

# SN74ALS233B

## 16 × 5 ASYNCHRONOUS FIRST-IN, FIRST-OUT MEMORY

SCAS253 – MARCH 1990 – REVISED JUNE 1992

- Independent Asynchronous Inputs and Outputs
- 16 Words by 5 Bits
- Data Rates From 0 to 40 MHz
- Fall-Through Time . . . 14 ns Typ
- 3-State Outputs
- Package Options Include Plastic Small-Outline Packages (DW), Plastic Chip Carriers (FN), and Standard Plastic 300-mil DIPs (N)

### description

This 80-bit memory uses advanced low-power Schottky technology and features high speed and a fast fall-through time. It is organized as 16 words by 5 bits.

A FIFO memory is a storage device that allows data to be written into and read from its array at independent data rates. This FIFO is designed to process data at rates from 0 to 40 MHz in a bit-parallel format, word by word.

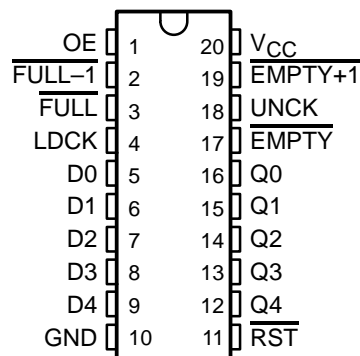
Data is written into memory on a low-to-high transition at the load clock (LDCK) input and is read out on a low-to-high transition at the unload clock (UNCK) input. The memory is full when the number of words clocked in exceeds by 16 the number of words clocked out. When the memory is full, LDCK signals have no effect. When the memory is empty, UNCK signals have no effect.

Status of the FIFO memory is monitored by the  $\overline{\text{FULL}}$ ,  $\overline{\text{EMPTY}}$ ,  $\overline{\text{FULL-1}}$ , and  $\overline{\text{EMPTY+1}}$  output flags. The  $\overline{\text{FULL}}$  output is low when the memory is full and high when it is not full. The  $\overline{\text{FULL-1}}$  output is low when the memory contains 15 data words. The  $\overline{\text{EMPTY}}$  output is low when the memory is empty and high when it is not empty. The  $\overline{\text{EMPTY+1}}$  output is low when one word remains in memory.

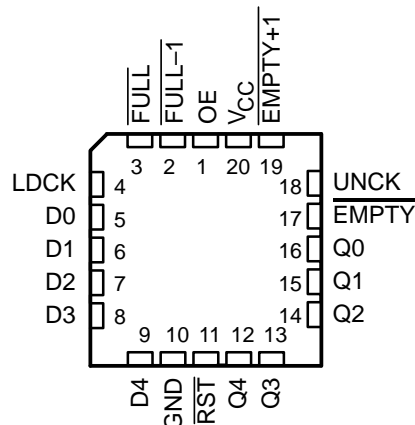
A low level on the reset ( $\overline{\text{RST}}$ ) input resets the internal stack control pointers and also sets  $\overline{\text{EMPTY}}$  low and sets  $\overline{\text{FULL}}$ ,  $\overline{\text{FULL-1}}$ , and  $\overline{\text{EMPTY+1}}$  high. The Q outputs are not reset to any specific logic level. The first low-to-high transition on LDCK, after either a  $\overline{\text{RST}}$  pulse or from an empty condition, causes  $\overline{\text{EMPTY}}$  to go high and the data to appear on the Q outputs. It is important to note that the first word does not have to be unloaded. Data outputs are noninverting with respect to the data inputs and are at high impedance when the output-enable (OE) input is low. OE does not affect the output flags. Cascading is easily accomplished in the word-width direction but is not possible in the word-depth direction.

The SN74ALS233B is characterized for operation from 0°C to 70°C.

