

16K x 4 Static RAM

Features

- High speed
— 20 ns
- Output enable ($\overline{OE}$) feature (7C166A)
- CMOS for optimum speed/power
- Low active power
— 550 mW
- Low standby power
— 220 mW
- TTL-compatible inputs and outputs
- Automatic power-down when deselected

Functional Description

The CY7C164A and CY7C166A are high-performance CMOS static RAMs organized as 16,384 by 4 bits. Easy memory expansion is provided by an active LOW chip enable ($\overline{CE}$) and three-state drivers. The CY7C166A has an active low output enable ($\overline{OE}$) feature. Both devices have an automatic power-down feature, reducing the power consumption by 60% when deselected.

Writing to the device is accomplished when the chip enable ($\overline{CE}$) and write enable ($\overline{WE}$) inputs are both LOW (and the output enable ($\overline{OE}$) is LOW for the 7C166A). Data on the four input/output pins (I/O_0

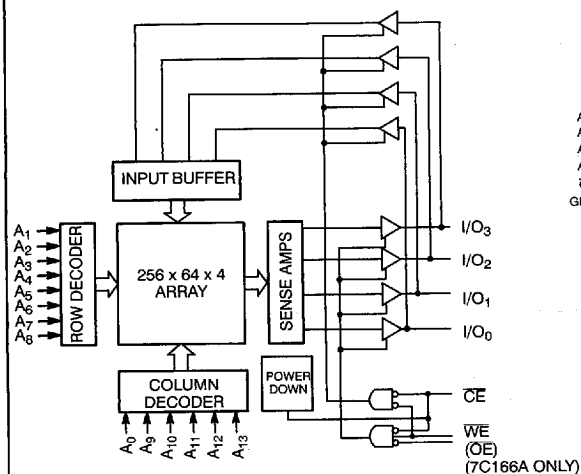
through I/O_3) is written into the memory location specified on the address pins (A_0 through A_{13}).

Reading the device is accomplished by taking chip enable ($\overline{CE}$) LOW (and $\overline{OE}$ LOW for 7C166A), while write enable ($\overline{WE}$) remains HIGH. Under these conditions the contents of the memory location specified on the address pins will appear on the four data I/O pins.

The I/O pins stay in high-impedance state when chip enable ($\overline{CE}$) is HIGH, or output enable ($\overline{OE}$) is HIGH for 7C166A.

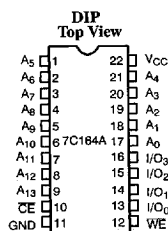
A die coat is used to ensure alpha immunity.

Logic Block Diagram

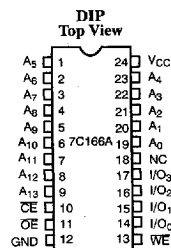


C164A-1

Pin Configurations



C164A-2



C164A-3

Selection Guide^[1]

		7C164A-15 7C166A-15	7C164A-20 7C166A-20	7C164A-25 7C166A-25	7C164A-35 7C166A-35
Maximum Access Time (ns)		15	20	25	35
Maximum Operating Current (mA)	Military	160	100	100	100
Maximum Standby Current (mA)	Military	40/20	40/20	40/20	30/20

Shaded area contains preliminary information.

Note:

1. For commercial specifications, see the CY7C164/CY7C166 datasheet.

Maximum Ratings

(Above which the useful life may be impaired. For user guidelines, not tested.)

