CY7S1049G
CY7S1049GE

4-Mbit (512K words × 8-bit) Static RAM with PowerSnooze™ and Error Correcting Code (ECC)

Features

- High speed
  - Access time (t_{AA}) = 10 ns / 15 ns
- Ultra-low power Deep-Sleep (DS) current
  - I_{DS} = 15 µA
- Low active and standby currents
  - Active Current I_{CC} = 38-mA typical
  - Standby Current I_{SB2} = 6-mA typical
- Wide operating voltage range: 1.65 V to 2.2 V, 2.2 V to 3.6 V, 4.5 V to 5.5 V
- Embedded ECC for single-bit error correction[1, 2]
- Error indication (ERR) pin to indicate 1-bit error detection and correction
- 1.0-V data retention
- TTL- compatible inputs and outputs
- Available in Pb-free 44-pin TSOP II, and 36-pin (400-mil) molded SOJ

Functional Description

The CY7S1049G/CY7S1049GE[1] is a high-performance PowerSnooze™ static RAM organized as 512K words × 8 bits. This device features fast access times (10 ns) and a unique ultra-low power Deep-Sleep mode[3]. With Deep-Sleep mode currents as low as 15 µA, the CY7S1049G/CY7S1049GE devices combine the best features of fast and low- power SRAMs in industry-standard package options. The device also features embedded ECC. logic which can detect and correct single-bit errors in the accessed location.

Deep-Sleep input ($\overline{DS}$) must be deasserted HIGH for normal operating mode.

To perform data writes, assert the Chip Enable ($\overline{CE}$) and Write Enable ($\overline{WE}$) inputs LOW, and provide the data and address on device data pins (I/O_0 through I/O_7) and address pins (A_0 through A_{18}) respectively.

To perform data reads, assert the Chip Enable ($\overline{CE}$) and Output Enable ($\overline{OE}$) inputs LOW and provide the required address on the address lines. Read data is accessible on the I/O lines (I/O_0 through I/O_7).

The device is placed in a low-power Deep-Sleep mode when the Deep-Sleep input ($\overline{DS}$) is asserted LOW. In this state, the device is disabled for normal operation and is placed in a low power data retention mode. The device can be activated by deasserting the Deep-Sleep input ($\overline{DS}$) to HIGH.

The CY7S1049G is available in 44-pin TSOP II, and 36-pin Molded SOJ (400 Mils).

Product Portfolio

Product[4]	Range	V_{CC} Range (V)	Speed (ns)	Power Dissipation					
				Operating I_{CC}, (mA) f = f_{max}		Standby, I_{SB2} (mA)		Deep-Sleep current (µA)	
				Typ [5]	Max	Typ [5]	Max	Typ [5]	Max
CY7S1049G(E)18	Industrial	1.65 V–2.2 V	15	–	40	6	8	–	15
CY7S1049G(E)30		2.2 V–3.6 V	10	38	45				
CY7S1049G(E)		4.5–5.5 V	10	38	45				

Notes
1. This device does not support automatic write back on error detection.
2. SER FIT Rate <0.1 FIT/Mb. Refer AN88889 for details.
3. Refer AN89371 for details on PowerSnooze™ feature.
4. ERR pin is available only for devices which have ERR option "E" in the ordering code. Refer Ordering Information on page 17 for details.
5. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at V_{CC} = 1.8 V (for V_{CC} range of 1.65 V–2.2 V), V_{CC} = 3 V (for V_{CC} range of 2.2 V–3.6 V), and V_{CC} = 5 V (for V_{CC} range of 4.5 V–5.5 V), T_A = 25 °C.

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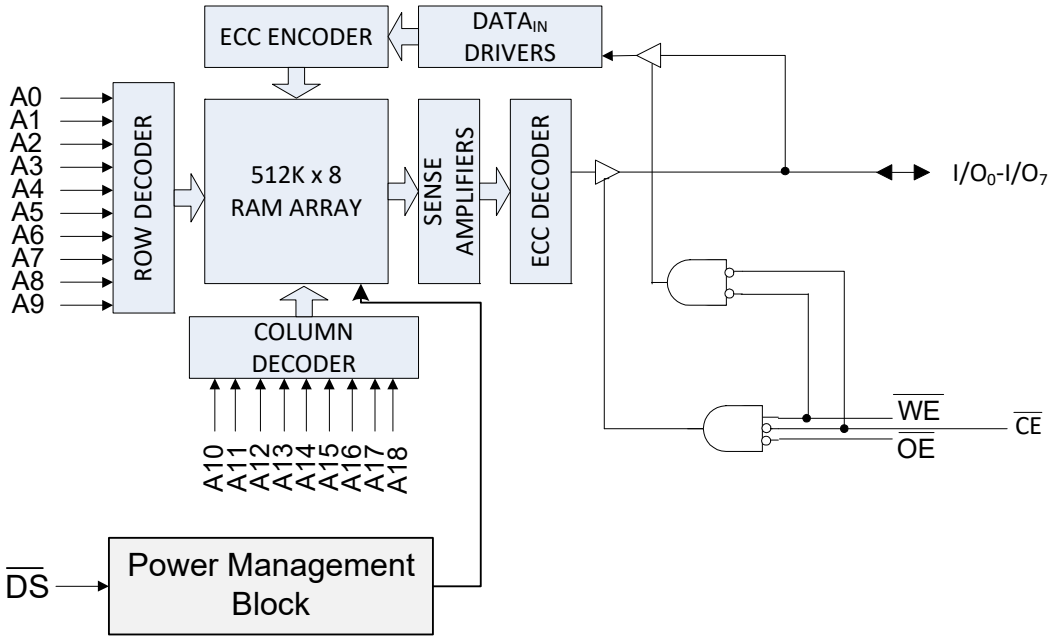
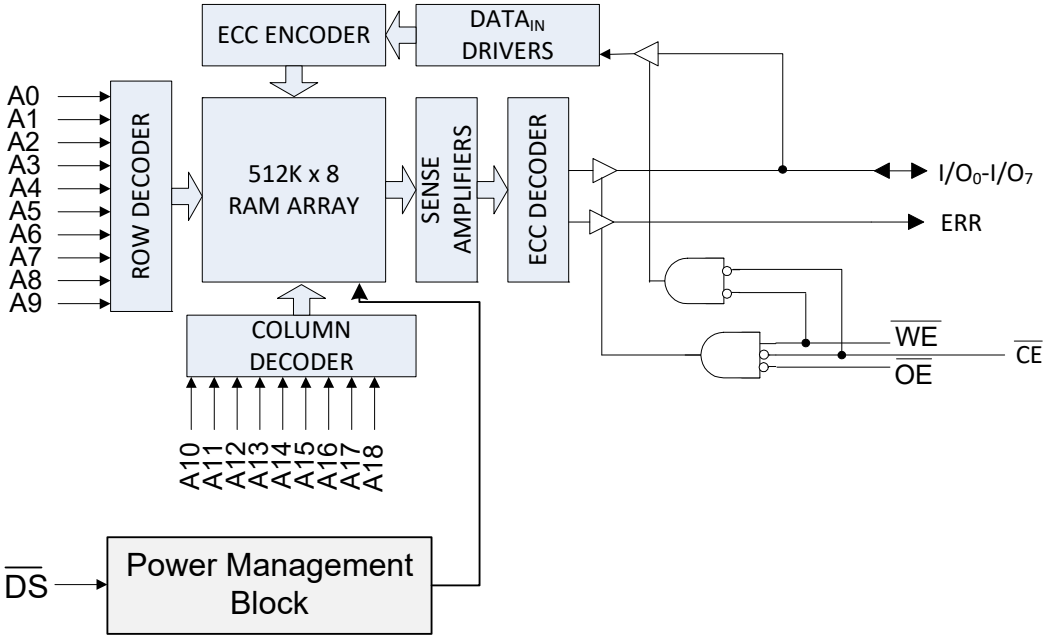
Logic Block Diagram – CY7S1049G



