

1-Mbit (128 K × 8) Static RAM

Features

- Pin- and function-compatible with CY7C109B/CY7C1009B
- High speed
 - $t_{AA} = 10 \text{ ns}$
- Low active power
 - $I_{CC} = 80 \text{ mA}$ at 10 ns
- Low CMOS standby power
 - $I_{SB2} = 3 \text{ mA}$
- 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]

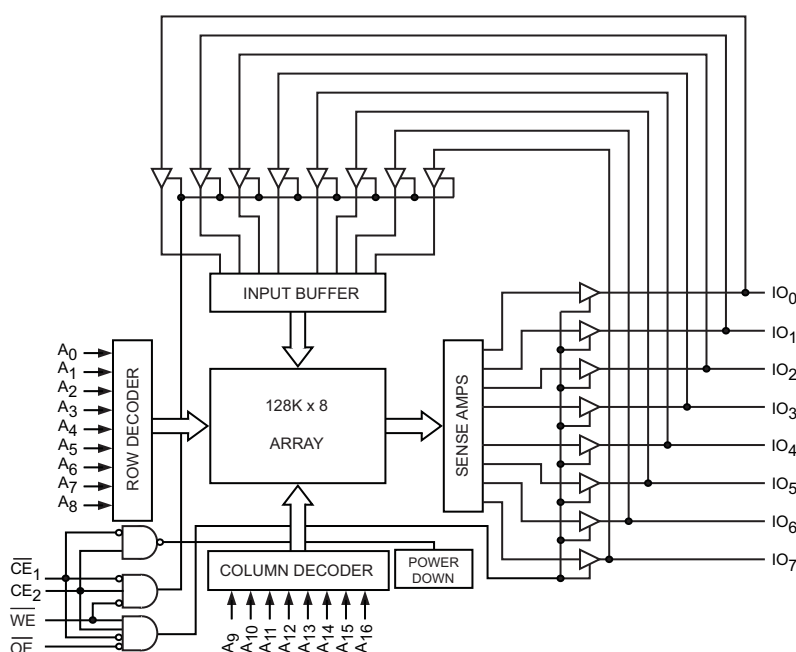
The CY7C109D/CY7C1009D is a high-performance CMOS static RAM organized as 131,072 words by 8 bits. Easy memory expansion is provided by an active LOW Chip Enable (\overline{CE}_1), an active HIGH Chip Enable (CE_2), an active LOW Output Enable (\overline{OE}), and tri-state drivers. The eight input and 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



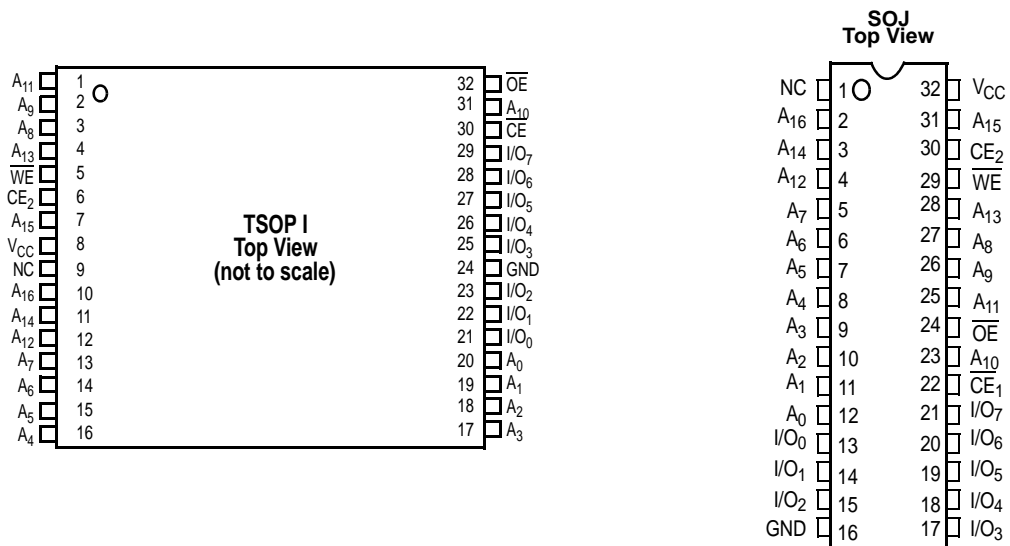
Note

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.

