEBA	CLKAB	CLKBA	SAB	SBA
H	H	X	X	L	X

**REAL-TIME TRANSFER
BUS A TO BUS B**

OEAB	OEBA	CLKAB	CLKBA	SAB	SBA
X	H	↑	X	X	X
L	X	X	↑	X	X
L	H	↑	↑	X	X

**STORAGE FROM
A, B, OR A AND B**

OEAB	OEBA	CLKAB	CLKBA	SAB	SBA
H	L	L	L	H	H

**TRANSFER STORED DATA
TO A AND/OR B**
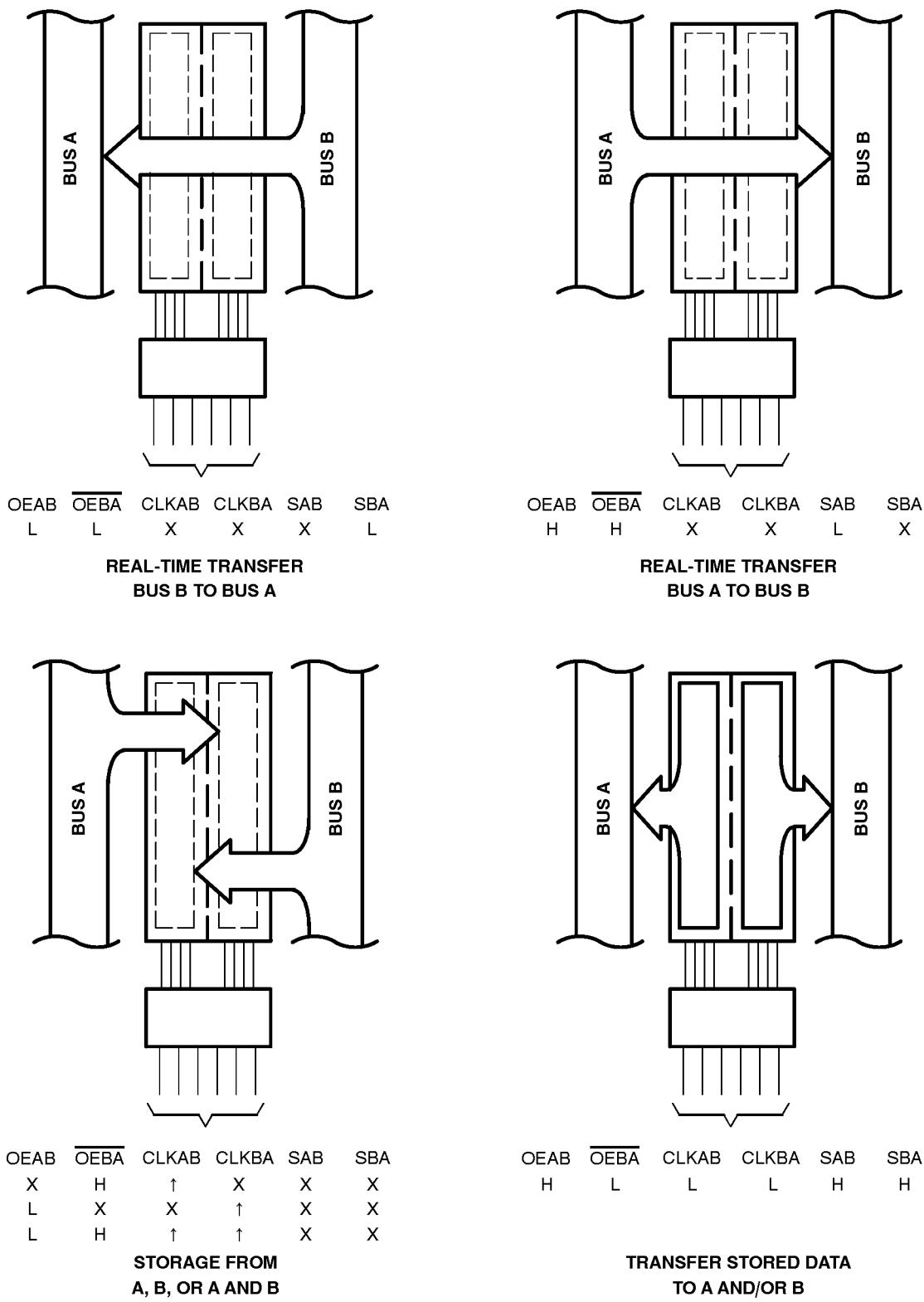