Storage Temperature	-65°C to +150°C
Ambient Temperature with Power Applied	-55°C to +125°C
Supply Voltage to Ground Potential	-0.5V to +7.0V
DC Voltage Applied to Outputs in High Z State ^[2]	-0.5V to +7.0V
DC Input Voltage ^[2]	-0.5V to +7.0V

Notes:

2. Minimum voltage is equal to -3.0V for pulse durations less than 30 ns.

Output Current into Outputs (Low)	20 mA
Static Discharge Voltage	>2001V (per MIL-STD-883, Method 3015)
Latch-up Current	>200 mA

Operating Range

Range	Ambient Temperature	V _{CC}
Military ^[3]	-55°C to +125°C	5V ± 10%

3. T_A is the "instant on" case temperature.

Electrical Characteristics Over the Operating Range^[4]

Parameter	Description	Test Conditions	7C164A-15 7C166A-15		7C164A-20 7C166A-20		Unit
			Min.	Max.	Min.	Max.	
V _{OH}	Output HIGH Voltage	V _{CC} = Min., I _{OH} = -4.0 mA	2.4		2.4		V
V _{OL}	Output LOW Voltage	V _{CC} = Min., I _{OL} = 8.0 mA		0.4		0.4	V
V _{IH}	Input HIGH Voltage		2.2	V _{CC}	2.2	V _{CC}	V
V _{IL}	Input LOW Voltage ^[2]		-3.0	0.8	-3.0	0.8	V
I _{IX}	Input Load Current	GND ≤ V _I ≤ V _{CC}	-5	+5	-5	+5	μA
I _{OZ}	Output Leakage Current	GND ≤ V _O ≤ V _{CC} , Output Disabled	-5	+5	-5	+5	μA
I _{OS}	Output Short Circuit Current ^[5]	V _{CC} = Max., V _{OUT} = GND		-350		-350	mA
I _{CC}	V _{CC} Operating Supply Current	V _{CC} = Max., I _{OUT} = 0 mA		160		100	mA
I _{SB1}	Automatic $\overline{CE}$ ^[6] Power Down Current	Max. V _{CC} , $\overline{CE} \geq V_{IH}$ Min. Duty Cycle = 100%		40		40	mA
I _{SB2}	Automatic $\overline{CE}$ ^[6] Power Down Current	Max. V _{CC} , $\overline{CE} \geq V_{IH} - 0.3V$ V _{IN} ≥ V _{CC} - 0.3V or V _{IN} ≤ 0.3V		20		20	mA

Shaded area contains preliminary information.

Electrical Characteristics Over the Operating Range ^[4](continued)

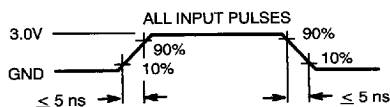
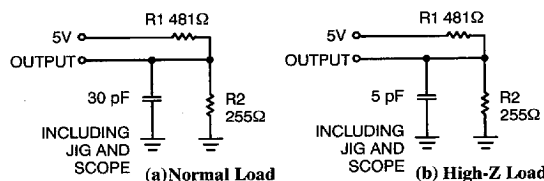
Parameter	Description	Test Conditions	7C164A-25 7C166A-25		7C164A-35 7C166A-35		Unit
			Min.	Max.	Min.	Max.	
V _{OH}	Output HIGH Voltage	V _{CC} = Min., I _{OH} = -4.0 mA	2.4		2.4		V
V _{OL}	Output LOW Voltage	V _{CC} = Min., I _{OL} = 8.0 mA		0.4		0.4	V
V _{IH}	Input HIGH Voltage		2.2	V _{CC}	2.2	V _{CC}	V
V _{IL}	Input LOW Voltage ^[2]		-3.0	0.8	-3.0	0.8	V
I _{IX}	Input Load Current	GND ≤ V _I ≤ V _{CC}	-10	+10	-10	+10	μA
I _{OZ}	Output Leakage Current	GND ≤ V _O ≤ V _{CC} , Output Disabled	-10	+10	-10	+10	μA
I _{OS}	Output Short Circuit Current ^[5]	V _{CC} = Max., V _{OUT} = GND		-350		-350	mA
I _{CC}	V _{CC} Operating Supply Current	V _{CC} = Max., I _{OUT} = 0 mA	Military			100	mA
I _{SB1}	Automatic $\overline{CE}$ ^[6] Power Down Current	Max. V _{CC} , $\overline{CE} \geq V_{IH}$ Min. Duty Cycle = 100%	Military			40	mA
I _{SB2}	Automatic $\overline{CE}$ ^[6] Power Down Current	Max. V _{CC} , $\overline{CE} \geq V_{IH} - 0.3V$ $V_{IN} \geq V_{CC} - 0.3V$ or $V_{IN} \leq 0.3V$	Military			20	mA

