

- Asynchronous Operation
- Organized as 64 Words by 5 Bits
- Data Rates From 0 to 25 MHz
- 3-State Outputs
- Package Options Include Plastic Small-Outline Packages (DW), Plastic J-Leaded Chip Carriers (FN), and Standard Plastic 300-mil DIPs (N)

## description

The SN74ALS235 is a 320-bit memory utilizing advanced low-power Schottky IMPACT™ technology. It features high speed with fast fall-through times and is organized as 64 words by 5 bits.

A first-in, first-out (FIFO) memory is a storage device that allows data to be written into and read from its array at independent data rates. The SN74ALS235 is designed to process data at rates from 0 to 25 MHz in a bit-parallel format, word by word.

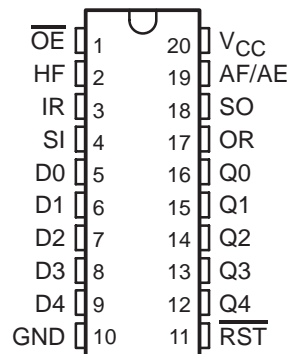
Data is written into memory on the rising edge of the shift-in (SI) input. When SI goes low, the first data word ripples through to the output (see Figure 1). As the FIFO fills up, the data words stack up in the order they were written. When the FIFO is full, additional shift-in pulses have no effect. Data is shifted out of memory on the falling edge of the shift-out (SO) input (see Figure 2). When the FIFO is empty, additional SO pulses have no effect. The last data word remains at the outputs until a new word falls through or reset (RST) goes low.

Status of the SN74ALS235 FIFO memory is monitored by the output-ready (OR), input-ready (IR), almost-full/almost-empty (AF/AE), and half-full (HF) flags. When OR is high, valid data is available at the outputs. OR is low when SO is high and stays low when the FIFO is empty. IR is high when the inputs are ready to receive more data. IR is low when SI is high and stays low when the FIFO is full. AF/AE is high when the FIFO contains eight or less words (see Figure 5) or 56 or more words (see Figure 6). AF/AE is low when the FIFO contains between nine and 55 words. HF is high when the FIFO contains 32 or more words and is low when the FIFO contains 31 words or less (see Figure 7).

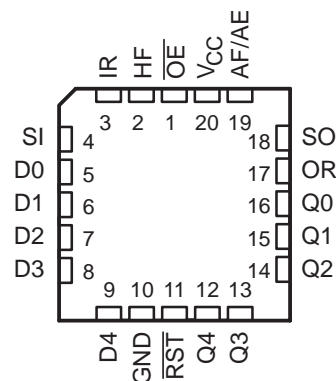
When the FIFO is empty, input data is shifted to the output automatically when SI goes low. If SO is held high during this time, the OR flag pulses high indicating valid data at the outputs (see Figure 3).

When the FIFO is full, data can be shifted in automatically by holding SI high and taking SO low. One propagation delay after SO goes low, IR will go high. If SI is still high when IR goes high, data at the inputs are automatically shifted in. Since IR is normally low when the FIFO is full and SI is high, only a high-level pulse is seen on the IR output.

DW OR N PACKAGE  
(TOP VIEW)



FN PACKAGE  
(TOP VIEW)



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INSTRUMENTS**

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# SN74ALS235

## 64 × 5 ASYNCHRONOUS FIRST-IN, FIRST-OUT MEMORY

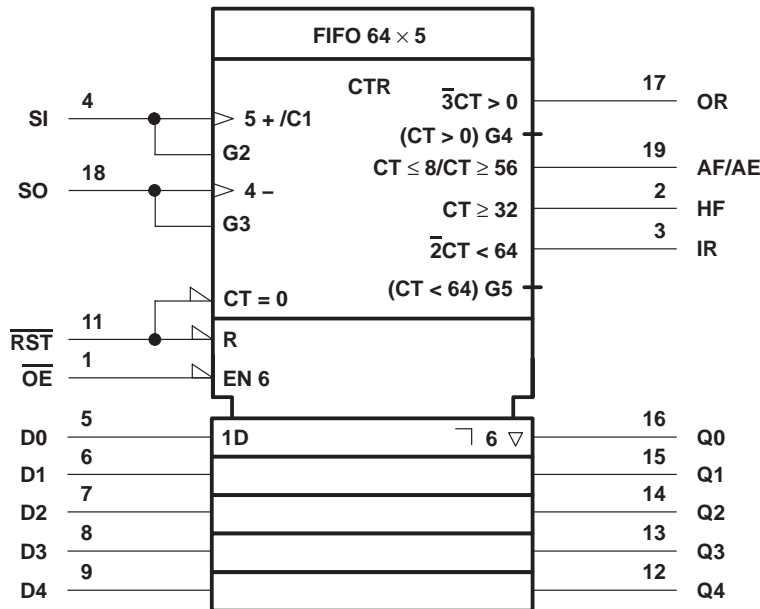
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### description (continued)

The FIFO must be reset after power up with a low-level pulse on the master reset ( $\overline{RST}$ ) input. This sets IR high and OR low signifying that the FIFO is empty. Resetting the FIFO sets the outputs to a low logic level (see Figure 1). If SI is high when  $\overline{RST}$  goes high, the input data is shifted in and IR goes low and remains low until SI goes low. If SI goes low before  $\overline{RST}$  goes high, the input data will not be shifted in and IR goes high. Data outputs are noninverting with respect to the data inputs and are at high impedance when the output-enable ( $\overline{OE}$ ) input is high.  $\overline{OE}$  does not affect the status-flag outputs (see Figure 2).

