

1M x 4 Static RAM

Features

- **High speed**
— $t_{AA} = 12 \text{ ns}$
- **Low active power**
— 935 mW (max.)
- **Low CMOS standby power (L version)**
— 2.75 mW (max.)
- **2.0V Data Retention (400 μW at 2.0V retention)**
- **Automatic power-down when deselected**
- **TTL-compatible inputs and outputs**
- **Easy memory expansion with $\overline{\text{CE}}$ and $\overline{\text{OE}}$ features**

Functional Description

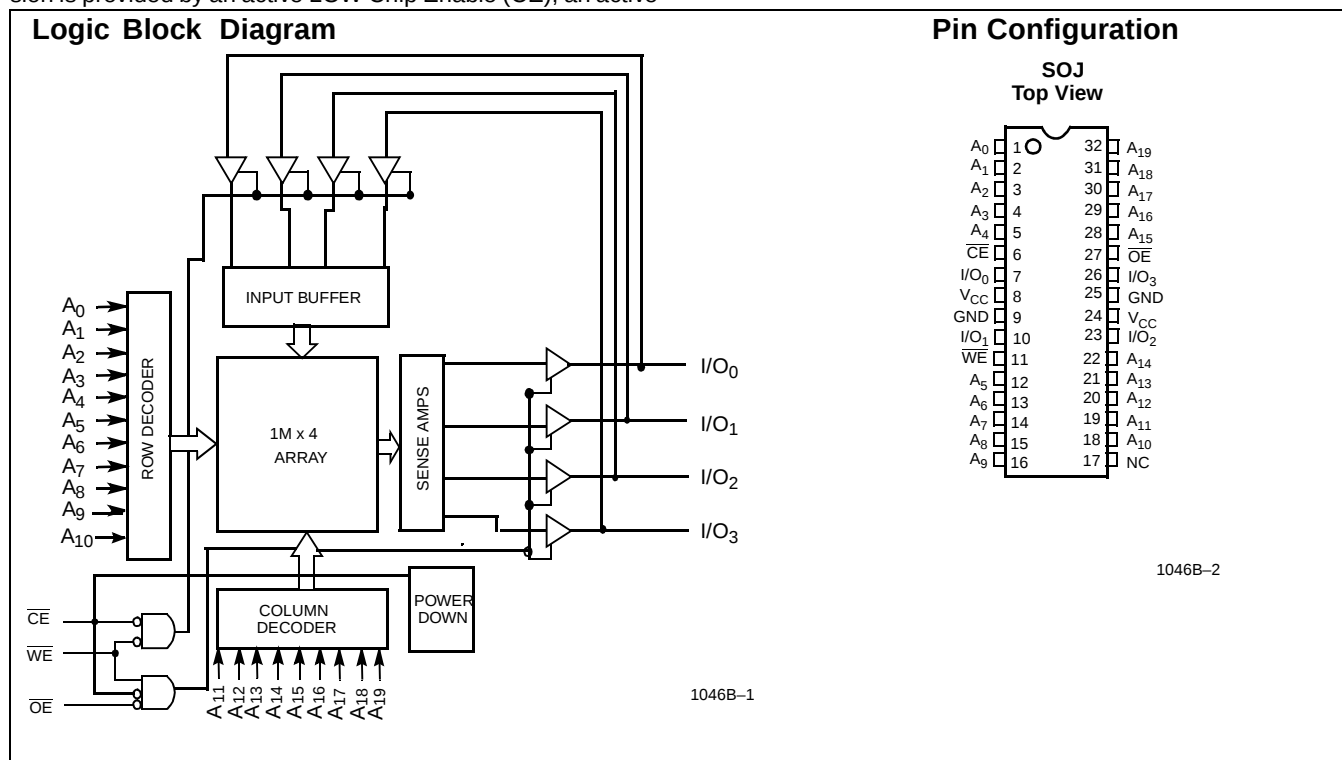
The CY7C1046B is a high-performance CMOS static RAM organized as 1,048,576 words by 4 bits. Easy memory expansion is provided by an active LOW Chip Enable ($\overline{\text{CE}}$), an active

LOW Output Enable ($\overline{\text{OE}}$), and three-state drivers. Writing to the device is accomplished by taking Chip Enable ($\overline{\text{CE}}$) and Write Enable ($\overline{\text{WE}}$) inputs LOW. Data on the four I/O pins (I/O_0 through I/O_3) is then written into the location specified on the address pins (A_0 through A_{19}).