Logic Block Diagram – CY7S1049GE



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Contents

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Pin Configurations

Figure 1. 44-pin TSOP II pinout without ERR [6]

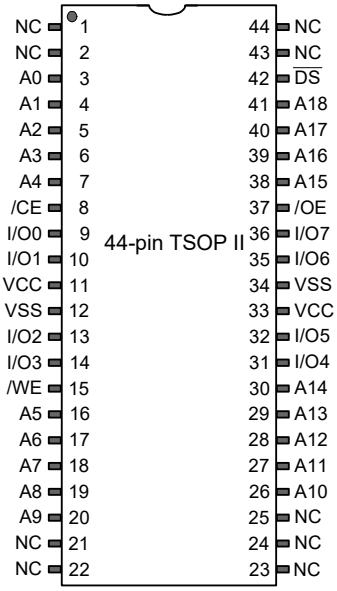
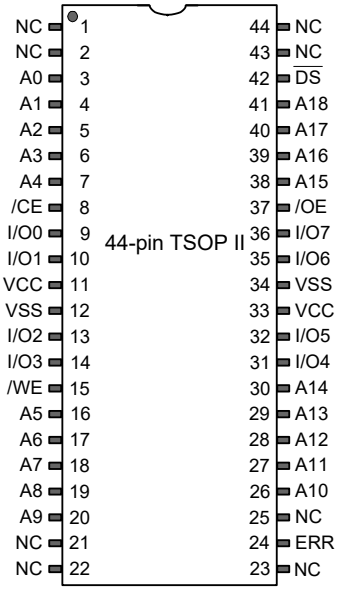


Figure 2. 44-pin TSOP II pinout with ERR [6, 7]



Notes
6. NC pins are not connected internally to the die.
7. ERR is an output pin.

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Pin Configurations (continued)

Figure 3. 36-pin SOJ pinout without ERR [8]

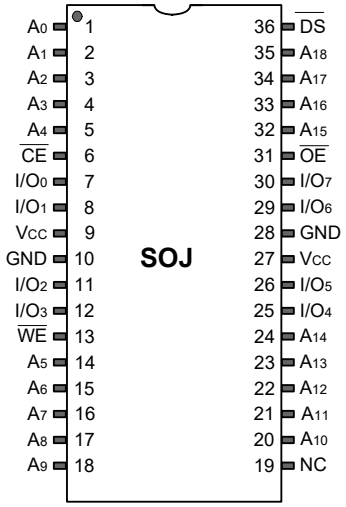
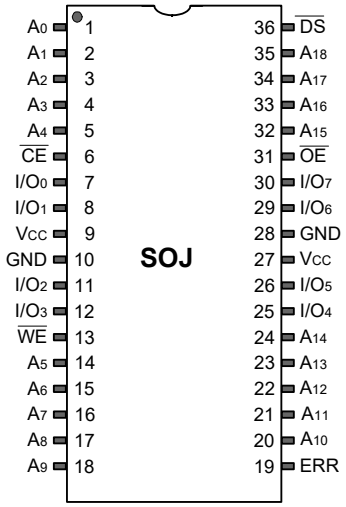


Figure 4. 36-pin SOJ pinout with ERR [8, 9]



Notes
8. NC pins are not connected internally to the die.
9. ERR is an output pin.

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Maximum Ratings

Exceeding maximum ratings may impair the useful life of the device. These 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} relative to GND [10] ..... –0.5 V to V_{CC} + 0.5 V

DC voltage applied to outputs in HI-Z State [10] ..... –0.5 V to V_{CC} + 0.5 V

DC input voltage [10] ..... –0.5 V to V_{CC} + 0.5 V

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

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

Latch-up current ..... > 140 mA

Operating Range

Range	Ambient Temperature	V_{CC}
Industrial	–40 °C to +85 °C	1.65 V to 2.2 V, 2.2 V to 3.6 V, 4.5 V to 5.5 V

DC Electrical Characteristics

Over the Operating Range of –40 °C to +85 °C

Parameter	Description		Test Conditions	10 ns/ 15 ns			Unit
				Min	Typ [11]	Max	
V_{OH}	Output HIGH voltage	1.65 V to 2.2 V	V_{CC} = Min, I_{OH} = –0.1 mA	1.4	–	–	V
		2.2 V to 2.7 V	V_{CC} = Min, I_{OH} = –1.0 mA	2	–	–	
		2.7 V to 3.6 V	V_{CC} = Min, I_{OH} = –4.0 mA	2.4	–	–	
		4.5 V to 5.5 V	V_{CC} = Min, I_{OH} = –4.0 mA	2.4	–	–	
		4.5 V to 5.5 V	V_{CC} = Min, I_{OH} = –0.1 mA	V_{CC} – 0.5 [12]	–	–	
V_{OL}	Output LOW voltage	1.65 V to 2.2 V	V_{CC} = Min, I_{OL} = 0.1 mA	–	–	0.2	V
		2.2 V to 2.7 V	V_{CC} = Min, I_{OL} = 2 mA	–	–	0.4	
		2.7 V to 3.6 V	V_{CC} = Min, I_{OL} = 8 mA	–	–	0.4	
		4.5 V to 5.5 V	V_{CC} = Min, I_{OL} = 8 mA	–	–	0.4	
V_{IH} [10, 13]	Input HIGH voltage	1.65 V to 2.2 V	–	1.4	–	V_{CC} + 0.2	V
		2.2 V to 2.7 V	–	2	–	V_{CC} + 0.3	
		2.7 V to 3.6 V	–	2	–	V_{CC} + 0.3	
		4.5 V to 5.5 V	–	2	–	V_{CC} + 0.5	
V_{IL} [10, 13]	Input LOW voltage	1.65 V to 2.2 V	–	–0.2	–	0.4	V
		2.2 V to 2.7 V	–	–0.3	–	0.6	
		2.7 V to 3.6 V	–	–0.3	–	0.8	
		4.5 V to 5.5 V	–	–0.5	–	0.8	
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, I_{OUT} = 0 mA, CMOS levels, f = 100 MHz	–	38	45	mA
			V_{CC} = Max, I_{OUT} = 0 mA, CMOS levels, f = 66.7 MHz	–	–	40	
I_{SB1}	Standby current – TTL inputs		Max V_{CC}, $\overline{CE}$ ≥ V_{IH}, V_{IN} ≥ V_{IH} or V_{IN} ≤ V_{IL}, f = f_{MAX}	–	–	15	mA