The SN74ALS235 is characterized for operation from 0°C to 70°C.

### logic symbol†



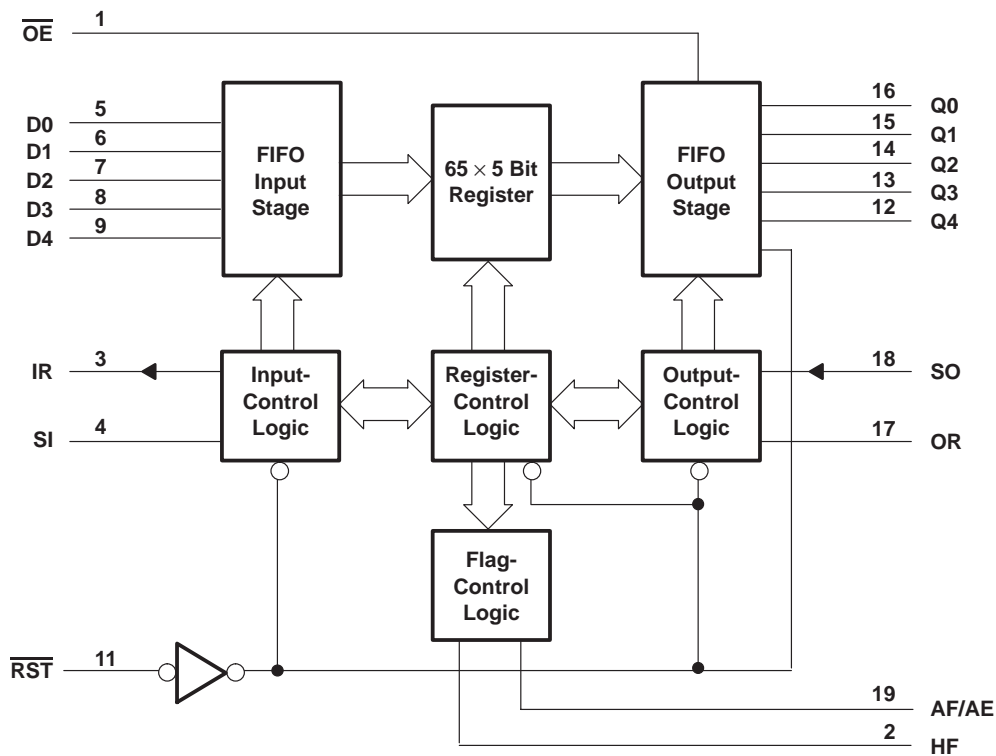
† This symbol is in accordance with ANSI/IEEE Standard 91-1984 and IEC Publication 617-12.

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## 64 × 5 ASYNCHRONOUS FIRST-IN, FIRST-OUT MEMORY

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### functional block diagram

