



# 16K x 4 Static RAM

## Features

- High speed  
— 15 ns
- Output enable ( $\overline{OE}$ ) feature (CY7C166)
- CMOS for optimum speed/power
- Low active power  
— 633 mW
- Low standby power  
— 110 mW
- TTL-compatible inputs and outputs
- Automatic power-down when deselected

## Functional Description

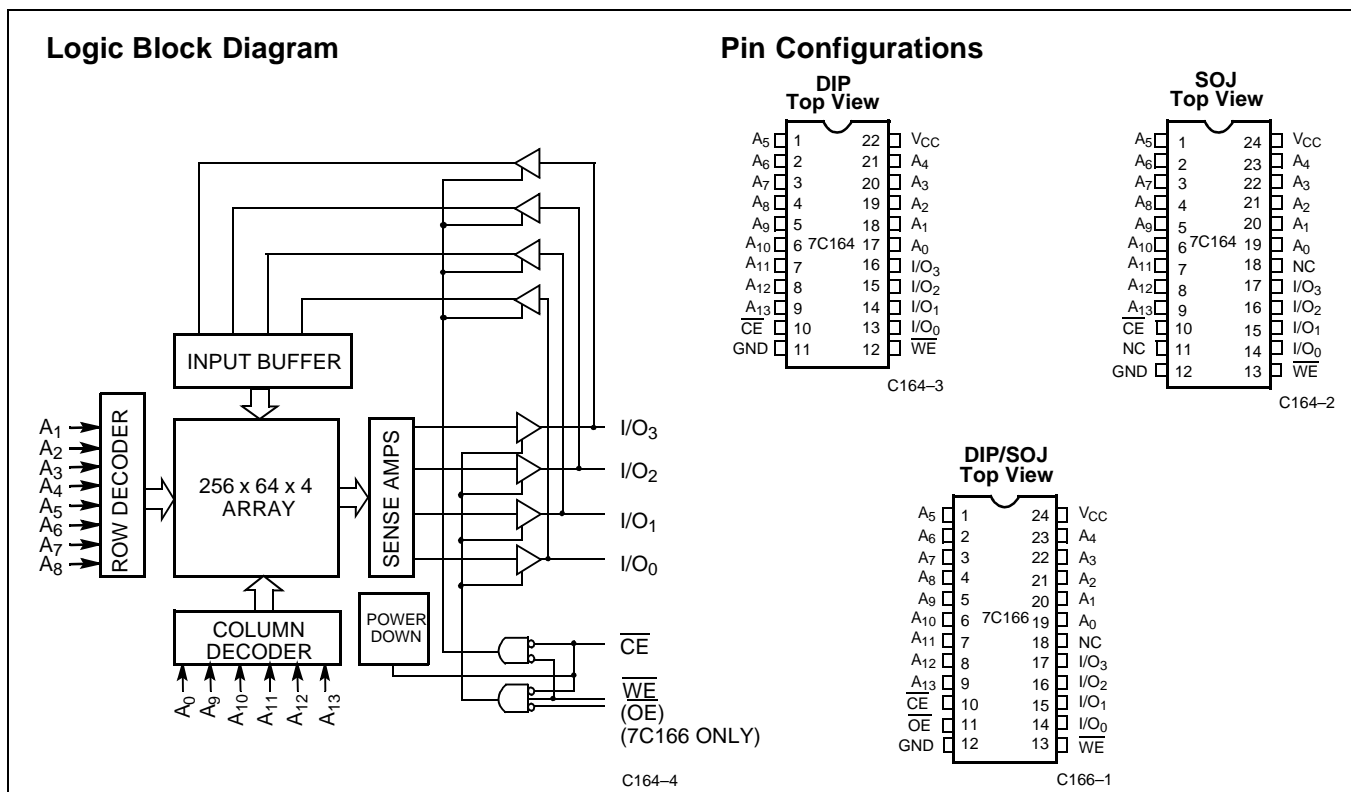
The CY7C164 and CY7C166 are high-performance CMOS static RAMs organized as 16,384 by 4 bits. Easy memory expansion is provided by an active LOW Chip Enable ( $\overline{CE}$ ) and

three-state drivers. The CY7C166 has an active LOW Output Enable ( $\overline{OE}$ ) feature. Both devices have an automatic power-down feature, reducing the power consumption by 65% 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 CY7C166). 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 CY7C166), 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 a high-impedance state when Chip Enable ( $\overline{CE}$ ) is HIGH (or Output Enable ( $\overline{OE}$ ) is HIGH for CY7C166). A die coat is used to insure alpha immunity.



