CY7C1046D

4-Mbit (1 M × 4) Static RAM

Features

- Pin- and function-compatible with CY7C1046B
- High speed
  - t_{AA} = 10 ns
- CMOS for optimum speed and power
- Low active power
  - I_{CC} = 90 mA at 10 ns
- Low CMOS standby power
  - I_{SB2} = 10 mA
- Data retention at 2.0 V
- Automatic power-down when deselected
- TTL-compatible inputs and outputs
- Easy memory expansion with $\overline{CE}$ and $\overline{OE}$ features
- Available in lead-free 400-mil-wide 32-pin SOJ package

Functional Description

The CY7C1046D is a high-performance CMOS static RAM organized as 1M words by 4 bits. Easy memory expansion is provided by an active LOW Chip Enable ($\overline{CE}$), an active LOW Output Enable ($\overline{OE}$), and tri-state drivers. Writing to the device is accomplished by taking Chip Enable ($\overline{CE}$) and Write Enable ($\overline{WE}$) 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 ($\overline{CE}$) and Output Enable ($\overline{OE}$) LOW while forcing Write Enable ($\overline{WE}$) HIGH. Under these conditions, the contents of the memory location specified by the address pins will appear on the I/O pins.

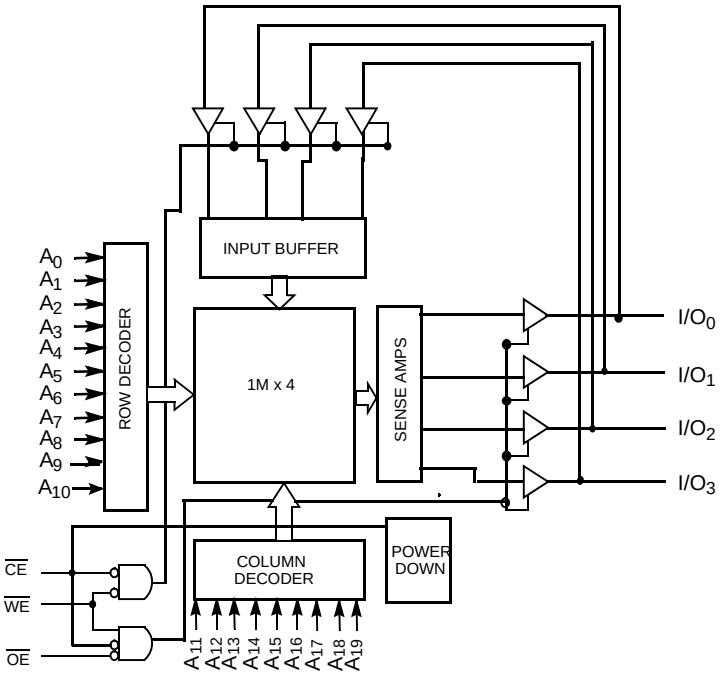
The four input/output pins (I/O_0 through I/O_3) are placed in a high-impedance state when the device is deselected ($\overline{CE}$ HIGH), the outputs are disabled ($\overline{OE}$ HIGH), or during a write operation ($\overline{CE}$ LOW, and $\overline{WE}$ LOW).

The CY7C1046D is available in a standard 400-mil-wide 32-pin SOJ package with center power and ground (revolutionary) pinout.

The CY7C1046D device is suitable for interfacing with processors that have TTL I/P levels. It is not suitable for processors that require CMOS I/P levels. Please see Electrical Characteristics on page 4 for more details and suggested alternatives.

For a complete list of related documentation, click here.

Logic Block Diagram



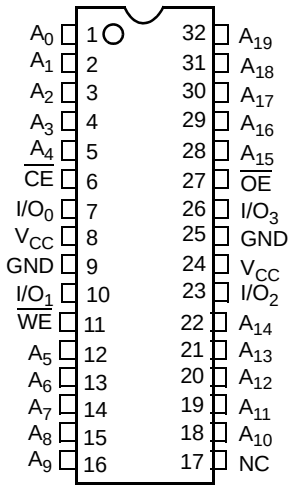
Contents

Selection Guide

Description	–10	Unit
Maximum Access Time	10	ns
Maximum Operating Current	90	mA
Maximum CMOS Standby Current (mA)	10	mA

Pin Configuration

Figure 1. 32-pin SOJ pinout (Top View)



Maximum Ratings

Exceeding maximum ratings may shorten the useful life of the device. User guidelines are not tested.