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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		Unit
			Min	Max	
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.

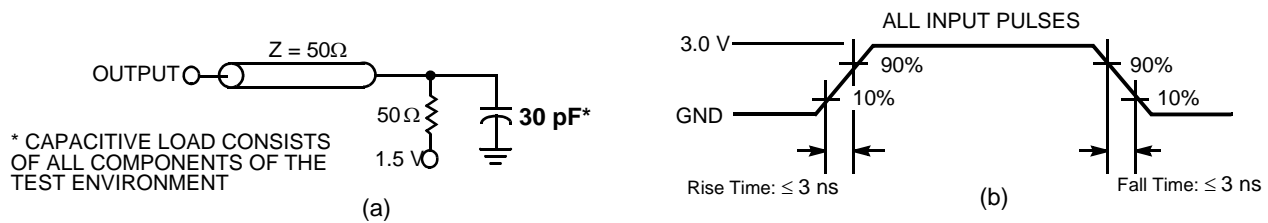
Capacitance ^[4]

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

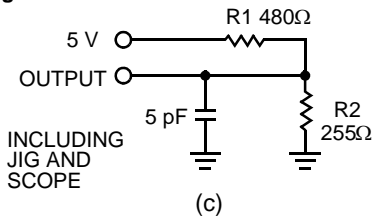
Thermal Resistance ^[4]

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		μ s
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

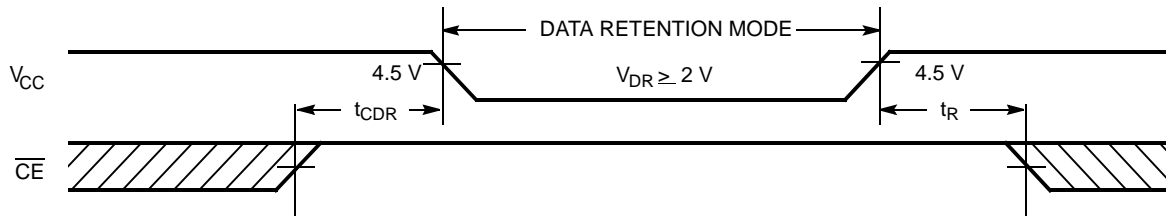
Notes

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	$V_{CC} = V_{DR} = 2.0\text{ V}$,	2.0		V
I_{CCDR}	Data Retention Current	$CE_1 \geq V_{CC} - 0.3\text{ V}$ or $CE_2 \leq 0.3\text{ V}$, $V_{IN} \geq V_{CC} - 0.3\text{ V}$ or $V_{IN} \leq 0.3\text{ V}$		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]