## Selection Guide

	7C164-15 7C166-15	7C164-20 7C166-20	7C164-25 7C166-25	7C164-35 7C166-35
Maximum Access Time (ns)	15	20	25	35
Maximum Operating Current (mA)	115	115	105	105
Maximum Standby Current (mA)	20	20	20	20

### 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 <sup>[1]</sup> .....	-0.5V to +7.0V
DC Input Voltage <sup>[1]</sup> .....	-0.5V to +7.0V

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 <sub>CC</sub>
Commercial	0°C to +70°C	5V ± 10%

### Electrical Characteristics Over the Operating Range

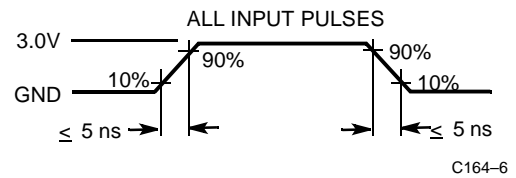
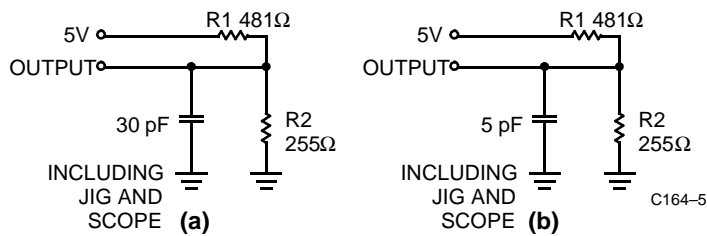
Parameter	Description	Test Conditions	7C164-15 7C166-15		7C164-20 7C166-20		7C164-25, 35 7C166-25, 35		Unit
			Min.	Max.	Min.	Max.	Min.	Max.	
V <sub>OH</sub>	Output HIGH Voltage	V <sub>CC</sub> = Min., I <sub>OH</sub> = -4.0 mA	2.4		2.4		2.4		V
V <sub>OL</sub>	Output LOW Voltage	V <sub>CC</sub> = Min., I <sub>OL</sub> = 8.0 mA		0.4		0.4		0.4	V
V <sub>IH</sub>	Input HIGH Voltage		2.2	V <sub>CC</sub>	2.2	V <sub>CC</sub>	2.2	V <sub>CC</sub>	V
V <sub>IL</sub>	Input LOW Voltage <sup>[1]</sup>		-0.5	0.8	-0.5	0.8	-0.5	0.8	V
I <sub>Ix</sub>	Input Load Current	GND ≤ V <sub>I</sub> ≤ V <sub>CC</sub>	-5	+5	-5	+5	-5	+5	μA
I <sub>OZ</sub>	Output Leakage Current	GND ≤ V <sub>O</sub> ≤ V <sub>CC</sub> , Output Disabled	-5	+5	-5	+5	-5	+5	μA
I <sub>OS</sub>	Output Short Circuit Current <sup>[2]</sup>	V <sub>CC</sub> = Max., V <sub>OUT</sub> = GND		-350		-350		-350	mA
I <sub>CC</sub>	V <sub>CC</sub> Operating Supply Current	V <sub>CC</sub> = Max., I <sub>OUT</sub> = 0 mA		115		115		105	mA
I <sub>SB1</sub>	Automatic CE Power-Down Current <sup>[3]</sup>	Max. V <sub>CC</sub> , CE ≥ V <sub>IH</sub> , Min. Duty Cycle = 100%		40		40		20	mA
I <sub>SB2</sub>	Automatic CE Power-Down Current <sup>[3]</sup>	Max. V <sub>CC</sub> , CE ≥ V <sub>CC</sub> - 0.3V, V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.3V or V <sub>IN</sub> ≤ 0.3V		20		20		20	mA