Reading from the device is accomplished by taking Chip Enable ($\overline{\text{CE}}$) and Output Enable ($\overline{\text{OE}}$) LOW while forcing Write Enable ($\overline{\text{WE}}$) HIGH. Under these conditions, the contents of the memory location specified by the address pins will appear on the I/O pins.

The four input/output pins (I/O_0 through I/O_3) are placed in a high-impedance state when the device is deselected ($\overline{\text{CE}}$ HIGH), the outputs are disabled ($\overline{\text{OE}}$ HIGH), or during a write operation ($\overline{\text{CE}}$ LOW, and $\overline{\text{WE}}$ LOW).

The CY7C1046B is available in a standard 400-mil-wide 32-pin SOJ package with center power and ground (revolutionary) pinout.



Selection Guide

		7C1046B-12	7C1046B-15	7C1046B-20
Maximum Access Time (ns)		12	15	20
Maximum Operating Current (mA)		170	150	130
Maximum CMOS Standby Current (mA)	Com'l	8	8	8
	L version	0.5	0.5	0.5

Shaded areas contain advance information.

Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, not tested.)

Storage Temperature -65°C to $+150^{\circ}\text{C}$

Ambient Temperature with
Power Applied -55°C to $+125^{\circ}\text{C}$

Supply Voltage on V_{CC} to Relative GND^[1] -0.5V to $+7.0\text{V}$

DC Voltage Applied to Outputs
in High Z State^[1] -0.5V to $V_{CC} + 0.5\text{V}$

DC Input Voltage^[1] -0.5V to $V_{CC} + 0.5\text{V}$

Current into Outputs (LOW) 20 mA

Static Discharge Voltage $>2001\text{V}$
(per MIL-STD-883, Method 3015)

Latch-Up Current $>200\text{ mA}$

Operating Range

Range	Ambient Temperature ^[2]	V_{CC}
Commercial	0°C to $+70^{\circ}\text{C}$	4.5V – 5.5V

Electrical Characteristics Over the Operating Range

Parameter	Description	Test Conditions	7C1046B-12		7C1046B-15		7C1046B-20		Unit
			Min.	Max.	Min.	Max.	Min.	Max.	
V_{OH}	Output HIGH Voltage	$V_{CC} = \text{Min.}, I_{OH} = -4.0\text{ mA}$	2.4		2.4		2.4		V
V_{OL}	Output LOW Voltage	$V_{CC} = \text{Min.}, I_{OL} = 8.0\text{ mA}$		0.4		0.4		0.4	V
V_{IH}	Input HIGH Voltage		2.2	$V_{CC} + 0.3$	2.2	$V_{CC} + 0.3$	2.2	$V_{CC} + 0.3$	V
V_{IL}	Input LOW Voltage ^[1]		-0.3	0.8	-0.3	0.8	-0.3	0.8	V
I_{IX}	Input Load Current	$\text{GND} \leq V_I \leq V_{CC}$	-1	+1	-1	+1	-1	+1	μA
I_{OZ}	Output Leakage Current	$\text{GND} \leq V_{OUT} \leq V_{CC}$, Output Disabled	-1	+1	-1	+1	-1	+1	μA
I_{CC}	V_{CC} Operating Supply Current	$V_{CC} = \text{Max.},$ $f = f_{\text{MAX}} = 1/t_{\text{RC}}$		170		150		130	mA
I_{SB1}	Automatic CE Power-Down Current —TTL Inputs	Max. V_{CC} , $\overline{\text{CE}} \geq V_{IH}$ $V_{IN} \geq V_{IH}$ or $V_{IN} \leq V_{IL}$, $f = f_{\text{MAX}}$		20		20		20	mA
I_{SB2}	Automatic CE Power-Down Current —CMOS Inputs	Max. V_{CC} , $\overline{\text{CE}} \geq V_{CC} - 0.3\text{V}$, $V_{IN} \geq V_{CC} - 0.3\text{V}$, or $V_{IN} \leq 0.3\text{V}$, $f = 0$	Com'I	8		8		8	mA
			L version	0.5		0.5		0.5	