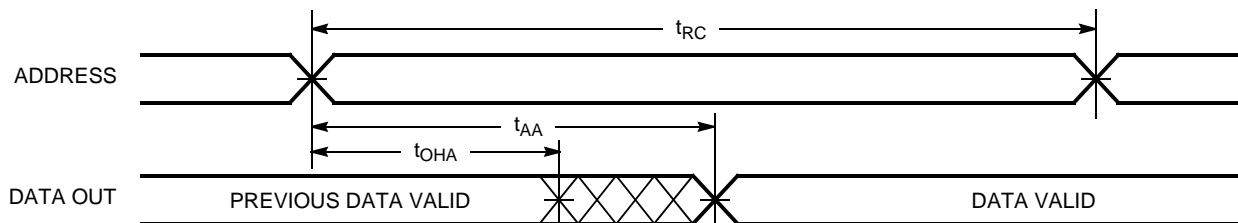
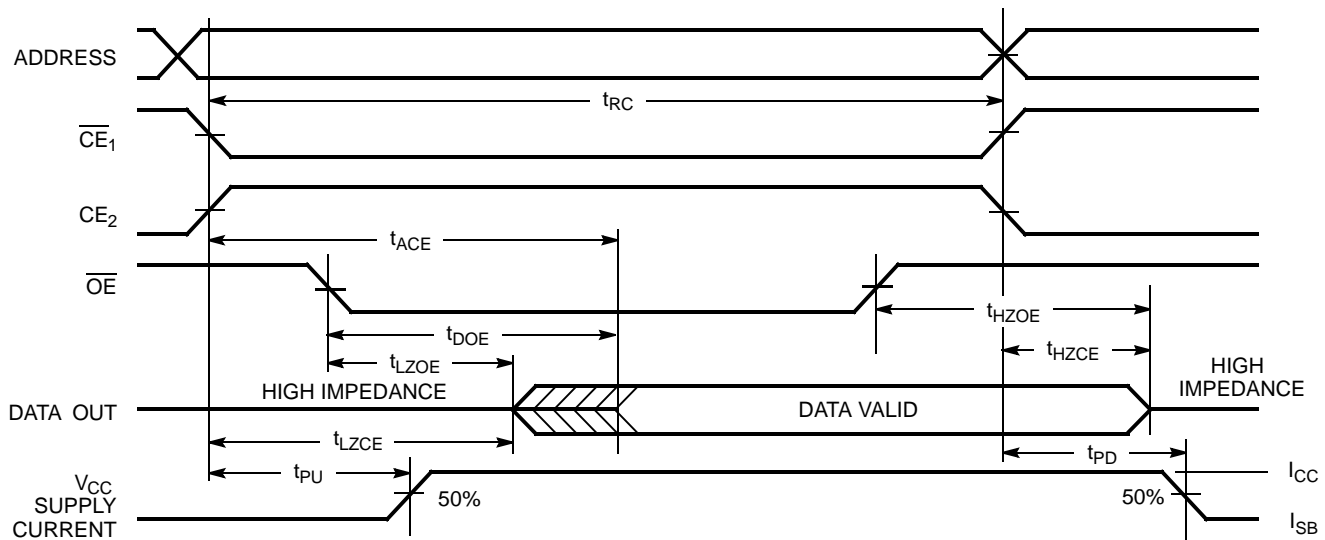


Figure 2. Read Cycle No. 2 (\overline{OE} Controlled) [15, 16]



Notes

13. Full device operation requires linear V_{CC} ramp from V_{DR} to $V_{CC(min)} \geq 50\ \mu\text{s}$ or stable at $V_{CC(min)} \geq 50\ \mu\text{s}$.
14. Device is continuously selected. \overline{OE} , $CE_1 = V_{IL}$, $CE_2 = V_{IH}$.
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]

