CY7C1049D

4-Mbit (512 K × 8) Static RAM

Features

- Pin- and function-compatible with CY7C1049B
- High speed
  - t_{AA} = 10 ns
- Low active power
  - I_{CC} = 90 mA at 10 ns
- Low CMOS Standby power
  - I_{SB2} = 10 mA
- 2.0 V data retention
- Automatic power-down when deselected
- TTL-compatible inputs and outputs
- Easy memory expansion with $\overline{CE}$ and $\overline{OE}$ features
- Available in Pb-free 36-Pin (400-Mil) Molded SOJ package

Functional Description

The CY7C1049D [1] is a high-performance CMOS static RAM organized as 512K words by 8 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 eight I/O pins (I/O_0 through I/O_7) is then written into the location specified on the address pins (A_0 through A_{18}).

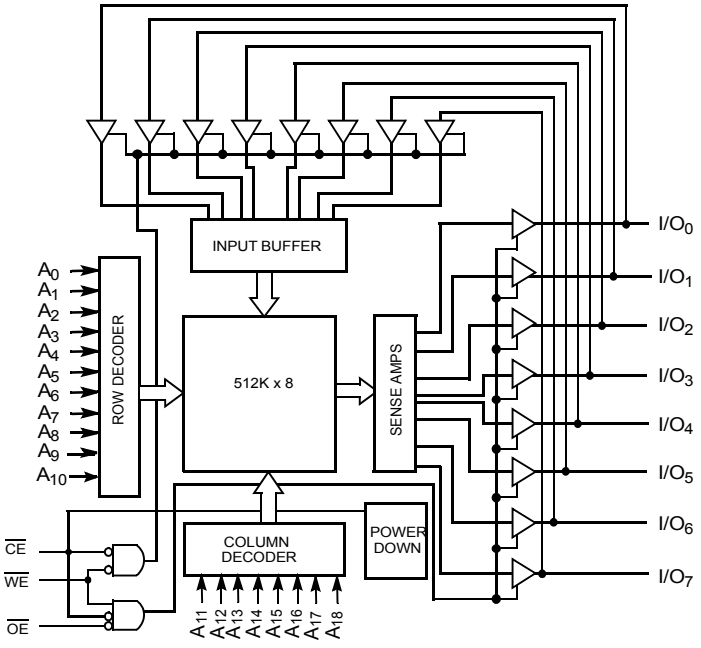
Reading from the device is accomplished by taking Chip Enable ($\overline{CE}$) and Output Enable ($\overline{OE}$) LOW while forcing Write Enable ($\overline{WE}$) HIGH. Under these conditions, the contents of the memory location specified by the address pins will appear on the I/O pins.

The eight input/output pins (I/O_0 through I/O_7) 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 CY7C1049D is available in a standard 400-mil-wide 36-pin SOJ package with center power and ground (revolutionary) pinout.

The CY7C1049D 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.

Logic Block Diagram



Note
1. For guidelines on SRAM system design, refer to the 'System Design Guidelines' Cypress application note, available on the internet at www.cypress.com.

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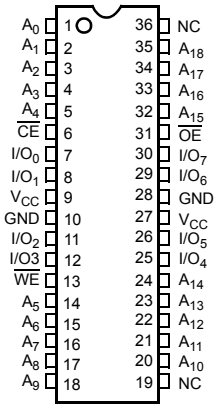
Pin Configuration

SOJ
Top View



Selection Guide

Description	–10	Unit
Maximum access time	10	ns
Maximum operating current	90	mA
Maximum CMOS standby current	10	mA

