CY7C109D
CY7C1009D

1-Mbit (128 K × 8) Static RAM

Features

- Pin- and function-compatible with CY7C109B/CY7C1009B
- High speed
  - t_{AA} = 10 ns
- Low active power
  - I_{CC} = 80 mA at 10 ns
- Low CMOS standby power
  - I_{SB2} = 3 mA
- 2.0 V Data Retention
- Automatic power-down when deselected
- TTL-compatible inputs and outputs
- Easy memory expansion with $\overline{CE}_1$, CE_2 and $\overline{OE}$ options
- CY7C109D available in Pb-free 32-pin 400-Mil wide Molded SOJ and 32-pin TSOP I packages. CY7C1009D available in Pb-free 32-pin 300-Mil wide Molded SOJ package

Functional Description [1]

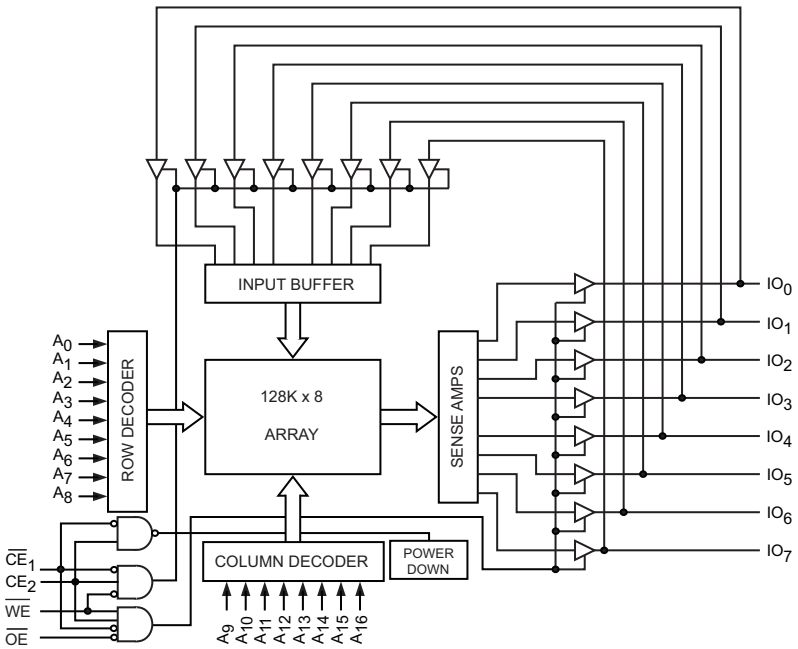
The CY7C109D/CY7C1009D is a high-performance CMOS static RAM organized as 131,072 words by 8 bits. Easy memory expansion is provided by an active LOW Chip Enable ($\overline{CE}_1$), an active HIGH Chip Enable (CE_2), an active LOW Output Enable ($\overline{OE}$), and tri-state drivers.The eight input and output pins (I/O_0 through I/O_7) are placed in a high-impedance state when:

- Deselected ($\overline{CE}_1$ HIGH or CE_2 LOW),
- Outputs are disabled ($\overline{OE}$ HIGH),
- When the write operation is active ($\overline{CE}_1$ LOW, CE_2 HIGH, and $\overline{WE}$ LOW)

Write to the device by taking Chip Enable One ($\overline{CE}_1$) and Write Enable ($\overline{WE}$) inputs LOW and Chip Enable Two (CE_2) input HIGH. 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_{16}).

Read from the device by taking Chip Enable One ($\overline{CE}_1$) and Output Enable ($\overline{OE}$) LOW while forcing Write Enable ($\overline{WE}$) and Chip Enable Two (CE_2) HIGH. Under these conditions, the contents of the memory location specified by the address pins appears on the I/O pins.

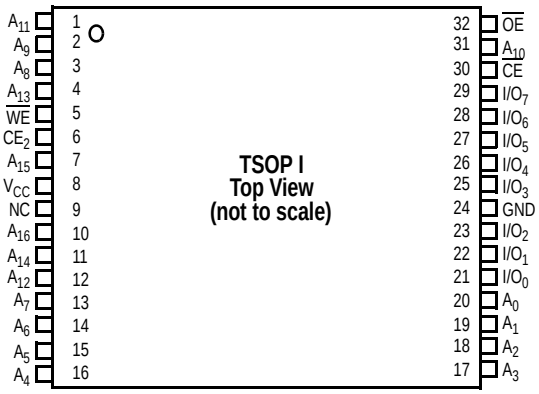
Logic Block Diagram

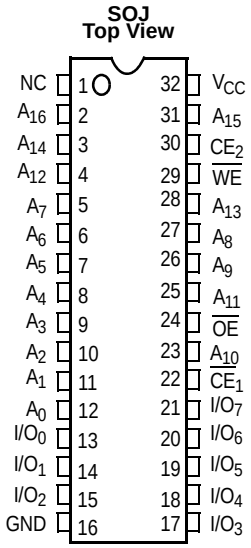


Note
1. For guidelines on SRAM system design, please refer to the 'System Design Guidelines' Cypress application note, available on the internet at www.cypress.com.

