

Features

- High speed
 - $t_{AA} = 8 \text{ ns}$
- Low active power
 - 1080 mW (max)
- Operating voltages of $3.3 \pm 0.3 \text{ V}$
- 2.0 V data retention
- Automatic power-down when deselected
- TTL-compatible inputs and outputs
- Easy memory expansion with \overline{CE}_0 , \overline{CE}_1 and \overline{CE}_2 features
- Available in non Pb-free 119 ball PBGA.

Functional Description

The CY7C1012AV33 is a high-performance CMOS static RAM organized as 512 K words by 24 bits. Each data byte is separately controlled by the individual chip selects (\overline{CE}_0 , \overline{CE}_1 , \overline{CE}_2). \overline{CE}_0 controls the data on the I/O₀–I/O₇, while \overline{CE}_1 controls the data on I/O₈–I/O₁₅, and \overline{CE}_2 controls the data on the data pins I/O₁₆–I/O₂₃. This device has an automatic power-down feature that significantly reduces power consumption when deselected.

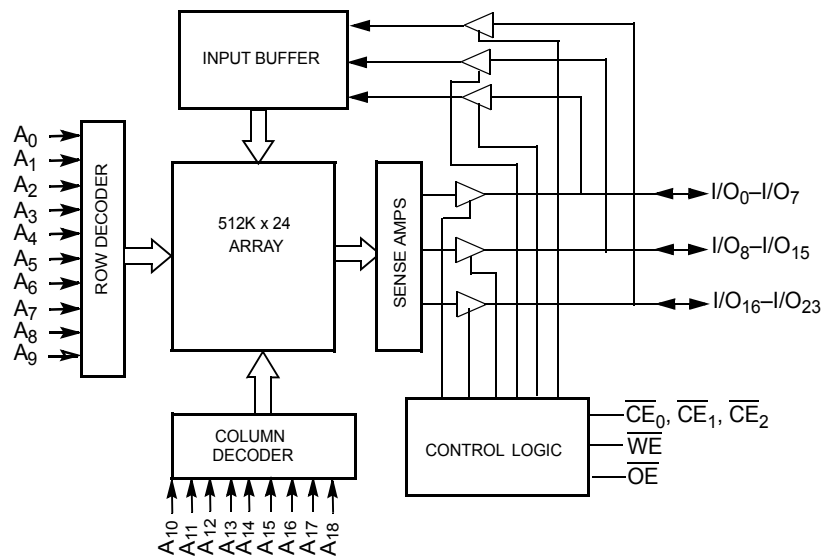
Writing the data bytes into the SRAM is accomplished when the chip select controlling that byte is LOW and the write enable input (\overline{WE}) input is LOW. Data on the respective input/output (I/O) pins is then written into the location specified on the address pins (A₀–A₁₈). Asserting all of the chip selects LOW and write enable LOW will write all 24 bits of data into the SRAM. Output enable (\overline{OE}) is ignored while in WRITE mode.

Data bytes can also be individually read from the device. Reading a byte is accomplished when the chip select controlling that byte is LOW and write enable (\overline{WE}) HIGH while output enable (\overline{OE}) remains LOW. Under these conditions, the contents of the memory location specified on the address pins will appear on the specified data input/output (I/O) pins. Asserting all the chip selects LOW will read all 24 bits of data from the SRAM.

The 24 I/O pins (I/O₀–I/O₂₃) are placed in a high-impedance state when all the chip selects are HIGH or when the output enable (\overline{OE}) is HIGH during a READ mode. For further details, refer to the truth table of this data sheet.

The CY7C1012AV33 is available in a standard 119-ball PBGA.

Functional Block Diagram



Contents

Selection Guide	3	Package Diagram	10
Pin Configurations	3	Acronyms	11
Maximum Ratings	4	Document Conventions	11
Operating Range	4	Units of Measure	11
DC Electrical Characteristics	4	Document History Page	12
Capacitance	4	Sales, Solutions, and Legal Information	13
AC Test Loads and Waveforms	5	Worldwide Sales and Design Support	13
AC Switching Characteristics	5	Products	13
Switching Waveforms	7	PSoC Solutions	13
Truth Table	9		
Ordering Information	9		
Ordering Code Definitions	9		