Shaded areas contain advance information.

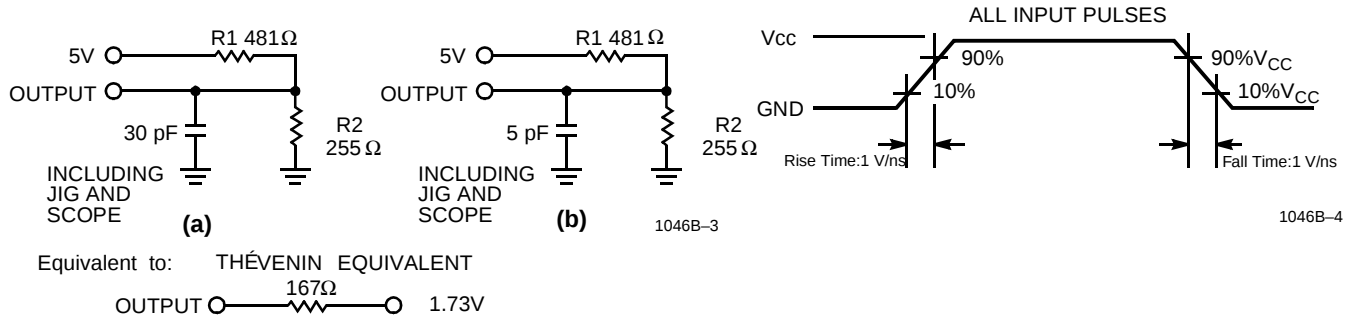
Capacitance^[3]

Parameter	Description	Test Conditions	Max.	Unit
C_{IN}	Input Capacitance	$T_A = 25^{\circ}\text{C}$, $f = 1\text{ MHz}$, $V_{CC} = 5.0\text{V}$	6	pF
C_{OUT}	I/O Capacitance		6	pF

Note:

- $V_{IL}(\text{min.}) = -2.0\text{V}$ for pulse durations of less than 20 ns.
- T_A is the "Instant On" case temperature.
- Tested initially and after any design or process changes that may affect these parameters.