Contents

Pin Configuration [2]





Selection Guide

	CY7C109D-10 CY7C1009D-10	Unit
Maximum Access Time	10	ns
Maximum Operating Current	80	mA
Maximum CMOS Standby Current	3	mA

Note
2. NC pins are not connected on the die.

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 [3] ..–0.5 V to +6.0 V

DC Voltage Applied to Outputs in High-Z State [3]..... –0.5 V to V_{CC} + 0.5 V

DC Input Voltage [3] ..... –0.5 V to V_{CC} + 0.5 V

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

Static Discharge Voltage..... > 2001 V (per MIL-STD-883, Method 3015)

Latch-up Current..... > 200 mA

Operating Range

Range	Ambient Temperature	V_{CC}	Speed
Industrial	–40°C to +85°C	5 V ± 0.5 V	10 ns

Electrical Characteristics (Over the Operating Range)

Parameter	Description	Test Conditions		7C109D-10 7C1009D-10 Min	7C109D-10 7C1009D-10 Max	Unit
V_{OH}	Output HIGH Voltage	I_{OH} = –4.0 mA		2.4		V
V_{OL}	Output LOW Voltage	I_{OL} = 8.0 mA			0.4	V
V_{IH}	Input HIGH Voltage			2.2	V_{CC} + 0.5	V
V_{IL}	Input LOW Voltage [3]			–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_I ≤ V_{CC}, Output Disabled		–1	+1	µA
I_{CC}	V_{CC} Operating Supply Current	V_{CC} = Max, I_{OUT} = 0 mA, f = f_{max} = $1/t_{RC}$	100 MHz		80	mA
			83 MHz		72	mA
			66 MHz		58	mA
			40 MHz		37	mA
I_{SB1}	Automatic CE Power-Down Current—TTL Inputs	Max V_{CC}, CE_1 ≥ V_{IH} or CE_2 ≤ V_{IL}, V_{IN} ≥ V_{IH} or V_{IN} ≤ V_{IL}, f = f_{max}			10	mA
I_{SB2}	Automatic CE Power-Down Current—CMOS Inputs	Max V_{CC}, CE_1 ≥ V_{CC} – 0.3 V, or CE_2 ≤ 0.3 V, V_{IN} ≥ V_{CC} – 0.3 V, or V_{IN} ≤ 0.3 V, f = 0			3	mA

Note
3. V_{IL} (min) = –2.0 V and V_{IH}(max) = V_{CC} + 1 V for pulse durations of less than 5 ns.

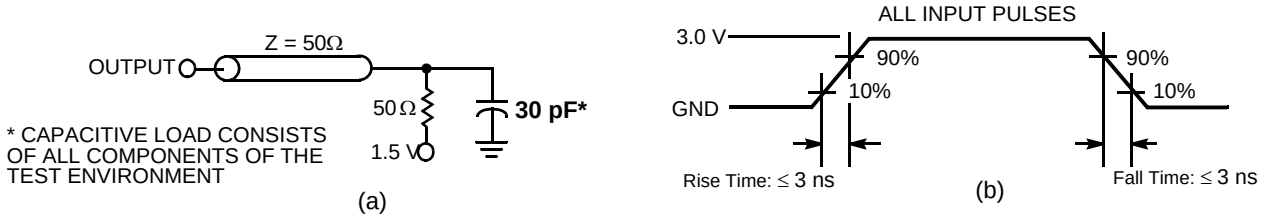
Capacitance [4]

Parameter	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}	Output Capacitance		8	pF

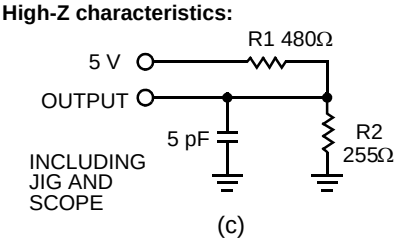
Thermal Resistance [4]

Parameter	Description	Test Conditions	300-Mil Wide SOJ	400-Mil Wide SOJ	TSOP I	Unit
Θ_{JA}	Thermal Resistance (Junction to Ambient)	Still Air, soldered on a 3 × 4.5 inch, four-layer printed circuit board	57.61	56.29	50.72	°C/W
Θ_{JC}	Thermal Resistance (Junction to Case)		40.53	38.14	16.21	°C/W

AC Test Loads and Waveforms [5]



High-Z characteristics:



Notes
4. Tested initially and after any design or process changes that may affect these parameters.
5. AC characteristics (except High-Z) 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).