Notes

10. V_{IL} (min) = –2.0 V and V_{IH} (max) = V_{CC} + 2 V for pulse durations of less than 20 ns.
11. Typical values are included for reference only and are not guaranteed or tested. Typical values are measured at V_{CC} = 1.8 V (for V_{CC} range of 1.65 V–2.2 V), V_{CC} = 3 V (for V_{CC} range of 2.2 V–3.6 V), and V_{CC} = 5 V (for V_{CC} range of 4.5 V–5.5 V), T_A = 25 °C.
12. Guaranteed by design and not tested.
13. For the $\overline{DS}$ pin, V_{IH} (min) is V_{CC} – 0.2 V and V_{IL} (max) is 0.2 V.

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DC Electrical Characteristics (continued)

Over the Operating Range of –40 °C to +85 °C

Parameter	Description	Test Conditions	10 ns/ 15 ns			Unit
			Min	Typ [11]	Max	
I_{SB2}	Standby current – CMOS inputs	Max V_{CC}, $\overline{CE} \geq V_{CC} - 0.2$ V, $\overline{DS} \geq V_{CC} - 0.2$ V, $V_{IN} \geq V_{CC} - 0.2$ V or $V_{IN} \leq 0.2$ V, f = 0	–	6	8	mA
I_{DS}	Deep-Sleep current	Max V_{CC}, $\overline{CE} \geq V_{CC} - 0.2$ V, $\overline{DS} \leq 0.2$ V, $V_{IN} \geq V_{CC} - 0.2$ V or $V_{IN} \leq 0.2$ V, f = 0	–	–	15	µA

Capacitance

Parameter [14]	Description	Test Conditions	All packages	Unit
C_{IN}	Input capacitance	T_A = 25 °C, f = 1 MHz, $V_{CC(typ)}$	10	pF
C_{OUT}	I/O capacitance		10	pF

Thermal Resistance

Parameter [14]	Description	Test Conditions	36-pin SOJ Package	44-pin TSOP II Package	Unit
Θ_{JA}	Thermal resistance (junction to ambient)	Still air, soldered on a 3 × 4.5 inch, four-layer printed circuit board	59.52	68.85	°C/W
Θ_{JC}	Thermal resistance (junction to case)		31.48	15.97	°C/W

Note
14. Tested initially and after any design or process changes that may affect these parameters.

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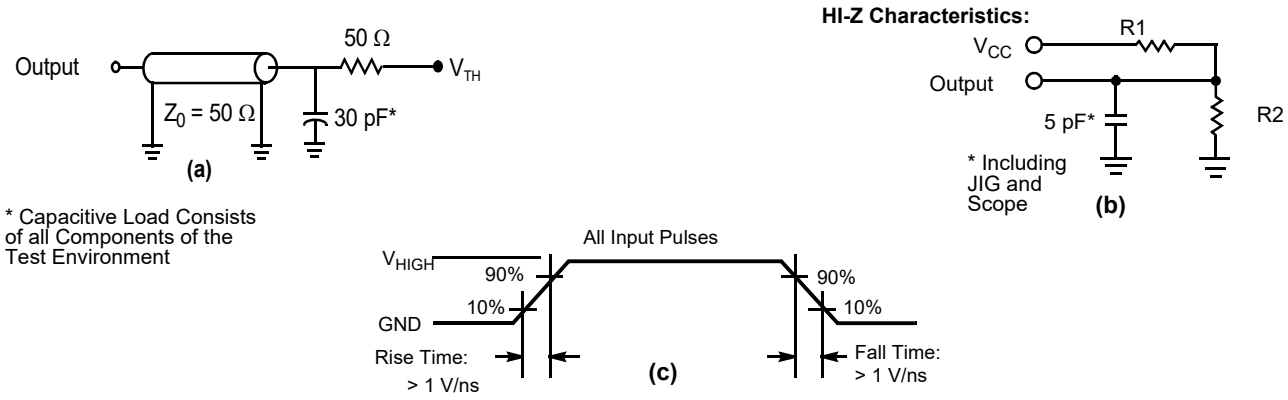
AC Test Loads and Waveforms

Figure 5. AC Test Loads and Waveforms [15]



Parameters	1.8 V	3.0 V	5.0 V	Unit
R1	1667	317	317	Ω
R2	1538	351	351	Ω
V_{TH}	$V_{CC}/2$	1.5	1.5	V
V_{HIGH}	1.8	3.0	3.0	V

Note
15. Full-device AC operation assumes a 100-µs ramp time from 0 to $V_{CC(min)}$ or 100-µs wait time after V_{CC} stabilization.

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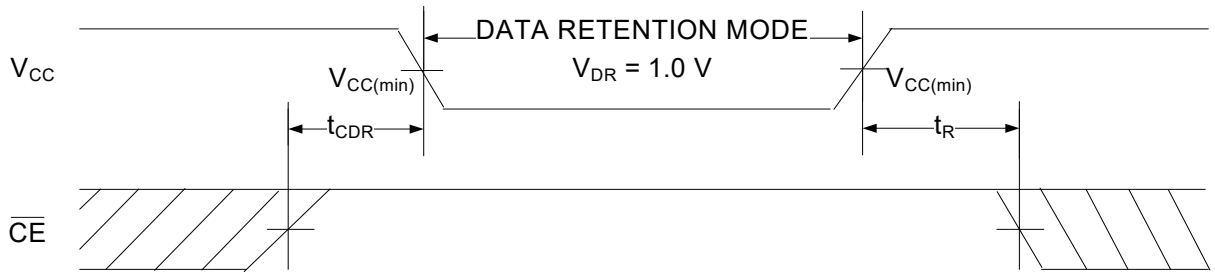
Data Retention Characteristics

Over the Operating Range of –40 °C to +85 °C

Parameter	Description	Conditions [16]	Min	Max	Unit
V_{DR}	V_{CC} for data retention	–	1.0	–	V
I_{CCDR}	Data retention current	$V_{CC} = V_{DR}$, $\overline{CE} \geq V_{CC} - 0.2$ V, $\overline{DS} \geq V_{CC} - 0.2$ V, $V_{IN} \geq V_{CC} - 0.2$ V or $V_{IN} \leq 0.2$ V	–	8	mA
t_{CDR} [17]	Chip deselect to data retention time	–	0	–	ns
t_R [17, 18]	Operation recovery time	2.2 V < $V_{CC} \leq$ 5.5 V	10	–	ns
		$V_{CC} \leq$ 2.2 V	15	–	ns

Data Retention Waveform

Figure 6. Data Retention Waveform [18]



Notes
16. $\overline{DS}$ signal must be HIGH during Data Retention Mode.
17. These parameters are guaranteed by design.
18. Full-device operation requires linear V_{CC} ramp from V_{DR} to $V_{CC(min.)} \geq 100$ µs or stable at $V_{CC(min.)} \geq 100$ µs.