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 [2] .....–0.5 V to +6.0 V

DC Voltage Applied to Outputs in High Z State[2] .....–0.5 V to V_{CC} + 0.5 V

DC Input Voltage[2] .....–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} = –0.1mA	–	3.4 [3]	
V_{OL}	Output LOW Voltage	V_{CC} = Min., I_{OL} = 8.0 mA		–	0.4	V
V_{IH}[2]	Input HIGH Voltage			2.0	V_{CC}+ 0.5	V
V_{IL}[2]	Input LOW Voltage[2]			–0.5	0.8	V
I_{IX}	Input Leakage Current	GND < V_I < V_{CC}		–1	+1	µA
I_{OZ}	Output Leakage Current	GND < V_{OUT} < V_{CC}, Output Disabled		–1	+1	µA
I_{CC}	VCC Operating Supply Current	V_{CC} = Max., f = f_{MAX} = $1/t_{RC}$	100 MHz	–	90	mA
				–		
			83 MHz	–	80	mA
				–		
			66 MHz	–	70	mA
				–		
			40 MHz	–	60	mA
				–		
I_{SB1}	Automatic CE Power-Down Current – TTL Inputs	Max. V_{CC}, 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}, CE > V_{CC} – 0.3 V, V_{IN} > V_{CC} – 0.3 V, or V_{IN} < 0.3 V, f = 0		–	10	mA

Notes

2. Minimum voltage is –2.0 V and V_{IH}(max) = V_{CC} + 2 V for pulse durations of less than 20 ns.
3. Please note that the maximum VOH limit doesnot exceed minimum CMOS V_{IH} of 3.5V. If you are interfacing this SRAM with 5 V legacy processors that require a minimum V_{IH} of 3.5 V, please refer to Application Note AN6081 for technical details and options you may consider.

Capacitance

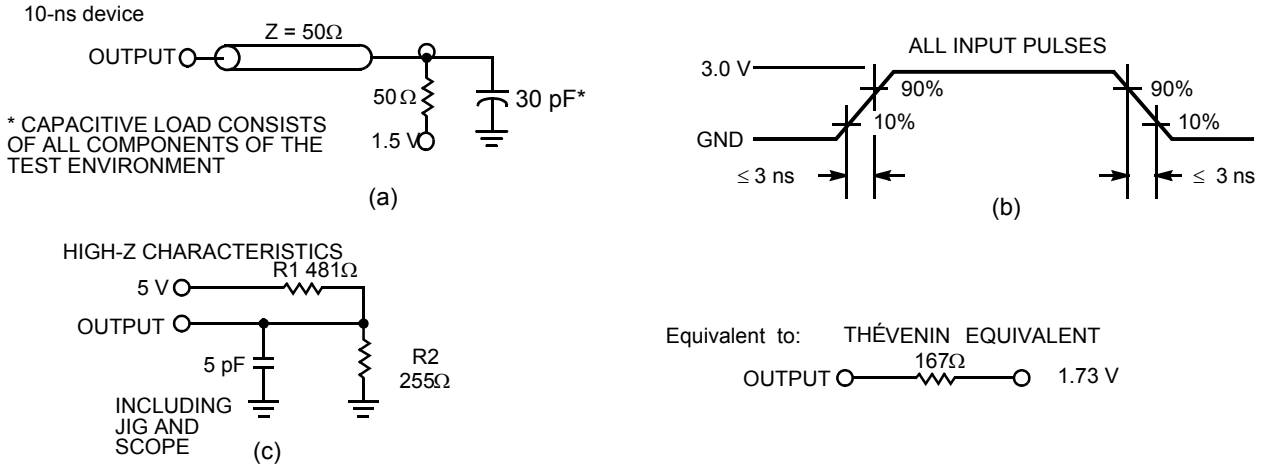
Parameter [4]	Description	Test Conditions	Max.	Unit
C_{IN}	Input capacitance	T_A = 25°C, f = 1 MHz, V_{CC} = 5.0 V	8	pF
C_{OUT}	I/O capacitance		8	pF

Thermal Resistance

Parameter [4]	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	57.91	°C/W
Θ_{JC}	Thermal resistance (Junction to Case)		36.73	°C/W

AC Test Loads and Waveforms

Figure 1. AC Test Loads and Waveforms [5]



Note
4. Tested initially and after any design or process changes that may affect these parameters.
5. AC characteristics (except High-Z) for 10-ns parts are tested using the load conditions shown in Figure (a). High-Z characteristics are tested for all speeds using the test load shown in Figure (c)