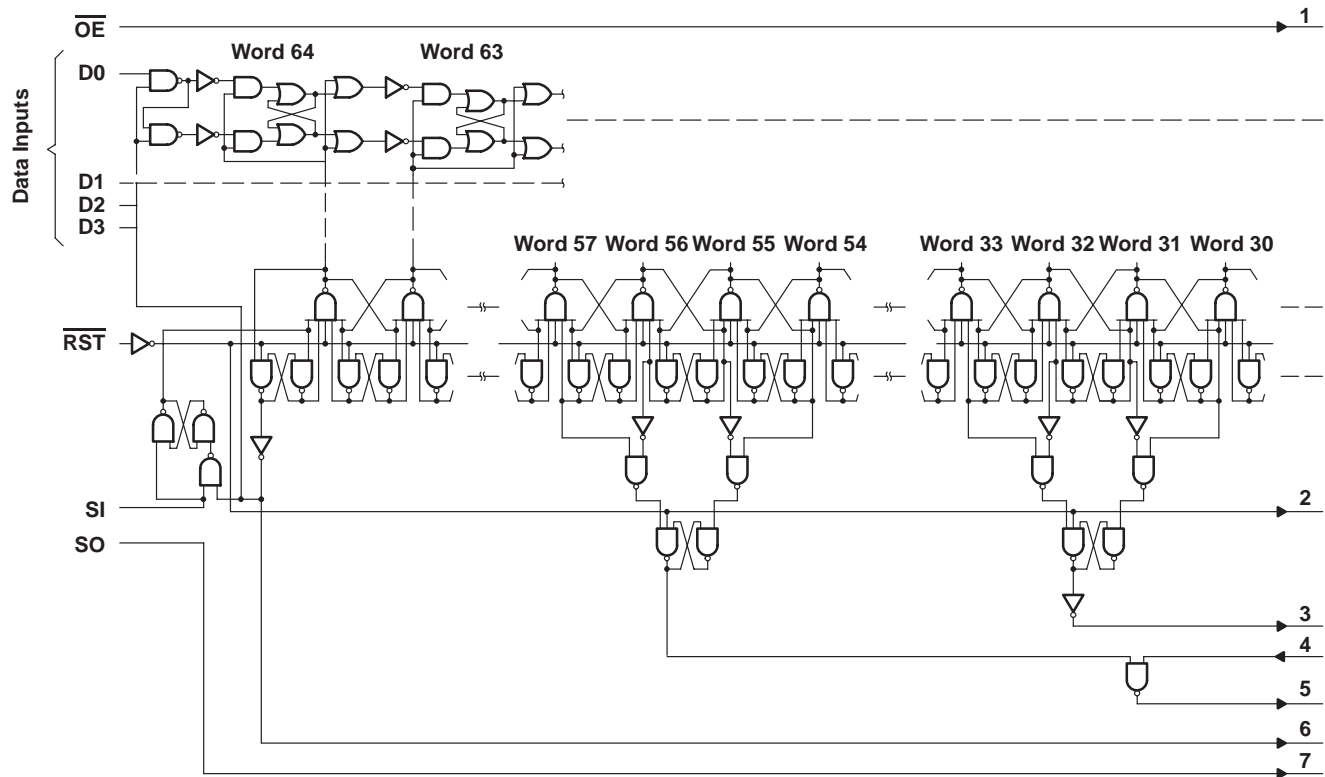


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### logic diagram (positive logic)



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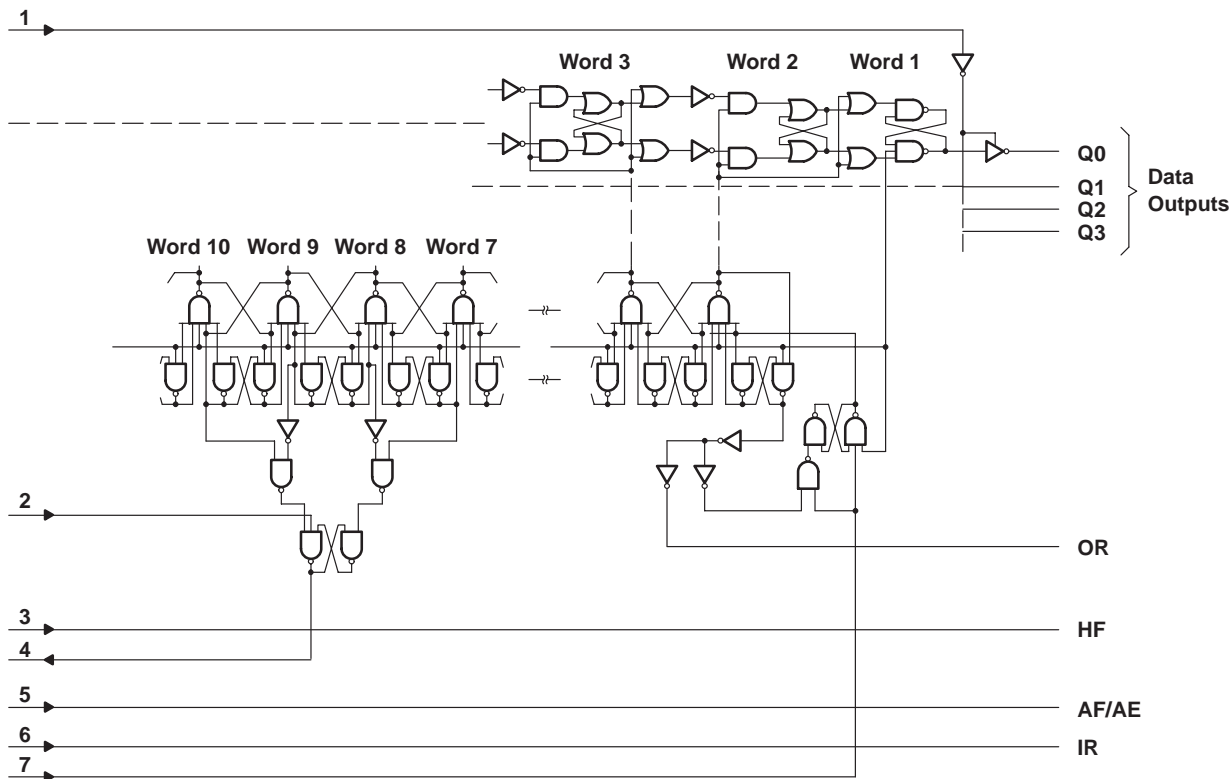
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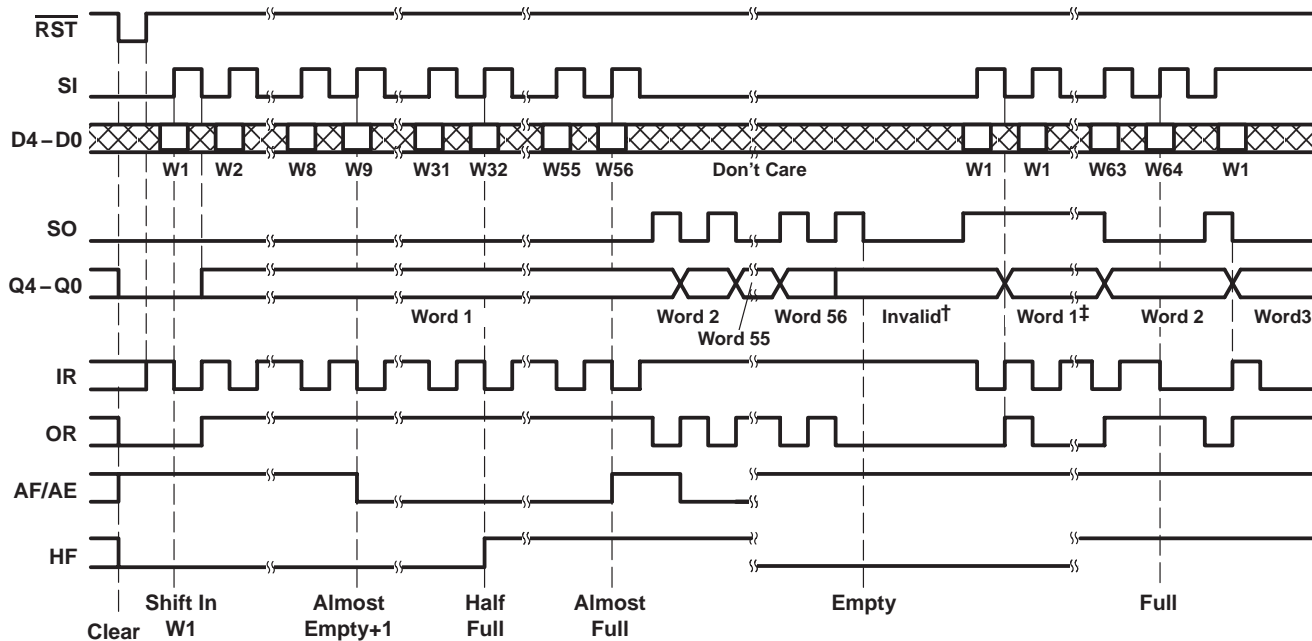
## 64 × 5 ASYNCHRONOUS FIRST-IN, FIRST-OUT MEMORY