DW OR N PACKAGE  
(TOP VIEW)



FN PACKAGE  
(TOP VIEW)



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**TEXAS  
INSTRUMENTS**

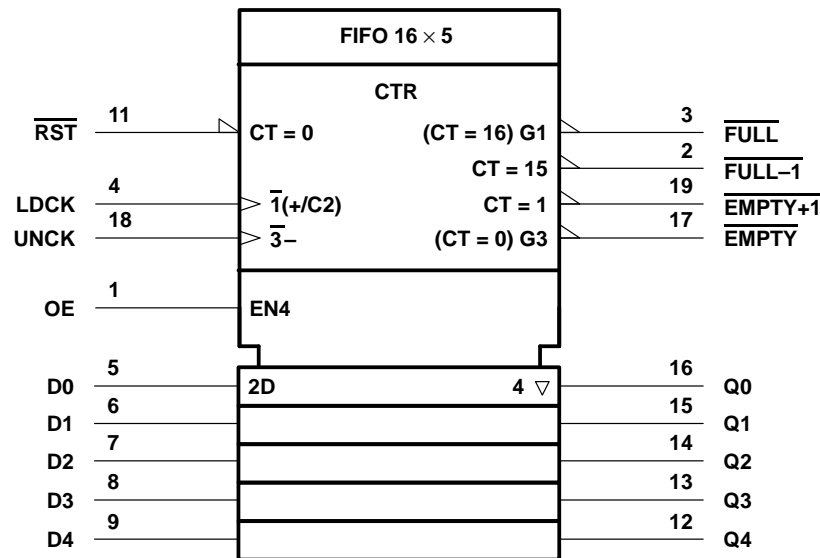
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SCAS253 – MARCH 1990 – REVISED JUNE 1992

logic symbol†



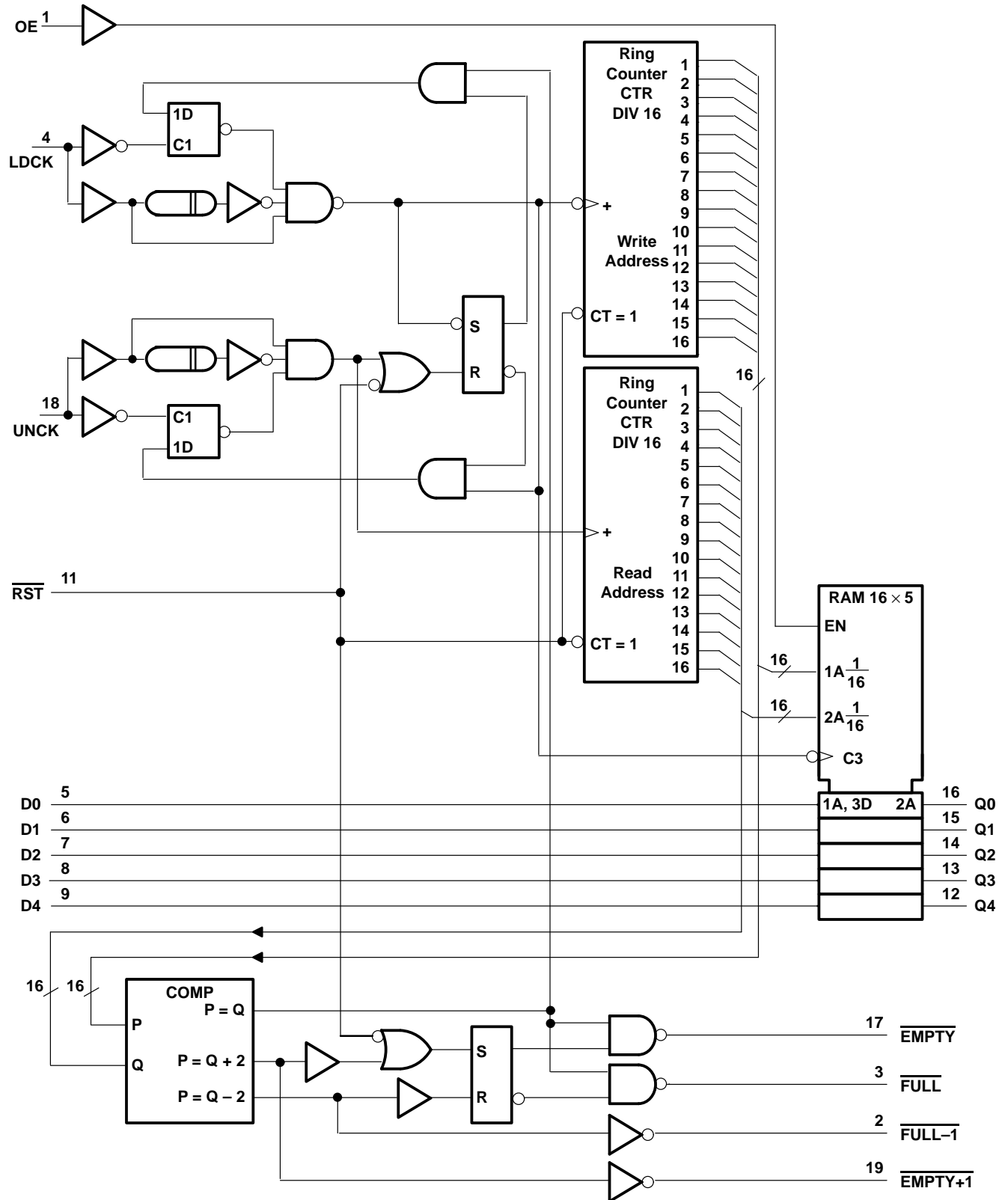
† This symbol is in accordance with ANSI/IEEE Standard 91-1984 and IEC Publication 617-12. The symbol is functionally accurate but does not show the details of implementation; for these, see the logic diagram. The symbol represents the memory as if it were controlled by a single counter whose content is the number of words stored at the time. Output data is invalid when the counter content (CT) is 0. Pin numbers shown are for the DW and N packages.