Selection Guide

Description		-8	Unit
Maximum Access Time		8	ns
Maximum Operating Current	Commercial	300	mA
	Industrial	300	
Maximum CMOS Standby Current	Commercial/Industrial	50	mA

Pin Configurations

Figure 1. 119-ball PBGA (Top View) ^[1, 2]

	1	2	3	4	5	6	7
A	NC	A	A	A	A	A	NC
B	NC	A	A	\overline{CE}_0	A	A	NC
C	I/O ₁₂	NC	\overline{CE}_1	NC	\overline{CE}_2	NC	I/O ₀
D	I/O ₁₃	V _{DD}	V _{SS}	V _{SS}	V _{SS}	V _{DD}	I/O ₁
E	I/O ₁₄	V _{SS}	V _{DD}	V _{SS}	V _{DD}	V _{SS}	I/O ₂
F	I/O ₁₅	V _{DD}	V _{SS}	V _{SS}	V _{SS}	V _{DD}	I/O ₃
G	I/O ₁₆	V _{SS}	V _{DD}	V _{SS}	V _{DD}	V _{SS}	I/O ₄
H	I/O ₁₇	V _{DD}	V _{SS}	V _{SS}	V _{SS}	V _{DD}	I/O ₅
J	NC	V _{SS}	V _{DD}	V _{SS}	V _{DD}	V _{SS}	DNU
K	I/O ₁₈	V _{DD}	V _{SS}	V _{SS}	V _{SS}	V _{DD}	I/O ₆
L	I/O ₁₉	V _{SS}	V _{DD}	V _{SS}	V _{DD}	V _{SS}	I/O ₇
M	I/O ₂₀	V _{DD}	V _{SS}	V _{SS}	V _{SS}	V _{DD}	I/O ₈
N	I/O ₂₁	V _{SS}	V _{DD}	V _{SS}	V _{DD}	V _{SS}	I/O ₉
P	I/O ₂₂	V _{DD}	V _{SS}	V _{SS}	V _{SS}	V _{DD}	I/O ₁₀
R	I/O ₂₃	A	NC	NC	NC	A	I/O ₁₁
T	NC	A	A	\overline{WE}	A	A	NC
U	NC	A	A	\overline{OE}	A	A	NC

Notes

1. NC pins are not connected on the die.
2. DNU pins have to be left floating or tied to VSS to ensure proper application.

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 +4.6 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

Operating Range

Range	Ambient Temperature	V_{CC}
Commercial	0 °C to +70 °C	3.3 V ± 0.3 V
Industrial	-40 °C to +85 °C	

DC Electrical Characteristics

Over the Operating Range

Parameter	Description	Test Conditions ^[4]	-8		Unit	
			Min	Max		
V_{OH}	Output HIGH Voltage	$V_{CC} = \text{Min}, I_{OH} = -4.0 \text{ mA}$	2.4	-	V	
V_{OL}	Output LOW Voltage	$V_{CC} = \text{Min}, I_{OL} = 8.0 \text{ mA}$	-	0.4	V	
V_{IH}	Input HIGH Voltage		2.0	$V_{CC} + 0.3$	V	
V_{IL} ^[3]	Input LOW Voltage		-0.3	0.8	V	
I_{IX}	Input Leakage Current	$GND \leq V_I \leq V_{CC}$	-1	+1	µA	
I_{OZ}	Output Leakage Current	$GND \leq V_{OUT} \leq V_{CC}$, Output Disabled	-1	+1	µA	
I_{CC}	V_{CC} Operating Supply Current	$V_{CC} = \text{Max}, f = f_{MAX} = 1/t_{RC}$	Commercial	-	300	mA
			Industrial	-	300	mA
I_{SB1}	Automatic CE Power-down Current — TTL Inputs	Max V_{CC} , $\overline{CE} \geq V_{IH}$, $V_{IN} \geq V_{IH}$ or $V_{IN} \leq V_{IL}$, $f = f_{MAX}$	-	100	mA	
I_{SB2}	Automatic CE Power-down Current — CMOS Inputs	Max V_{CC} , $\overline{CE} \geq V_{CC} - 0.3 \text{ V}$, $V_{IN} \geq V_{CC} - 0.3 \text{ V}$, or $V_{IN} \leq 0.3 \text{ V}$, $f = 0$	-	50	mA	