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### logic diagram (positive logic) (continued)



### timing diagram



† The last data word shifted out of the FIFO remains at the output until a new word falls through or a  $\overline{\text{RST}}$  pulse clears the FIFO.

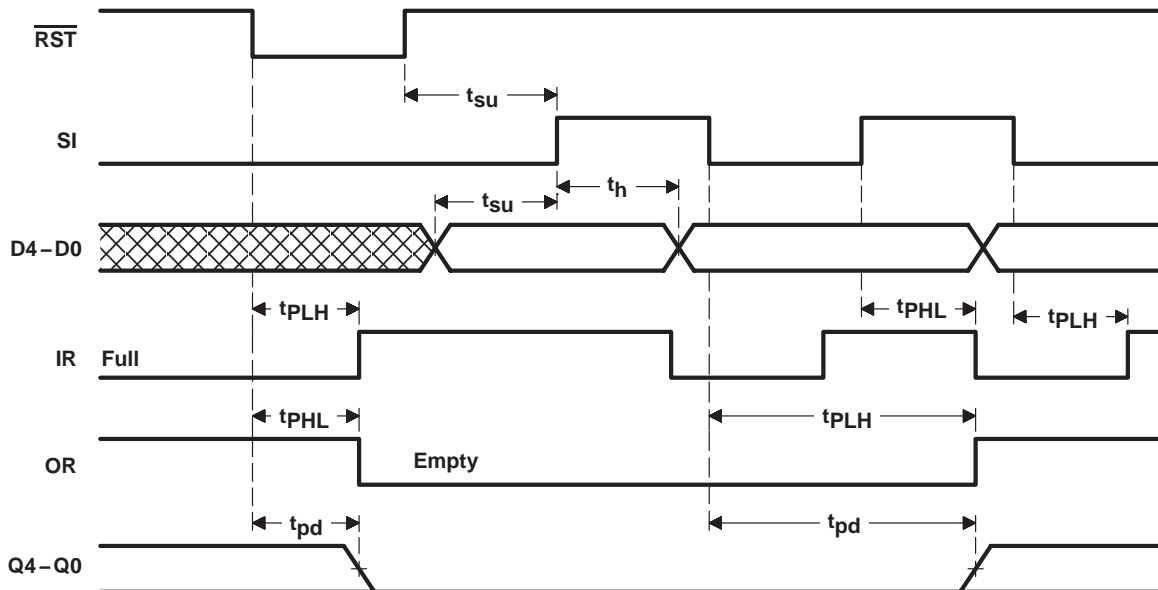
‡ While the output data is considered valid only when the OR flag is high, the stored data remains at the output. Any additional words written into the FIFO will stack up behind the first word and will not appear at the output until SO is taken low.