### Capacitance<sup>[4]</sup>

Parameter	Description	Test Conditions	Max.	Unit
C <sub>IN</sub>	Input Capacitance	T <sub>A</sub> = 25°C, f = 1 MHz, V <sub>CC</sub> = 5.0V	10	pF
C <sub>OUT</sub>	Output Capacitance		10	pF

#### Notes:

1. Minimum voltage is equal to -3.0V for pulse durations less than 30 ns.
2. Not more than 1 output should be shorted at one time. Duration of the short circuit should not exceed 30 seconds.
3. A pull-up resistor to V<sub>CC</sub> on the CE input is required to keep the device deselected during V<sub>CC</sub> power-up, otherwise I<sub>SB</sub> will exceed values given.
4. Tested initially and after any design or process changes that may affect these parameters.

**AC Test Loads and Waveforms**


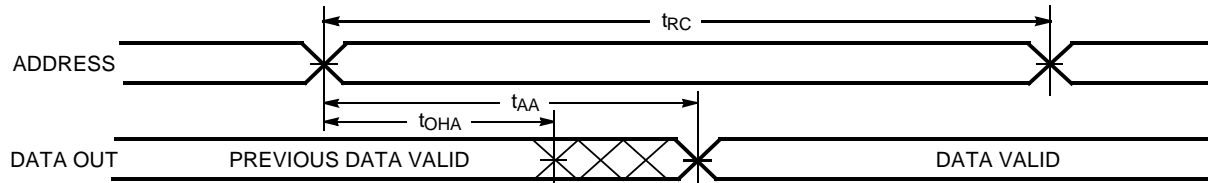
Equivalent to: THÉVENIN EQUIVALENT  
 OUTPUT — 167Ω — 1.73V

**Switching Characteristics** Over the Operating Range<sup>[5]</sup>

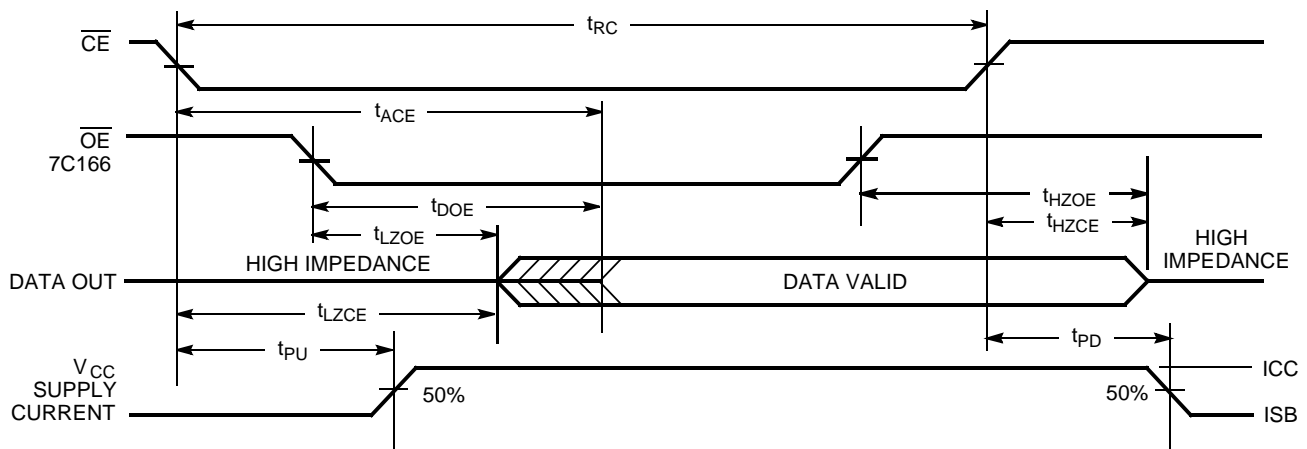
Parameter	Description	7C164-15 7C166-15		7C164-20 7C166-20		7C164-25 7C166-25		7C164-35 7C166-35		Unit
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
<b>READ CYCLE</b>										
t <sub>RC</sub>	Read Cycle Time	15		20		25		35		ns
t <sub>AA</sub>	Address to Data Valid		15		20		25		35	ns
t <sub>OHA</sub>	Output Hold from Address Change	3		5		5		5		ns
t <sub>ACE</sub>	CE LOW to Data Valid		15		20		25		35	ns
t <sub>DOE</sub>	OE LOW to Data Valid		10		10		12		15	ns
t <sub>LZOE</sub>	OE LOW to Low Z	3		3		3		3		ns
t <sub>HZOE</sub>	OE HIGH to High Z		8		8		10		12	ns
t <sub>LZCE</sub>	CE LOW to Low Z <sup>[6]</sup>	3		5		5		5		ns
t <sub>HZCE</sub>	CE HIGH to High Z <sup>[6, 7]</sup>		8		8		10		15	ns
t <sub>PU</sub>	CE LOW to Power-Up	0		0		0		0		ns
t <sub>PD</sub>	CE HIGH to Power-Down		15		20		20		20	ns
<b>WRITE CYCLE<sup>[8]</sup></b>										
t <sub>WC</sub>	Write Cycle Time	15		20		20		25		ns
t <sub>SCE</sub>	CE LOW to Write End	12		15		20		25		ns
t <sub>AW</sub>	Address Set-Up to Write End	12		15		20		25		ns
t <sub>HA</sub>	Address Hold from Write End	0		0		0		0		ns
t <sub>SA</sub>	Address Set-Up to Write Start	0		0		0		0		ns
t <sub>PWE</sub>	WE Pulse Width	12		15		15		20		ns
t <sub>SD</sub>	Data Set-Up to Write End	10		10		10		15		ns
t <sub>HD</sub>	Data Hold from Write End	0		0		0		0		ns
t <sub>LZWE</sub>	WE HIGH to Low Z <sup>[6]</sup>	5		5		5		5		ns
t <sub>HZWE</sub>	WE LOW to High Z <sup>[6, 7]</sup>		7		7		7		10	ns