Capacitance

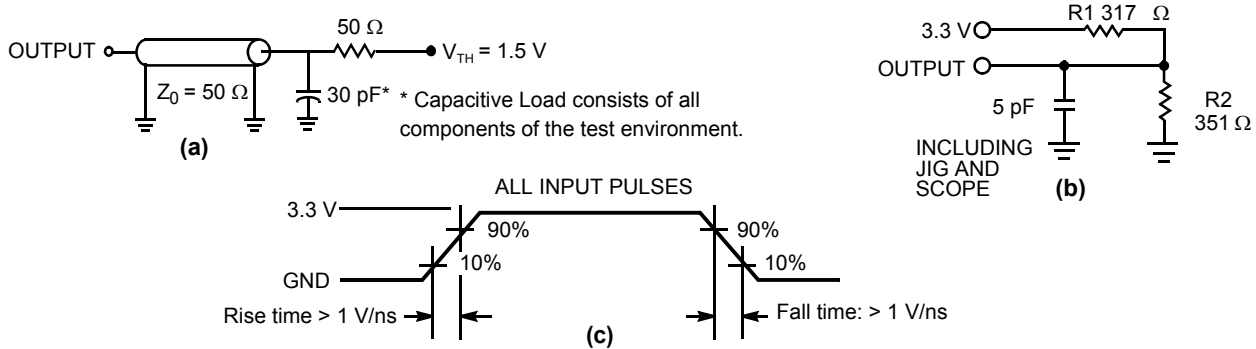
Parameter ^[5]	Description	Test Conditions	Max	Unit
C_{IN}	Input Capacitance	$T_A = 25 \text{ °C}, f = 1 \text{ MHz}, V_{CC} = 3.3 \text{ V}$	8	pF
C_{OUT}	I/O Capacitance		10	pF

Notes

- V_{IL} (min) = -2.0 V for pulse durations of less than 20 ns.
- \overline{CE} refers to a combination of \overline{CE}_0 , \overline{CE}_1 , and \overline{CE}_2 . \overline{CE} is active LOW when all three of these signals are active LOW at the same time.
- Tested initially and after any design or process changes that may affect these parameters.

AC Test Loads and Waveforms

Figure 2. AC Test Loads and Waveforms^[6]



AC Switching Characteristics

Over the Operating Range

Parameter ^[7]	Description	-8		Unit
		Min	Max	
Read Cycle				
$t_{power}^{[8]}$	V_{CC} (typical) to the first access	1	–	ms
t_{RC}	Read Cycle Time	8	–	ns
t_{AA}	Address to Data Valid	–	8	ns
t_{OHA}	Data Hold from Address Change	3	–	ns
t_{ACE}	\overline{CE}_1 , \overline{CE}_2 , and \overline{CE}_3 LOW to Data Valid	–	8	ns
t_{DOE}	\overline{OE} LOW to Data Valid	–	5	ns
t_{LZOE}	\overline{OE} LOW to low $Z^{[9]}$	1	–	ns
t_{HZOE}	\overline{OE} HIGH to high $Z^{[9]}$	–	5	ns
t_{LZCE}	\overline{CE}_1 , \overline{CE}_2 , and \overline{CE}_3 LOW to low $Z^{[9]}$	3	–	ns
t_{HZCE}	\overline{CE}_1 , \overline{CE}_2 , or \overline{CE}_3 HIGH to high $Z^{[9]}$	–	5	ns
t_{PU}	\overline{CE}_1 , \overline{CE}_2 , and \overline{CE}_3 LOW to power-up ^[10]	0	–	ns
t_{PD}	\overline{CE}_1 , \overline{CE}_2 , or \overline{CE}_3 HIGH to power-down ^[10]	–	8	ns
t_{DBE}	Byte Enable to Data Valid	–	5	ns
t_{LZBE}	Byte Enable to low $Z^{[9]}$	1	–	ns
t_{HZBE}	Byte Disable to high $Z^{[9]}$	–	5	ns

Notes

- Valid SRAM operation does not occur until the power supplies have reached the minimum operating V_{DD} (3.0 V). As soon as 1 ms (T_{power}) after reaching the minimum operating V_{DD} , normal SRAM operation can begin including reduction in V_{DD} to the data retention (V_{CCDR} , 2.0 V) voltage.
- 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 transmission line loads. Test conditions for the read cycle use output loading as shown in part (a) of the Figure 2, unless specified otherwise.
- This part has a voltage regulator which steps down the voltage from 3 V to 2 V internally. t_{power} time has to be provided initially before a read/write operation is started.
- t_{HZOE} , t_{HZCE} , t_{HZWE} , t_{HZBE} , and t_{LZOE} , t_{LZCE} , t_{LZWE} , t_{LZBE} are specified with a load capacitance of 5 pF as in part (b) of Figure 2. Transition is measured ± 200 mV from steady-state voltage.
- These parameters are guaranteed by design and are not tested.

