CY7C164
CY7C166

16K x 4 Static RAM

Features

- **High speed**
  — 15 ns
- **Output enable ($\overline{OE}$) feature (7C166)**
- **CMOS for optimum speed/power**
- **Low active power**
  — 633 mW
- **Low standby power**
  — 220 mW
- **TTL-compatible inputs and outputs**
- **Automatic power-down when deselected**

Functional Description

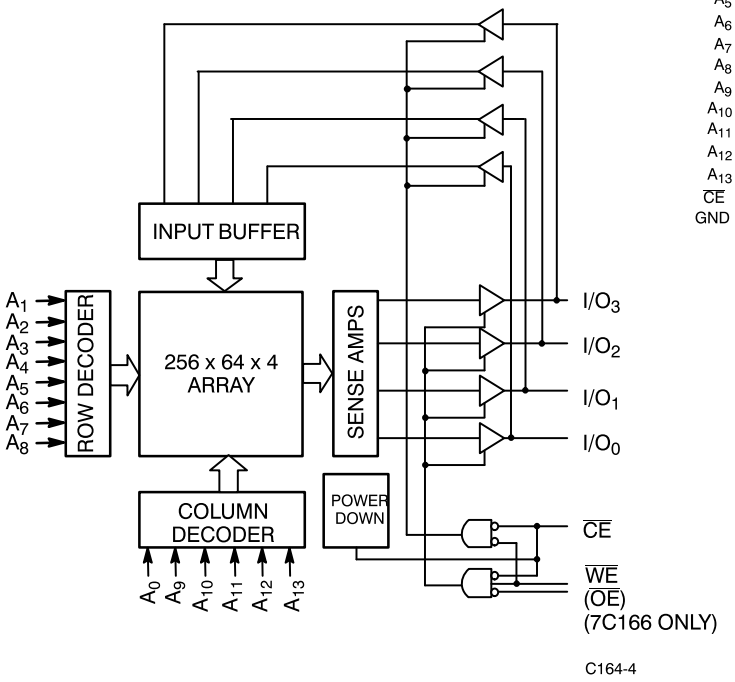
The CY7C164 and CY7C166 are high-performance CMOS static RAMs organized as 16,384 by 4 bits. Easy memory expansion is provided by an active LOW chip enable ($\overline{CE}$) and three-state drivers. The CY7C166 has an active low output enable ($\overline{OE}$) feature. Both devices have an automatic 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 7C166). 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 7C166), 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.

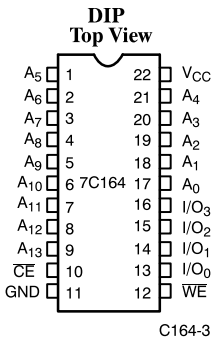
The I/O pins stay in a high-impedance state when chip enable ($\overline{CE}$) is HIGH (or output enable ($\overline{OE}$) is HIGH for 7C166). A die coat is used to insure alpha immunity.

Logic Block Diagram

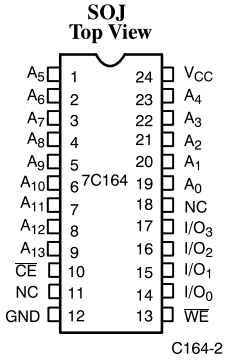


C164-4

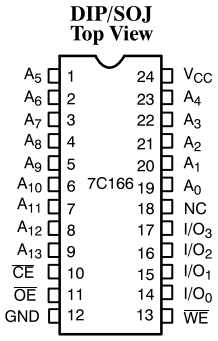
Pin Configurations



C164-3



C164-2



C164-1

Selection Guide[1]

	7C164−12 7C166−12	7C164−15 7C166−15	7C164−20 7C166−20	7C164−25 7C166−25	7C164−35 7C166−35
Maximum Access Time (ns)	12	15	20	25	35
Maximum Operating Current (mA)	160	115	80	70	70
Maximum Standby Current (mA)	40/20	40/20	40/20	20/20	20/20

Shaded area contains advanced information.