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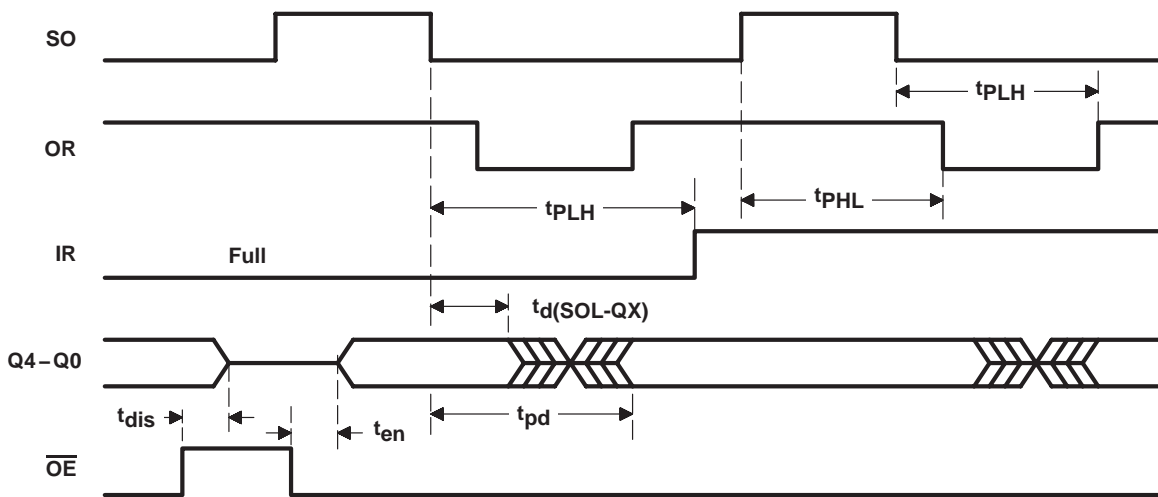
## 64 × 5 ASYNCHRONOUS FIRST-IN, FIRST-OUT MEMORY

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NOTE A: SO is low.

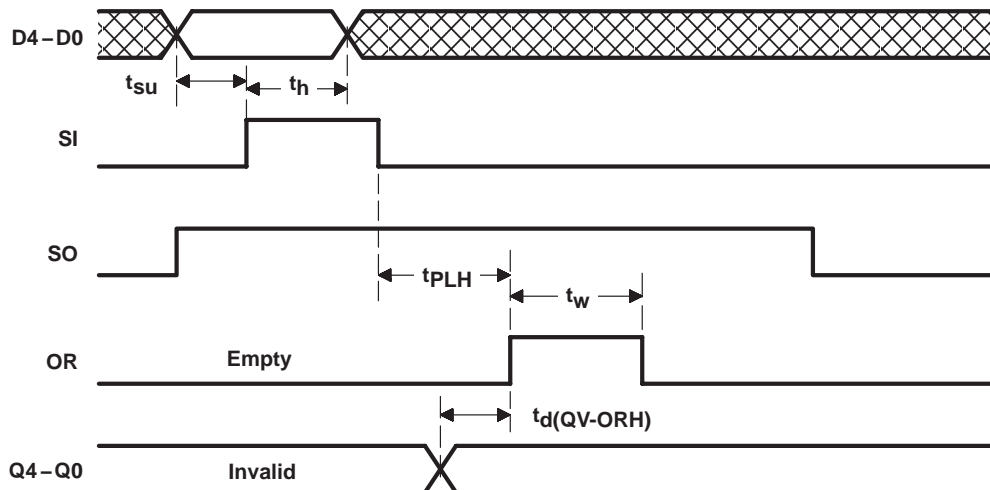
Figure 1. Master Reset and Data-In Waveforms



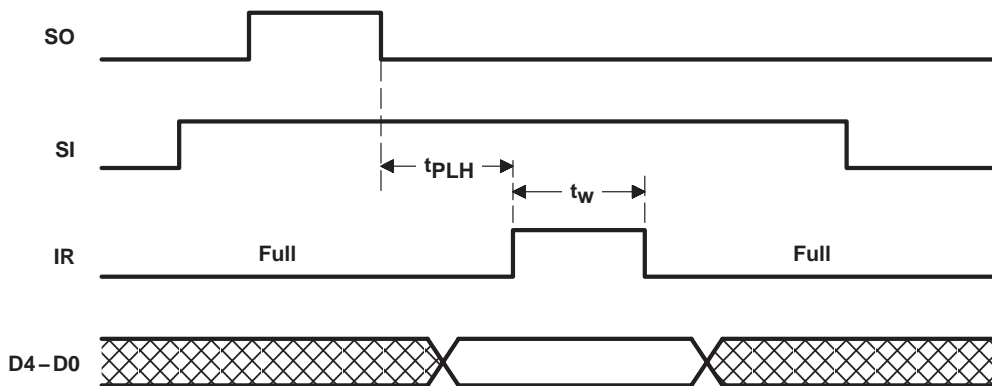
NOTE A: SI is low.

Figure 2. Data-Out Waveforms





**Figure 3. Data Fall-Through Waveforms**



**Figure 4. Automatic Data-In Waveforms**

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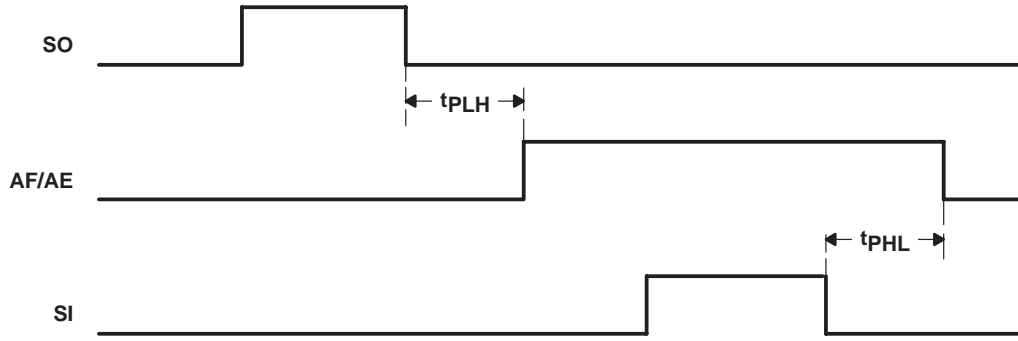