AC Switching Characteristics *(continued)*

Over the Operating Range

Parameter ^[7]	Description	-8		Unit
		Min	Max	
Write Cycle ^[11, 12]				
t_{WC}	Write Cycle Time	8	–	ns
t_{SCE}	\overline{CE}_1 , \overline{CE}_2 , and \overline{CE}_3 LOW to Write End	6	–	ns
t_{AW}	Address Set-up to Write End	6	–	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	6	–	ns
t_{SD}	Data Set-up to Write End	5	–	ns
t_{HD}	Data Hold from Write End	0	–	ns
t_{LZWE}	\overline{WE} HIGH to low Z ^[13]	3	–	ns
t_{HZWE}	\overline{WE} LOW to high Z ^[13]	–	5	ns
t_{BW}	Byte Enable to End of Write	6	–	ns

Notes

11. The internal write time of the memory is defined by the overlap of \overline{CE}_1 , \overline{CE}_2 , and \overline{CE}_3 LOW and \overline{WE} LOW. The chip enables must be active and \overline{WE} must be LOW 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} .
13. t_{HZOE} , t_{HZCE} , t_{HZWE} , t_{HZBE} , and t_{LZOE} , t_{LZCE} , t_{LZWE} , t_{LZBE} are specified with a load capacitance of 5 pF as in part (b) of [Figure 2 on page 5](#). Transition is measured ± 200 mV from steady-state voltage.

Switching Waveforms

Figure 3. Read Cycle No. 1 [14, 15]

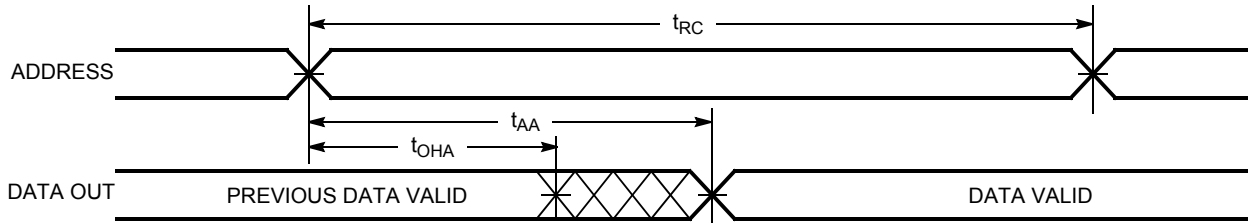


Figure 4. Read Cycle No. 2 (OE Controlled) [16, 18, 19]