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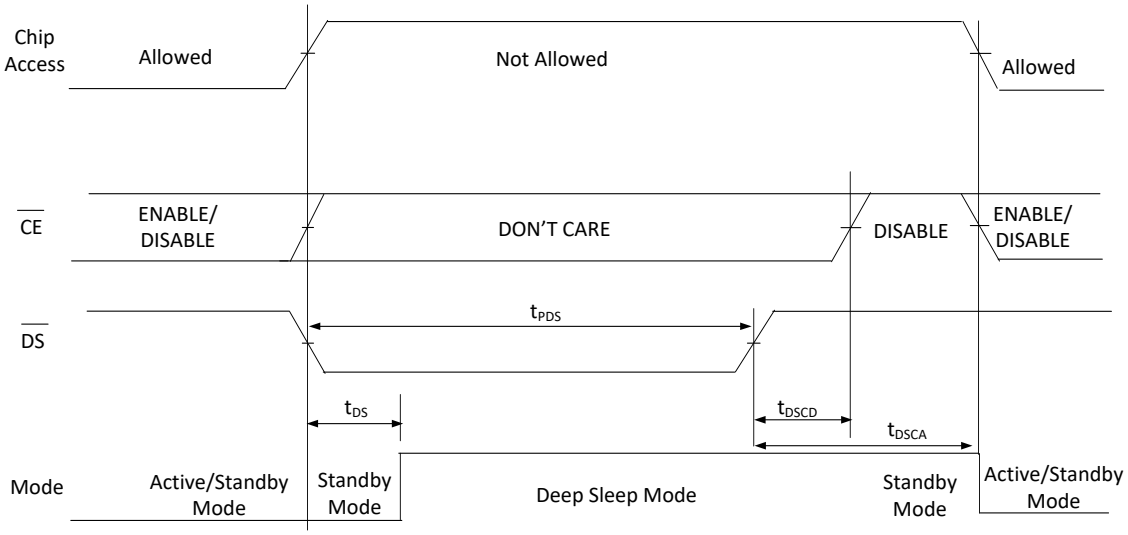
Deep-Sleep Mode Characteristics

Over the Operating Range of –40 °C to +85 °C

Parameter	Description	Conditions	Min	Max	Unit
I_{DS}	Deep-Sleep mode current	$V_{CC} = V_{CC}$ (max), $\overline{DS} \le 0.2$ V, $V_{IN} \ge V_{CC} - 0.2$ V or $V_{IN} \le 0.2$ V	–	15	µA
t_{PDS}[19]	Minimum time for $\overline{DS}$ to be LOW for part to successfully exit Deep-Sleep mode	–	100	–	ns
t_{DS}[20]	$\overline{DS}$ assertion to Deep-Sleep mode transition time	–	–	1	ms
t_{DSCD}[19]	$\overline{DS}$ deassertion to chip disable	If $t_{PDS} \ge t_{PDS(min)}$	–	100	µs
		If $t_{PDS} < t_{PDS(min)}$	–	0	µs
t_{DSCA}	$\overline{DS}$ deassertion to chip access (Active/Standby)	If $t_{PDS} \ge t_{PDS(min)}$	300	–	µs
		If $t_{PDS} < t_{PDS(min)}$			

Figure 7. Active, Standby, and Deep-Sleep Operation Modes



Notes

19. $\overline{CE}$ must be pulled HIGH within t_{DSCD} time of $\overline{DS}$ de-assertion to avoid SRAM data loss.
20. After assertion of $\overline{DS}$ signal, device will take a maximum of t_{DS} time to stabilize to Deep-Sleep current I_{DS}. During this period, $\overline{DS}$ signal must continue to be asserted to logic level LOW to keep the device in Deep-Sleep mode.

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AC Switching Characteristics

Over the Operating Range of –40 °C to +85 °C

Parameter [21]	Description	10 ns		15 ns		Unit
		Min	Max	Min	Max	
Read Cycle						
t_{RC}	Read cycle time	10	–	15	–	ns
t_{AA}	Address to data valid	–	10	–	15	ns
t_{OHA}	Data hold from address change	3	–	3	–	ns
t_{ACE}	$\overline{CE}$ LOW to data valid	–	10	–	15	ns
t_{DOE}	$\overline{OE}$ LOW to data valid	–	4.5	–	8	ns
t_{LZOE}	$\overline{OE}$ LOW to low impedance [22, 23, 24]	0	–	0	–	ns
t_{HZOE}	$\overline{OE}$ HIGH to HI-Z [22, 23, 24]	–	5	–	8	ns
t_{LZCE}	$\overline{CE}$ LOW to low impedance [22, 23, 24]	3	–	3	–	ns
t_{HZCE}	$\overline{CE}$ HIGH to HI-Z [22, 23, 24]	–	5	–	8	ns
t_{PU}	$\overline{CE}$ LOW to power-up [24]	0	–	0	–	ns
t_{PD}	$\overline{CE}$ HIGH to power-down [24]	–	10	–	15	ns
Write Cycle [25, 26]						
t_{WC}	Write cycle time	10	–	15	–	ns
t_{SCE}	$\overline{CE}$ LOW to write end	7	–	12	–	ns
t_{AW}	Address setup to write end	7	–	12	–	ns
t_{HA}	Address hold from write end	0	–	0	–	ns
t_{SA}	Address setup to write start	0	–	0	–	ns
t_{PWE}	$\overline{WE}$ pulse width	7	–	12	–	ns
t_{SD}	Data setup to write end	5	–	8	–	ns
t_{HD}	Data hold from write end	0	–	0	–	ns
t_{LZWE}	$\overline{WE}$ HIGH to low impedance [22, 23, 24]	3	–	3	–	ns
t_{HZWE}	$\overline{WE}$ LOW to HI-Z [22, 23, 24]	–	5	–	8	ns

Notes

21. Test conditions assume a signal transition time (rise/fall) of 3 ns or less, timing reference levels of 1.5 V (for $V_{CC} \geq 3$ V) and $V_{CC}/2$ (for $V_{CC} < 3$ V), and input pulse levels of 0 to 3 V (for $V_{CC} \geq 3$ V) and 0 to V_{CC} (for $V_{CC} < 3$ V). Test conditions for the read cycle use output loading shown in part (a) of Figure 5 on page 8, unless specified otherwise.
22. t_{HZOE}, t_{HZCE}, t_{HZWE}, t_{LZOE}, t_{LZCE}, and t_{LZWE} are specified with a load capacitance of 5 pF as in (b) of Figure 5 on page 8. Transition is measured ±200 mV from steady state voltage.
23. At any 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 device.
24. These parameters are guaranteed by design.
25. The internal write time of the memory is defined by the overlap of $\overline{WE}$ = V_{IL}, $\overline{CE}$ = V_{IL} ,$\overline{DS}$ = V_{IH} and $\overline{WE}$, $\overline{CE}$, signals must be LOW and $\overline{DS}$ must be HIGH to initiate a write, and a HIGH transition of any of $\overline{WE}$, $\overline{CE}$, signals or LOW transition on $\overline{DS}$ signal can terminate the operation. The input data setup and hold timing should be referenced to the edge of the signal that terminates the write.
26. The minimum write pulse width for Write Cycle No. 2 ($\overline{WE}$ Controlled, $\overline{OE}$ LOW) should be the sum of t_{HZWE} and t_{SD}.