Figure 1. Bus-Management Functions

logic symbol†

1OEBA	56	EN1 [BA]
1OEAB	1	EN2 [AB]
1CLKBA	55	C3
1SBA	54	G4
1CLKAB	2	C5
1SAB	3	G6
2OEBA	29	EN7 [BA]
2OEAB	28	EN8 [AB]
2CLKBA	30	C9
2SBA	31	G10
2CLKAB	27	C11
2SAB	26	G12
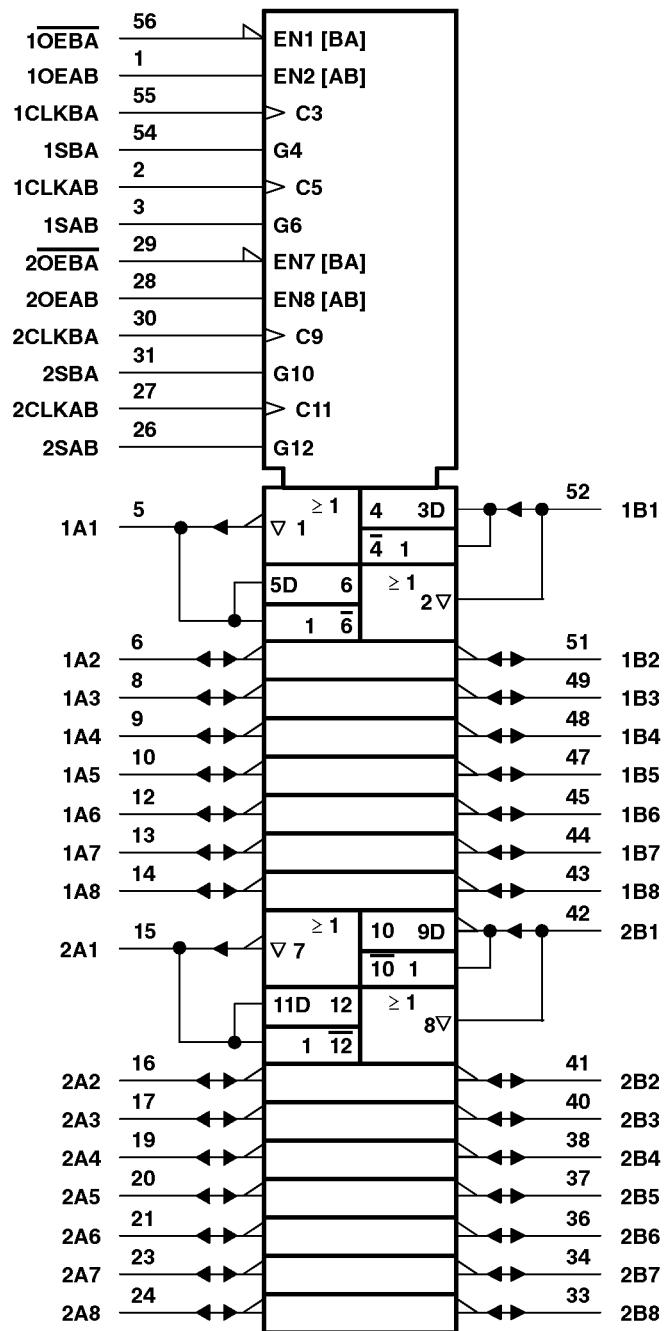
† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