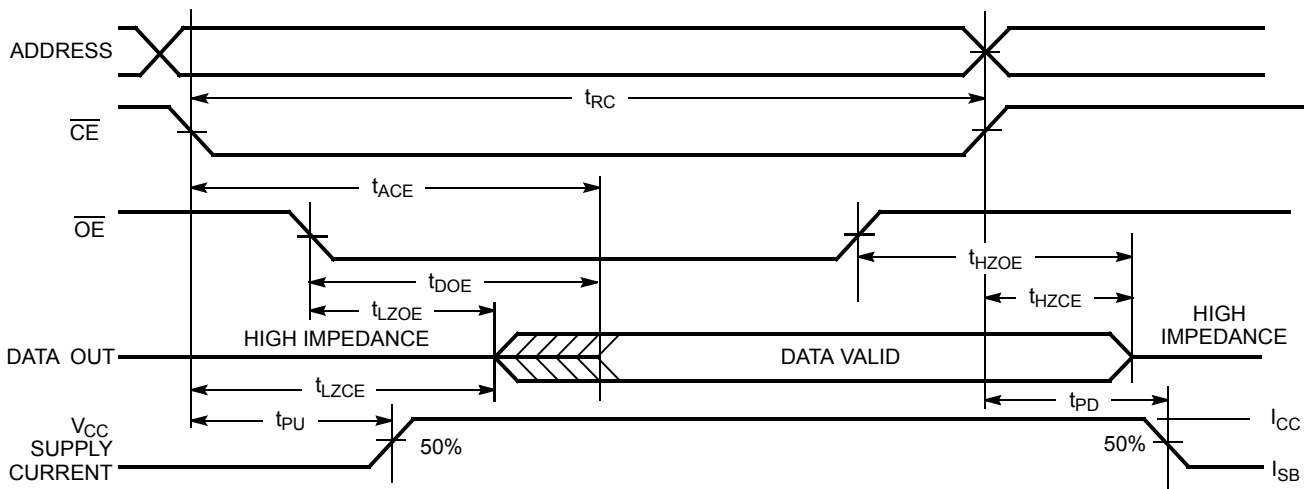
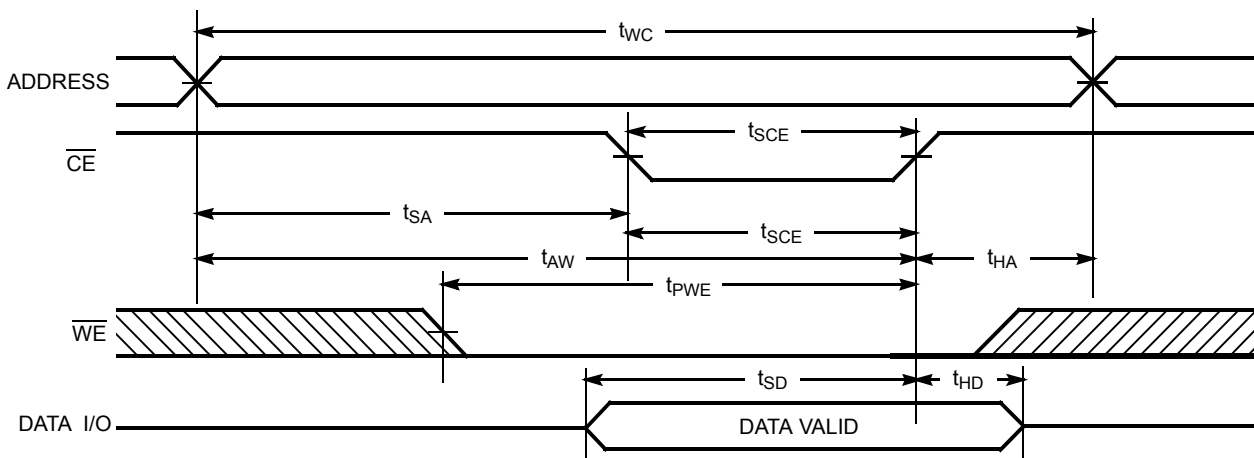


Figure 5. Write Cycle No. 1 (CE Controlled) [17, 18, 19]



Notes

- 14. Device is continuously selected. $\overline{OE}, \overline{CE} = V_{IL}$.
- 15. WE is HIGH for read cycle.
- 16. Address valid prior to or coincident with \overline{CE} transition LOW.
- 17. CE refers to a combination of $\overline{CE}_0, \overline{CE}_1,$ and \overline{CE}_2 . CE is active LOW when all three of these signals are active LOW at the same time.
- 18. Data I/O is high impedance if $\overline{OE} = V_{IH}$.
- 19. If CE goes HIGH simultaneously with WE going HIGH, the output remains in a high-impedance state.

Switching Waveforms (continued)

Figure 6. Write Cycle No. 2 (\overline{WE} Controlled, \overline{OE} HIGH During Write) [20, 21]