**Notes:**

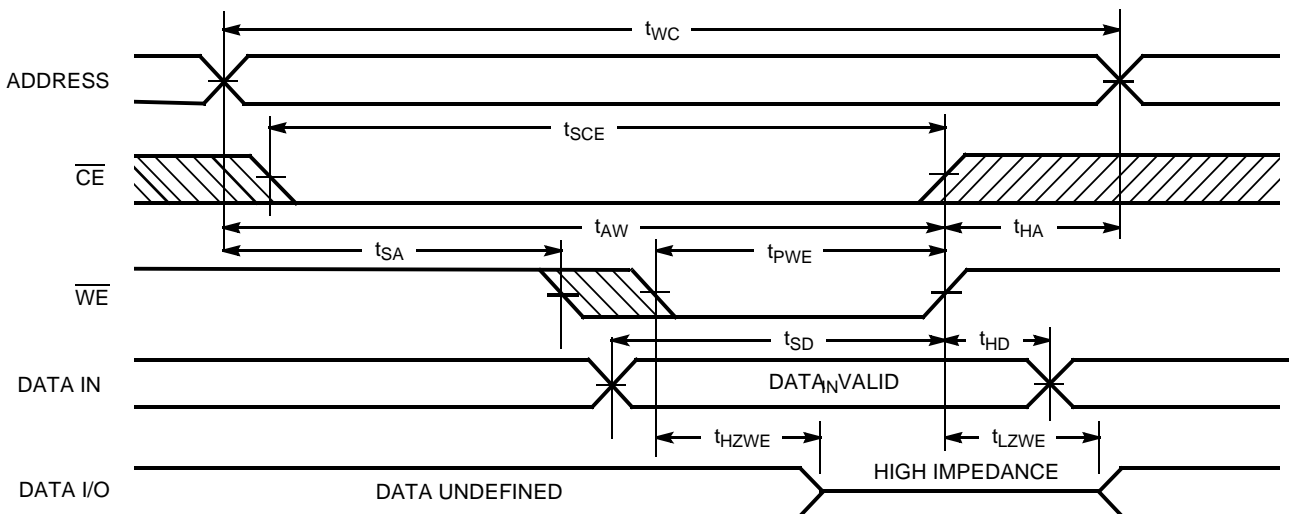
- Test conditions assume signal transition time of 5 ns or less, timing reference levels of 1.5V, input pulse levels of 0 to 3.0V, and output loading of the specified I<sub>OL</sub>/I<sub>OH</sub> and 30-pF load capacitance.
- At any given temperature and voltage condition, t<sub>HZCE</sub> is less than t<sub>LZCE</sub> for any given device. These parameters are guaranteed by design and not 100% tested.
- t<sub>HZCE</sub> and t<sub>HZWE</sub> are specified with C<sub>L</sub> = 5 pF as in part (b) in AC Test Loads. Transition is measured ±500 mV from steady-state voltage.
- 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 [9, 10]**