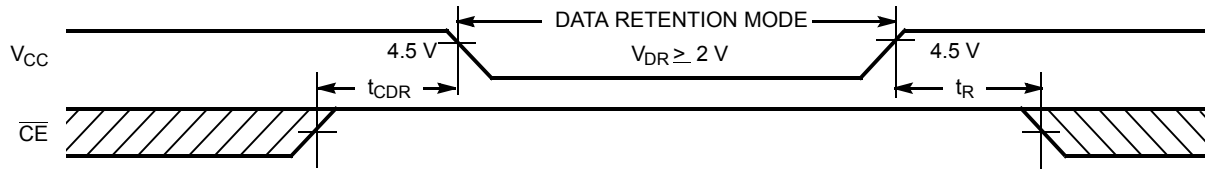
Data Retention Characteristics

Over the Operating Range

Parameter	Description	Conditions[6]	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}[7]	Chip Deselect to Data Retention Time		0	–	ns
t_R[8]	Operation Recovery Time		t_{RC}	–	ns

Data Retention Waveform

Figure 2. Data Retention Waveform



Notes
6. No input may exceed V_{CC} + 0.5 V.
7. Tested initially and after any design or process changes that may affect these parameters.
8. 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 [9]	Description	-10		Unit
		Min.	Max.	
Read Cycle				
t_{power}	V_{CC}(typical) to the First Access[10]	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[12]	0	–	ns
t_{HZOE}	$\overline{OE}$ HIGH to High Z[11, 12]	–	5	ns
t_{LZCE}	$\overline{CE}$ LOW to Low Z[12]	3	–	ns
t_{HZCE}	$\overline{CE}$ HIGH to High Z[11, 12]	–	5	ns
t_{PU}	$\overline{CE}$ LOW to Power-Up	0	–	ns
t_{PD}	$\overline{CE}$ HIGH to Power-Down	–	10	ns
Write Cycle[13, 14]				
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[12]	3	–	ns
t_{HZWE}	$\overline{WE}$ LOW to High Z[11, 12]	–	5	ns

Notes

9. 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, and output loading of the specified I_{OL}/I_{OH} and 30-pF load capacitance.
10. t_{POWER} gives the minimum amount of time that the power supply should be at typical V_{CC} values until the first memory access can be performed.
11. t_{HZOE}, t_{HZCE}, and t_{HZWE} are specified with a load capacitance of 5 pF as in part (c) of AC Test Loads. Transition is measured when the outputs enter a high impedance state.
12. 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.
13. 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.
14. 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 3. Read Cycle No. 1 [15, 16]

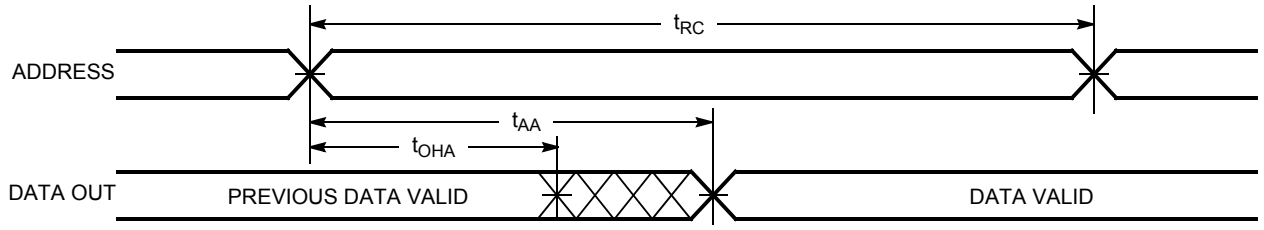
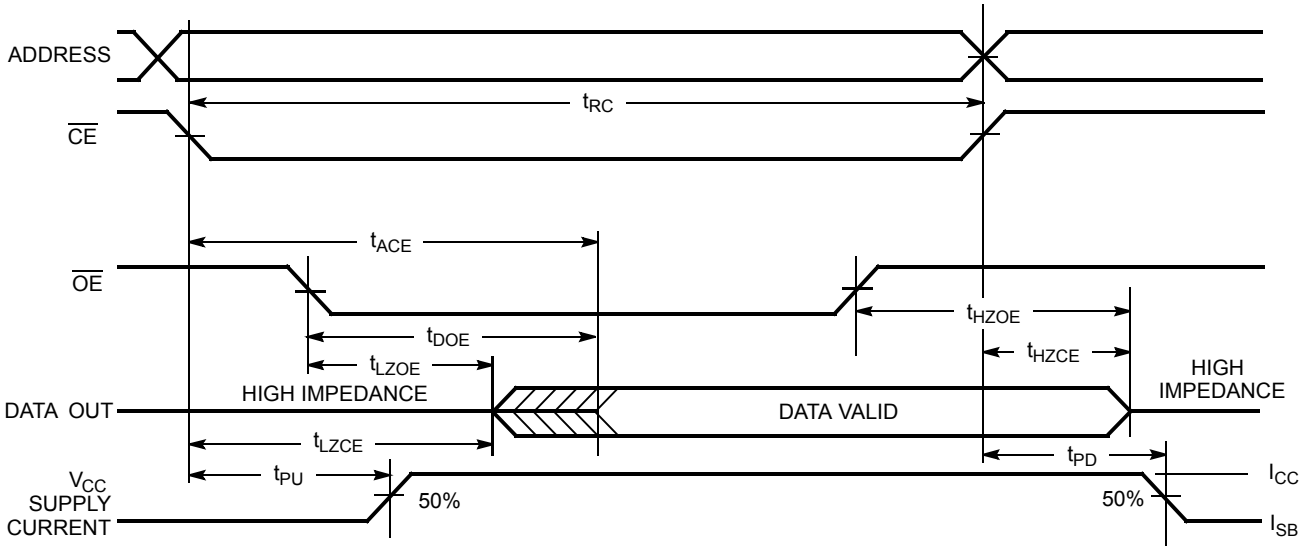