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Switching Waveforms

Figure 8. Read Cycle No. 1 of CY7S1049G (Address Transition Controlled) [27, 28, 29]

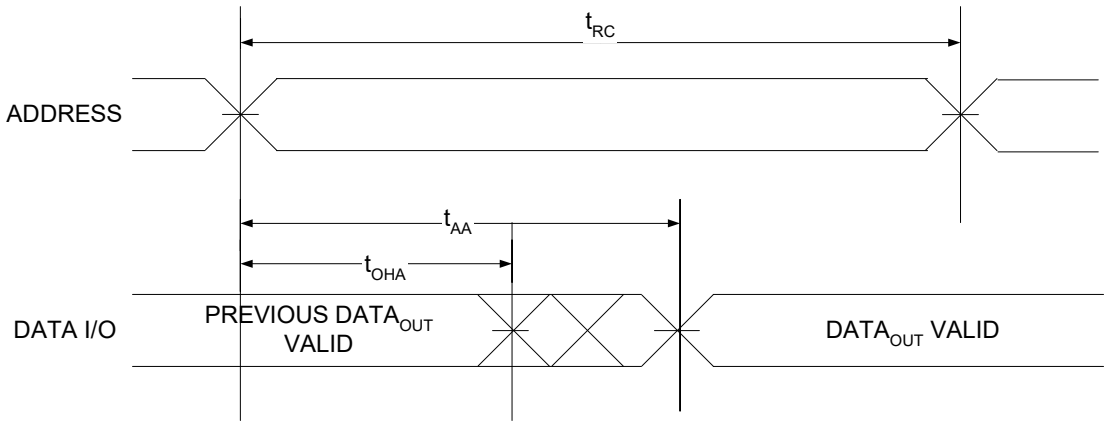
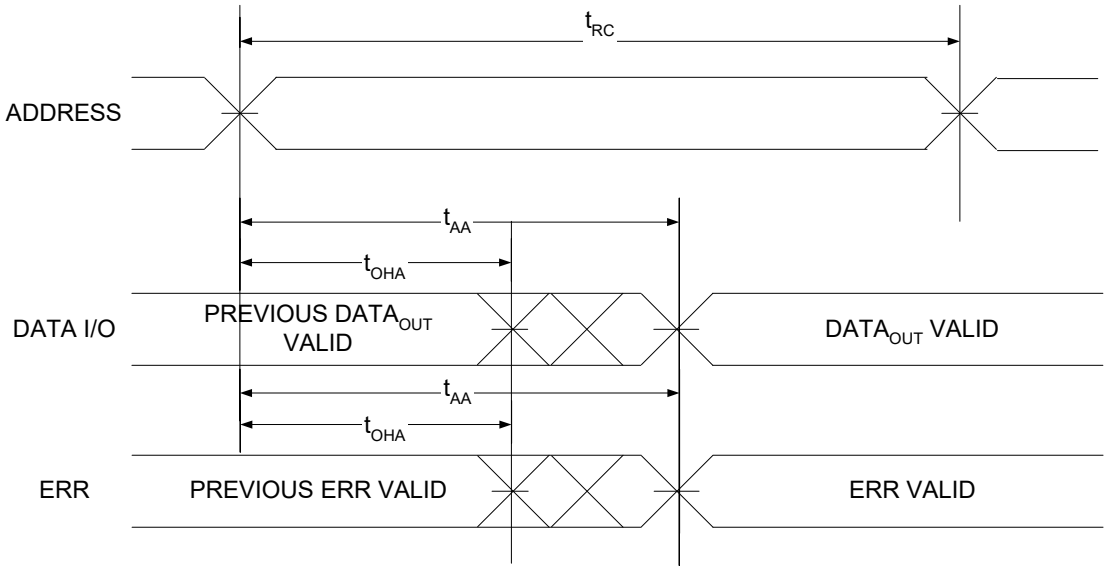


Figure 9. Read Cycle No. 2 of CY7S1041GE (Address Transition Controlled) [27, 28, 29]



Notes
27. The device is continuously selected. $\overline{OE}$ = V_{IL}, $\overline{CE}$ = V_{IL}.
28. $\overline{WE}$ is HIGH for read cycle.
29. $\overline{DS}$ is HIGH for chip access.

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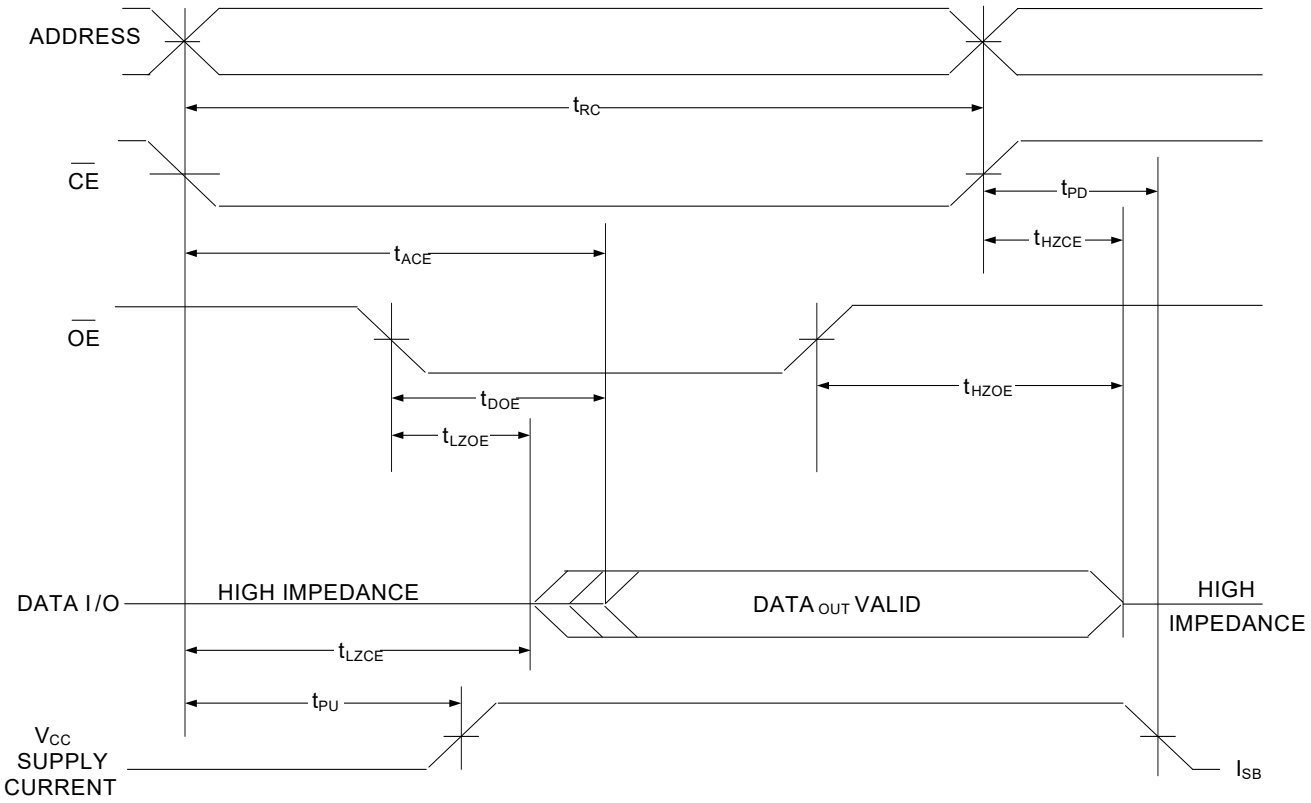
Switching Waveforms (continued)