C164-7

**Read Cycle No. 2 [9, 11]**


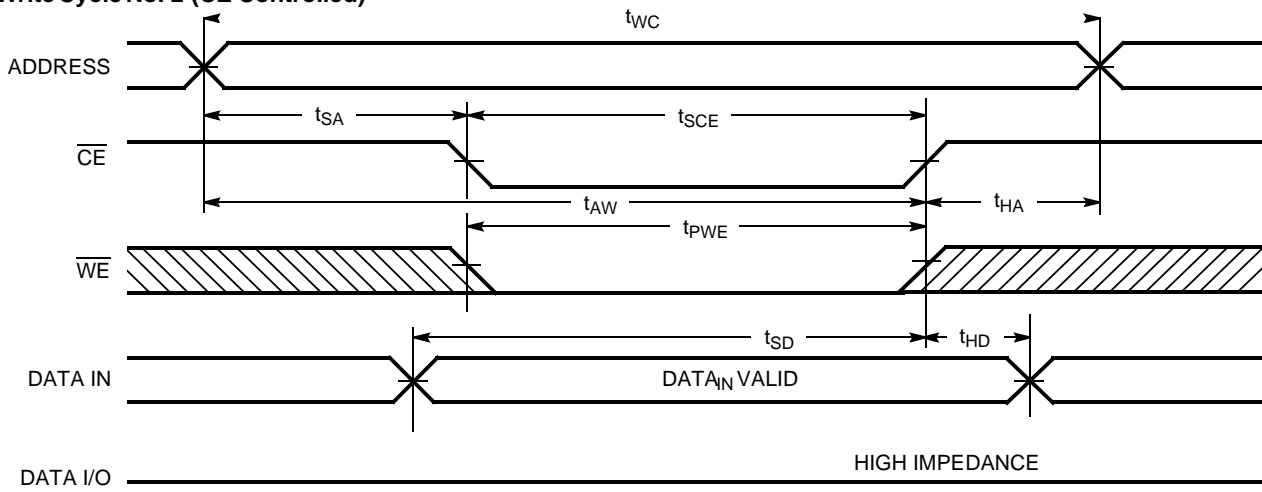
C164-8

**Write Cycle No. 1 (WE Controlled) [8, 12]**


C164-9

**Notes:**

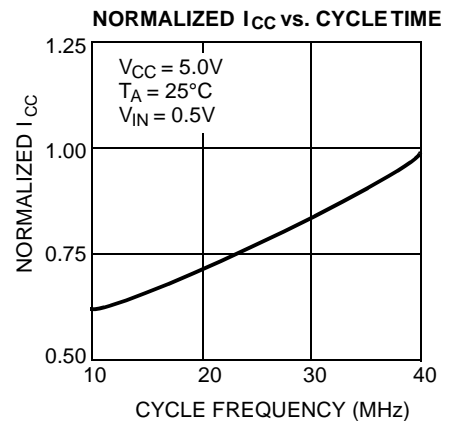
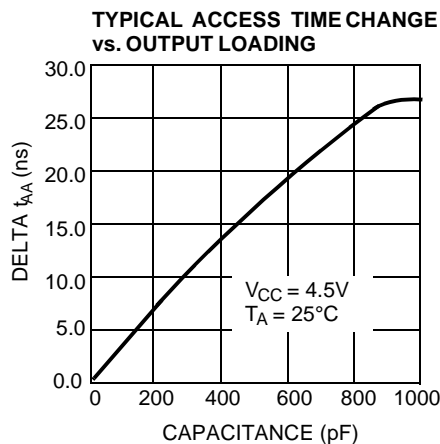
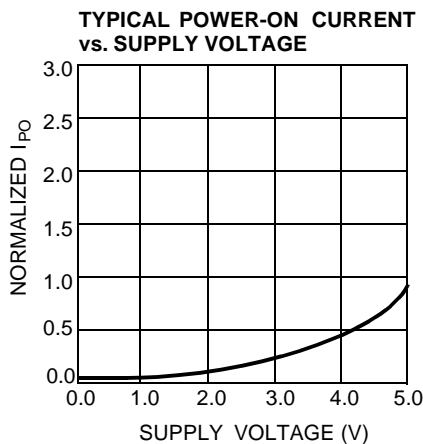
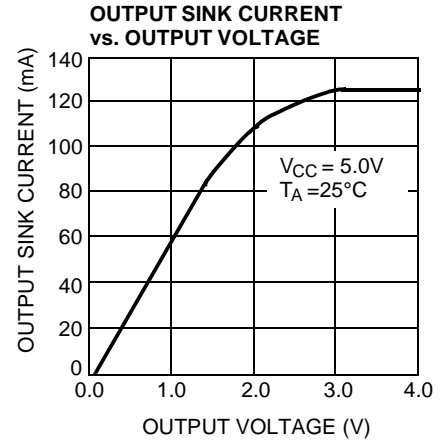
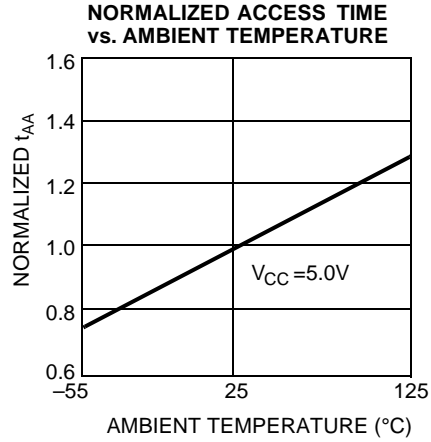
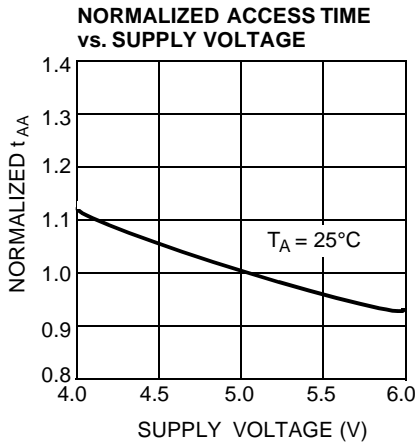