Figure 5. Almost-Empty Waveforms

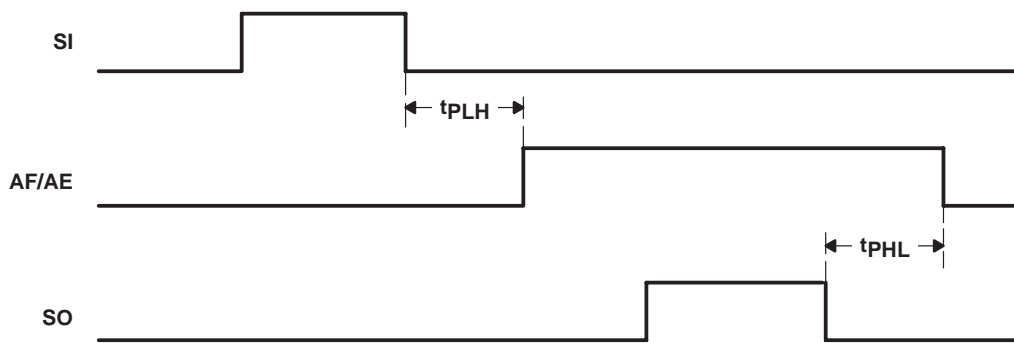


Figure 6. Almost-Full Waveforms

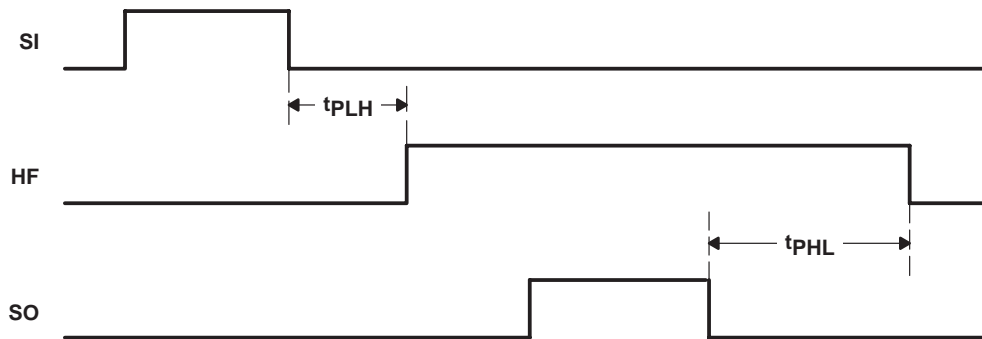


Figure 7. Half-Full Waveforms





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## 64 × 5 ASYNCHRONOUS FIRST-IN, FIRST-OUT MEMORY

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

Supply voltage, $V_{CC}$ (see Note 1)	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°
Storage temperature range	–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.

NOTE 1: All voltage values are with respect to GND.

### recommended operating conditions

		MIN	NOM	MAX	UNIT	
$V_{CC}$	Supply voltage	4.5	5	5.5	V	
$V_{IH}$	High-level input voltage	2			V	
$V_{IL}$	Low-level input voltage			0.8	V	
$I_{OH}$	High-level output current	Q outputs		– 2.6	mA	
		Flags		– 0.4		
$I_{OL}$	Low-level output current	Q outputs		24	mA	
		Flags		8		
$f_{clock}$	Clock frequency			0	25	MHz
$t_w$	Pulse duration	SI or SO	High or low	15		ns
		$\overline{RST}$	Low	15		
$t_{su}$	Setup time before $SI\uparrow$	Data		0		ns
		$\overline{RST}$	High (inactive)	15		
$t_h$	Hold time, data after $SI\uparrow$	17				ns
$T_A$	Operating free-air temperature	0		70		°C



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## 64 × 5 ASYNCHRONOUS FIRST-IN, FIRST-OUT MEMORY

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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>	Any Q	V <sub>CC</sub> = 4.5 V	I <sub>OH</sub> = -1 mA				V	
			I <sub>OH</sub> = -2.6 mA	2.4	3.2			
	Flags	V <sub>CC</sub> = 4.5 V,	I <sub>OH</sub> = -0.4 mA	2.7	3.4			
V <sub>OL</sub>	Any Q	V <sub>CC</sub> = 4.5 V	I <sub>OL</sub> = 12 mA		0.25	0.4	V	
			I <sub>OL</sub> = 24 mA		0.35	0.5		
	Flags	V <sub>CC</sub> = 4.5 V	I <sub>OL</sub> = 4 mA		0.25	0.4		
			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			-0.1	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		Low		112	165	mA
				High		105	160	
				Disabled		115	170	