TEXAS INSTRUMENTS

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

logic diagram (positive logic)
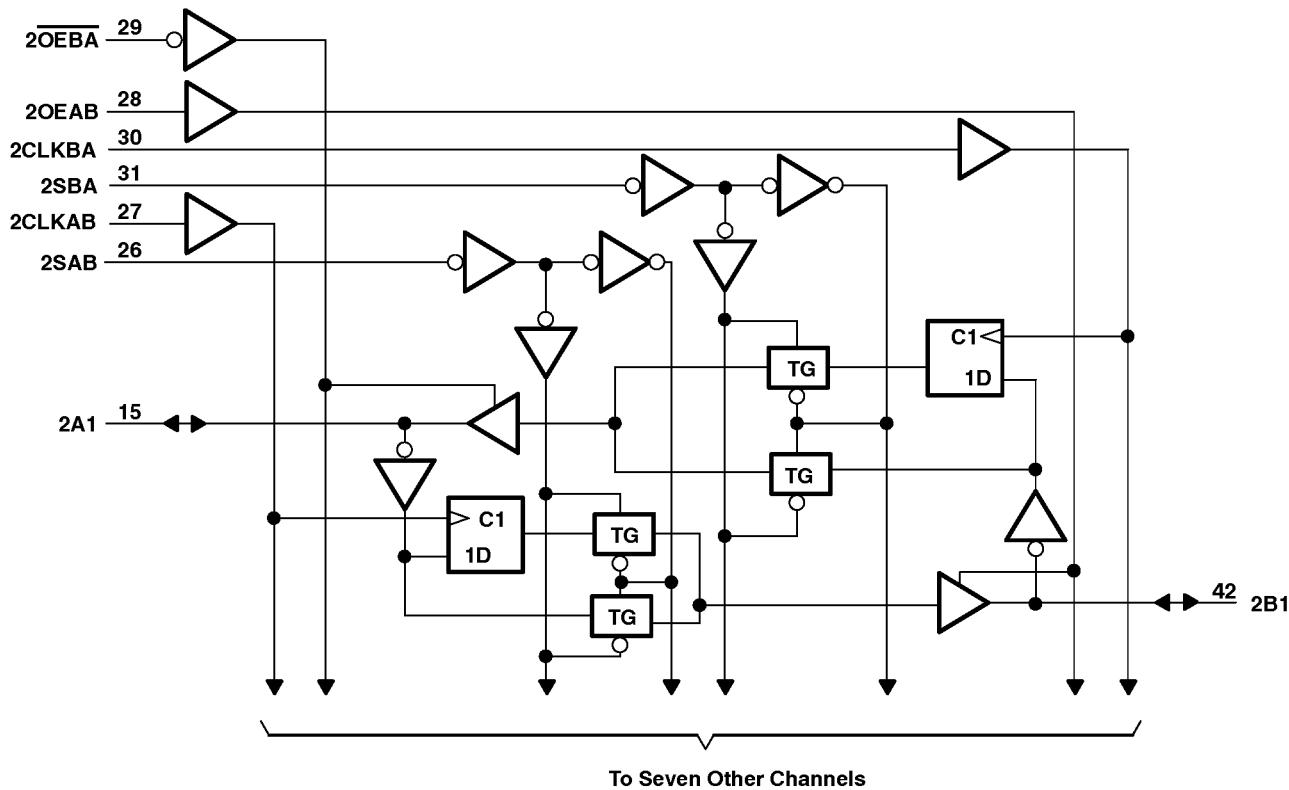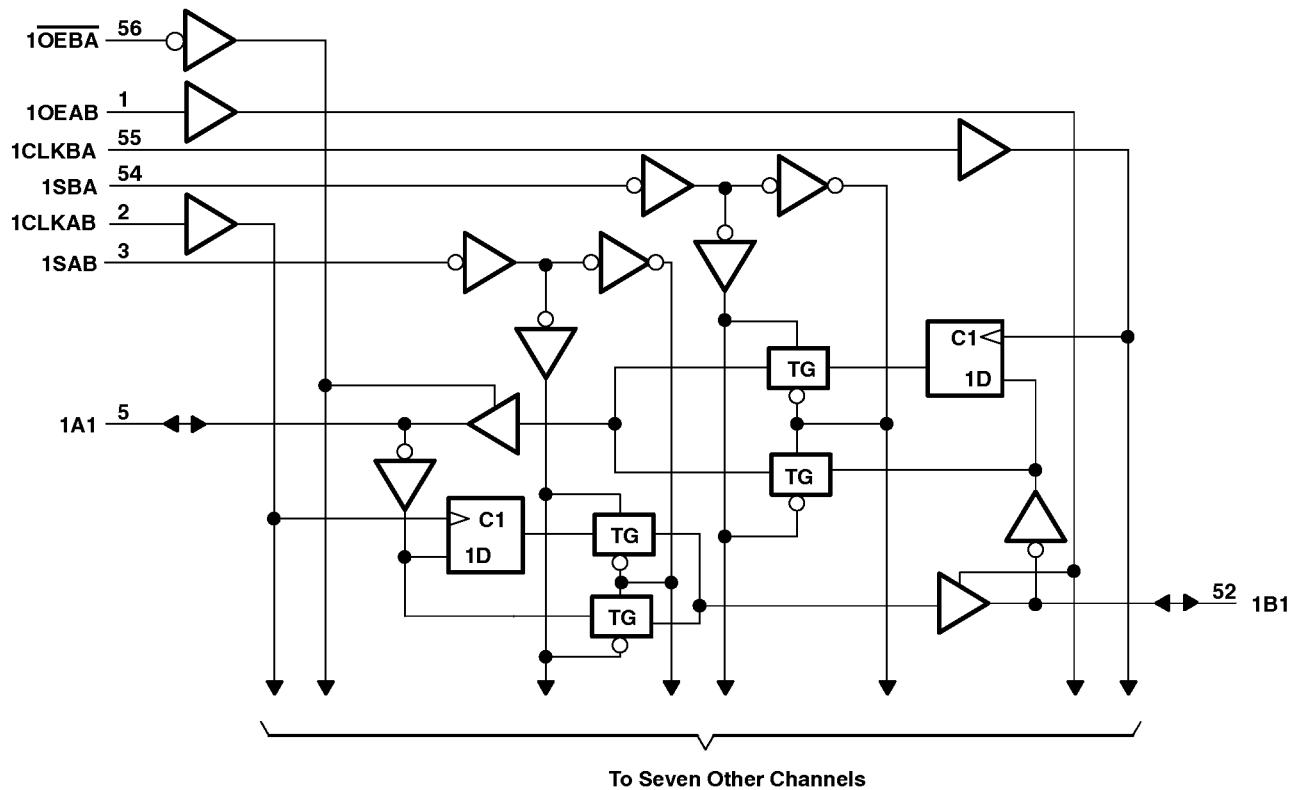
To Seven Other Channels