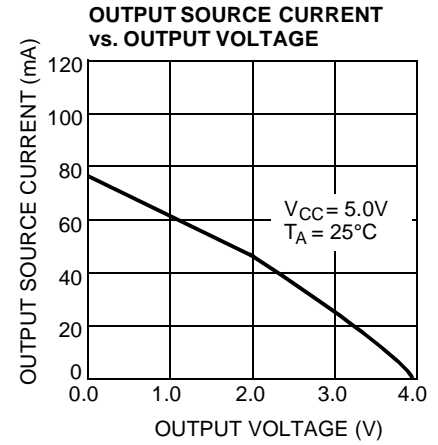
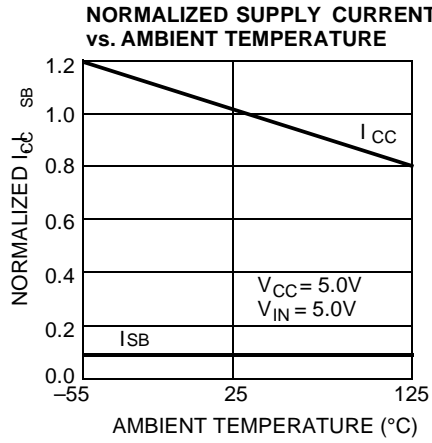
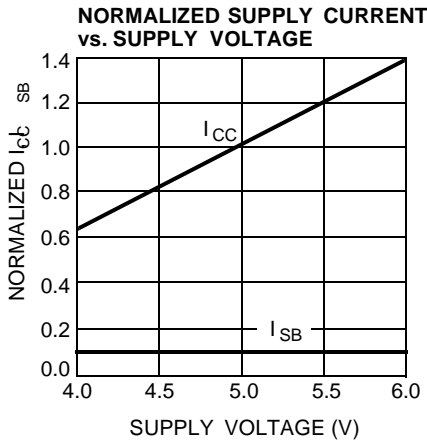
9. WE is HIGH for read cycle.
10. Device is continuously selected,  $\overline{CE} = V_{IL}$  (CY7C166:  $\overline{OE} = V_{IL}$  also).
11. Address valid prior to or coincident with CE transition LOW.
12. CY7C166 only: Data I/O will be high-impedance if  $OE = V_{IH}$ .