Note:
1. For military specifications, see the CY6C164A/CY7C166A 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

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}
Commercial	0°C to +70°C	5V ± 10%

Electrical Characteristics Over the Operating Range

Parameter	Description	Test Conditions	7C164−12 7C166−12		7C164−15 7C166−15		7C164−20 7C166−20		7C164−25, 35 7C166−25, 35		Unit
			Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
V_{OH}	Output HIGH Voltage	V_{CC} = Min., I_{OH} = − 4.0 mA	2.4		2.4		2.4		2.4		V
V_{OL}	Output LOW Voltage	V_{CC} = Min., I_{OL} = 8.0 mA		0.4		0.4		0.4		0.4	V
V_{IH}	Input HIGH Voltage		2.2	V_{CC}	2.2	V_{CC}	2.2	V_{CC}	2.2	V_{CC}	V
V_{IL}	Input LOW Voltage[2]		−0.5	0.8	−0.5	0.8	−0.5	0.8	−0.5	0.8	V
I_{IX}	Input Load Current	GND ≤ V_I ≤ V_{CC}	−5	+5	−5	+5	−5	+5	−5	+5	µA
I_{OZ}	Output Leakage Current	GND ≤ V_O ≤ V_{CC}, Output Disabled	−5	+5	−5	+5	−5	+5	−5	+5	µA
I_{OS}	Output Short Circuit Current[3]	V_{CC} = Max., V_{OUT} = GND		−350		−350		−350		−350	mA
I_{CC}	V_{CC} Operating Supply Current	V_{CC} = Max., I_{OUT} = 0 mA		160		115		80		70	mA
I_{SB1}	Automatic $\overline{CE}$ Power-Down Current[4]	Max. V_{CC}, $\overline{CE}$ ≥ V_{IH}, Min. Duty Cycle = 100%		40		40		40		20	mA
I_{SB2}	Automatic $\overline{CE}$ Power-Down Current[4]	Max. V_{CC}, $\overline{CE}$ ≥ V_{CC} − 0.3V, V_{IN} ≥ V_{CC} − 0.3V or V_{IN} ≤ 0.3V		20		20		20		20	mA

Shaded area contains advanced information.

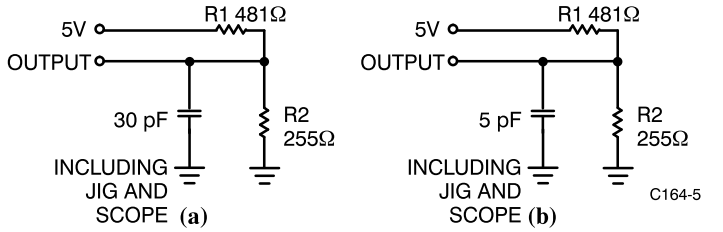
Capacitance[5]

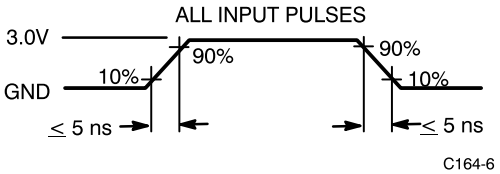
Parameter	Description	Test Conditions	Max.	Unit
C_{IN}	Input Capacitance	T_A = 25°C, f = 1 MHz, V_{CC} = 5.0V	10	pF
C_{OUT}	Output Capacitance		10	pF

Notes:

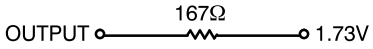
2. Minimum voltage is equal to −3.0V for pulse durations less than 30 ns.
3. Not more than 1 output should be shorted at one time. Duration of the short circuit should not exceed 30 seconds.
4. A pull-up resistor to V_{CC} on the $\overline{CE}$ input is required to keep the device deselected during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

AC Test Loads and Waveforms





Equivalent to: THÉVENIN EQUIVALENT



Switching Characteristics Over the Operating Range[6]