Figure 4. Read Cycle No. 2 ($\overline{OE}$ Controlled) [16, 17]



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

Switching Waveforms(continued)

Figure 5. Write Cycle No. 1 ($\overline{CE}$ Controlled) [18, 19]

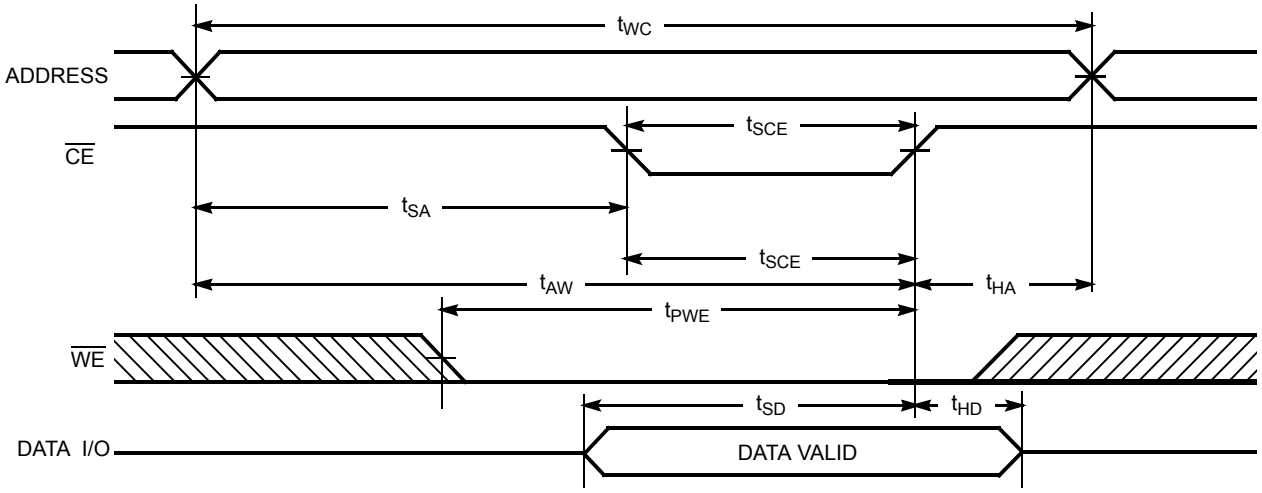
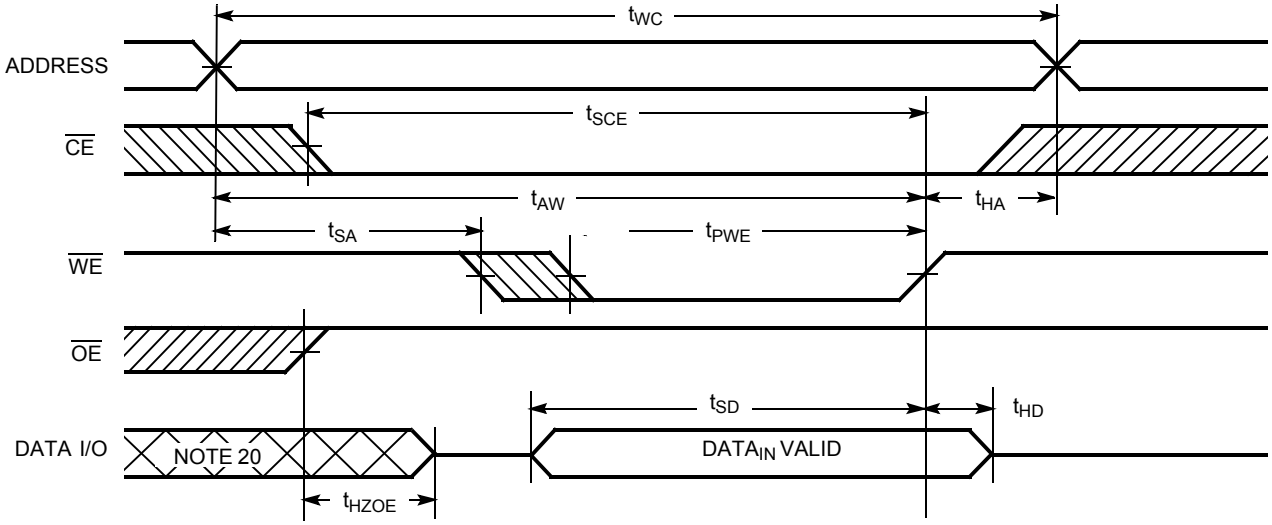