To Seven Other Channels

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 package power dissipation at T_A = 55°C (in still air) (see Note 2): 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 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)

		54ACT16651			74ACT16651			UNIT
		MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage	4.5	5	5.5	4.5	5	5.5	V
V_{IH}	High-level input voltage	2			2			V
V_{IL}	Low-level input voltage			0.8			0.8	V
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			–24			–24	mA
I_{OL}	Low-level output current			24			24	mA
$\Delta t/\Delta v$	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.

TEXAS INSTRUMENTS

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

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

PARAMETER		TEST CONDITIONS	V_{CC}	$T_A = 25°C$			54ACT16651		74ACT16651		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V_{OH}		$I_{OH} = -50 \ \mu A$	4.5 V	4.4			4.4		4.4		V
			5.5 V	5.4			5.4		5.4		
		$I_{OH} = -24 \ mA$	4.5 V	3.94			3.7		3.8		
			5.5 V	4.94			4.7		4.8		
		$I_{OH} = -50 \ mA†$	5.5 V				3.85				
		$I_{OH} = -75 \ mA†$	5.5 V						3.85		
V_{OL}		$I_{OL} = 50 \ \mu A$	4.5 V			0.1		0.1		0.1	V
			5.5 V			0.1		0.1		0.1	
		$I_{OL} = 24 \ mA$	4.5 V			0.36		0.5		0.44	
			5.5 V			0.36		0.5		0.44	
		$I_{OL} = 50 \ mA†$	5.5 V					1.65			
		$I_{OL} = 75 \ mA†$	5.5 V							1.65	
I_I	Control inputs	$V_I = V_{CC}$ or GND	5.5 V			±0.1		±1		±1	μA
$I_{OZ}‡$	A or B ports	$V_O = V_{CC}$ or GND	5.5 V			±0.5		±10		±5	μA
I_{CC}		$V_I = V_{CC}$ or GND, $\quad I_O = 0$	5.5 V			8		160		80	μA
$\Delta I_{CC}§$		One input at 3.4 V, Other inputs at V_{CC} or GND	5.5 V			0.9		1		1	mA
C_i	Control inputs	$V_I = V_{CC}$ or GND	5 V		4						pF
C_{io}	A or B ports	$V_O = V_{CC}$ or GND	5 V		12						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_{OZ} includes the input leakage current.
§ This is the increase in supply current for each input that is at one of the specified TTL voltage levels rather than 0 V or V_{CC}.