Parameter	Description		7C164–12 7C166–12		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.	Min.	Max.	
READ CYCLE													
t_{RC}	Read Cycle Time		12		15		20		25		35		ns
t_{AA}	Address to Data Valid			12		15		20		25		35	ns
t_{OHA}	Output Hold from Address Change		3		3		5		5		5		ns
t_{ACE}	$\overline{CE}$ LOW to Data Valid			12		15		20		25		35	ns
t_{DOE}	$\overline{OE}$ LOW to Data Valid	7C166		6		10		10		12		15	ns
t_{LZOE}	$\overline{OE}$ LOW to Low Z	7C166	0		3		3		3		3		ns
t_{HZOE}	$\overline{OE}$ HIGH to High Z	7C166		7		8		8		10		12	ns
t_{LZCE}	$\overline{CE}$ LOW to Low Z[7]		3		3		5		5		5		ns
t_{HZCE}	$\overline{CE}$ HIGH to High Z[7, 8]			7		8		8		10		15	ns
t_{PU}	$\overline{CE}$ LOW to Power-Up		0		0		0		0		0		ns
t_{PD}	$\overline{CE}$ HIGH to Power-Down			12		15		20		20		20	ns
WRITE CYCLE[9]													
t_{WC}	Write Cycle Time		12		15		20		20		25		ns
t_{SCE}	$\overline{CE}$ LOW to Write End		8		12		15		20		25		ns
t_{AW}	Address Set-Up to Write End		9		12		15		20		25		ns
t_{HA}	Address Hold from Write End		0		0		0		0		0		ns
t_{SA}	Address Set-Up to Write Start		0		0		0		0		0		ns
t_{PWE}	$\overline{WE}$ Pulse Width		8		12		15		15		20		ns
t_{SD}	Data Set-Up to Write End		6		10		10		10		15		ns
t_{HD}	Data Hold from Write End		0		0		0		0		0		ns
t_{LZWE}	$\overline{WE}$ HIGH to Low Z[7]		3		5		5		5		5		ns
t_{HZWE}	$\overline{WE}$ LOW to High Z[7, 8]			6		7		7		7		10	ns

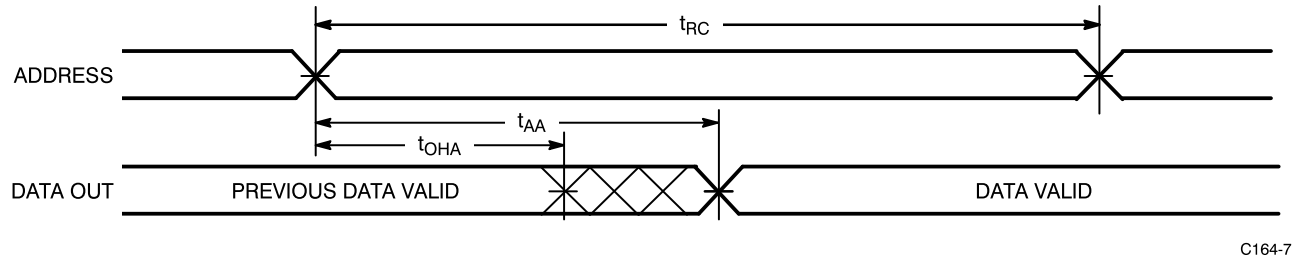
Shaded area contains advanced information.

Notes:

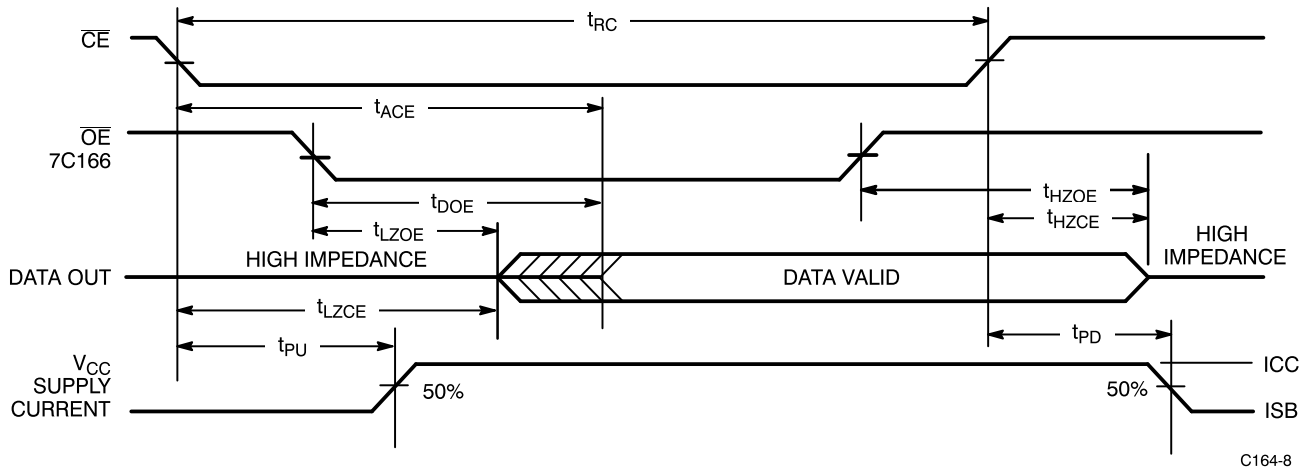
6. Test conditions assume signal transition time of 5 ns or less, timing reference levels of 1.5V, input pulse levels of 0 to 3.0V, and output loading of the specified I_{OL}/I_{OH} and 30-pF load capacitance.
7. At any given temperature and voltage condition, t_{HZCE} is less than t_{LZCE} for any given device. These parameters are guaranteed by design and not 100% tested.
8. 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.
9. The internal write time of the memory is defined by the overlap of $\overline{CE}$ LOW and $\overline{WE}$ 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