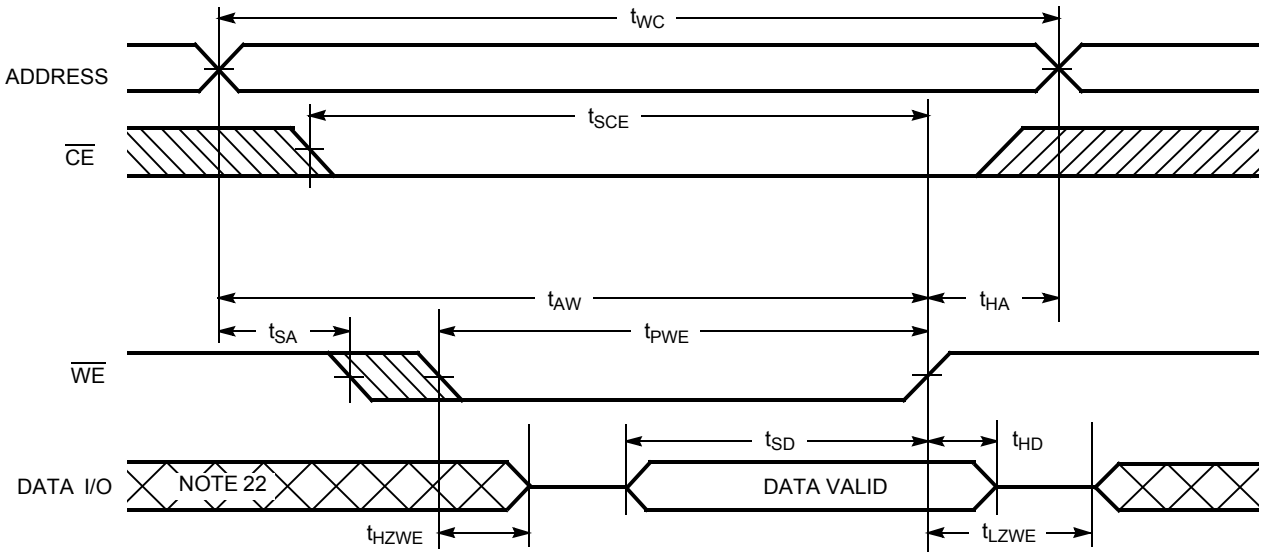
Figure 6. Write Cycle No. 2 ($\overline{WE}$ Controlled, $\overline{OE}$ HIGH During Write) [18, 19]