Storage temperature ..... –65 °C to +150 °C

Ambient temperature with power applied ..... –55 °C to +125 °C

Supply voltage on V_{CC} to relative GND [1] .....–0.5 V to +6.0 V

DC voltage applied to outputs in high Z state [1].....–0.5 V to V_{CC} + 0.5 V

DC input voltage [1] .....–0.5 V to V_{CC} + 0.5 V

Current into outputs (LOW) ..... 20 mA

Static discharge voltage (per MIL-STD-883, method 3015) .....> 2001 V

Latch up current .....> 200 mA

Operating Range

Range	Ambient Temperature	V_{CC}
Industrial	–40 °C to +85 °C	4.5 V–5.5 V

Electrical Characteristics

Over the Operating Range

Parameter	Description	Test Conditions		-10		Unit
				Min	Max	
V_{OH}	Output HIGH voltage	V_{CC} = Min, I_{OH} = –4.0 mA		2.4	–	V
		V_{CC} = Max, I_{OH} = –0.1 mA		–	3.4 [2]	
V_{OL}	Output LOW voltage	V_{CC} = Min, I_{OL} = 8.0 mA		–	0.4	V
V_{IH}	Input HIGH voltage			2.0	V_{CC} + 0.5	V
V_{IL}	Input LOW voltage [1]			–0.5	0.8	V
I_{IX}	Input leakage current	GND ≤ V_{IN} ≤ V_{CC}		–1	+1	µA
I_{OZ}	Output leakage current	GND ≤ V_{OUT} ≤ V_{CC}, output disabled		–1	+1	µA
I_{CC}	V_{CC} operating supply current	V_{CC} = Max, f = f_{MAX} = $1/t_{RC}$	100 MHz	–	90	mA
			83 MHz	–	80	
			66 MHz	–	70	
			40 MHz	–	60	
I_{SB1}	Automatic CE Power-Down Current – TTL inputs	Max V_{CC}, $\overline{CE}$ ≥ V_{IH}, V_{IN} ≥ V_{IH} or V_{IN} ≤ V_{IL}, f = f_{MAX}		–	20	mA
I_{SB2}	Automatic CE Power-Down Current – CMOS inputs	Max V_{CC}, $\overline{CE}$ ≥ V_{CC} – 0.3 V, V_{IN} ≥ V_{CC} – 0.3 V, or V_{IN} ≤ 0.3 V, f = 0		–	10	mA

Notes
1. V_{IL} (min) = –2.0 V and V_{IH}(max) = V_{CC} + 2 V for pulse durations of less than 20 ns.
2. Please note that the maximum V_{OH} limit does not exceed minimum CMOS V_{IH} of 3.5V. If you are interfacing this SRAM with 5V legacy processors that require a minimum V_{IH} of 3.5V, please refer to Application Note AN6081 for technical details and options you may consider.

Capacitance

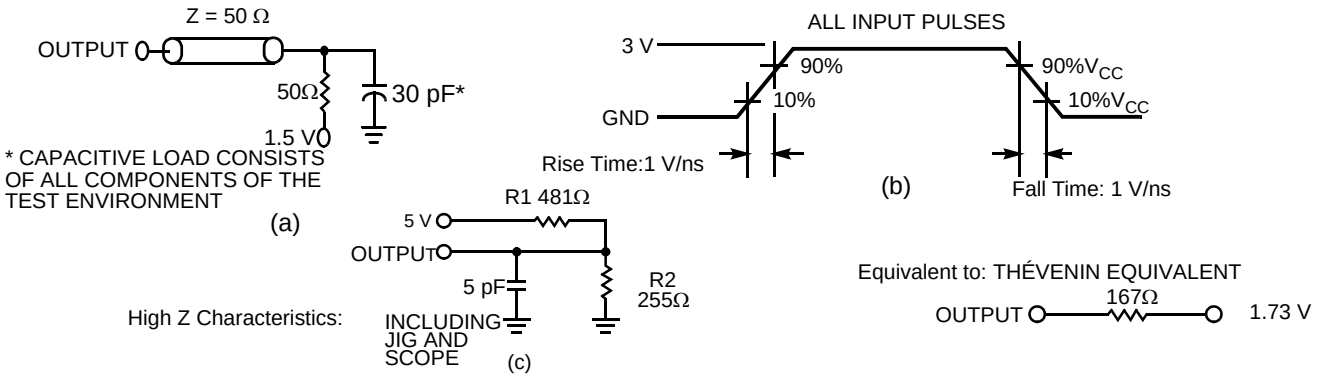
Parameter [3]	Description	Test Conditions	Max	Unit
C_{IN}	Input capacitance	T_A = 25 °C, f = 1 MHz, V_{CC} = 5.0 V	8	pF
C_{OUT}	I/O capacitance		8	pF