AC Test Loads and Waveforms



Switching Characteristics^[4] Over the Operating Range

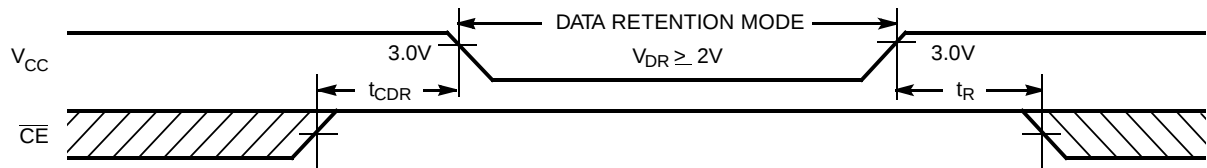
Parameter	Description	7C1046B-12		7C1046B-15		7C1046B-20		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	
READ CYCLE								
t _{power}	V _{CC} (typical) to the first access ^[5]	1		1		1		μs
t _{RC}	Read Cycle Time	12		15		20		ns
t _{AA}	Address to Data Valid		12		15		20	ns
t _{OHA}	Data Hold from Address Change	3		3		3		ns
t _{ACE}	$\overline{\text{CE}}$ LOW to Data Valid		12		15		20	ns
t _{DOE}	$\overline{\text{OE}}$ LOW to Data Valid		6		7		8	ns
t _{LZOE}	$\overline{\text{OE}}$ LOW to Low Z ^[7]	0		0		0		ns
t _{HZOE}	$\overline{\text{OE}}$ HIGH to High Z ^[6, 7]		6		7		8	ns
t _{LZCE}	$\overline{\text{CE}}$ LOW to Low Z ^[7]	3		3		3		ns
t _{HZCE}	$\overline{\text{CE}}$ HIGH to High Z ^[6, 7]		6		7		8	ns
t _{PU}	$\overline{\text{CE}}$ LOW to Power-Up	0		0		0		ns
t _{PD}	$\overline{\text{CE}}$ HIGH to Power-Down		12		15		20	ns
WRITE CYCLE ^[8, 9]								
t _{WC}	Write Cycle Time	12		15		20		ns
t _{SCE}	$\overline{\text{CE}}$ LOW to Write End	8		10		15		ns
t _{AW}	Address Set-Up to Write End	8		10		15		ns
t _{HA}	Address Hold from Write End	0		0		0		ns
t _{SA}	Address Set-Up to Write Start	0		0		0		ns
t _{PWE}	$\overline{\text{WE}}$ Pulse Width	8		10		12		ns
t _{SD}	Data Set-Up to Write End	6		8		10		ns
t _{HD}	Data Hold from Write End	0		0		0		ns
t _{LZWE}	$\overline{\text{WE}}$ HIGH to Low Z ^[7]	3		3		3		ns
t _{HZWE}	$\overline{\text{WE}}$ LOW to High Z ^[6, 7]		6		7		8	ns

Notes:

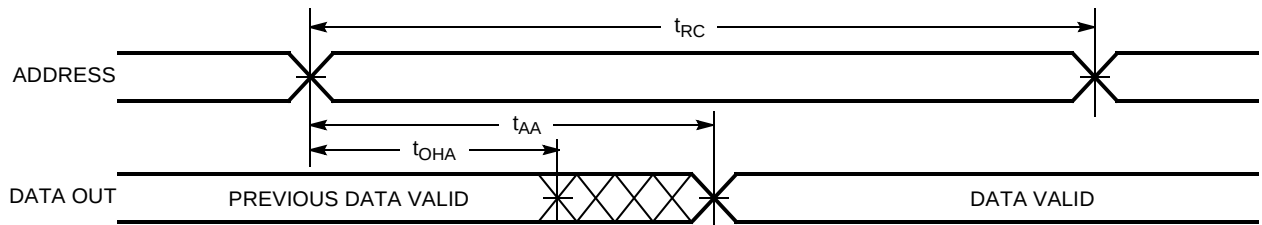
- Test conditions assume signal transition time of 3 ns or less, timing reference levels of 1.5V, input pulse levels of 0 to 3.0V, and output loading of the specified $I_{\text{OL}}/I_{\text{OH}}$ and 30-pF load capacitance.
- This part has a voltage regulator which steps down the voltage from 5V to 3.3V internally. t_{power} time has to be provided initially before a read/write operation is started.
- t_{HZOE} , t_{HZCE} , and t_{HZWE} are specified with a load capacitance of 5 pF as in part (b) of AC Test Loads. Transition is measured ± 500 mV from steady-state voltage.
- At any given temperature and voltage condition, t_{HZCE} is less than t_{LZCE} , t_{HZOE} is less than t_{LZOE} , and t_{HZWE} is less than t_{LZWE} for any given device.
- The internal write time of the memory is defined by the overlap of $\overline{\text{CE}}$ LOW, and $\overline{\text{WE}}$ LOW. $\overline{\text{CE}}$ and $\overline{\text{WE}}$ must be LOW to initiate a write, and the transition of either of these signals can terminate the write. The input data set-up and hold timing should be referenced to the leading edge of the signal that terminates the write.
- The minimum write cycle time for Write Cycle no. 3 ($\overline{\text{WE}}$ controlled, $\overline{\text{OE}}$ LOW) is the sum of t_{HZWE} and t_{SD} .