Switching Characteristics (Over the Operating Range) [6]

Parameter	Description	7C109D-10 7C1009D-10		Unit
		Min	Max	
Read Cycle				
t_{power} [7]	V_{CC}(typical) to the first access	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}	$\overline{CE}_1$ LOW to Data Valid, CE_2 HIGH to Data Valid		10	ns
t_{DOE}	$\overline{OE}$ LOW to Data Valid		5	ns
t_{LZOE}	$\overline{OE}$ LOW to Low Z	0		ns
t_{HZOE}	$\overline{OE}$ HIGH to High Z [8, 9]		5	ns
t_{LZCE}	$\overline{CE}_1$ LOW to Low Z, CE_2 HIGH to Low Z [9]	3		ns
t_{HZCE}	$\overline{CE}_1$ HIGH to High Z, CE_2 LOW to High Z [8, 9]		5	ns
t_{PU} [10]	$\overline{CE}_1$ LOW to Power-Up, CE_2 HIGH to Power-Up	0		ns
t_{PD} [10]	$\overline{CE}_1$ HIGH to Power-Down, CE_2 LOW to Power-Down		10	ns
Write Cycle [11, 12]				
t_{WC}	Write Cycle Time	10		ns
t_{SCE}	$\overline{CE}_1$ LOW to Write End, CE_2 HIGH 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 [9]	3		ns
t_{HZWE}	$\overline{WE}$ LOW to High Z [8, 9]		5	ns

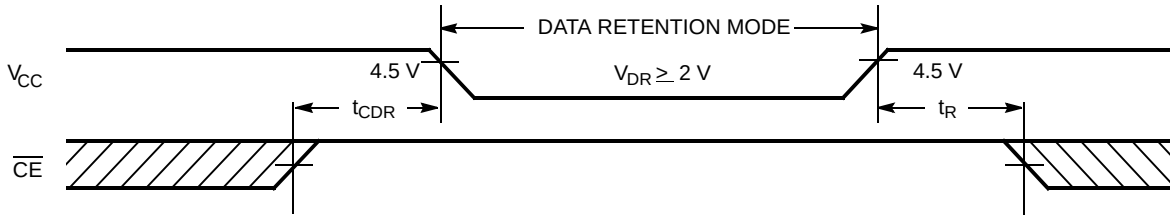
Notes

6. 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.
7. 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
8. t_{HZOE}, t_{HZCE} and t_{HZWE} are specified with a load capacitance of 5 pF as in part (c) of "AC Test Loads and Waveforms [5]" on page 5. Transition is measured when the outputs enter a high impedance state.
9. 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.
10. This parameter is guaranteed by design and is not tested.
11. The internal write time of the memory is defined by the overlap of $\overline{CE}_1$ LOW, CE_2 HIGH, and $\overline{WE}$ LOW. $\overline{CE}_1$ and $\overline{WE}$ must be LOW and CE_2 HIGH to initiate a write, and the transition of any 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.
12. 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}.

Data Retention Characteristics (Over the Operating Range)

Parameter	Description	Conditions	Min	Max	Unit
V_{DR}	V_{CC} for Data Retention	$V_{CC} = V_{DR} = 2.0$ V,	2.0		V
I_{CCDR}	Data Retention Current	$\overline{CE}_1 \geq V_{CC} - 0.3$ V or $CE_2 \leq 0.3$ V, $V_{IN} \geq V_{CC} - 0.3$ V or $V_{IN} \leq 0.3$ V		3	mA
t_{CDR} [4]	Chip Deselect to Data Retention Time		0		ns
t_R [13]	Operation Recovery Time		t_{RC}		ns

Data Retention Waveform



Switching Waveforms

Figure 1. Read Cycle No. 1 (Address Transition Controlled) [14, 15]