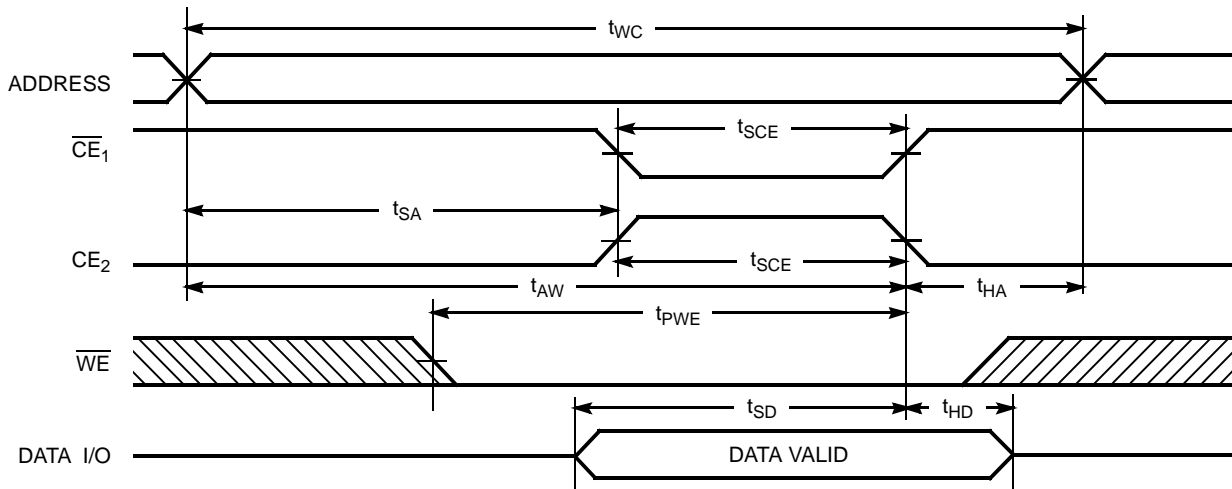
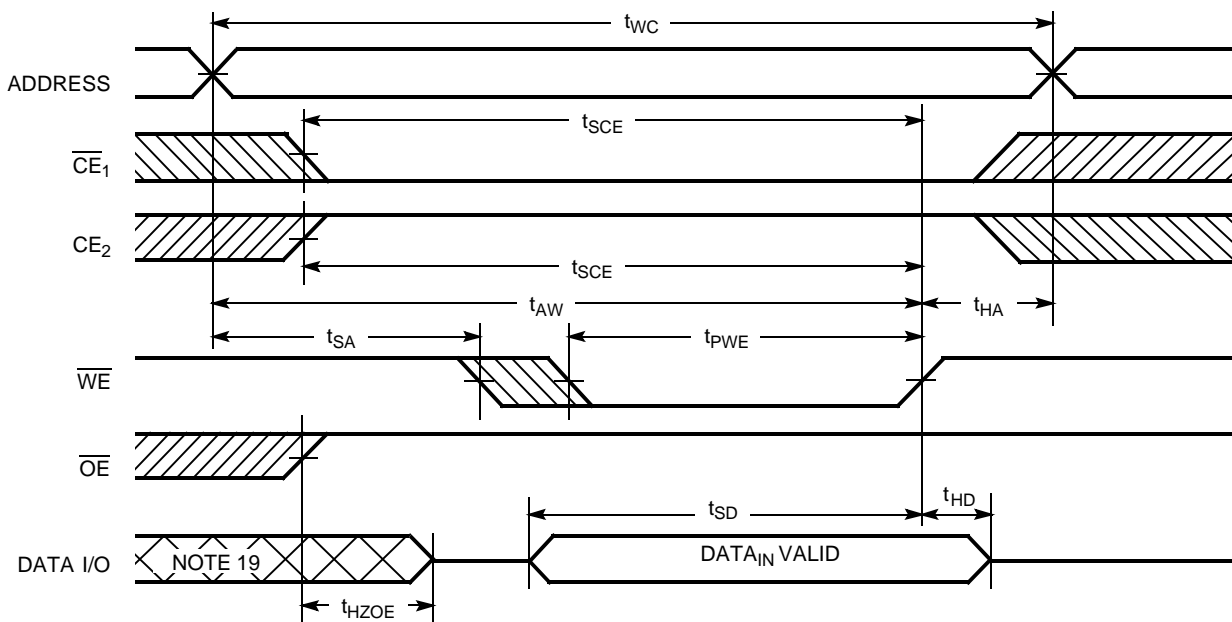


Figure 4. Write Cycle No. 2 (\overline{WE} Controlled, \overline{OE} HIGH During Write) [17, 18]