# SN74ALS233B

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SCAS253 – MARCH 1990 – REVISED JUNE 1992

### logic diagram (positive logic)

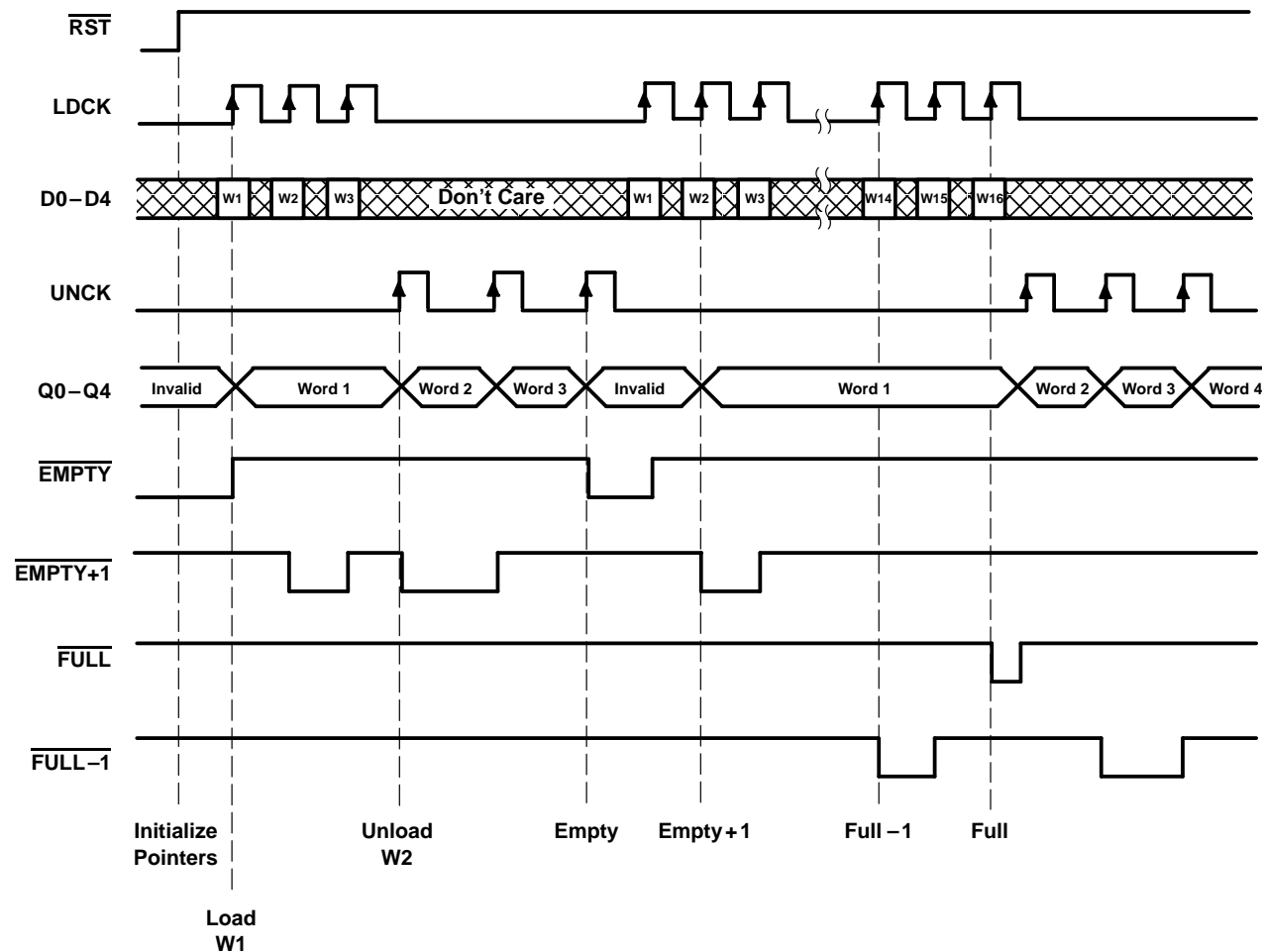


Pin numbers shown are for the DW and N packages.

SN74ALS233B  
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SCAS253 – MARCH 1990 – REVISED JUNE 1992

timing diagram



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

Supply voltage, $V_{CC}$	7 V
Input voltage, $V_I$	7 V
Voltage applied to a disabled 3-state output	5.5 V
Operating free-air temperature range, $T_A$	0°C to 70°C
Storage temperature range	-65°C to 150°C

<sup>†</sup> 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.

# SN74ALS233B

## 16 × 5 ASYNCHRONOUS FIRST-IN, FIRST-OUT MEMORY

SCAS253 – MARCH 1990 – REVISED JUNE 1992

### recommended operating conditions (see Note 1)

		MIN	NOM	MAX	UNIT
V <sub>CC</sub>	Supply voltage	4.5	5	5.5	V
V <sub>IH</sub>	High-level input voltage	2			V
V <sub>IL</sub>	Low-level input voltage			0.8	V
I <sub>OH</sub>	High-level output current			–1.6	mA
				–0.4	
I <sub>OL</sub>	Low-level output current			24	mA
				8	
f <sub>clock</sub>	Clock frequency			0	MHz
				40	
t <sub>w</sub>	Pulse duration			18	ns
				15	
				10	
				15	
				10	
t <sub>su</sub>	Setup time			8	ns
				5	
				5	
t <sub>h</sub>	Hold time			5	ns
T <sub>A</sub>	Operating free-air temperature	0		70	°C

NOTE 1: To ensure proper operation of this high-speed FIFO device, it is necessary to provide a clean signal to the LDCK and UNCK clock inputs. Any excessive noise or glitching on the clock inputs that violates the V<sub>IL</sub>, V<sub>IH</sub>, or minimum pulse duration limits can cause a false clock or improper operation of the internal read and write pointers.