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

Switching Waveforms(continued)

Figure 7. Write Cycle No. 3 ($\overline{WE}$ Controlled, $\overline{OE}$ LOW) [21]



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

Truth Table

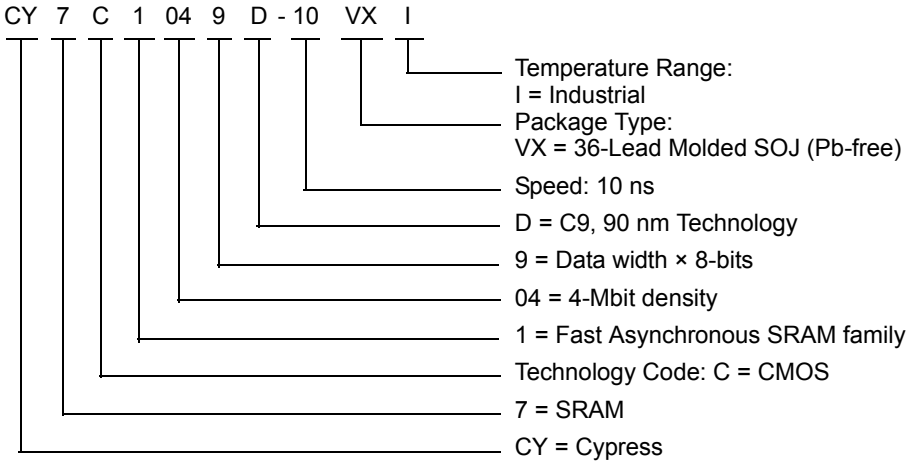
$\overline{CE}$	$\overline{OE}$	$\overline{WE}$	I/O_0–I/O_7	Mode	Power
H	X	X	High-Z	Power-down	Standby (I_{SB})
L	L	H	Data Out	Read	Active (I_{CC})
L	X	L	Data In	Write	Active (I_{CC})
L	H	H	High-Z	Selected, Outputs Disabled	Active (I_{CC})

Ordering Information

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
10	CY7C1049D-10VXI	51-85090	36-Lead (400-Mil) Molded SOJ (Pb-free)	Industrial

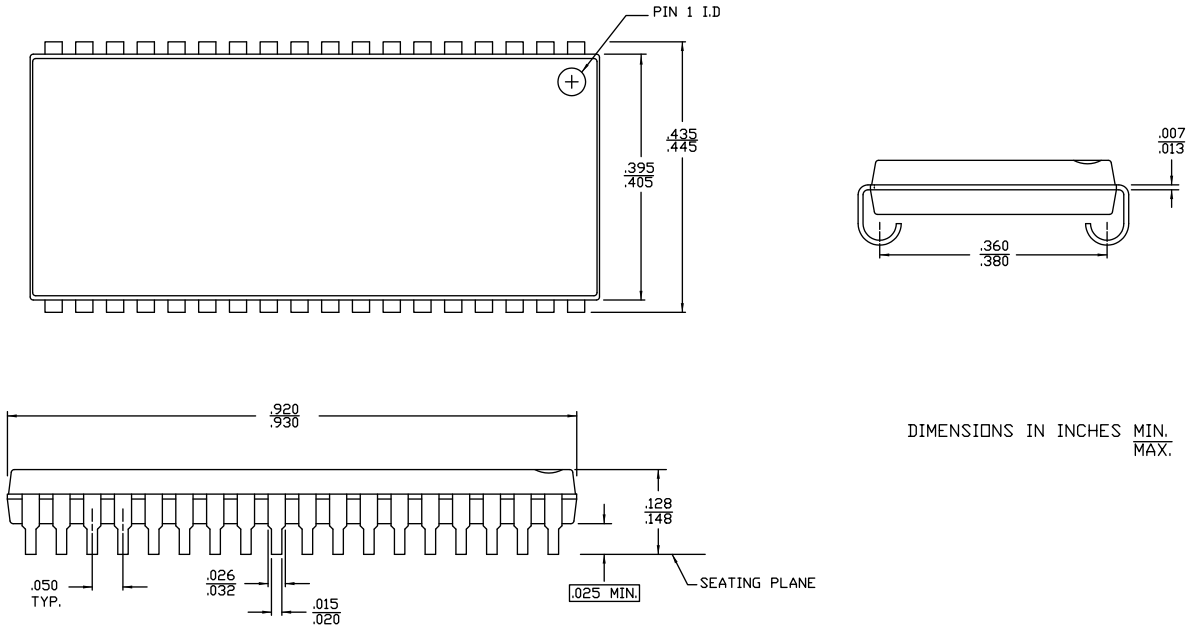
Please contact your local Cypress sales representative for availability of these parts.