Thermal Resistance

Parameter [3]	Description	Test Conditions	SOJ Package	Unit
Θ_{JA}	Thermal resistance (junction to ambient)	Still Air, soldered on a 3 × 4.5 inch, four-layer printed circuit board	53.44	°C/W
Θ_{JC}	Thermal resistance (junction to case)		38.25	°C/W

AC Test Loads and Waveforms

Figure 2. AC Test Loads and Waveforms [4]



Notes
3. Tested initially and after any design or process changes that may affect these parameters.
4. AC characteristics (except high Z) are tested using the load conditions shown in (a). High Z characteristics are tested for all speeds using the test load shown in (c).

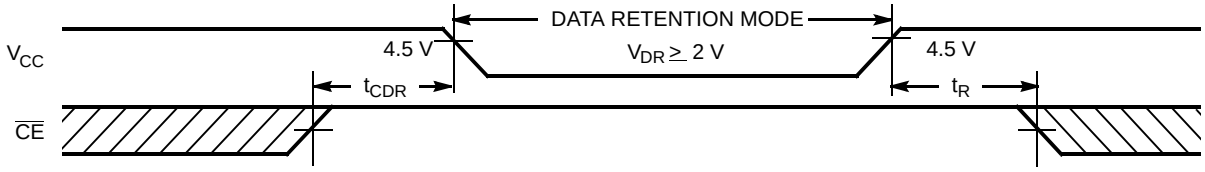
Data Retention Characteristics

Over the Operating Range

Parameter	Description	Conditions [5]	Min	Max	Unit
V_{DR}	V_{CC} for data retention		2.0	–	V
I_{CCDR}	Data retention current	$V_{CC} = V_{DR} = 2.0$ V, $\overline{CE} \geq V_{CC} - 0.3$ V, $V_{IN} \geq V_{CC} - 0.3$ V or $V_{IN} \leq 0.3$ V	–	10	mA
t_{CDR} [6]	Chip deselect to data retention time		0	–	ns
t_R [7]	Operation recovery time		t_{RC}	–	ns

Data Retention Waveform

Figure 3. Data Retention Waveform



Notes
5. No inputs may exceed V_{CC} + 0.3 V.
6. Tested initially and after any design or process changes that may affect these parameters.
7. Full device operation requires linear V_{CC} ramp from V_{DR} to $V_{CC(min)} \geq 50$ µs or stable at $V_{CC(min)} \geq 50$ µs.

Switching Characteristics

Over the Operating Range

Parameter [8]	Description	7C1046D-10		Unit
		Min	Max	
Read Cycle				
t_{power}	V_{CC}(typical) to the first access[9]	100	–	µs
t_{RC}	Read cycle time	10	–	ns
t_{AA}	Address to data valid	–	10	ns
t_{OHA}	Data hold from address change	3	–	ns
t_{ACE}	$\overline{CE}$ LOW to data valid	–	10	ns
t_{DOE}	$\overline{OE}$ LOW to data valid	–	5	ns
t_{LZOE}	$\overline{OE}$ LOW to low Z[11]	0	–	ns
t_{HZOE}	$\overline{OE}$ HIGH to high Z[10, 11]	–	5	ns
t_{LZCE}	$\overline{CE}$ LOW to low Z[11]	3	–	ns
t_{HZCE}	$\overline{CE}$ HIGH to high Z[10, 11]	–	5	ns
t_{PU}	$\overline{CE}$ LOW to power-up	0	–	ns
t_{PD}	$\overline{CE}$ HIGH to power-down	–	10	ns
Write Cycle[12, 13]				
t_{WC}	Write cycle time	10	–	ns
t_{SCE}	$\overline{CE}$ LOW to write end	7	–	ns
t_{AW}	Address set-up to write end	7	–	ns
t_{HA}	Address hold from write end	0	–	ns
t_{SA}	Address set-up to write start	0	–	ns
t_{PWE}	$\overline{WE}$ pulse width	7	–	ns
t_{SD}	Data set-up to write end	6	–	ns
t_{HD}	Data hold from write end	0	–	ns
t_{LZWE}	$\overline{WE}$ HIGH to low Z[11]	3	–	ns
t_{HZWE}	$\overline{WE}$ LOW to high Z[10, 11]	–	5	ns