Figure 10. Read Cycle No. 3 ($\overline{OE}$ Controlled) [30, 31, 32]



Notes
30. $\overline{WE}$ is HIGH for read cycle.
31. Address valid prior to or coincident with $\overline{CE}$ LOW transition.
32. $\overline{DS}$ must be HIGH for chip access.

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Switching Waveforms (continued)

Figure 11. Write Cycle No. 1 ($\overline{CE}$ Controlled) [33, 34, 35]

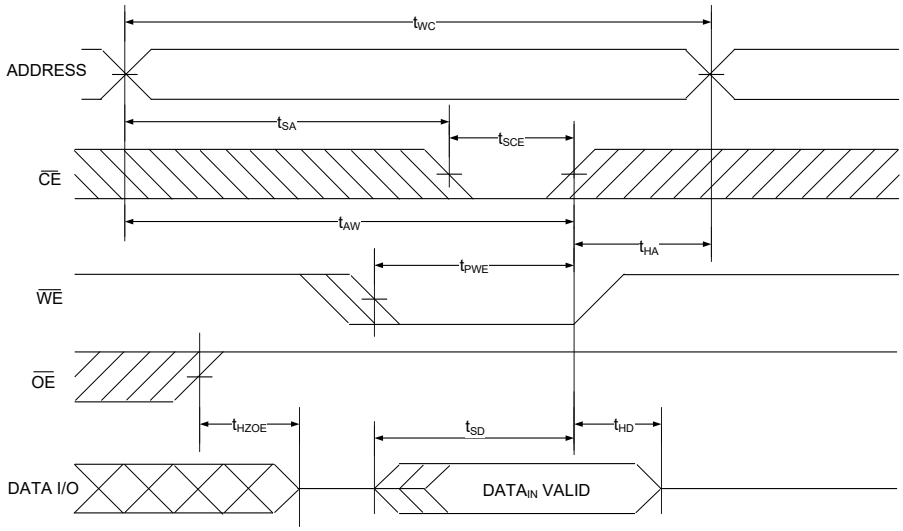
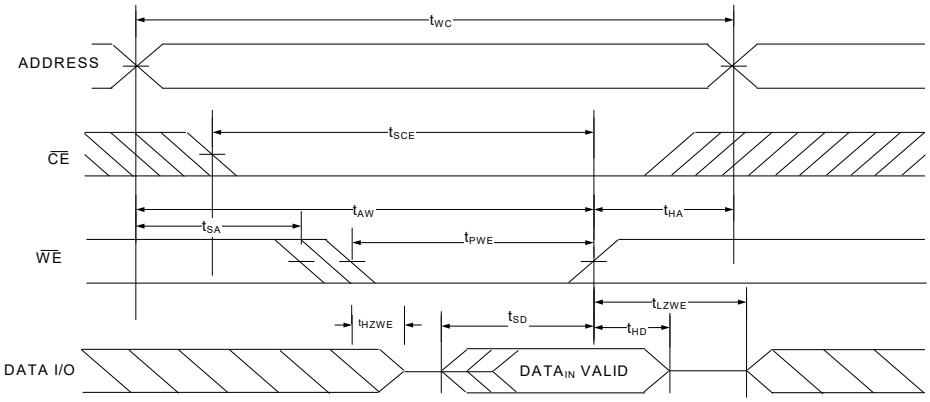


Figure 12. Write Cycle No. 2 ($\overline{WE}$ Controlled, $\overline{OE}$ LOW) [33, 34, 35, 36]



Notes

33. The internal write time of the memory is defined by the overlap of $\overline{WE}$ = V_{IL}, $\overline{CE}$ = V_{IL}, $\overline{DS}$ = V_{IH} and $\overline{WE}$, $\overline{CE}$ signals must be LOW and $\overline{DS}$ must be HIGH to initiate a write, and a HIGH transition of any of $\overline{WE}$, $\overline{CE}$ signals or LOW transition on $\overline{DS}$ signal can terminate the operation. The input data setup and hold timing should be referenced to the edge of the signal that terminates the write.
34. Data I/O is in HI-Z state if $\overline{CE}$ = V_{IH}, or $\overline{OE}$ = V_{IH}.
35. $\overline{DS}$ must be HIGH for chip access.
36. The minimum write pulse width for Write Cycle No. 2 ($\overline{WE}$ Controlled, $\overline{OE}$ LOW) should be sum of t_{HZWE} and t_{SD}.

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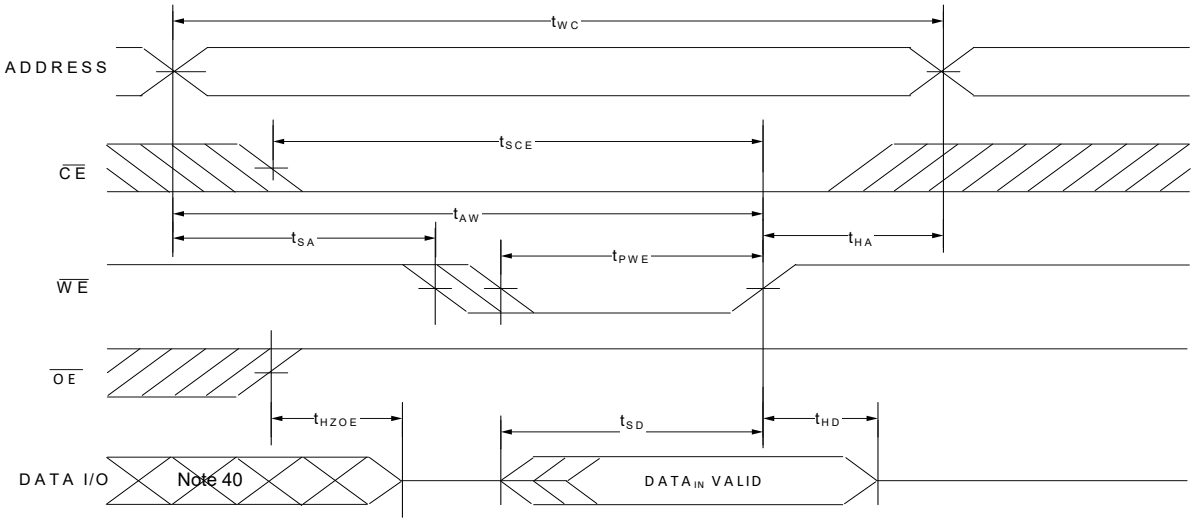
Switching Waveforms (continued)