Ordering Code Definitions



Package Diagram

Figure 8. 36-pin SOJ V 36.4 (Molded) Package Outline, 51-85090



Acronyms

Acronym	Description
$\overline{CE}$	Chip Enable
CMOS	Complementary Metal Oxide Semiconductor
I/O	Input/Output
$\overline{OE}$	Output Enable
SRAM	Static Random Access Memory
SOJ	Small Outline J-Lead
VFBGA	Very Fine-Pitch Ball Grid Array

Document Conventions

Units of Measure

Symbol	Unit of Measure
°C	degree Celsius
MHz	megahertz
µA	microampere
mA	milliampere
mV	millivolt
mW	milliwatt
ns	nanosecond
pF	picofarad
V	volt
W	watt

Document History Page

Document Title: CY7C1049D, 4-Mbit (512 K × 8) Static RAM Document Number: 38-05474				
Revision	**ECN**	**Orig. of Change**	**Submission Date**	**Description of Change**
**	201560	SWI	See ECN	Advance Datasheet for C9 IPP
*A	233729	RKF	See ECN	1.AC, DC parameters are modified as per EROS(Spec # 01-2165) 2.Pb-free offering in the 'ordering information'
*B	351096	PCI	See ECN	Changed from Advance to Preliminary Removed 17, 20 ns Speed bin Added footnote # 4 Redefined I_{CC} values for Com'l and Ind'l temperature ranges I_{CC} (Com'l): Changed from 67 and 54 mA to 75 and 70 mA for 12 and 15 ns speed bins respectively I_{CC} (Ind'l): Changed from 80, 67 and 54 mA to 90, 85 and 80 mA for 10, 12 and 15 ns speed bins respectively Added $V_{IH(max)}$ spec in Note# 2 Modified Note# 10 on t_R Changed t_{SCE} from 8 to 7 ns for 10 ns speed bin Changed reference voltage level for measurement of Hi-Z parameters from ±500 mV to ±200 mV Added Truth Table on page# 6 Removed L-Version Added 10 ns parts in the Ordering Information Table Added Lead-Free Product Information Shaded Ordering Information Table
*C	446328	NXR	See ECN	Converted from Preliminary to Final Removed -12 and -15 speed bins Removed Commercial Operating Range product information Changed Maximum Rating for supply voltage from 7 V to 6 V Updated Thermal Resistance table Changed t_{HZWE} from 6 ns to 5 ns Updated footnote #7 on High-Z parameter measurement Replaced Package Name column with Package Diagram in the Ordering Information table
*D	3109184	AJU	12/13/2010	Added Ordering Code Definitions. Updated Package Diagram.
*E	3235742	PRAS	04/20/2011	Updated template. Added Acronyms and Units of measure.
*F	4040855	MEMJ	06/26/2013	Updated Functional Description. Updated Electrical Characteristics: Added one more Test Condition "V_{CC} = Max, I_{OH} = –0.1mA" for V_{OH} parameter and added maximum value corresponding to that Test Condition. Added Note 3 and referred the same note in maximum value for V_{OH} parameter corresponding to Test Condition "V_{CC} = Max, I_{OH} = –0.1mA". Updated Package Diagram: spec 51-85090 – Changed revision from *E to *F. Updated in new template.

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