Data Retention Characteristics Over the Operating Range

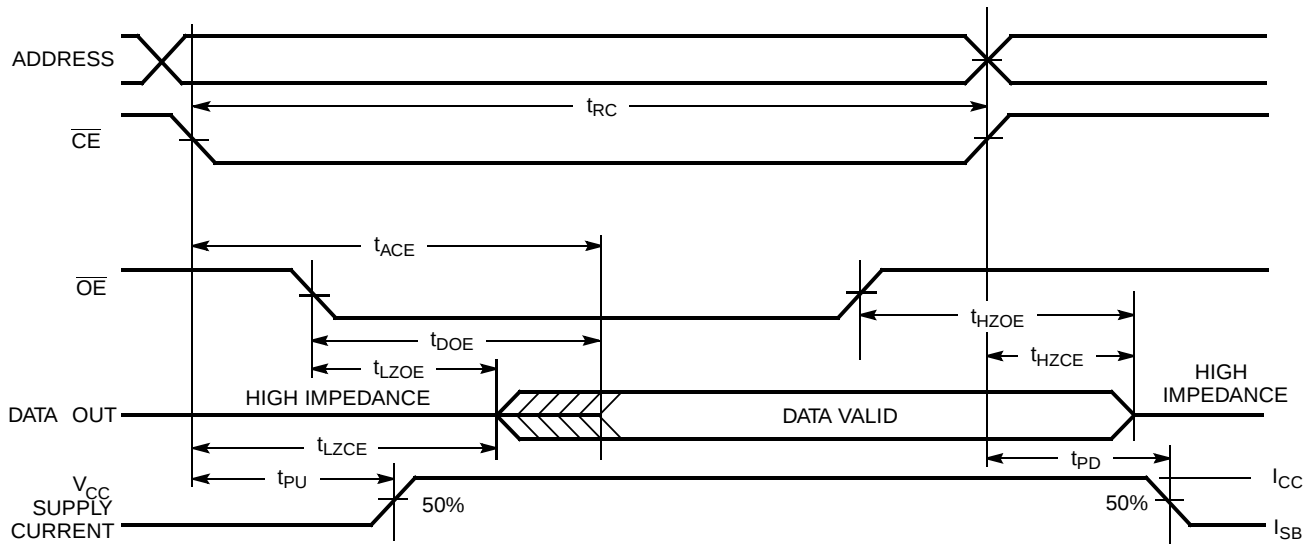
Parameter	Description		Conditions ^[10]	Min.	Max	Unit
V _{DR}	V _{CC} for Data Retention			2.0		V
I _{CCDR}	Data Retention Current	Com'l	V _{CC} = V _{DR} = 2.0V, CE ≥ V _{CC} − 0.3V V _{IN} ≥ V _{CC} − 0.3V or V _{IN} ≤ 0.3V		200	μA
t _{CDR} ^[3]	Chip Deselect to Data Retention Time			0		ns
t _R	Operation Recovery Time			200		μs

Data Retention Waveform


1046B-5

Switching Waveforms
Read Cycle No. 1^[11, 12]