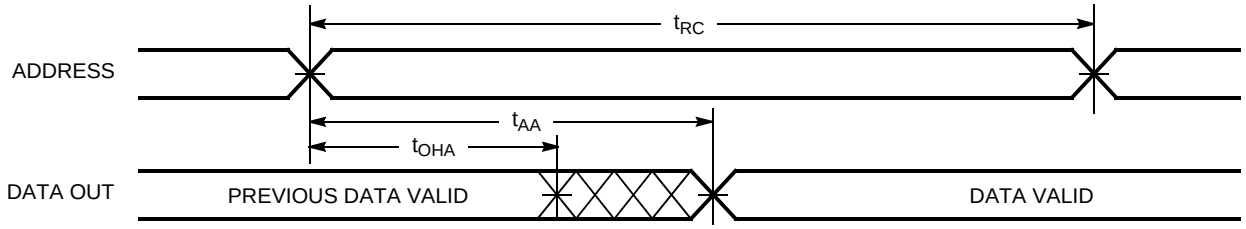
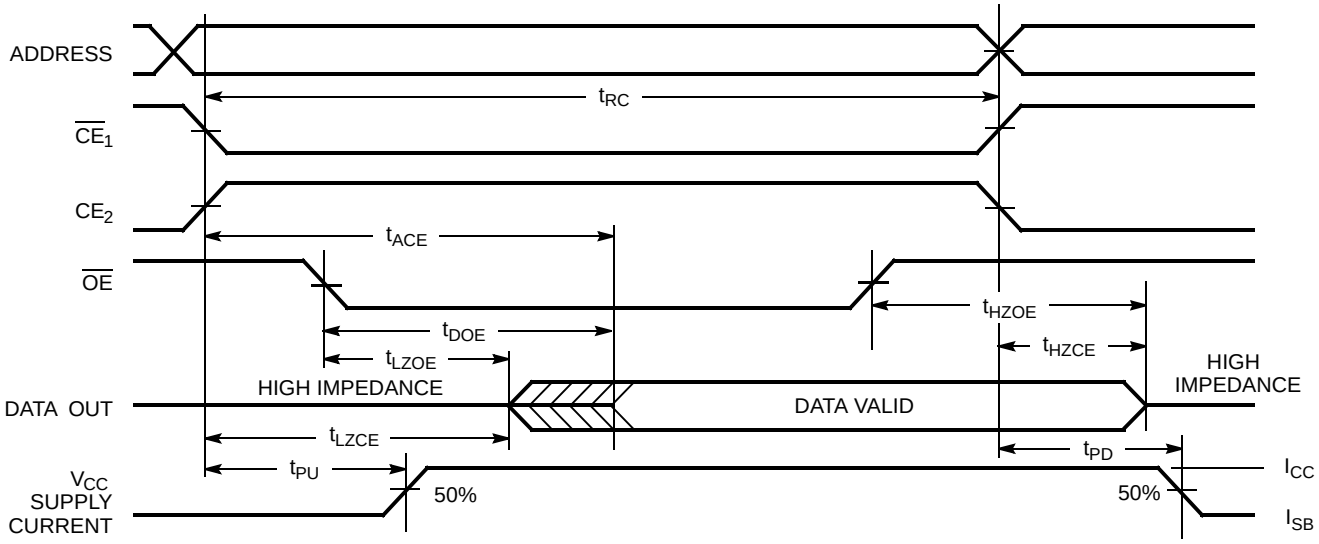


Figure 2. Read Cycle No. 2 ($\overline{OE}$ Controlled) [15, 16]



Notes
13. 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.
14. Device is continuously selected. $\overline{OE}$, $\overline{CE}_1 = V_{IL}$, $CE_2 = V_{IH}$.
15. $\overline{WE}$ is HIGH for read cycle.
16. Address valid prior to or coincident with $\overline{CE}_1$ transition LOW and CE_2 transition HIGH.

Switching Waveforms (continued)

Figure 3. Write Cycle No. 1 ($\overline{CE}_1$ or CE_2 Controlled) [17, 18]