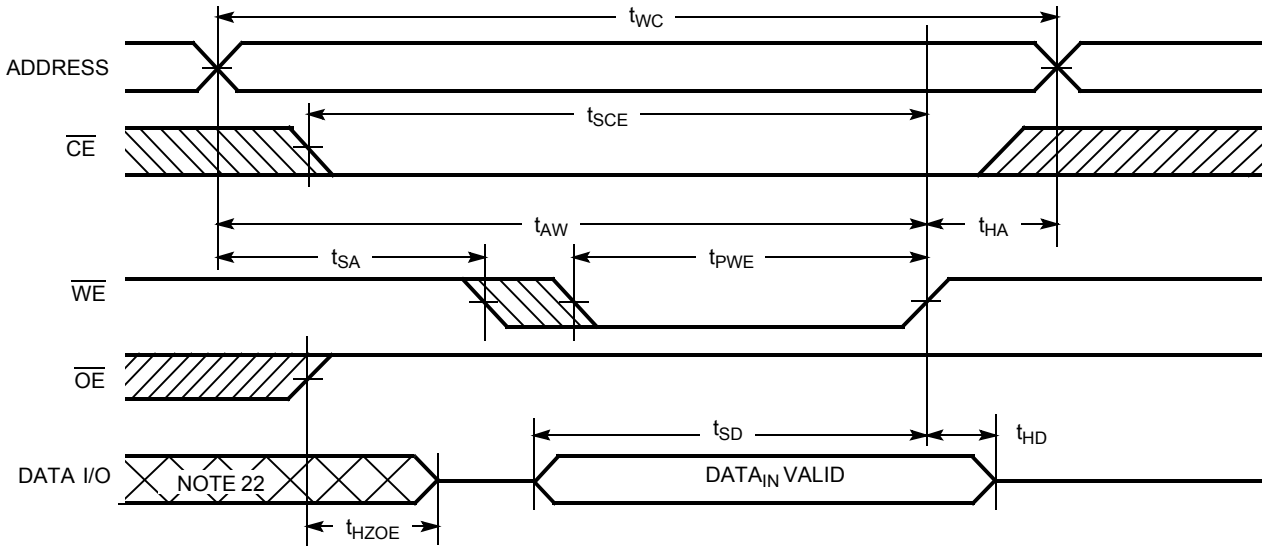
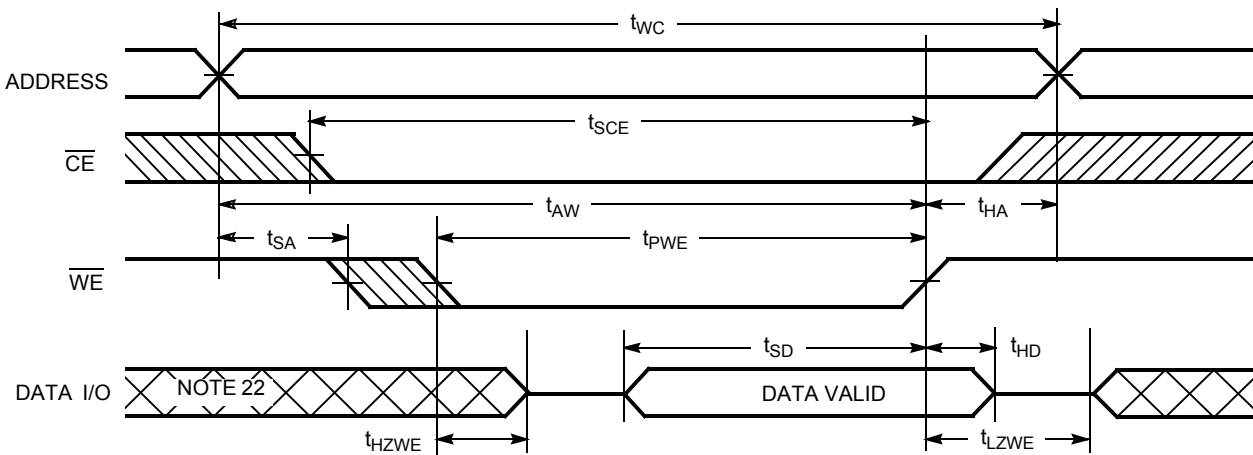


Figure 7. Write Cycle No. 3 (\overline{WE} Controlled, \overline{OE} LOW) [21, 23]