Notes

8. Test conditions assume signal transition time of 3 ns or less, timing reference levels of 1.5 V, input pulse levels of 0 to 3.0 V.
9. t_{POWER} gives the minimum amount of time that the power supply should be at stable, typical V_{CC} values until the first memory access can be performed.
10. 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 when the outputs enter a high impedance state.
11. 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.
12. The internal write time of the memory is defined by the overlap of $\overline{CE}$ LOW, and $\overline{WE}$ LOW. $\overline{CE}$ and $\overline{WE}$ 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.
13. The minimum write cycle time for Write Cycle no. 3 ($\overline{WE}$ controlled, $\overline{OE}$ LOW) is the sum of t_{HZWE} and t_{SD}.

Switching Waveforms

Figure 4. Read Cycle No. 1 [14, 15]

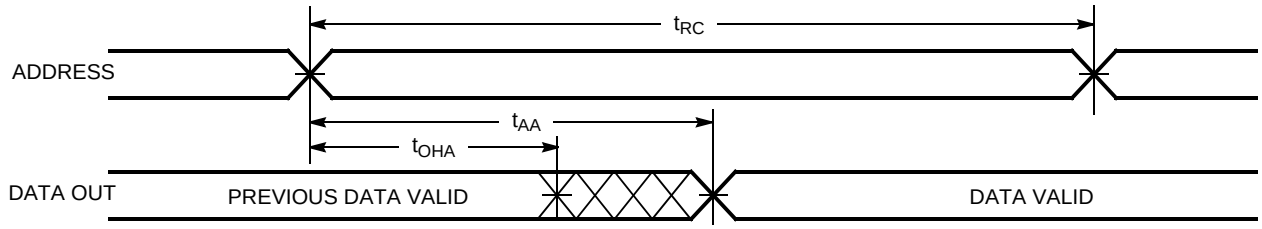
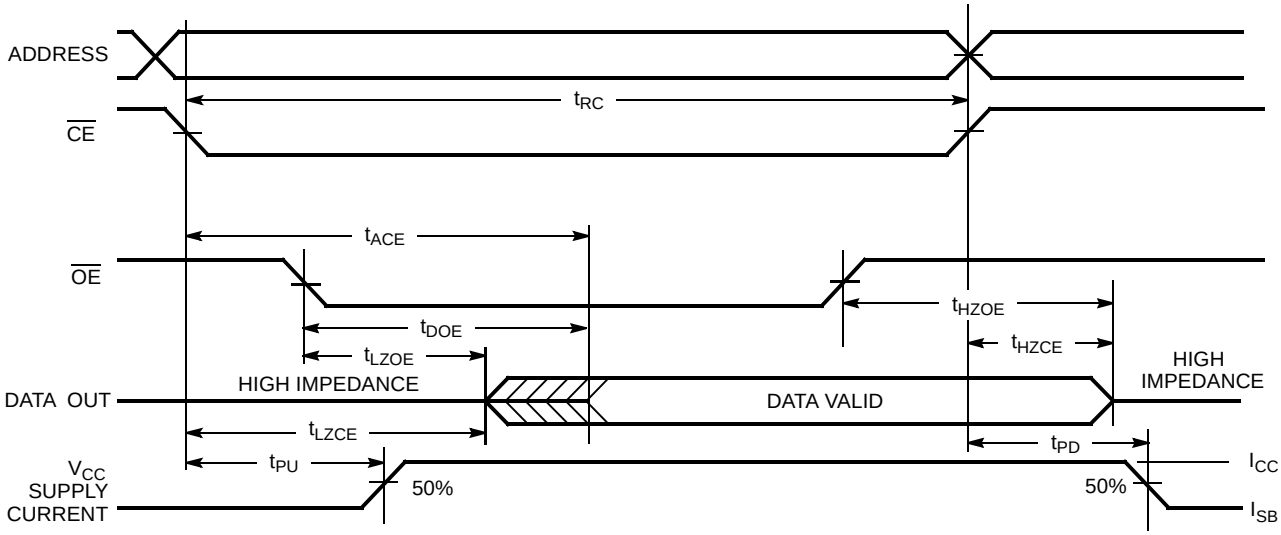