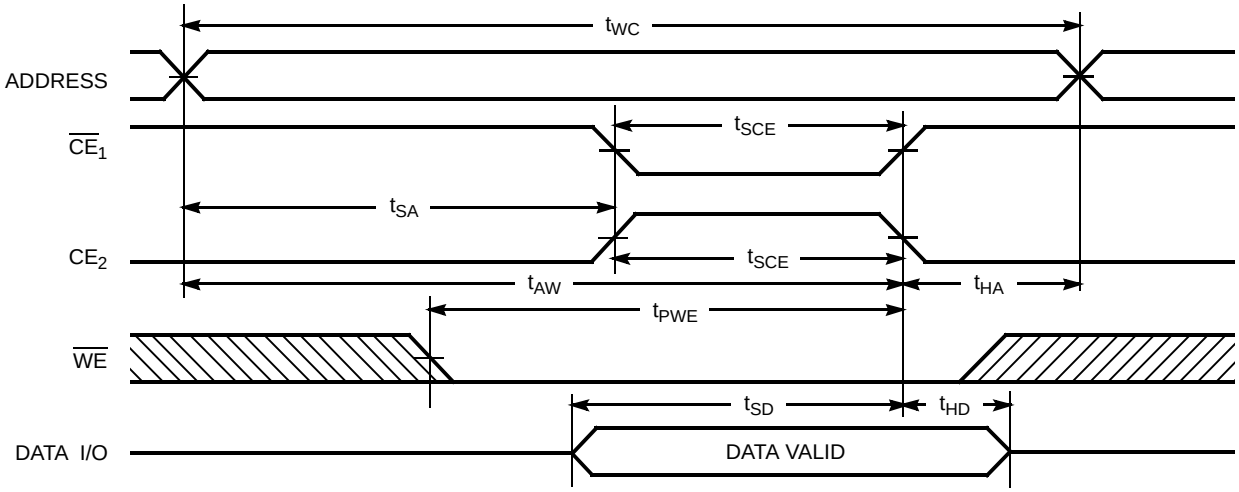
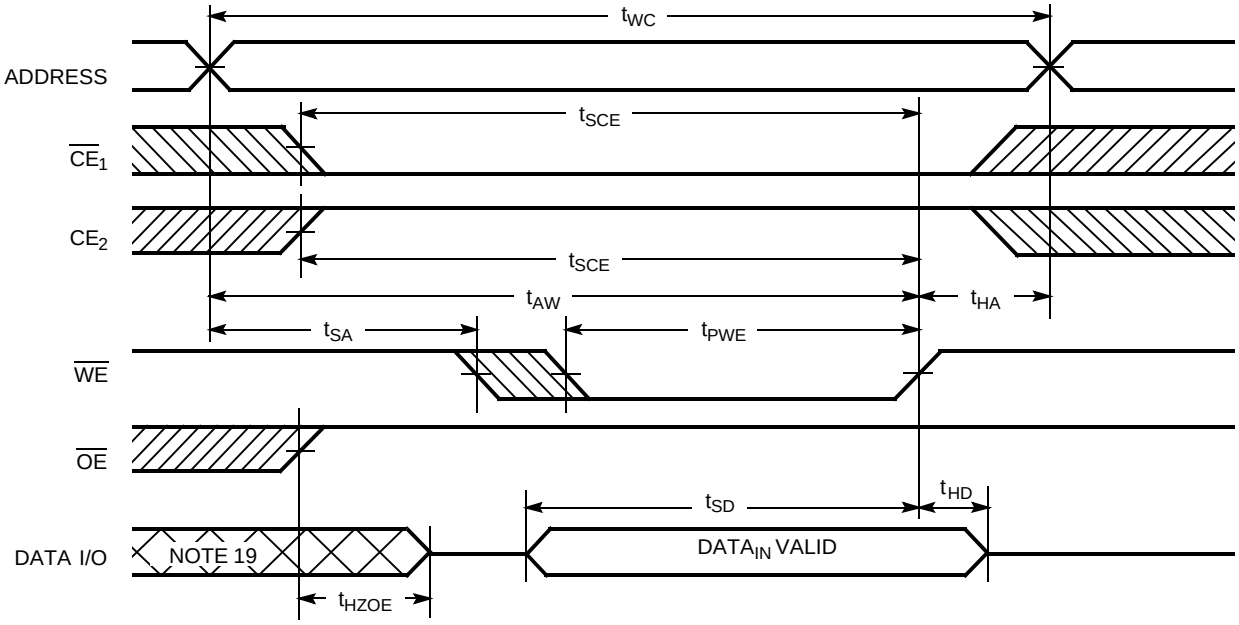


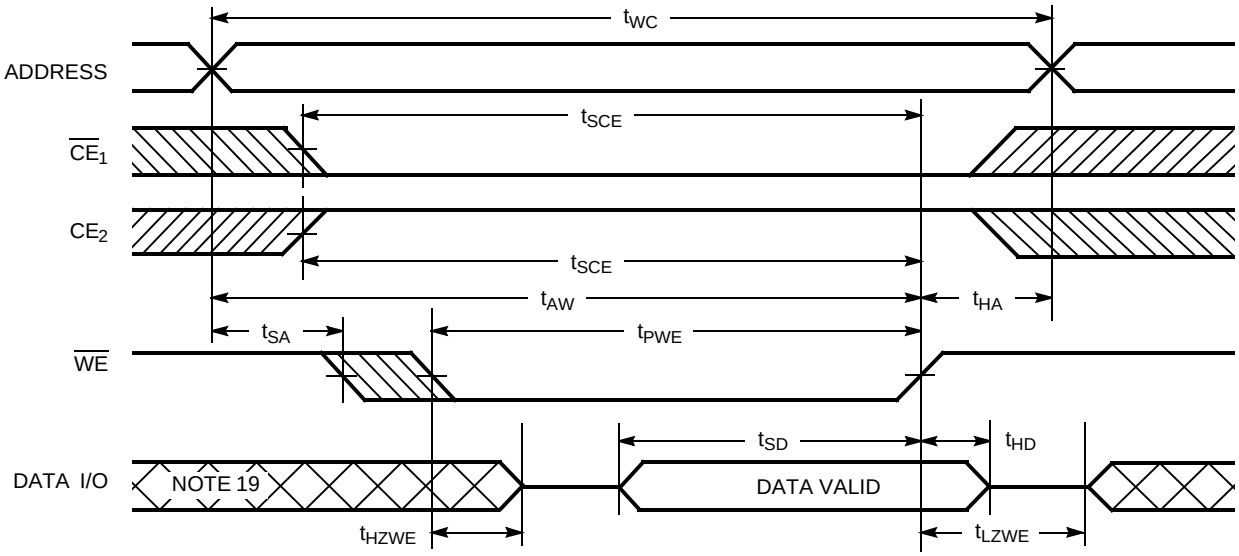
Figure 4. Write Cycle No. 2 ($\overline{WE}$ Controlled, $\overline{OE}$ HIGH During Write) [17, 18]