† 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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### switching characteristics (see Figure 9)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V <sub>CC</sub> = 5 V, C <sub>L</sub> = 50 pF, R1 = 500 Ω, R2 = 500 Ω, T <sub>A</sub> = 25°C			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> = MIN to MAX†		UNIT
			MIN	TYP	MAX	MIN	MAX	
f <sub>max</sub>	SI		30			25		MHz
	SO		30			25		
tw‡	IR high		15			8		ns
tw§	OR high		19			8		ns
t <sub>d</sub> (QV-ORH)	Q valid before OR↑		6	9	-5	12	ns	
t <sub>d</sub> (SOL-QX)	Q valid after SO↓		13			4		ns
t <sub>pd</sub>	SI↓	Q	600	800	350	1000	ns	
t <sub>PHL</sub>	SI↑	IR	20	26	8	30	ns	
t <sub>PLH</sub>	SI↓		6	21	6	25		
t <sub>PLH</sub> ¶	SI↓	OR	600	800	350	1000	ns	
t <sub>PHL</sub>	SI↓	AF/AE	550	700	290	880	ns	
t <sub>PLH</sub>			85	115	40	150		
t <sub>PLH</sub>	SI↓	HF	340	410	180	510	ns	
t <sub>pd</sub>	SO↓	Q	13	17	4	22	ns	
t <sub>PHL</sub>	SO↑	OR	23	27	7	33	ns	
t <sub>PLH</sub>	SO↓		6	24	6	30		
t <sub>PLH</sub> ¶	SO↓	IR	600	800	350	1000	ns	
t <sub>PHL</sub>	SO↓	AF/AE	550	700	290	880	ns	
t <sub>PLH</sub>			85	115	35	150		
t <sub>PHL</sub>	SO↓	HF	340	410	170	510	ns	
t <sub>PHL</sub>	$\overline{\text{RST}}\downarrow$	OR	22	26	10	34	ns	
t <sub>PLH</sub>	$\overline{\text{RST}}\uparrow$	IR	12	18	5	22	ns	
t <sub>PHL</sub>	$\overline{\text{RST}}\downarrow$	IR	12	18	5	22	ns	
		Q	14	17	5	19		
t <sub>dis</sub>	$\overline{\text{OE}}\uparrow$	Q	7	13	2	15	ns	
t <sub>en</sub>	$\overline{\text{OE}}\downarrow$	Q	6	12	2	13	ns	

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

‡ The IR output pulse occurs when the FIFO is full, SI is high, and SO is pulsed (see Figure 4).

§ The OR output pulse occurs when the FIFO is empty, SO is high, and SI is pulsed (see Figure 3).

¶ Data throughput or fall-through times



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### APPLICATION INFORMATION

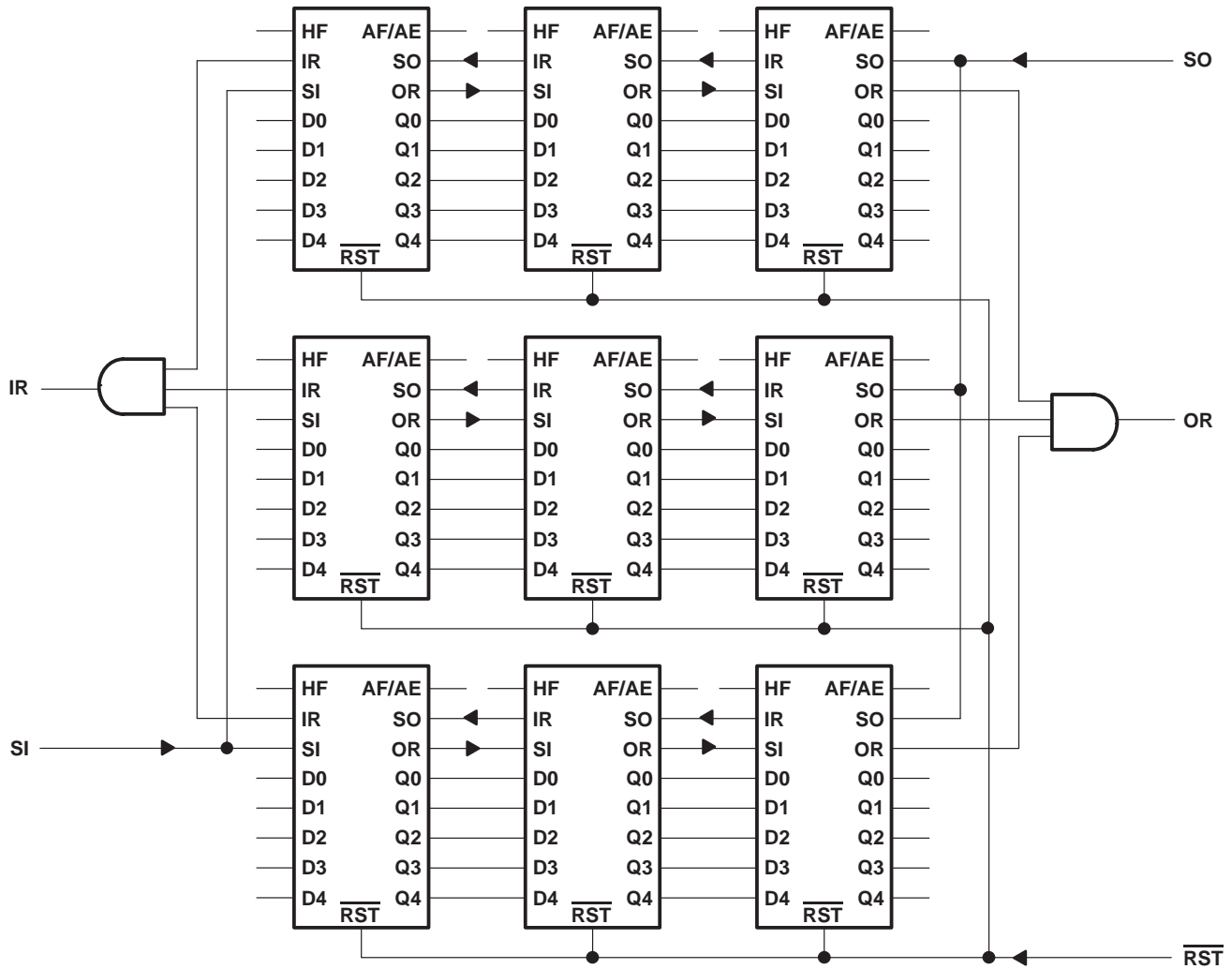
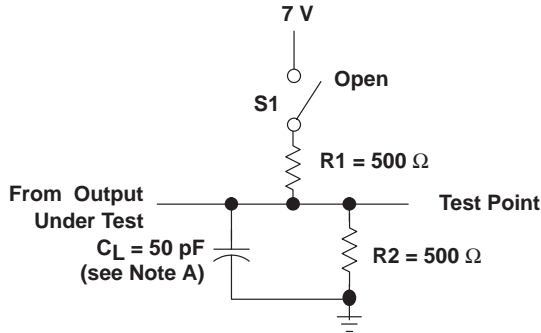