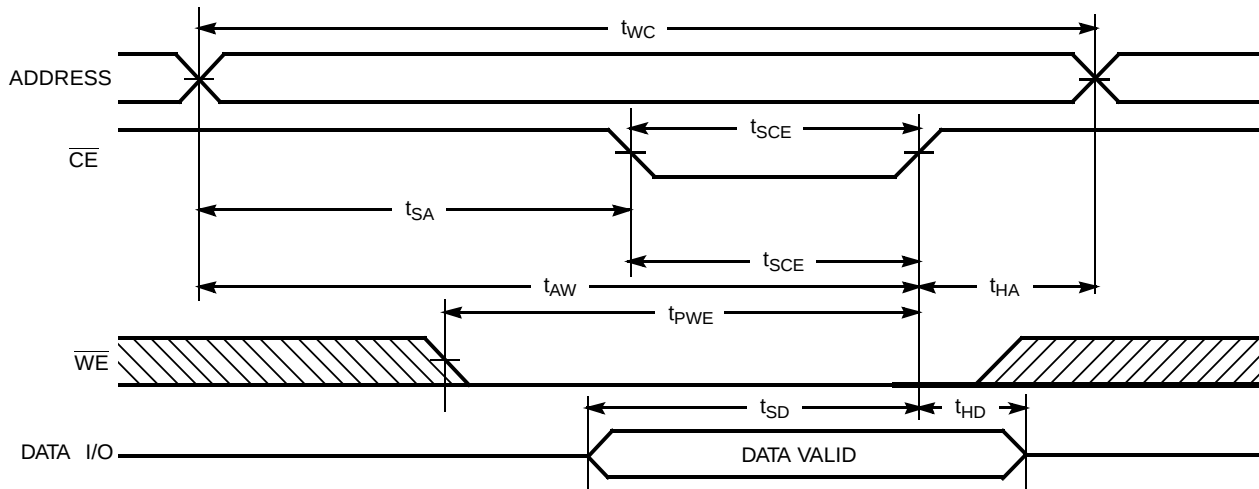
1046B-6

Read Cycle No. 2 ($\overline{OE}$ Controlled)^[12, 13]


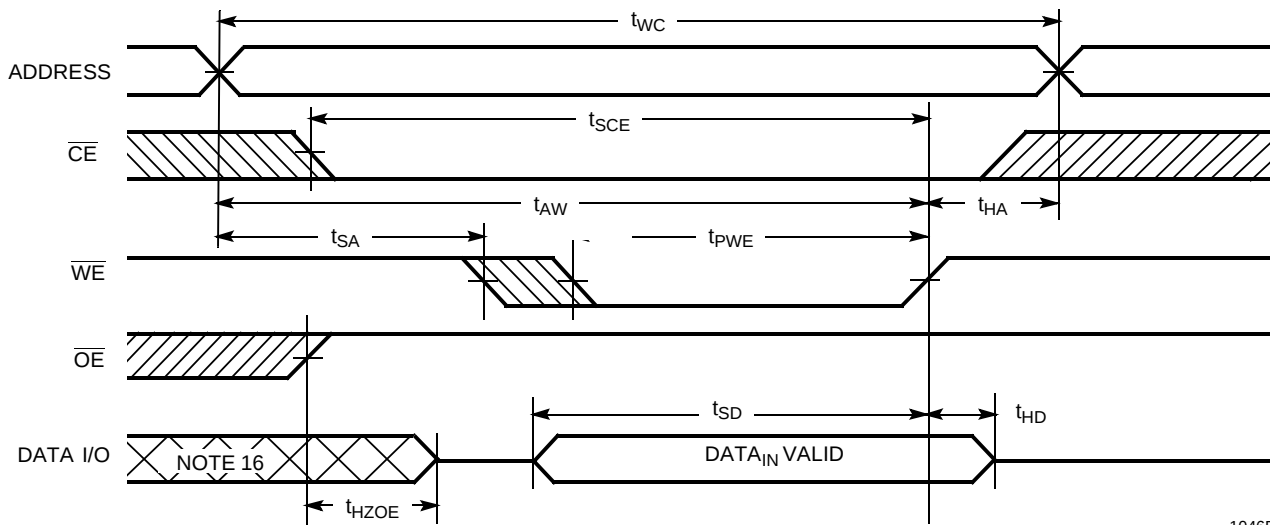
1046B-7

Notes:

10. No input may exceed $V_{CC} + 0.5V$.
11. Device is continuously selected. $\overline{OE}$, $\overline{CE} = V_{IL}$.
12. $\overline{WE}$ is HIGH for read cycle.
13. Address valid prior to or coincident with $\overline{CE}$ transition LOW.