Capacitance^[7]

Parameter	Description	Test Conditions	Max.	Unit
C _{IN}	Input Capacitance	T _A = 25°C, f = 1 MHz, V _{CC} = 5.0V	10	pF
C _{OUT}	Output Capacitance		10	pF

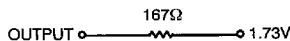
Notes:

- See the last page of this specification for Group A subgroup testing information.
- Not more than 1 output should be shorted at one time. Duration of the short circuit should not exceed 30 seconds.
- A pull-up resistor to V_{CC} on the $\overline{CE}$ input is required to keep the device deselected during V_{CC} power-up, otherwise I_{SB} will exceed values given.
- Tested initially and after any design or process changes that may affect these parameters.

AC Test Loads and Waveforms


C164A-5

Equivalent to: THÉVENIN EQUIVALENT



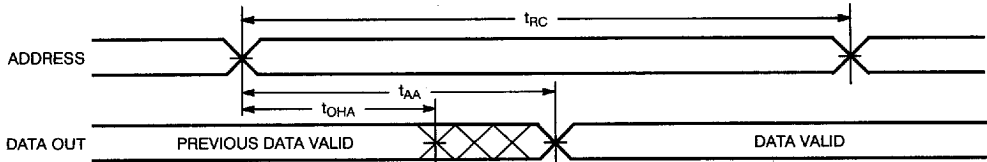
Switching Characteristics Over the Operating Range^[4, 8]

Parameter	Description	7C164A–15 7C166A–15		7C164A–20 7C166A–20		7C164A–25 7C166A–25		7C164A–35 7C166A–35		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
READ CYCLE										
t _{RC}	Read Cycle Time	15		20		25		35		ns
t _{AA}	Address to Data Valid		15		20		25		35	ns
t _{OHA}	Output Hold from Address Change	3		3		3		3		ns
t _{ACE}	CE LOW to Data Valid		15		20		25		35	ns
t _{DOE}	OE LOW to Data Valid (7C166A)		7		10		12		15	ns
t _{LZOE}	OE LOW to Low Z (7C166A)	0		3		3		3		ns
t _{HZOE}	OE HIGH to High Z (7C166A)		8		8		10		12	ns
t _{LZCE}	CE LOW to Low Z ^[9]	3		5		5		5		ns
t _{HZCE}	CE HIGH to High Z ^[9, 10]		8		8		10		15	ns
t _{PU}	CE LOW to Power-Up	0		0		0		0		ns
t _{PD}	CE HIGH to Power-Down		15		20		20		20	ns
WRITE CYCLE ^[11]										
t _{WC}	Write Cycle Time	15		20		20		25		ns
t _{SCE}	CE LOW to Write End	10		15		20		25		ns
t _{AW}	Address Set-Up to Write End	10		15		20		25		ns
t _{HA}	Address Hold from Write End	0		0		0		0		ns
t _{SA}	Address Set-Up to Write Start	0		0		0		0		ns
t _{PWE}	WE Pulse Width	10		15		15		20		ns
t _{SD}	Data Set-Up to Write End	7		10		10		15		ns
t _{HD}	Data Hold from Write End	0		0		0		0		ns
t _{LZWE}	WE HIGH to Low Z ^[9]	3		5		5		5		ns
t _{HZWE}	WE LOW to High Z ^[9, 10]		7		7		7		10	ns