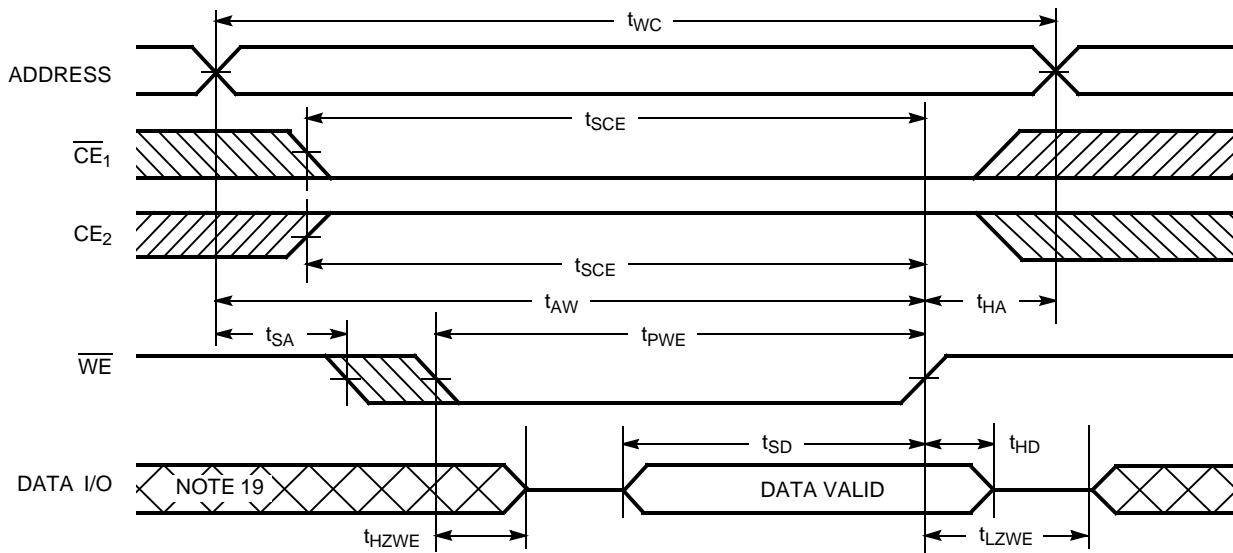


Notes

- 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

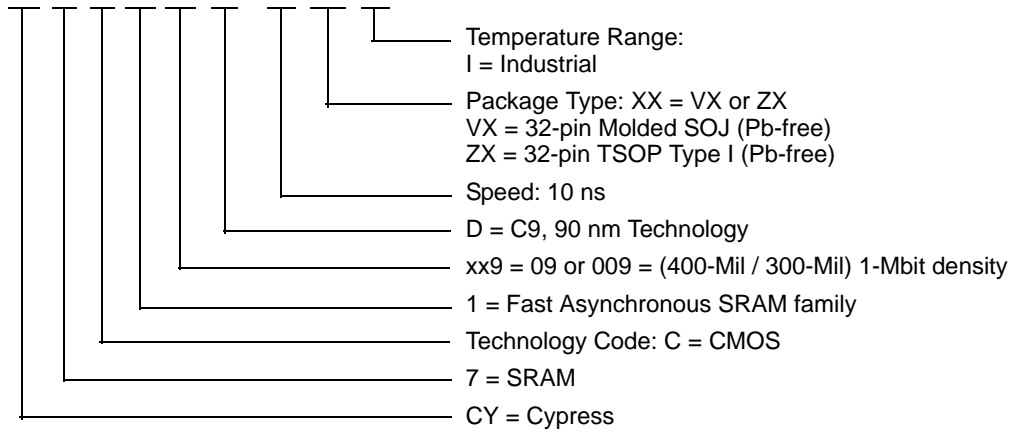
\overline{CE}_1	CE_2	\overline{OE}	\overline{WE}	I/O ₀ -I/O ₇	Mode	Power
H	X	X	X	High Z	Power-down	Standby (I_{SB})
X	L	X	X	High Z	Power-down	Standby (I_{SB})
L	H	L	H	Data Out	Read	Active (I_{CC})
L	H	X	L	Data In	Write	Active (I_{CC})
L	H	H	H	High Z	Selected, Outputs Disabled	Active (I_{CC})