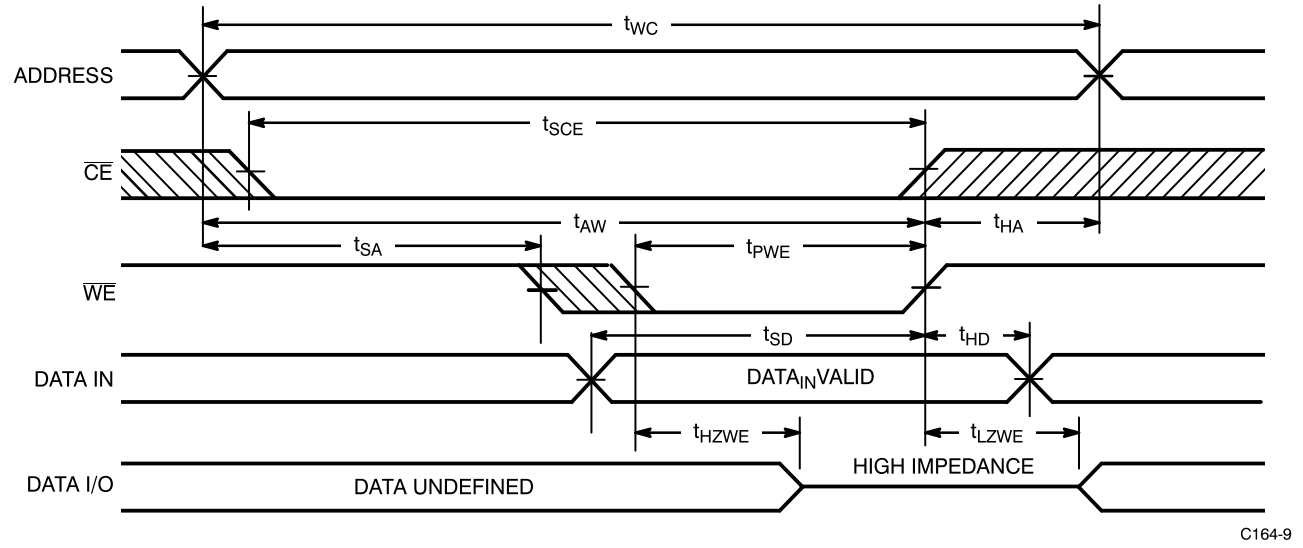
Read Cycle No. 1[10, 11]



Read Cycle No. 2[10, 12]