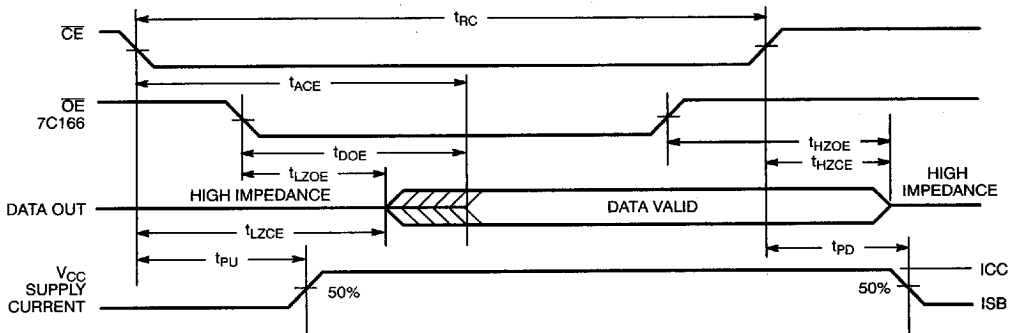
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Notes:

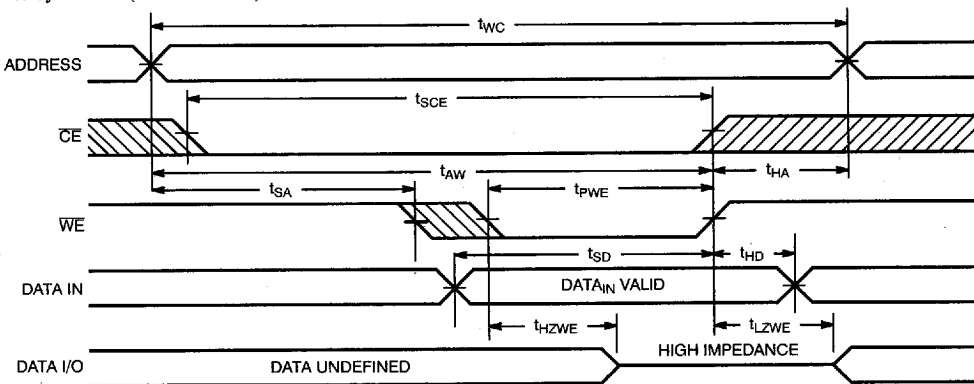
8. Test conditions assume signal transition time of 5 ns or less, timing reference levels of 1.5V, input pulse levels of 0 to 3.0V, and output loading of the specified I_{OL}/I_{OH} and 30-pF load capacitance.
9. At any given temperature and voltage condition, t_{HZCE} is less than t_{LZCE} for any given device. These parameters are guaranteed by design and not 100% tested.
10. t_{HZCE} and t_{HZWE} are specified with C_L = 5 pF as in part (b) in AC Test Loads. Transition is measured ±500 mV from steady-state voltage.
11. The internal write time of the memory is defined by the overlap of CE LOW and WE LOW. Both signals must be LOW to initiate a write and either signal can terminate a write by going HIGH. The data input set-up and hold timing should be referenced to the rising edge of the signal that terminates the write.

Switching Waveforms
Read Cycle No. 1^[12, 13]


C164A-6

Read Cycle No. 2^[12, 14]


C164A-7

Write Cycle No. 1 (WE Controlled)^[11, 15]


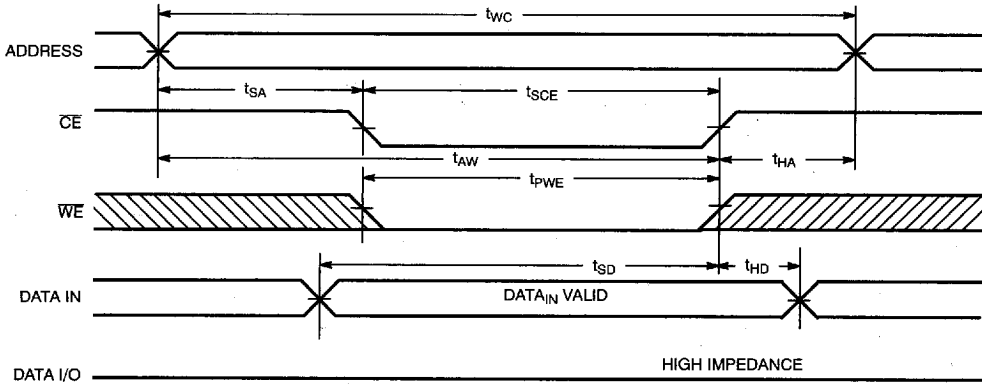
C164A-8

Notes:

12. $\overline{WE}$ is HIGH for read cycle.
13. Device is continuously selected, $\overline{CE} = V_{IL}$. (7C166A $\overline{OE} = V_{IL}$ also).
14. Address valid prior to or coincident with $\overline{CE}$ transition LOW.
15. 7C166A only: Data I/O will be high impedance if $\overline{OE} = V_{IH}$.

Switching Waveforms (continued)

Write Cycle No. 2 (CE Controlled) [11, 15, 16]

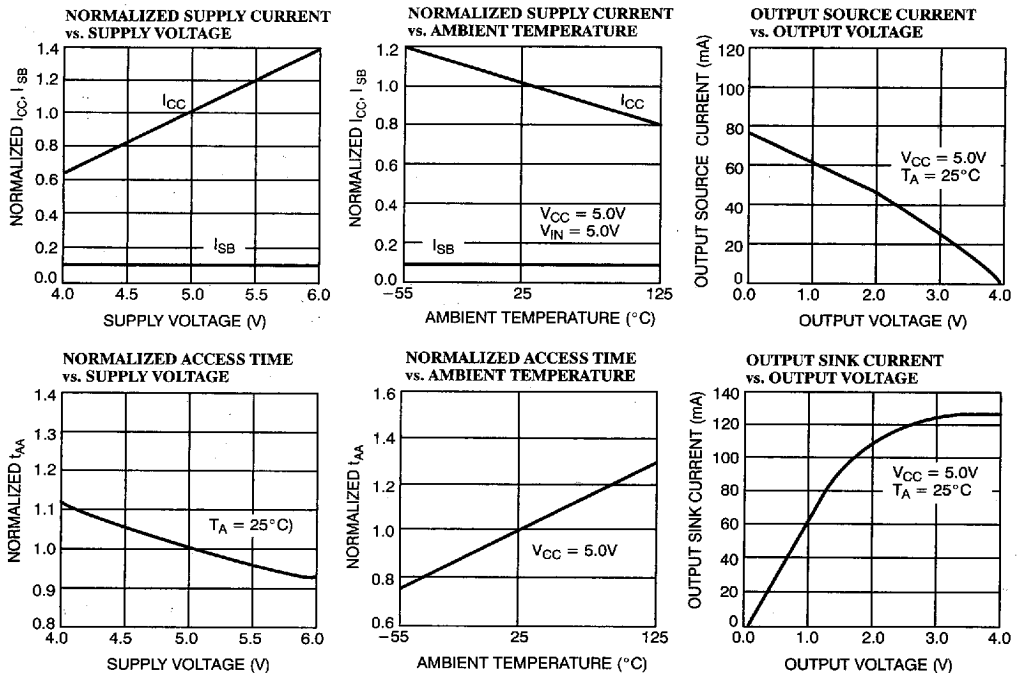


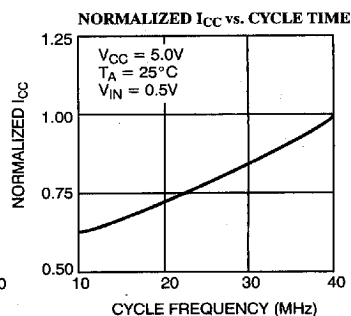
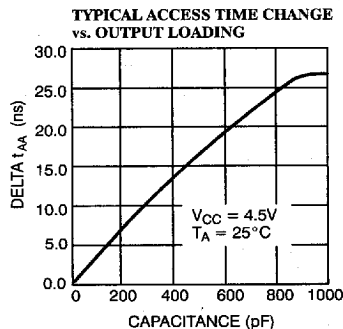
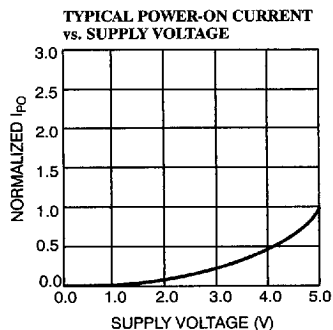
C164A-9