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

CY 7 C 1 xx9 D - 10 XX I



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

Package Diagrams

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

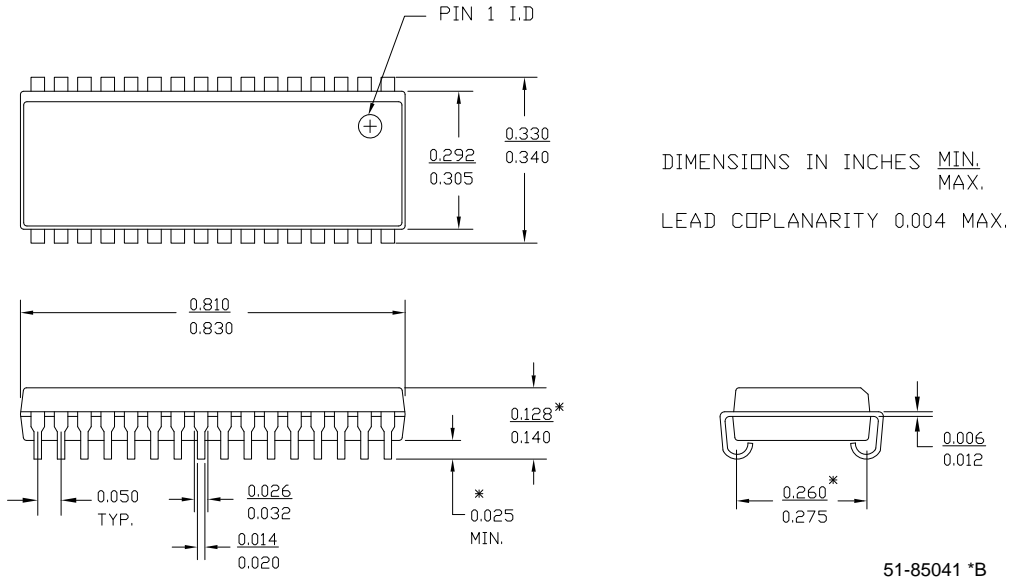
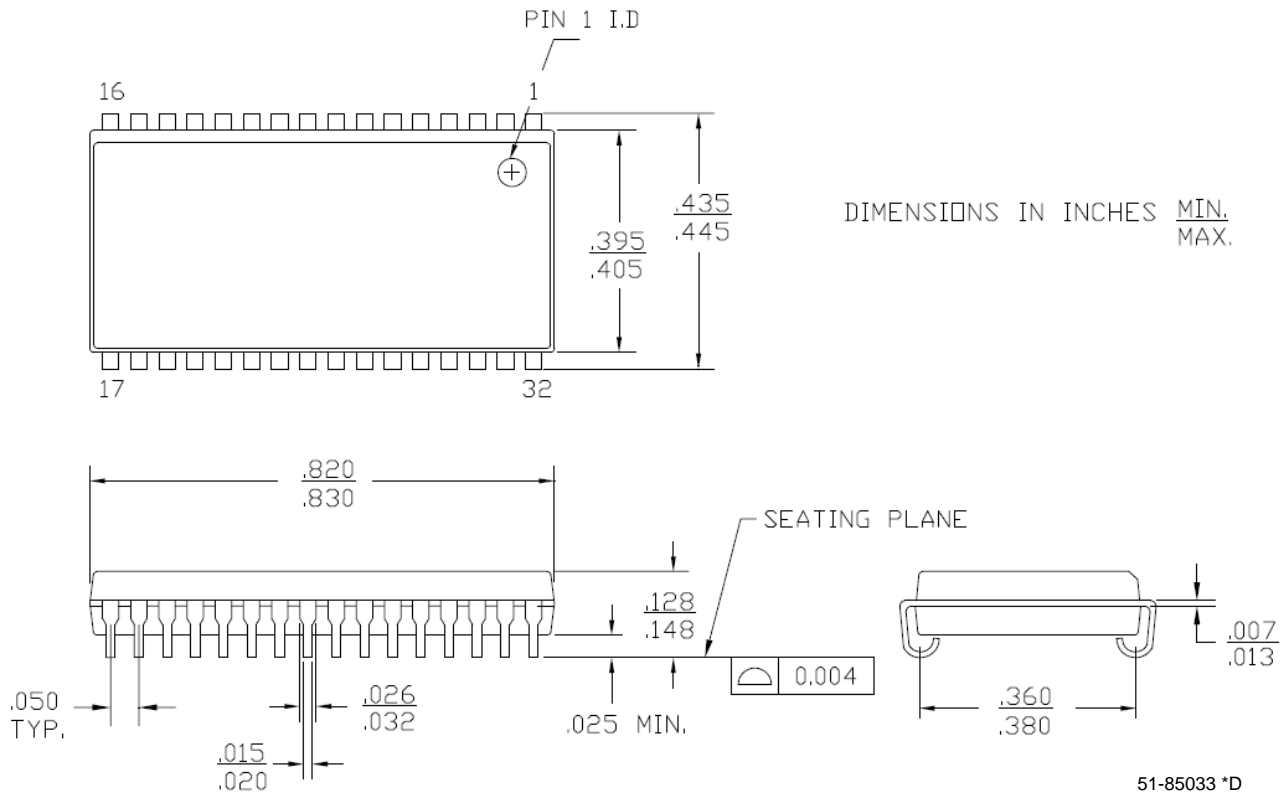