Notes
17. Data I/O is high impedance if $\overline{OE} = V_{IH}$.
18. If $\overline{CE}_1$ goes HIGH or CE_2 goes LOW 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 5. Write Cycle No. 3 ($\overline{WE}$ Controlled, $\overline{OE}$ LOW) [12, 18]



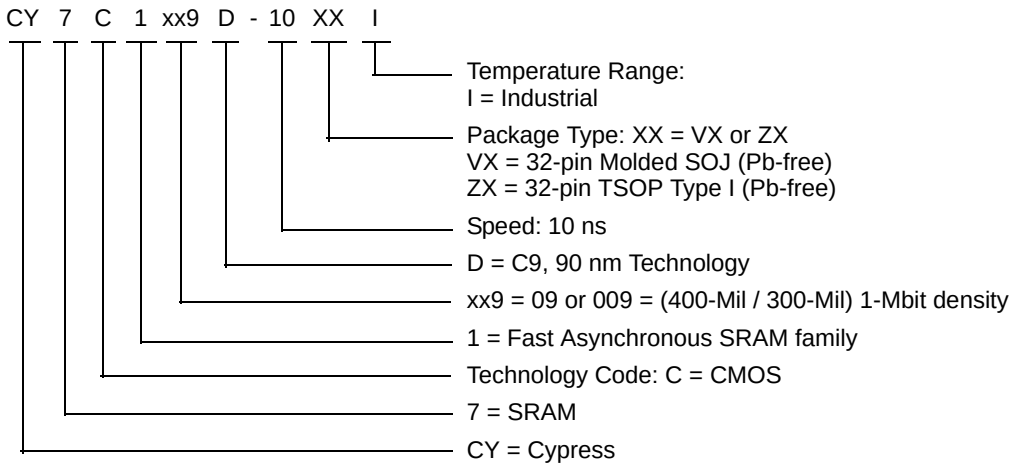
Truth Table

$\overline{CE_1}$	CE_2	$\overline{OE}$	$\overline{WE}$	I/O_0–I/O_7	Mode	Power
H	X	X	X	High Z	Power-down	Standby (I_{SB})
X	L	X	X	High Z	Power-down	Standby (I_{SB})
L	H	L	H	Data Out	Read	Active (I_{CC})
L	H	X	L	Data In	Write	Active (I_{CC})
L	H	H	H	High Z	Selected, Outputs Disabled	Active (I_{CC})

Ordering Information

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
10	CY7C109D-10VXI	51-85033	32-pin (400-Mil) Molded SOJ (Pb-free)	Industrial
	CY7C109D-10ZXI	51-85056	32-pin TSOP Type I (Pb-free)	
	CY7C1009D-10VXI	51-85041	32-pin (300-Mil) Molded SOJ (Pb-free)	