timing requirements over recommended operating free-air temperature range, V_{CC} = 5 V ± 0.5 V (unless otherwise noted) (see Figure 2)

		$T_A = 25°C$		54ACT16651		74ACT16651		UNIT
		MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency	0	90	0	90	0	90	MHz
t_w	Pulse duration, CLKAB or CLKBA high or low	5.5		5.5		5.5		ns
t_{su}	Setup time, A before CLKAB↑ or B before CLKBA↑	5.3		5.3		5.3		ns
t_h	Hold time, A after CLKAB↑ or B after CLKBA↑	1		1		1		ns

TEXAS INSTRUMENTS

switching characteristics over recommended operating free-air temperature range,
V_{CC} **= 5 V ± 0.5 V (unless otherwise noted) (see Figure 2)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	T_A = 25°C			54ACT16651		74ACT16651		UNIT
			MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			90			90		90		MHz
t_{PLH}	A or B	B or A	3	6.6	10	3	12.2	3	11.3	ns
t_{PHL}			4.6	8	10.6	4.6	12.7	4.6	11.9	
t_{PLH}	CLKBA or CLKAB	A or B	5.4	9.1	12	5.4	14.8	5.4	13.7	ns
t_{PHL}			5.4	9.1	12	5.4	14.6	5.4	13.6	
t_{PLH}	SBA or SAB (with A or B high)	A or B	4.6	7.9	10.5	4.6	13.1	4.6	12.1	ns
t_{PHL}			5.4	10.9	15.5	5.4	19.6	5.4	17.8	
t_{PLH}	SBA or SAB (with A or B low)	A or B	5	10.4	14.9	5	19.2	5	17.3	ns
t_{PHL}			4.9	8.6	11.9	4.9	13.7	4.9	12.7	
t_{PZH}	$\overline{OEBA}$	A	3.2	7.2	10.8	3.2	13.6	3.2	12.3	ns
t_{PZL}			3.8	8	12.2	3.8	15.3	3.8	13.9	
t_{PHZ}	$\overline{OEBA}$	A	5.1	7.8	9.8	5.1	11.3	5.1	10.6	ns
t_{PLZ}			4.9	7.7	9.9	4.9	11.4	4.9	10.8	
t_{PZH}	OEAB	B	4.9	8	10.5	4.9	12.9	4.9	11.9	ns
t_{PZL}			5.4	8.8	11.8	5.4	14.7	5.4	13.5	
t_{PHZ}	OEAB	B	4.3	7.5	10.7	4.3	12	4.3	11.4	ns
t_{PLZ}			4.5	7.6	10.8	4.5	12.3	4.5	11.6	

operating characteristics, V_{CC} **= 5 V,** T_A **= 25°C**

PARAMETER		TEST CONDITIONS		TYP	UNIT
C_{pd}	Power dissipation capacitance per transceiver	Outputs enabled	C_L = 50 pF, f = 1 MHz	62	pF
		Outputs disabled		14	