Figure 5. Read Cycle No. 2 ($\overline{OE}$ Controlled) [15, 16]



Notes
14. Device is continuously selected. $\overline{OE}$, $\overline{CE}$ = V_{IL}.
15. $\overline{WE}$ is HIGH for read cycle.
16. Address valid prior to or coincident with $\overline{CE}$ transition LOW.

Switching Waveforms *(continued)*

Figure 6. Write Cycle No. 1 ($\overline{CE}$ Controlled) [17, 18]

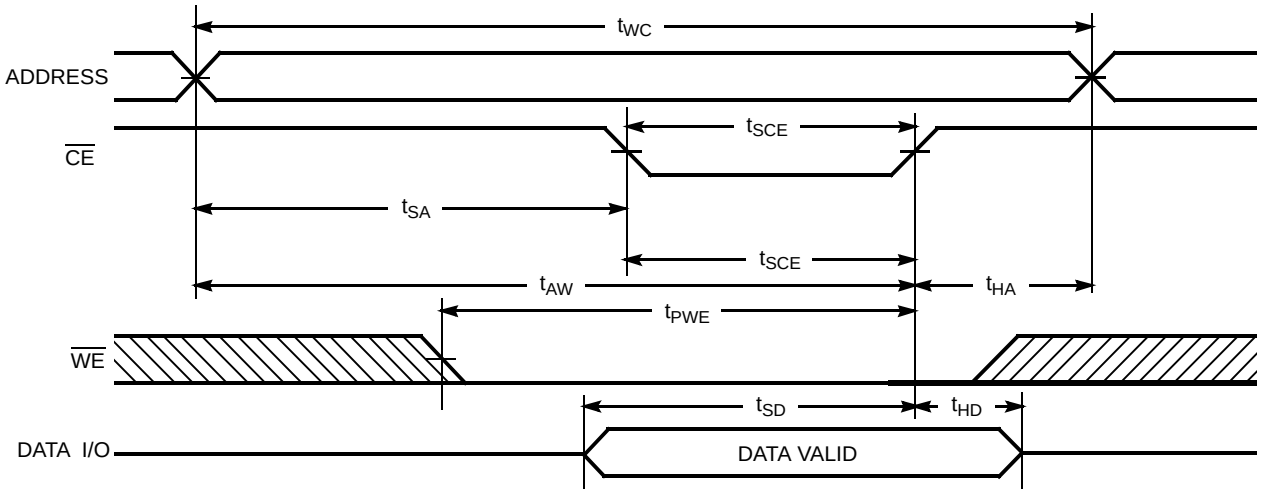
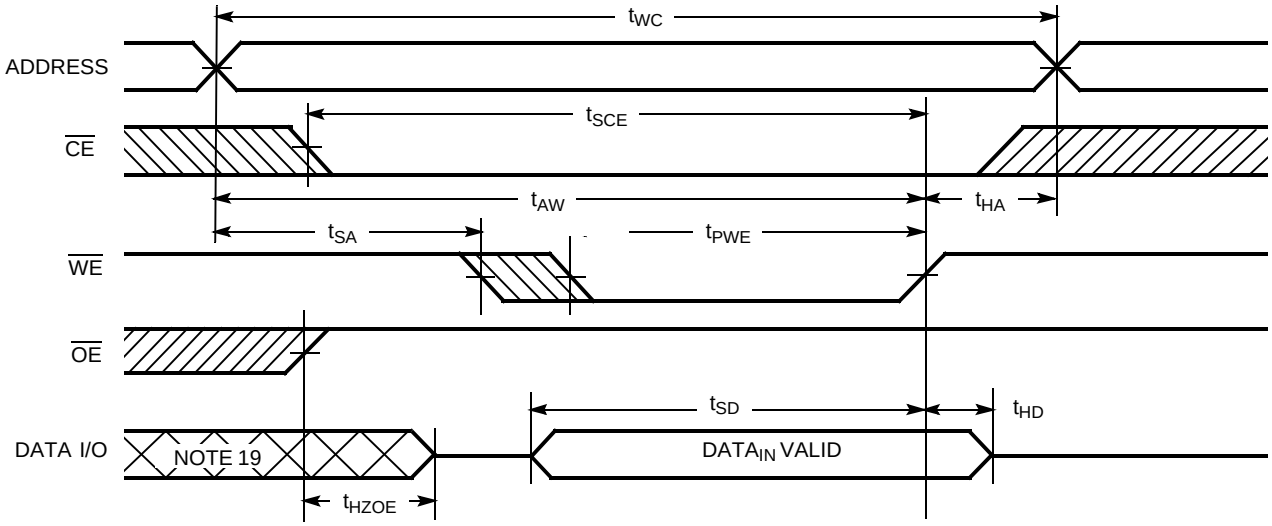