**Switching Waveforms (continued)**
**Write Cycle No. 2 (CE Controlled)** [8, 12, 13]


C164-10

**Note:**

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

**Typical DC and AC Characteristics**


**CY7C164 Truth Table**

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

**CY7C166 Truth Table**

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

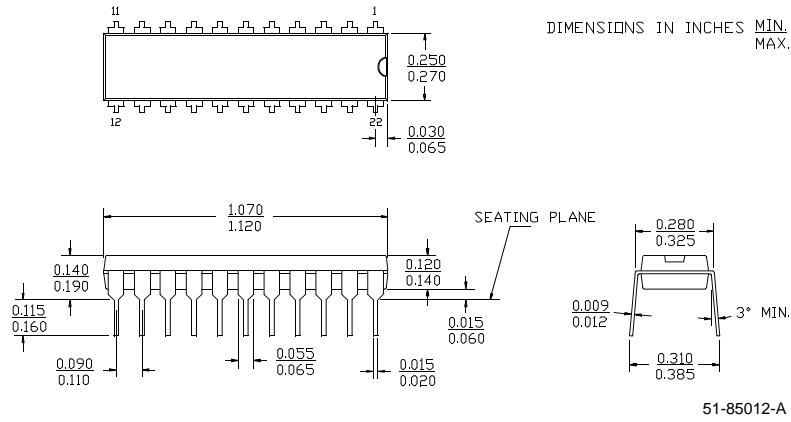
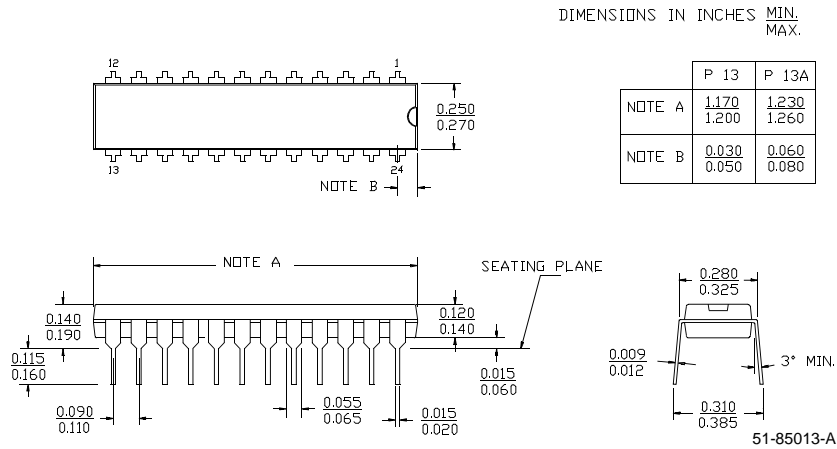
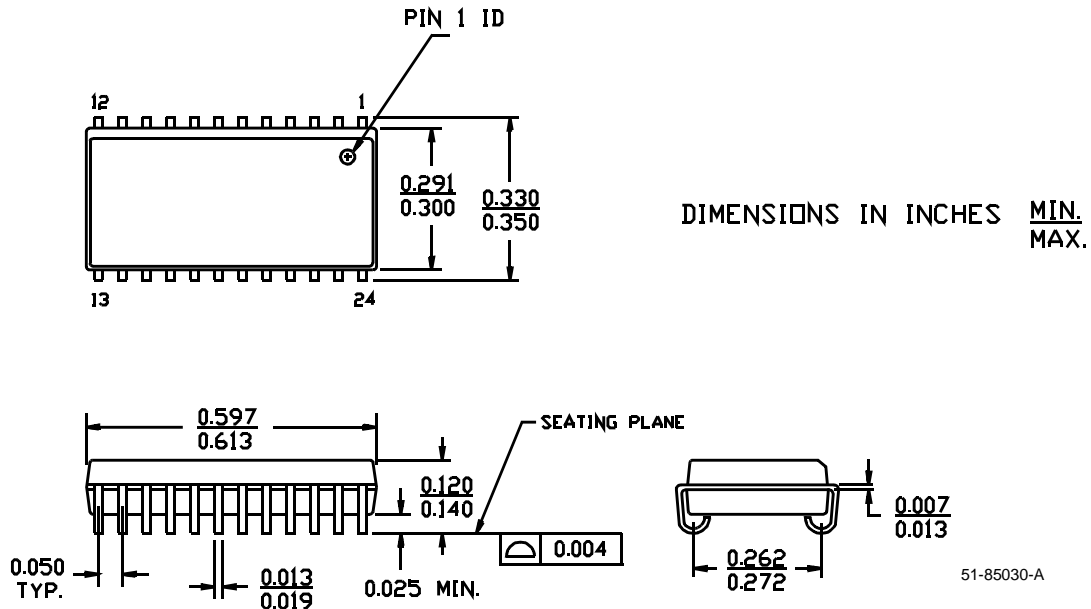
**Address Designators**