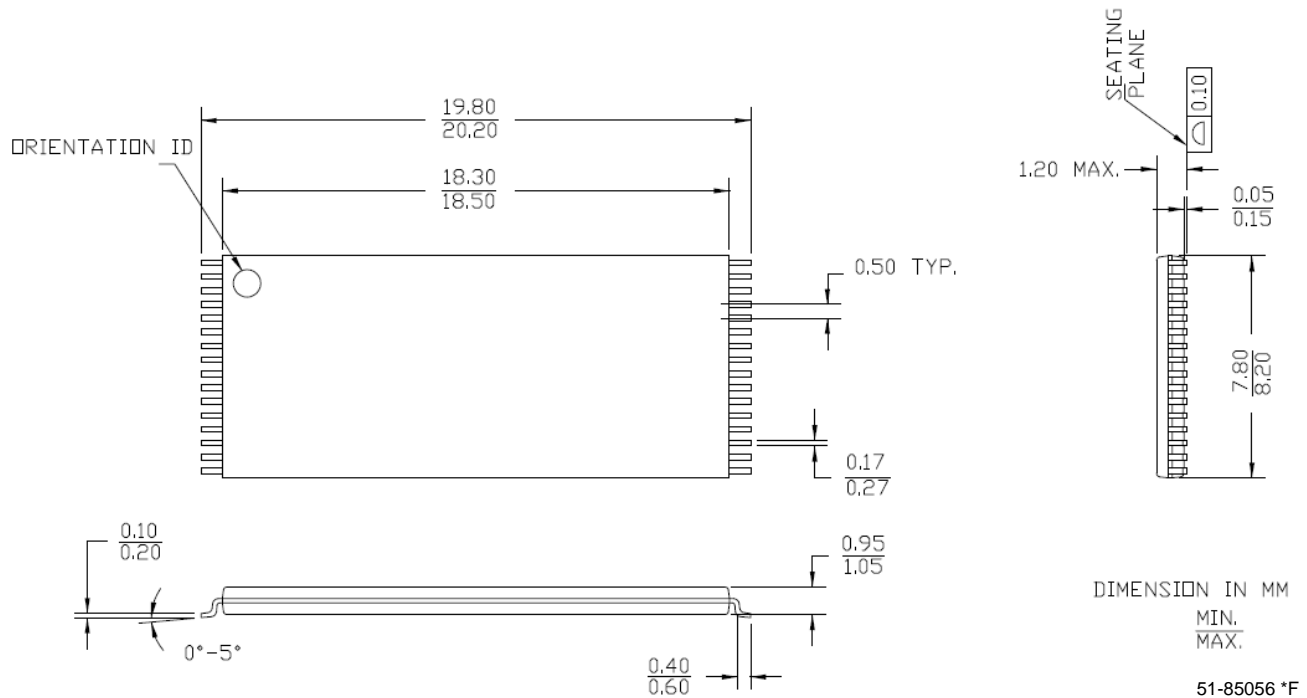


Figure 7. 32-pin (400-Mil) Molded SOJ, 51-85033



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
°C	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

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