Figure 13. Write Cycle No. 3 ($\overline{WE}$ Controlled) [37, 38, 39]



Notes

37. The internal write time of the memory is defined by the overlap of $\overline{WE}$ = V_{IL}, $\overline{CE}$ = V_{IL}, $\overline{DS}$ = V_{IH} and $\overline{WE}$, $\overline{CE}$, signals must be LOW and $\overline{DS}$ must be HIGH to initiate a write, and a HIGH transition of any of $\overline{WE}$, $\overline{CE}$, signals or LOW transition on $\overline{DS}$ signal can terminate the operation. The input data setup and hold timing should be referenced to the edge of the signal that terminates the write.
38. Data I/O is in HI-Z state if $\overline{CE}$ = V_{IH}, or $\overline{OE}$ = V_{IH} or $\overline{DS}$ = V_{IL}.
39. $\overline{DS}$ must be HIGH for chip access.
40. During this period, the I/Os are in output state. Do not apply input signals.

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Truth Table

$\overline{DS}$	$\overline{CE}$	$\overline{OE}$	$\overline{WE}$	I/O_0–I/O_7	Mode	Power
H	H	X[41]	X[41]	HIGH-Z	Standby	Standby (I_{SB})
H	L	L	H	Data out	Read all bits	Active (I_{CC})
H	L	X	L	Data in	Write all bits	Active (I_{CC})
H	L	H	H	HI-Z	Selected, outputs disabled	Active (I_{CC})
L[42]	X	X	X	HI-Z	Deep-Sleep	Deep-Sleep Ultra Low Power (I_{DS})

ERR Output – CY7S1049GE

Output [43]	Mode
0	Read operation, no single-bit error in the stored data.
1	Read operation, single-bit error detected and corrected.
High-Z	Device deselected / outputs disabled / Write operation

Notes
41. The input voltage levels on these pins should be either at V_{IH} or V_{IL}.
42. V_{IL} on $\overline{DS}$ must be $\leq$ 0.2 V.
43. ERR is an Output pin.If not used, this pin should be left floating.

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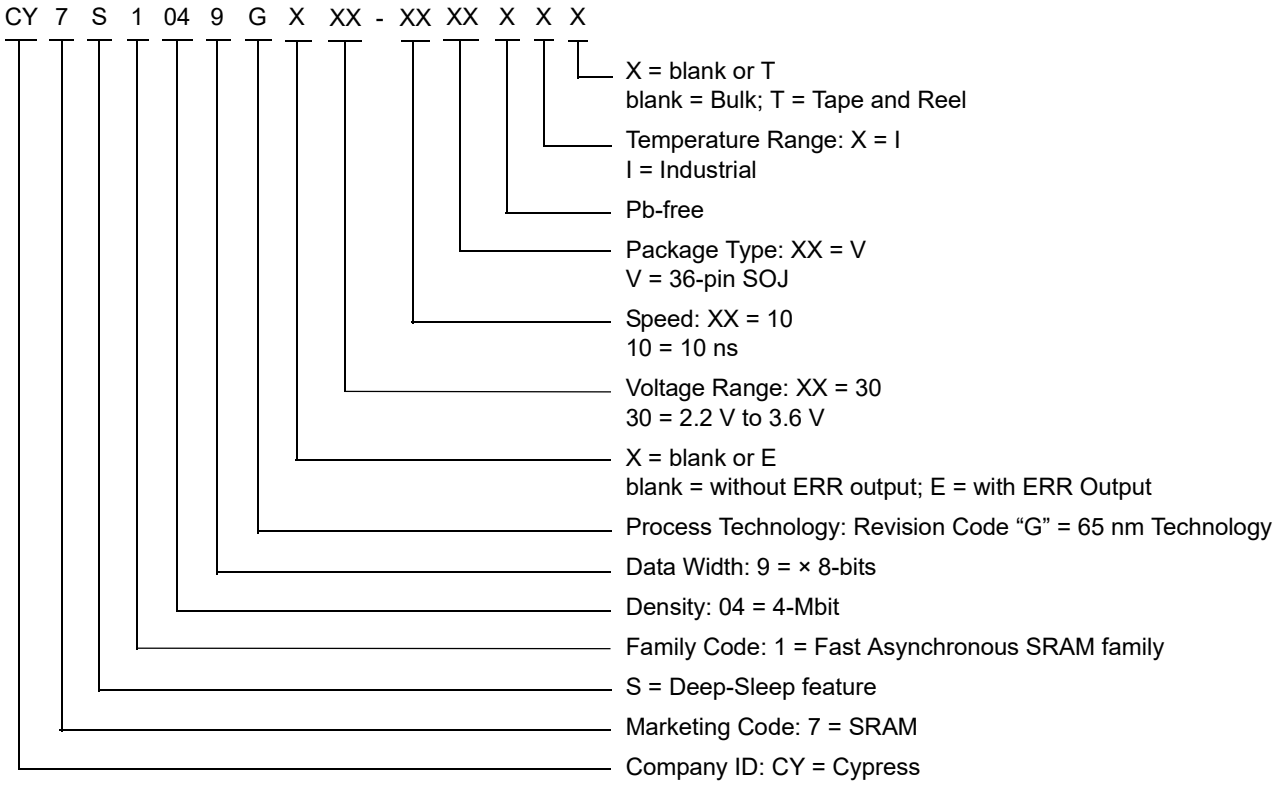
Ordering Information

Speed (ns)	Voltage Range	Ordering Code	Package Diagram	Package Type (All Pb-free)	Operating Range
10	2.2 V–3.6 V	CY7S1049G30-10VXI	51-85090	36-pin SOJ	Industrial
		CY7S1049G30-10VXIT	51-85090	36-pin SOJ, Tape and Reel	
		CY7S1049GE30-10VXI	51-85090	36-pin SOJ, ERR Output	
		CY7S1049GE30-10VXIT	51-85090	36-pin SOJ, ERR Output, Tape and Reel	