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

PARAMETER		TEST CONDITIONS		MIN	TYP†	MAX	UNIT
V <sub>IK</sub>		V <sub>CC</sub> = 4.5 V,	I <sub>I</sub> = –18 mA			–1.2	V
V <sub>OH</sub>	Q outputs	V <sub>CC</sub> = 4.5 V,	I <sub>OH</sub> = –2.6 mA	2.4	3.2		V
	Status flags	V <sub>CC</sub> = 4.5 V to 5.5 V,	I <sub>OH</sub> = –0.4 mA	V <sub>CC</sub> – 2			
V <sub>OL</sub>	Q outputs	V <sub>CC</sub> = 4.5 V,	I <sub>OL</sub> = 12 mA	0.25	0.4		V
		V <sub>CC</sub> = 4.5 V,	I <sub>OL</sub> = 24 mA	0.35	0.5		
	Status flags	V <sub>CC</sub> = 4.5 V,	I <sub>OL</sub> = 4 mA	0.25	0.4		
		V <sub>CC</sub> = 4.5 V,	I <sub>OL</sub> = 8 mA	0.35	0.5		
I <sub>OZH</sub>		V <sub>CC</sub> = 5.5 V,	V <sub>O</sub> = 2.7 V			20	μA
I <sub>OZL</sub>		V <sub>CC</sub> = 5.5 V,	V <sub>O</sub> = 0.4 V			–20	μA
I <sub>I</sub>		V <sub>CC</sub> = 5.5 V,	V <sub>I</sub> = 7 V			0.1	mA
I <sub>IH</sub>		V <sub>CC</sub> = 5.5 V,	V <sub>I</sub> = 2.7 V			20	μA
I <sub>IL</sub>		V <sub>CC</sub> = 5.5 V,	V <sub>I</sub> = 0.4 V			–0.2	mA
I <sub>O‡</sub>		V <sub>CC</sub> = 5.5 V,	V <sub>O</sub> = 2.25 V	–30		–112	mA
I <sub>CC</sub>		V <sub>CC</sub> = 5.5 V			88	133	mA

† All typical values are at V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C.

‡ The output conditions have been chosen to produce a current that closely approximates one half of the true short-circuit output current, I<sub>OS</sub>.



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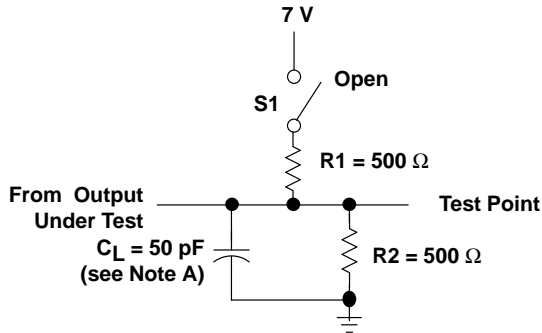
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SCAS253 – MARCH 1990 – REVISED JUNE 1992

### switching characteristics (see Figure 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 4.5 V to 5.5 V, C <sub>L</sub> = 50 pF, R1 = 500 Ω, R2 = 500 Ω, T <sub>A</sub> = 0°C to 70°C		UNIT
			MIN	MAX	
f <sub>max</sub>	LDCK, UNCK		40		MHz
t <sub>pd</sub>	LDCK↑	Any Q	6	32	ns
	UNCK↑		6	30	
t <sub>PLH</sub>	LDCK↑	$\overline{\text{EMPTY}}$	5	25	ns
t <sub>PHL</sub>	UNCK↑		6	27	
t <sub>PHL</sub>	$\overline{\text{RST}}$ ↓	$\overline{\text{EMPTY}}$	5	25	ns
t <sub>pd</sub>	LDCK↑	$\overline{\text{EMPTY}}+1$	7	34	ns
	UNCK↑		7	34	
t <sub>PLH</sub>	$\overline{\text{RST}}$ ↓	$\overline{\text{EMPTY}}+1$	8	31	ns
t <sub>pd</sub>	LDCK↑	$\overline{\text{FULL}}-1$	9	33	ns
	UNCK↑		8	32	
t <sub>PLH</sub>	$\overline{\text{RST}}$ ↓	$\overline{\text{FULL}}-1$	11	32	ns
t <sub>PHL</sub>	LDCK↑	$\overline{\text{FULL}}$	6	27	ns
t <sub>PLH</sub>	UNCK↑	$\overline{\text{FULL}}$	5	25	ns
	$\overline{\text{RST}}$ ↓		9	30	
t <sub>en</sub>	OE↑	Q	2	15	ns
t <sub>dis</sub>	OE↓	Q	1	15	ns