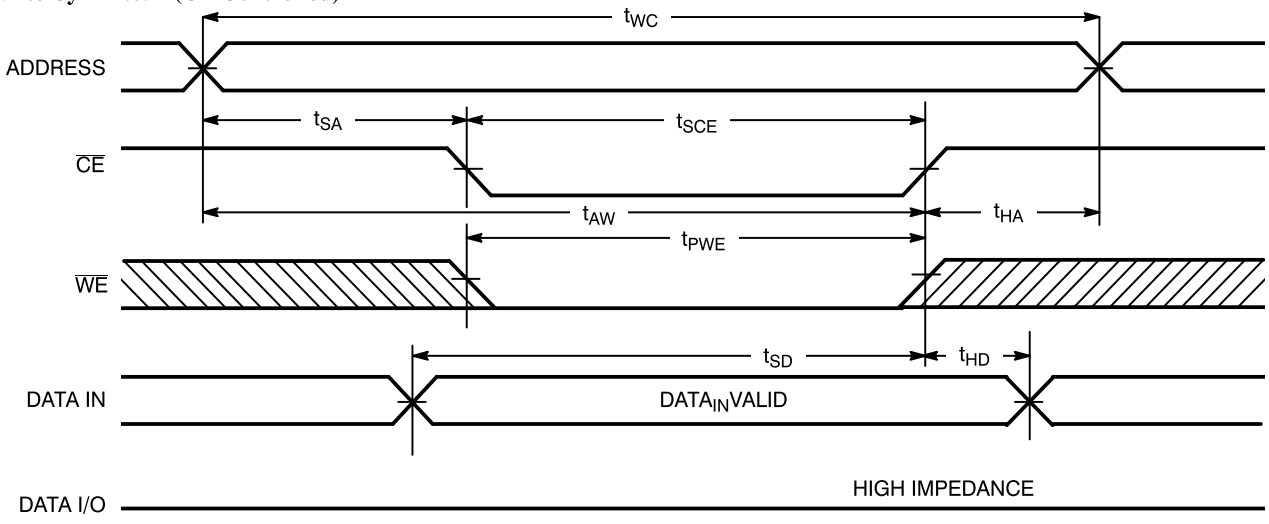
Write Cycle No. 1 ($\overline{WE}$ Controlled)[9, 13]



Notes:
10. $\overline{WE}$ is HIGH for read cycle.
11. Device is continuously selected, $\overline{CE}$ = V_{IL}. (7C166: $\overline{OE}$ = V_{IL} also).
12. Address valid prior to or coincident with $\overline{CE}$ transition LOW.
13. 7C166 only: Data I/O will be high impedance if $\overline{OE}$ = V_{IH}.

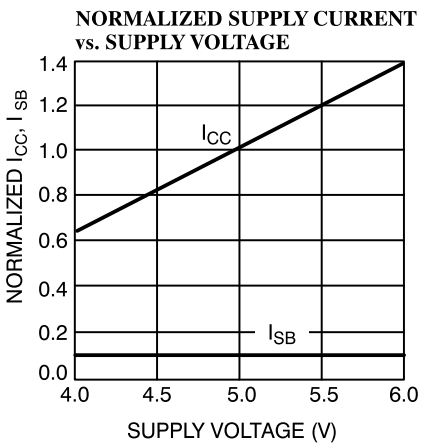
Switching Waveforms (continued)

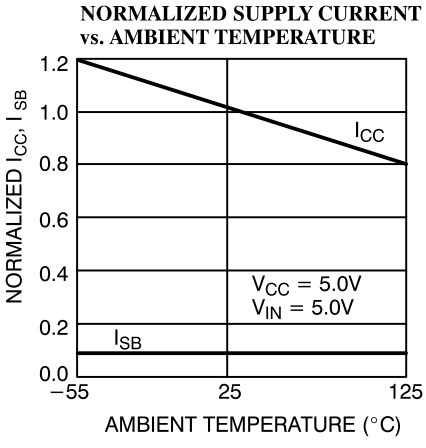
Write Cycle No. 2 ($\overline{CE}$ Controlled)[9, 13, 14]

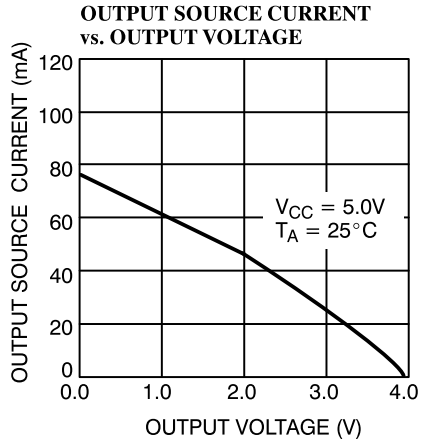


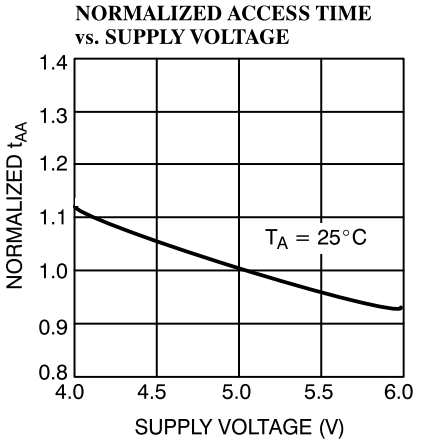
Note:
14. If $\overline{CE}$ goes HIGH simultaneously with $\overline{WE}$ HIGH, the output remains in a high-impedance state.