Figure 8. 192-Word by 15-Bit Expansion

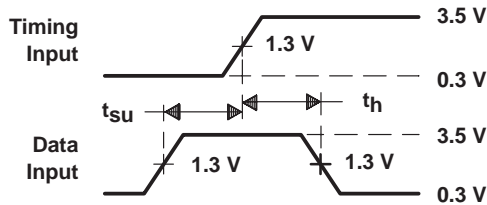
**PARAMETER MEASUREMENT INFORMATION**



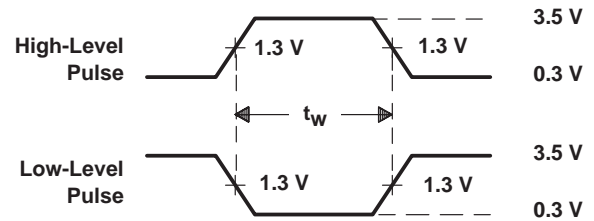
**LOAD CIRCUIT FOR 3-STATE OUTPUTS**

**SWITCH POSITION TABLE**

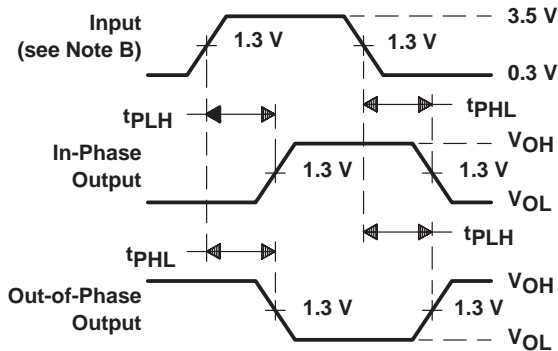
TEST	S1
t <sub>PLH</sub>	Open
t <sub>PHL</sub>	Open
t <sub>PZH</sub>	Open
t <sub>PZL</sub>	Closed
t <sub>PHZ</sub>	Open
t <sub>PLZ</sub>	Closed



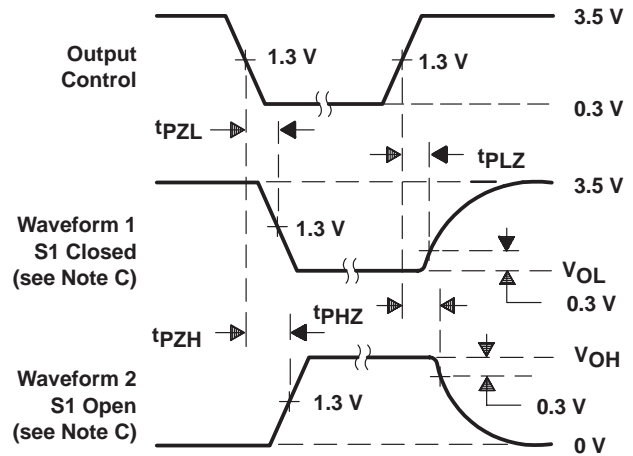
**VOLTAGE WAVEFORMS  
SETUP AND HOLD TIMES**



**VOLTAGE WAVEFORMS  
PULSE DURATION**



**VOLTAGE WAVEFORMS  
PROPAGATION DELAY TIMES**



**VOLTAGE WAVEFORMS  
ENABLE AND DISABLE TIMES, 3-STATE OUTPUTS**

- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 1$  MHz,  $Z_0 = 50 \Omega$ ,  $t_r \leq 2$  ns,  $t_f \leq 2$  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 9. Load Circuit and Voltage Waveforms**



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Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>

### Applications

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
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