Address Name	Address Function	CY 7C164 Pin Number	CY7C166 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 Name	Package Type	Operating Range
15	CY7C164-15PC	P9	22-Lead (300-Mil) Molded DIP	Commercial
	CY7C164-15VC	V13	24-Lead Molded SOJ	
20	CY7C164-20PC	P9	22-Lead (300-Mil) Molded DIP	Commercial
	CY7C164-20VC	V13	24-Lead Molded SOJ	
25	CY7C164-25PC	P9	22-Lead (300-Mil) Molded DIP	Commercial
	CY7C164-25VC	V13	24-Lead Molded SOJ	
35	CY7C164-35PC	P9	22-Lead (300-Mil) Molded DIP	Commercial
	CY7C164-35VC	V13	24-Lead Molded SOJ	

Speed (ns)	Ordering Code	Package Name	Package Type	Operating Range
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	CY7C166-15VC	V13	24-Lead Molded SOJ	
20	CY7C166-20PC	P13	24-Lead (300-Mil) Molded DIP	Commercial
	CY7C166-20VC	V13	24-Lead Molded SOJ	
25	CY7C166-25PC	P13	24-Lead (300-Mil) Molded DIP	Commercial
	CY7C166-25VC	V13	24-Lead Molded SOJ	
35	CY7C166-35PC	P13	24-Lead (300-Mil) Molded DIP	Commercial
	CY7C166-35VC	V13	24-Lead Molded SOJ	

**Package Diagrams**
**22-Lead (300-Mil) Molded DIP P9**

**24-Lead (300-Mil) Molded DIP P13/P13A**

**24-Lead (300-Mil) Molded SOJ V13**






<b>Document Title: CY7C164, CY7C166 16K x 4 Static RAM</b> <b>Document Number: 38-05025</b>				
<b>REV.</b>	<b>ECN NO.</b>	<b>Issue Date</b>	<b>Orig. of Change</b>	<b>Description of Change</b>
**	106811	09/10/01	SZV	Change from Spec number: 38-00032 to 38-05025