Note:

16. If $\overline{CE}$ goes HIGH simultaneously with $\overline{WE}$ HIGH, the output remains in a high-impedance state.

Typical DC and AC Characteristics



Typical DC and AC Characteristics (continued)

CY7C164A Truth Table

CE	WE	Inputs/Outputs	Mode
H	X	High Z	Deselect/Power-Down
L	H	Data Out	Read
L	L	Data In	Write

CY7C166A Truth Table

CE	WE	OE	Inputs/Outputs	Mode
H	X	X	High Z	Deselect/Power-Down
L	H	L	Data Out	Read
L	L	X	Data In	Write
L	H	H	High Z	Deselect

Address Designators

Address Name	Address Function	CY7C164A Pin Number	CY7C166A Pin Number
A5	X3	1	1
A6	X4	2	2
A7	X5	3	3
A8	X6	4	4
A9	X7	5	5
A10	Y5	6	6
A11	Y4	7	7
A12	Y0	8	8
A13	Y1	9	9
A0	Y2	17	19
A1	Y3	18	20
A2	X0	19	21
A3	X1	20	22
A4	X2	21	23

Ordering Information

Speed (ns)	Ordering Code	Package Type	Package Type	Operating Range
15	CY7C164A-15DMB	D10	22-Lead (300-Mil) CerDIP	Military
20	CY7C164A-20DMB	D10	22-Lead (300-Mil) CerDIP	Military
25	CY7C164A-25DMB	D10	22-Lead (300-Mil) CerDIP	Military
35	CY7C164A-35DMB	D10	22-Lead (300-Mil) CerDIP	Military

Speed (ns)	Ordering Code	Package Type	Package Type	Operating Range
15	CY7C166A-15DMB	D14	24-Lead (300-Mil) CerDIP	Military
20	CY7C166A-20DMB	D14	24-Lead (300-Mil) CerDIP	Military
25	CY7C166A-25DMB	D14	24-Lead (300-Mil) CerDIP	Military
35	CY7C166A-35DMB	D14	24-Lead (300-Mil) CerDIP	Military

Shaded area contains preliminary information.

MILITARY SPECIFICATIONS
Group A Subgroup Testing
DC Characteristics

Parameter	Subgroups
V _{OH}	1, 2, 3
V _{OL}	1, 2, 3
V _{IH}	1, 2, 3
V _{IL} Max.	1, 2, 3
I _{IX}	1, 2, 3
I _{OZ}	1, 2, 3
I _{OS}	1, 2, 3
I _{CC}	1, 2, 3
I _{SB1}	1, 2, 3
I _{SB1}	1, 2, 3

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Switching Characteristics

Parameter	Subgroups
READ CYCLE	
t _{RC}	7, 8, 9, 10, 11
t _{AA}	7, 8, 9, 10, 11
t _{OHA}	7, 8, 9, 10, 11
t _{ACE}	7, 8, 9, 10, 11
t _{DOE} ^[17]	7, 8, 9, 10, 11
WRITE CYCLE	
t _{WC}	7, 8, 9, 10, 11
t _{SCE}	7, 8, 9, 10, 11
t _{AW}	7, 8, 9, 10, 11
t _{HA}	7, 8, 9, 10, 11
t _{SA}	7, 8, 9, 10, 11
t _{PWE}	7, 8, 9, 10, 11
t _{SD}	7, 8, 9, 10, 11
t _{HD}	7, 8, 9, 10, 11

Note:

17. 7C166A only.