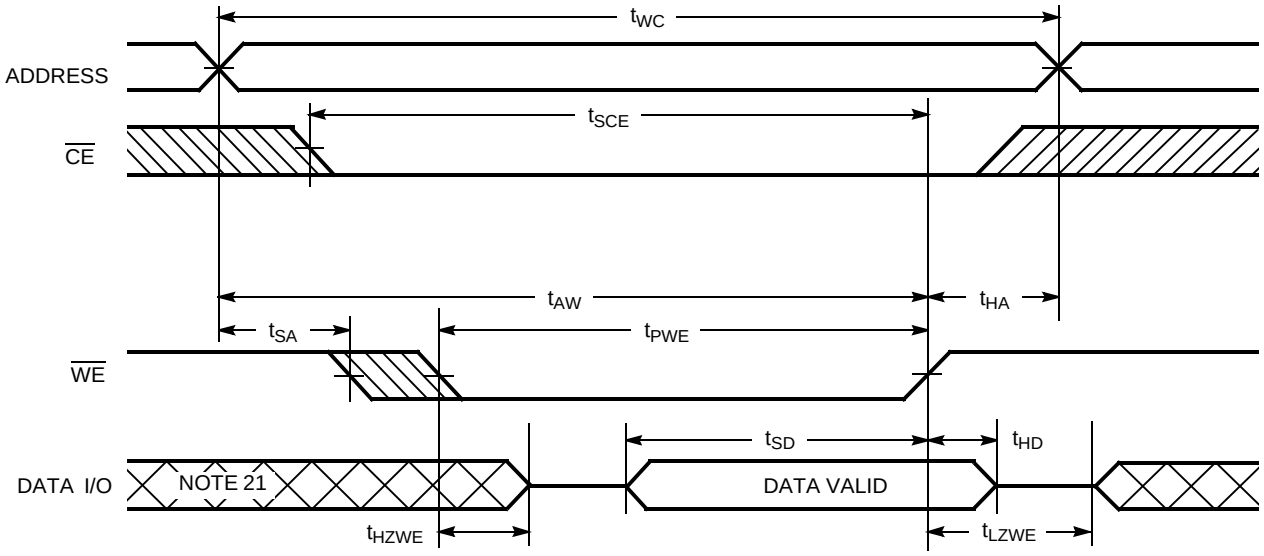
Figure 7. Write Cycle No. 2 ($\overline{WE}$ Controlled, $\overline{OE}$ HIGH During Write) [17, 18]



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

Switching Waveforms *(continued)*

Figure 8. Write Cycle No. 3 ($\overline{WE}$ Controlled, $\overline{OE}$ LOW) [20]



Notes
20. If $\overline{CE}$ goes HIGH simultaneously with $\overline{WE}$ going HIGH, the output remains in a high-impedance state.
21. During this period the I/Os are in the output state and input signals should not be applied.