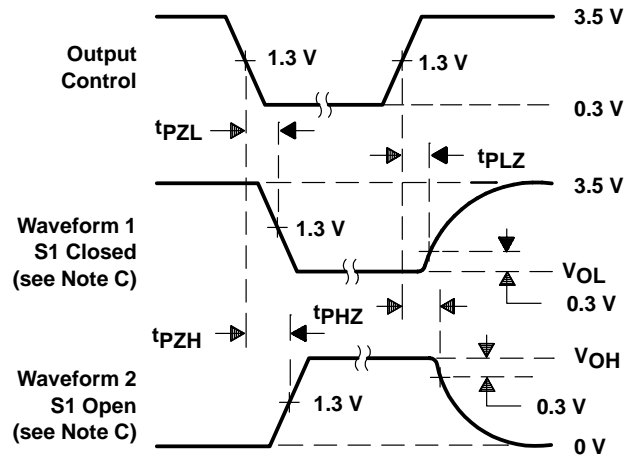
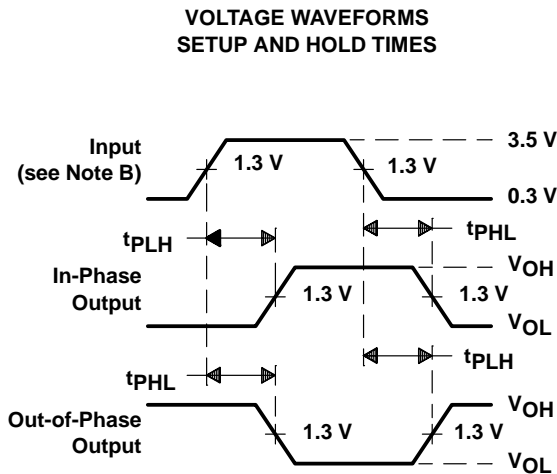
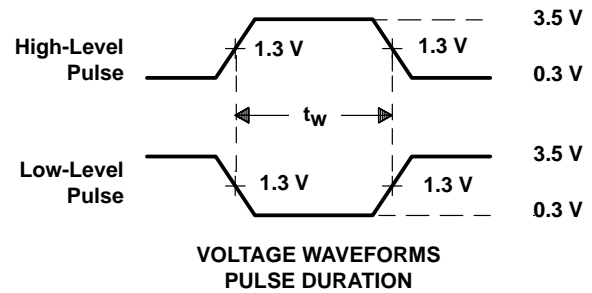
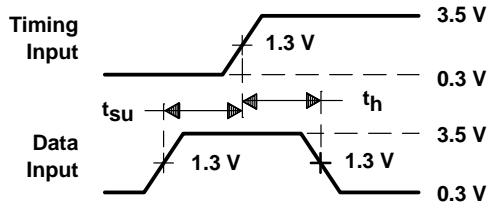
## PARAMETER MEASUREMENT INFORMATION



SWITCH POSITION TABLE

TEST	S1
t <sub>PLH</sub>	Open
t <sub>PHL</sub>	Open
t <sub>PZH</sub>	Open
t <sub>PZL</sub>	Closed
t <sub>PHZ</sub>	Open
t <sub>PLZ</sub>	Closed

LOAD CIRCUIT FOR 3-STATE OUTPUTS



- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1 \text{ MHz}$ ,  $Z_0 = 50 \Omega$ ,  $t_r \leq 2 \text{ ns}$ ,  $t_f \leq 2 \text{ ns}$ .  
 C. 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.  
 D. The outputs are measured one at a time with one transition per measurement.

**Figure 1. Load Circuit and Voltage Waveforms**

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