Notes

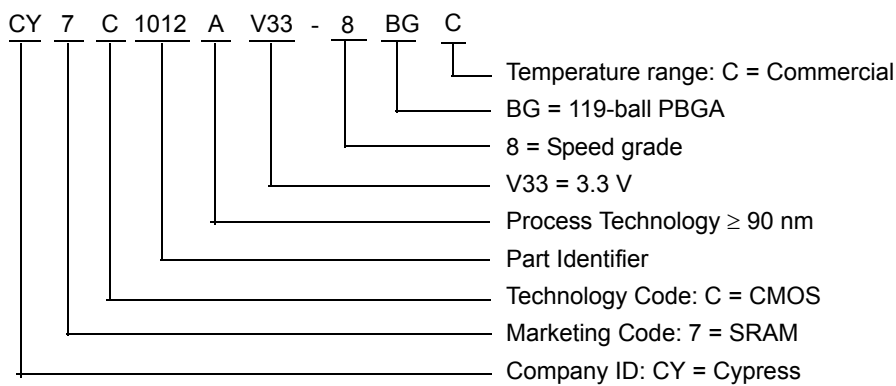
- 20. Data I/O is high impedance if $\overline{OE} = V_{IH}$.
- 21. If \overline{CE} goes HIGH simultaneously with \overline{WE} going HIGH, the output remains in a high-impedance state.
- 22. During this period the I/Os are in the output state and input signals should not be applied.
- 23. \overline{CE} refers to a combination of \overline{CE}_0 , \overline{CE}_1 , and \overline{CE}_2 . \overline{CE} is active LOW when all three of these signals are active LOW at the same time.

Truth Table

\overline{CE}_0	\overline{CE}_1	\overline{CE}_2	\overline{OE}	\overline{WE}	I/O ₀ –I/O ₂₃	Mode	Power
H	H	H	X	X	High Z	Power-down	Standby (I _{SB})
L	H	H	L	H	I/O ₀ –I/O ₇ Data Out	Read	Active (I _{CC})
H	L	H	L	H	I/O ₈ –I/O ₁₅ Data Out	Read	Active (I _{CC})
H	H	L	L	H	I/O ₁₆ –I/O ₂₃ Data Out	Read	Active (I _{CC})
L	L	L	L	H	Full Data Out	Read	Active (I _{CC})
L	H	H	X	L	I/O ₀ –I/O ₇ Data In	Write	Active (I _{CC})
H	L	H	X	L	I/O ₈ –I/O ₁₅ Data In	Write	Active (I _{CC})
H	H	L	X	L	I/O ₁₆ –I/O ₂₃ Data In	Write	Active (I _{CC})
L	L	L	X	L	Full Data In	Write	Active (I _{CC})
L	L	L	H	H	High Z	Selected, Outputs Disabled	Active (I _{CC})