Truth Table

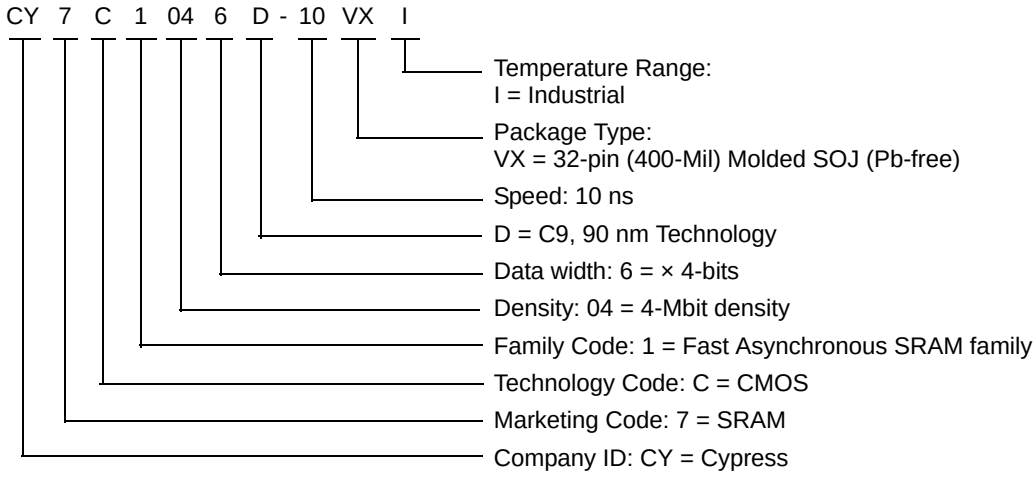
$\overline{CE}$	$\overline{OE}$	$\overline{WE}$	$I/O_0–I/O_3$	Mode	Power
H	X	X	High Z	Power-down	Standby (I_{SB})
L	L	H	Data Out	Read	Active (I_{CC})
L	X	L	Data In	Write	Active (I_{CC})
L	H	H	High Z	Selected, outputs disabled	Active (I_{CC})

Ordering Information

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
10	CY7C1046D-10VXI	51-85033	32-pin (400-Mil) Molded SOJ (Pb-free)	Industrial

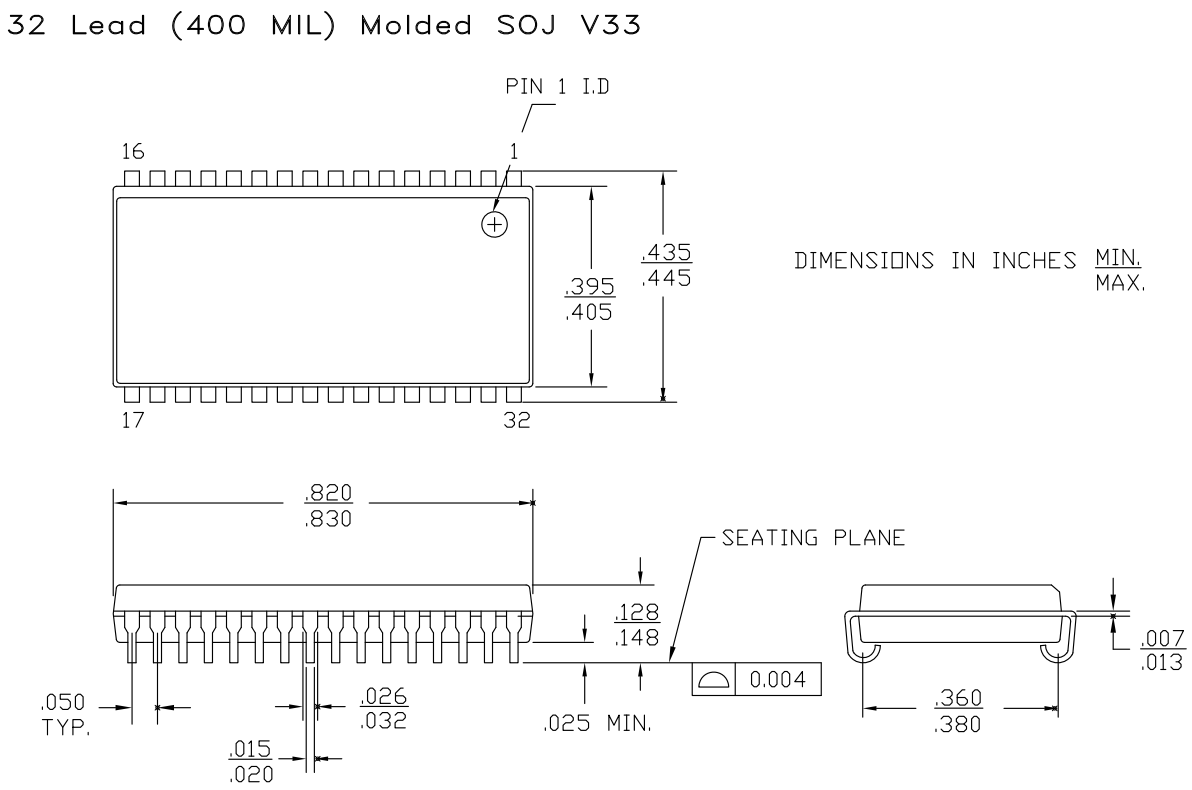
Please contact your local Cypress sales representative for availability of these parts.