Ordering Code Definitions



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

Package Diagrams

Figure 6. 32-pin (300-Mil) Molded SOJ, 51-85041

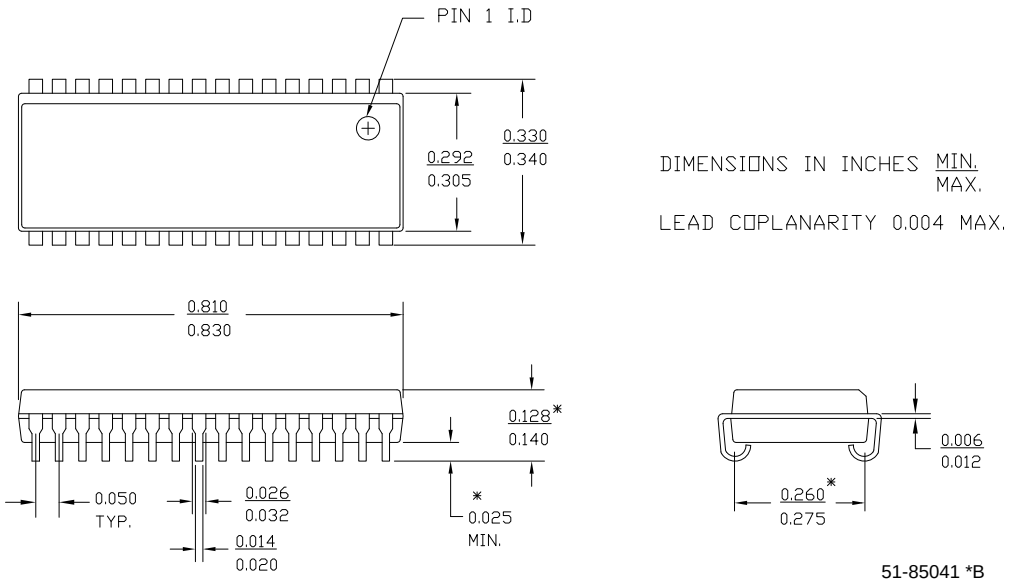
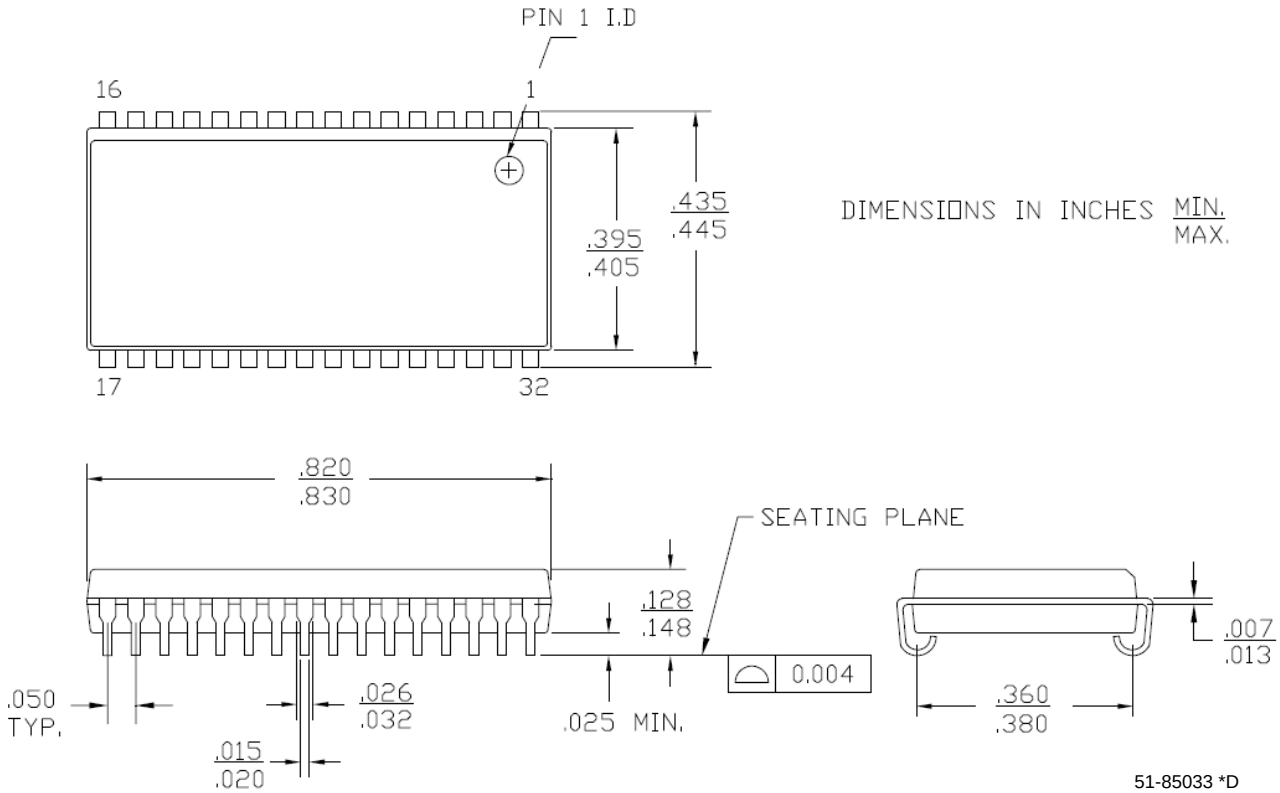
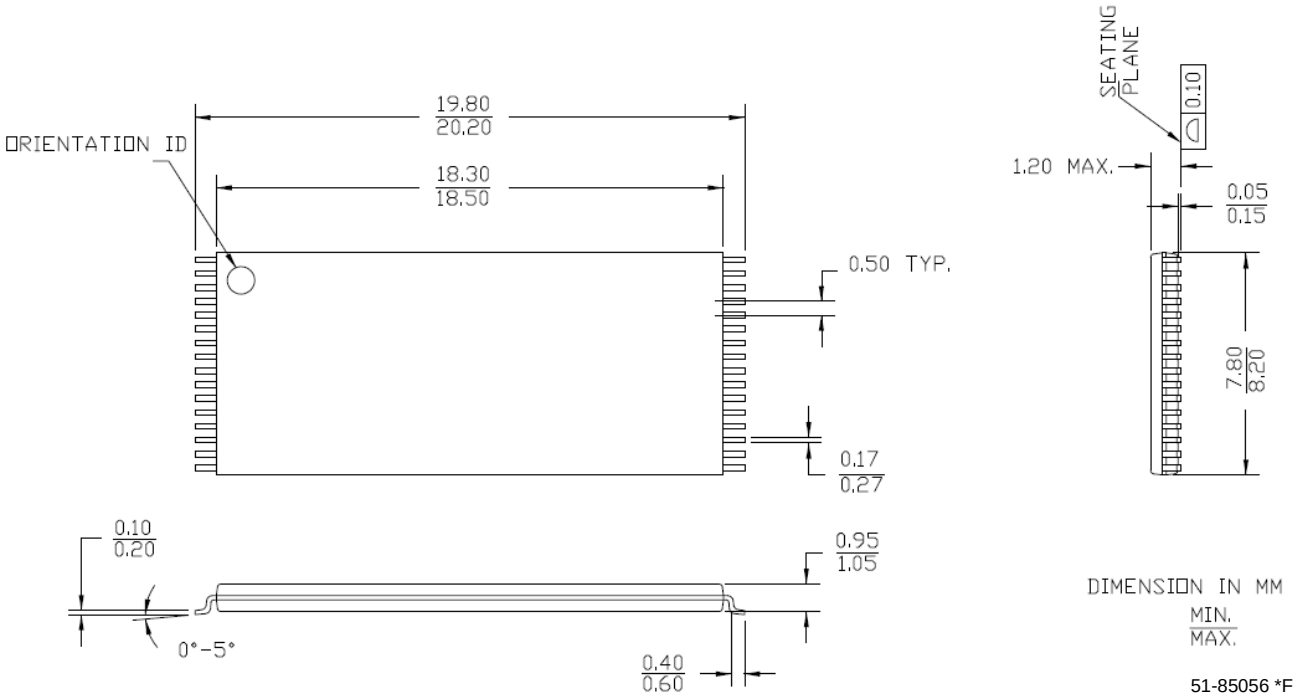