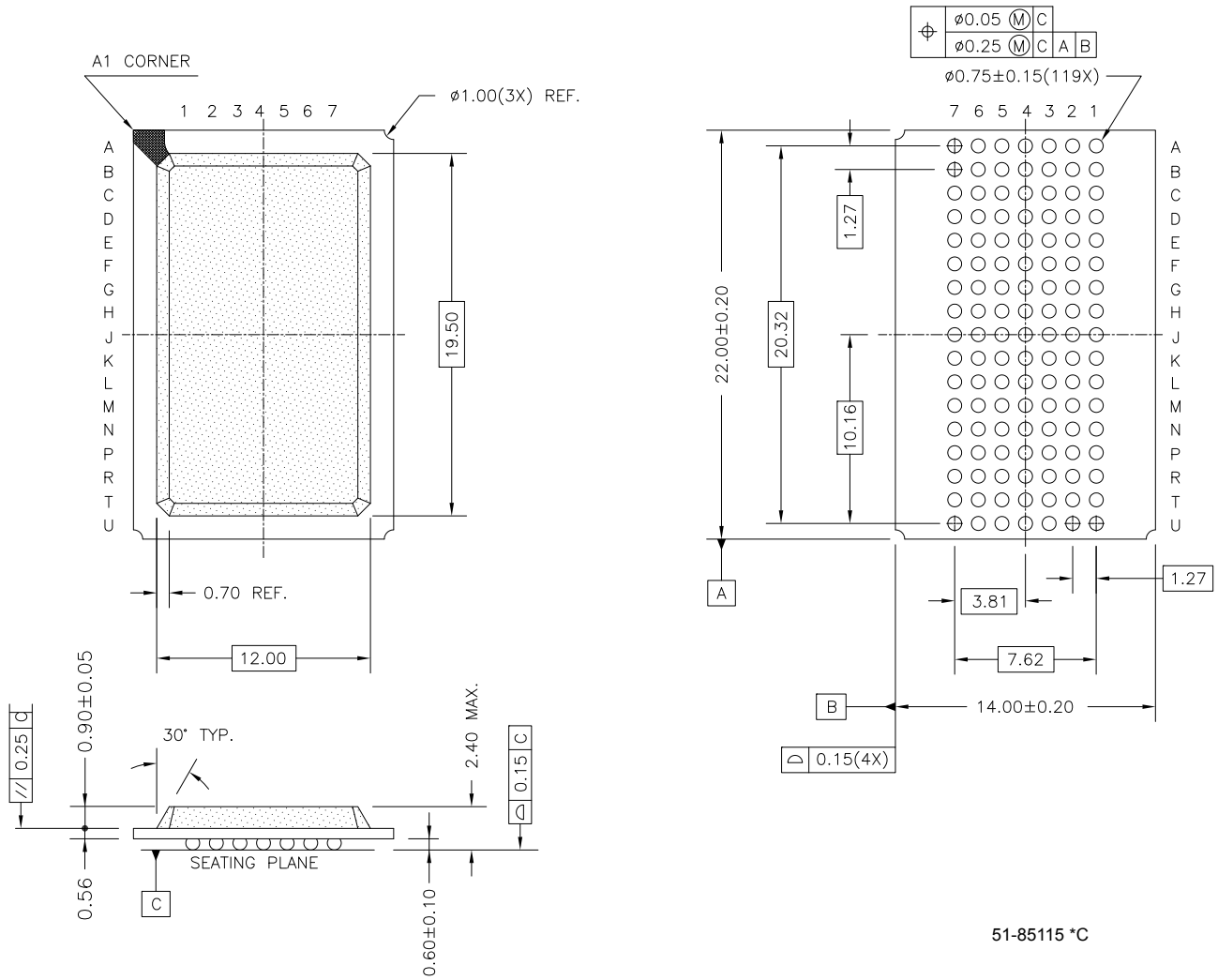
Ordering Information

Speed (ns)	Ordering Code	Package Diagram	Package Type	Operating Range
8	CY7C1012AV33-8BGC	51-85115	119-ball (14 × 22 × 2.4 mm) PBGA	Commercial

Ordering Code Definitions


Package Diagram

Figure 8. 119-ball PBGA (14 × 22 × 2.4 mm) BG119, 51-85115



Acronyms

Acronym	Description
CMOS	complementary metal oxide semiconductor
CE	chip enable
I/O	input/output
OE	output enable
PBGA	plastic ball grid array
SRAM	static random access memory
TTL	transistor-transistor logic
WE	write enable

Document Conventions

Units of Measure

Symbol	Unit of Measure
°C	degree Celcius
MHz	Mega Hertz
μA	micro Amperes
mA	milli Amperes
mm	milli meter
ms	milli seconds
mV	milli Volts
mW	milli Watts
ns	nano seconds
%	percent
pF	pico Farad
V	Volts
W	Watts

Document History Page

Document Title: CY7C1012AV33, 512 K × 24 Static RAM Document Number: 38-05254				
REV.	ECN NO.	Issue Date	Orig. of Change	Description of Change
**	113711	03/11/02	NSL	New Data Sheet
*A	117057	07/31/02	DFP	Removed 15-ns bin
*B	117988	09/03/02	DFP	Added 8-ns bin
*C	118992	09/19/02	DFP	Change Cin - input capacitance -from 6 pF to 8 pF Change Cout -output capacitance from 8 pF to 10 pF
*D	120382	11/15/02	DFP	Final data sheet. Added note 4 to "AC Test Loads and Waveforms"
*E	492137	See ECN	NXR	Removed 12 ns speed bin from product offering Included note #1 and 2 on page #2 Changed the description of I _{IX} from Input Load Current to Input Leakage Current in DC Electrical Characteristics table Updated Ordering Information Table
*F	2896044	03/19/2010	AJU	Updated Ordering Information Table Updated Package Diagram Added Sales, Solutions, and Legal Information
*G	3097955	11/30/2010	PRAS	Added Ordering Code Definitions . Added Acronyms and Units of Measure . Minor edits.
*H	3086499	06/07/2011	AJU	Updated Selection Guide (Removed -10 column). Updated DC Electrical Characteristics (Removed -10 column). Updated AC Switching Characteristics (Removed -10 column). Updated in new template.

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