Ordering Code Definitions



Package Diagrams

Figure 9. 32-pin SOJ (400 Mils) V32.4 (Molded SOJ V33) Package Outline, 51-85033



Acronyms

Acronym	Description
CMOS	Complementary Metal Oxide Semiconductor
$\overline{CE}$	Chip Enable
I/O	Input/Output
$\overline{OE}$	Output Enable
SOJ	Small-Outline J-leaded
SRAM	Static Random Access Memory
TTL	Transistor-Transistor Logic
$\overline{WE}$	Write Enable

Document Conventions

Units of Measure

Symbol	Unit of Measure
°C	degree Celsius
MHz	megahertz
µs	microsecond
µA	microampere
mA	milliampere
ns	nanosecond
%	percent
pF	picofarad
V	volt
W	watt

Document History Page

Document Title: CY7C1046D, 4-Mbit (1 M × 4) Static RAM Document Number: 38-05705				
Rev.	**ECN No.**	**Issue Date**	**Orig. of Change**	**Description of Change**
**	307613	See ECN	RKF	New data sheet.
*A	399070	See ECN	NXR	Changed from Advance to Preliminary Changed address of Cypress Semiconductor Corporation on Page# 1 from “3901 North First Street” to “198 Champion Court” Removed -20 speed bin Removed L-Version Redefined I_{CC} values for Com’l and Ind’l temperature ranges I_{CC} (Com’l): Changed from 70 and 55 mA to 75 and 70 mA for 12 and 15 ns speed bins respectively I_{CC} (Ind’l): Changed from 80, 70 and 55 mA to 90, 85 and 80 mA for 10, 12 and 15 ns speed bins respectively Added Industrial Operating Range Changed reference voltage level for measurement of Hi-Z parameters from ±500 mV to ±200 mV Changed V_{CC} to 3 V in the Input pulse waveform at the AC Test Loads and Waveforms on page # 3 Changed t_{SCE} from 8 to 7 ns for -10 speed bin Added Truth Table Added 10 ns parts in the Ordering Information table Changed part names from V33 to V324 in the Ordering Information Table Shaded Ordering Information Table
*B	459072	See ECN	NXR	Converted from Preliminary to Final. Removed -12 and -15 Speed bins Removed Commercial Operating Range product information. Changed Maximum Rating for supply voltage from 7V to 6V Changed the Capacitance value of input pins and I/O pins from 6 pF to 8 pF Updated the Thermal Resistance table. Changed t_{HZWE} from 6 ns to 5 ns Added footnote #4 and 11 Updated footnote #7 on High-Z parameter measurement Updated the Ordering Information and replaced Package Name column with Package Diagram in the Ordering Information table.
*C	3059162	10/14/2010	PRAS	Added Ordering Code Definitions. Updated Package Diagrams.
*D	3098812	12/01/2010	PRAS	Added Acronyms and Units of Measure. Minor edits and updated in new template.
*E	3446913	11/24/2011	TAVA	Removed Note referring to SRAM System Guidelines application note on page 1. Updated test conditions for IIX parameter.
*F	4039540	06/25/2013	MEMJ	Updated Functional Description. Updated Electrical Characteristics: Added one more Test Condition “V_{CC} = Max, I_{OH} = –0.1 mA” for V_{OH} parameter and added maximum value corresponding to that Test Condition. Added Note 2 and referred the same note in maximum value for V_{OH} parameter corresponding to Test Condition “V_{CC} = Max, I_{OH} = –0.1 mA”.
*G	4574311	11/20/2014	MEMJ	Added related documentation hyperlink in page 1. Updated Figure 9 in Package Diagrams (spec 51-85033 *D to *E).

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