Figure 7. 32-pin (400-Mil) Molded SOJ, 51-85033



Package Diagrams (continued)

Figure 8. 32-pin Thin Small Outline Package Type I (8 × 20 mm), 51-85056



Acronyms

Acronym	Description
CE	chip enable
CMOS	Complementary metal oxide semiconductor
I/O	Input/output
OE	output enable
SRAM	Static random access memory
SOJ	Small Outline J-Lead
TSOP	Thin Small Outline Package
VFBGA	Very Fine-Pitch Ball Grid Array

Document Conventions

Units of Measure

Symbol	Unit of Measure
ns	nano seconds
V	Volts
µA	micro Amperes
mA	milli Amperes
mV	milli Volts
mW	milli Watts
MHz	Mega Hertz
pF	pico Farad
℃	degree Celcius
W	Watts

Document History Page

Document Title: CY7C109D/CY7C1009D, 1-Mbit (128 K × 8) Static RAM Document Number: 38-05468				
Revision	**ECN**	**Submission Date**	**Orig. of Change**	**Description of Change**
**	201560	See ECN	SWI	Advance Information data sheet for C9 IPP
*A	233722	See ECN	RKF	DC parameters are modified as per EROS (Spec # 01-2165) Pb-free offering in Ordering Information
*B	262950	See ECN	RKF	Added Data Retention Characteristics table Added T_{power} Spec in Switching Characteristics Table Shaded Ordering Information
*C	See ECN	See ECN	RKF	Reduced Speed bins to -10 and -12 ns
*D	560995	See ECN	VKN	Converted from Preliminary to Final Removed Commercial Operating range Removed 12 ns speed bin Added I_{CC} values for the frequencies 83MHz, 66MHz and 40MHz Updated Thermal Resistance table Updated Ordering Information Table Changed Overshoot spec from V_{CC}+2 V to V_{CC}+1 V in footnote #3
*E	802877	See ECN	VKN	Changed I_{CC} spec from 60 mA to 80 mA for 100MHz, 55 mA to 72 mA for 83MHz, 45 mA to 58 mA for 66MHz, 30 mA to 37 mA for 40MHz
*F	3104943	12/08/2010	AJU	Added Ordering Code Definitions. Updated Package Diagrams.
*G	3220123	04/08/2011	PRAS	Updated template and styles as per current Cypress standards. Added Acronyms and units of measure. Updated package diagrams: 51-85033 to *D 51-85056 to *F

Sales, Solutions, and Legal Information

Worldwide Sales and Design Support

Cypress maintains a worldwide network of offices, solution centers, manufacturer's representatives, and distributors. To find the office closest to you, visit us at Cypress Locations.

Products

Automotive	cypress.com/go/automotive
Clocks & Buffers	cypress.com/go/clocks
Interface	cypress.com/go/interface
Lighting & Power Control	cypress.com/go/powerpsoc cypress.com/go/plc
Memory	cypress.com/go/memory
Optical & Image Sensing	cypress.com/go/image
PSoC	cypress.com/go/psoc
Touch Sensing	cypress.com/go/touch
USB Controllers	cypress.com/go/USB
Wireless/RF	cypress.com/go/wireless

PSoC Solutions

psoc.cypress.com/solutions

PSoC 1 | PSoC 3 | PSoC 5