![Texas Instruments logo] **TEXAS INSTRUMENTS**

PARAMETER MEASUREMENT INFORMATION

TEST	S1
t_{PLH}/t_{PHL}	Open
t_{PLZ}/t_{PZL}	$2 \times V_{CC}$
t_{PHZ}/t_{PZH}	GND
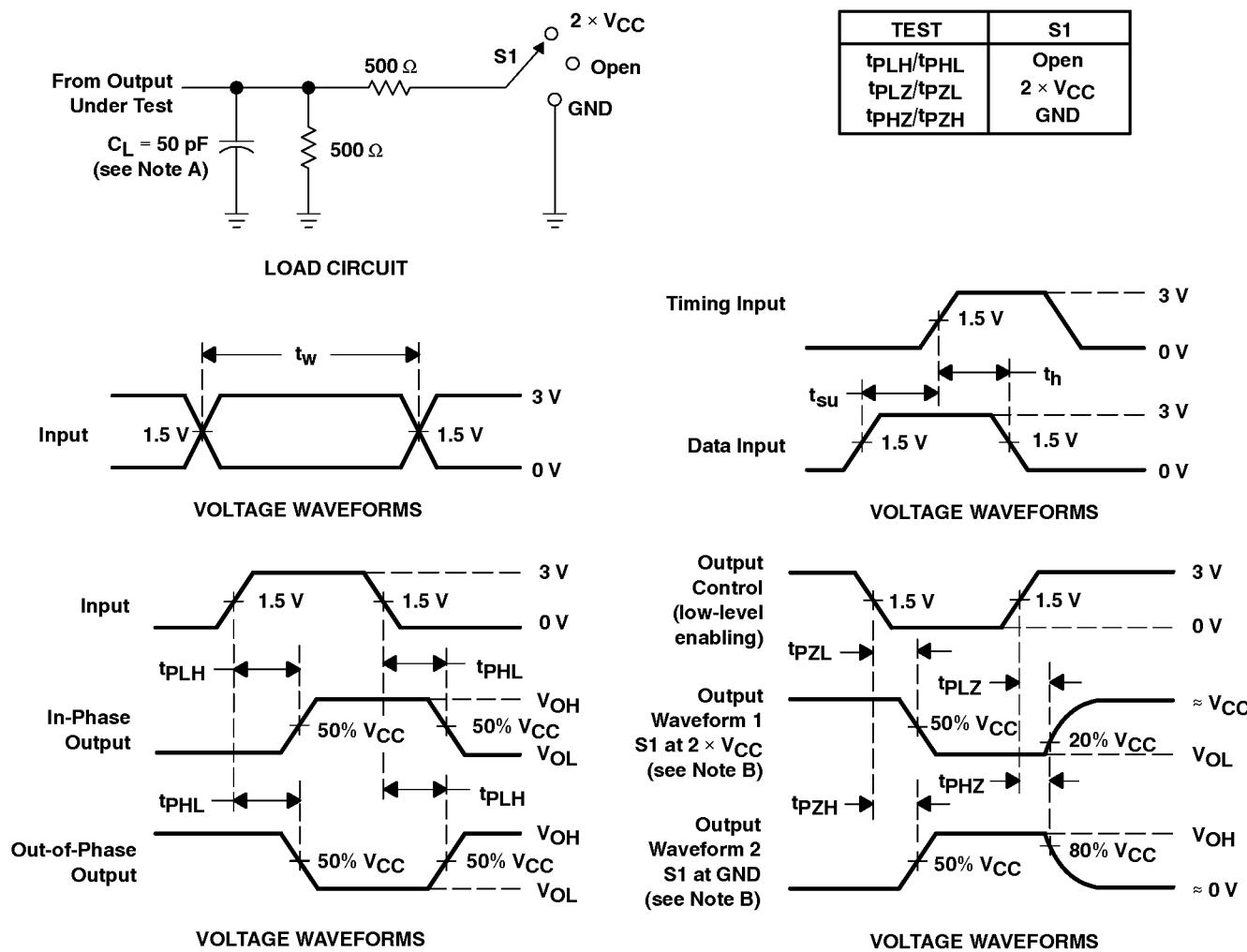
NOTES: A. C_L includes probe and jig capacitance.
    B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control.
        Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
    C. All input pulses are supplied by generators having the following characteristics: PRR ≤ 1 MHz, Z_O = 50 Ω, t_r = 3 ns, t_f = 3 ns.
    D. The outputs are measured one at a time with one input transition per measurement.

Figure 2. Load Circuit and Voltage Waveforms