Ordering Code Definitions



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Package Diagrams

Figure 14. 36-pin SOJ V36.4 (Molded) Package Outline, 51-85090

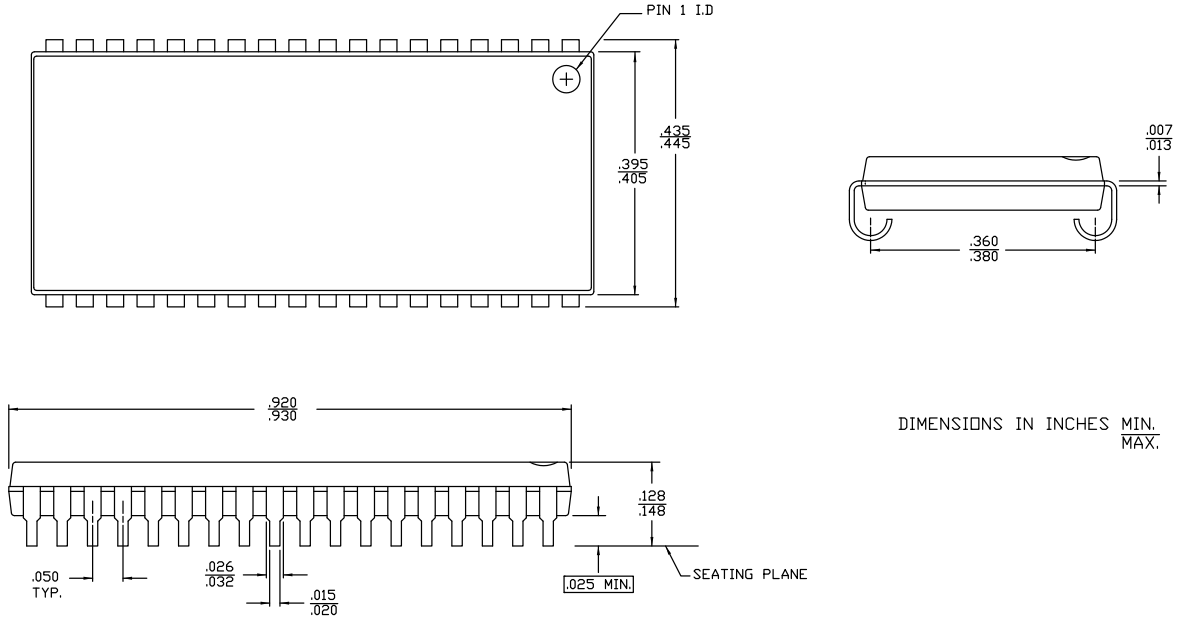
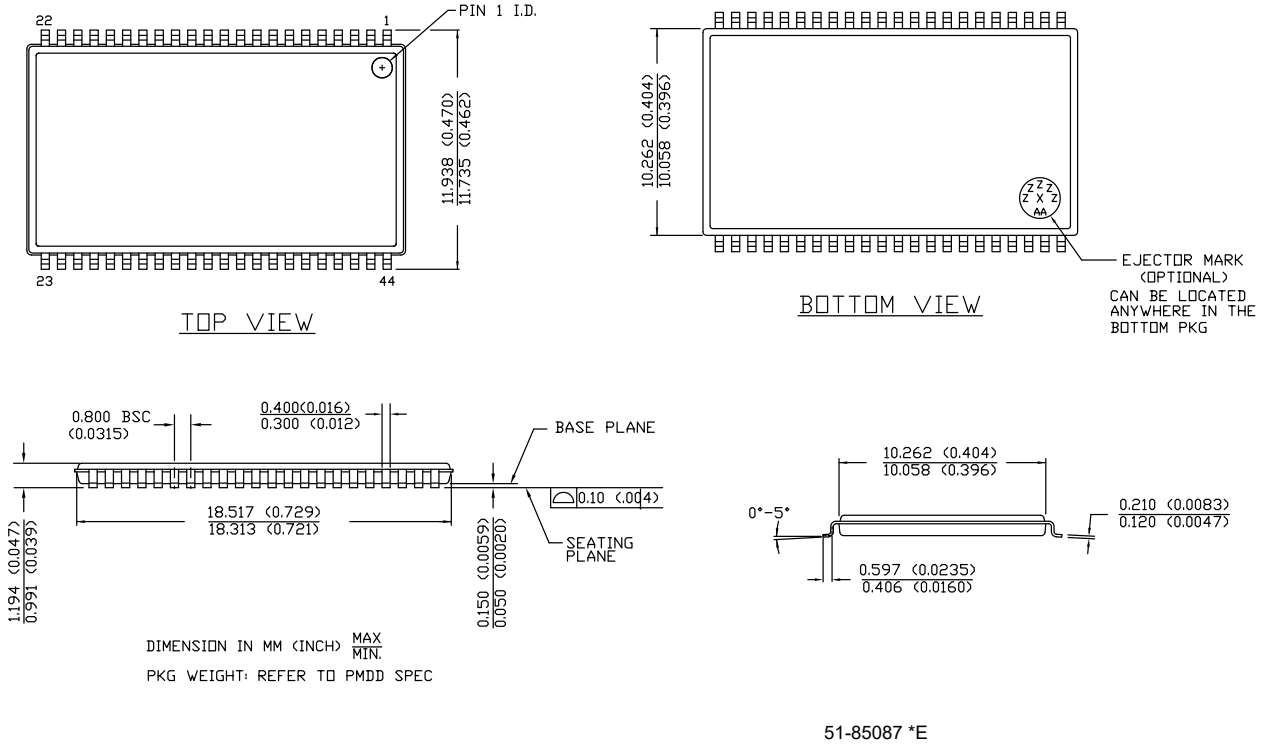


Figure 15. 44-pin TSOP II Package Outline, 51-85087



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Acronyms

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

Document Conventions

Units of Measure

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

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Document History Page

Document Title: CY7S1049G/CY7S1049GE, 4-Mbit (512K words × 8-bit) Static RAM with PowerSnooze™ and Error Correcting Code (ECC) Document Number: 001-95414				
Rev.	**ECN No.**	**Orig. of Change**	**Submission Date**	**Description of Change**
*B	5025315	VINI	11/24/2015	Changed status from Preliminary to Final.
*C	5090263	NILE	01/18/2016	Updated Ordering Information: Updated part numbers. Completing Sunset Review.
*D	5428860	NILE	09/07/2016	Updated Functional Description: Added Note 1 and referred the same note in “CY7S1049G/CY7S1049GE”. Updated Maximum Ratings: Updated Note 10 (Replaced “2 ns” with “20 ns”). Updated DC Electrical Characteristics: Changed minimum value of V_{OH} parameter from 2.2 V to 2.4 V corresponding to Operating Range “2.7 V to 3.6 V” and Test Condition “V_{CC} = Min, I_{OH} = –4.0 mA”. Changed minimum value of V_{IH} parameter from 2.2 V to 2 V corresponding to Operating Range “4.5 V to 5.5 V”. Updated Ordering Information: Updated part numbers. Updated to new template.
*E	5981584	AESATMP8	12/01/2017	Updated logo and Copyright.
*F	6120487	NILE	04/03/2018	Updated Features: Referred Note 1 in “Embedded ECC for single-bit error correction”. Added Note 2 and referred the same note in “Embedded ECC for single-bit error correction”. Updated Functional Description: Added Note 3 and referred the same note at the end of sentence “This device features fast access times (10 ns) and a unique ultra-low power Deep-Sleep mode”. Updated to new template. Completing Sunset Review.

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