Switching Waveforms (continued)
Write Cycle No. 1 ($\overline{\text{CE}}$ Controlled)^[14, 15]


1046B-8

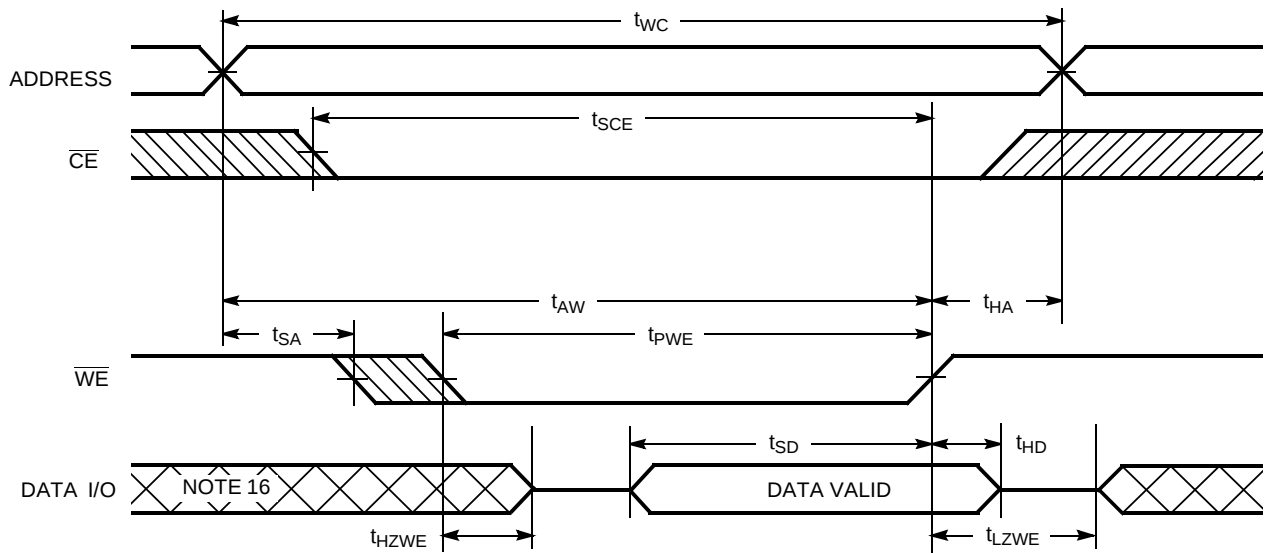
Write Cycle No. 2 ($\overline{\text{WE}}$ Controlled, $\overline{\text{OE}}$ HIGH During Write)^[14, 15]


1046B-9

Notes:

14. Data I/O is high impedance if $\overline{\text{OE}} = V_{IH}$.
15. If $\overline{\text{CE}}$ goes HIGH simultaneously with $\overline{\text{WE}}$ going HIGH, the output remains in a high-impedance state.
16. During this period the I/Os are in the output state and input signals should not be applied.

Switching Waveforms (continued)

Write Cycle No. 3 ($\overline{WE}$ Controlled, $\overline{OE}$ LOW)^[15]


1046B-10

Ordering Information

Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
12	CY7C1046B-12VC	V33	32-Lead (400-Mil) Molded SOJ	Commercial
15	CY7C1046B-15VC	V33	32-Lead (400-Mil) Molded SOJ	
20	CY7C1046B-20VC	V33	32-Lead (400-Mil) Molded SOJ	
12	CY7C1046BL-12VC	V33	32-Lead (400-Mil) Molded SOJ	
15	CY7C1046BL-15VC	V33	32-Lead (400-Mil) Molded SOJ	
20	CY7C1046BL-20VC	V33	32-Lead (400-Mil) Molded SOJ	

Shaded areas contain advance information.

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Package Diagram

32-Lead (400-Mil) Molded SOJ V33