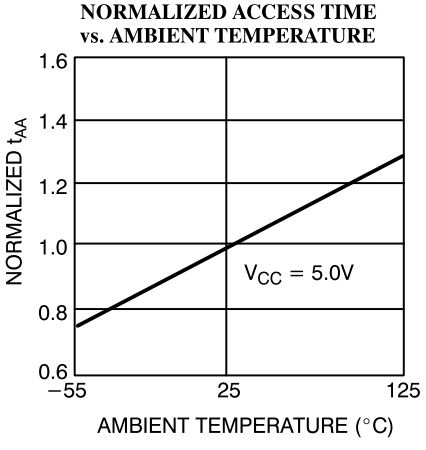
Typical DC and AC Characteristics

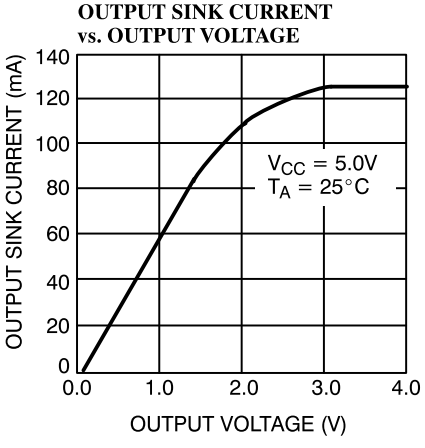






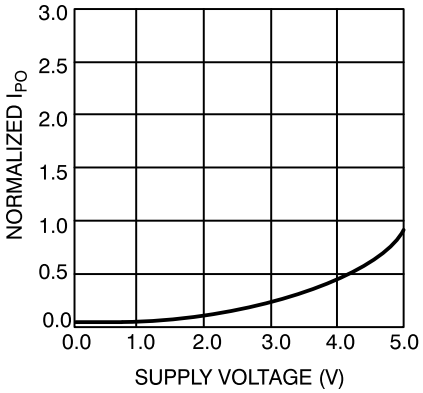




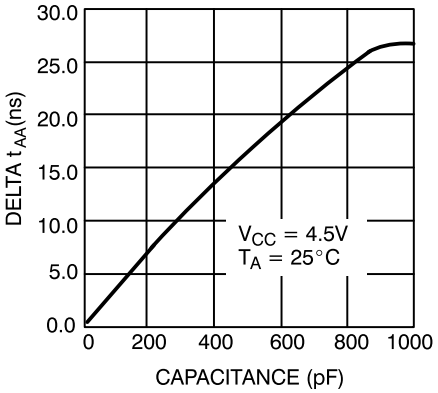


Typical DC and AC Characteristics (continued)

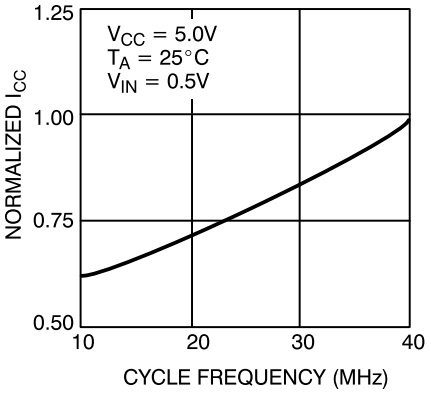
TYPICAL POWER-ON CURRENT vs. SUPPLY VOLTAGE



TYPICAL ACCESS TIME CHANGE vs. OUTPUT LOADING



NORMALIZED I_{CC} vs. CYCLE TIME



CY7C164 Truth Table

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

CY7C166 Truth Table

$\overline{CE}$	$\overline{WE}$	$\overline{OE}$	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
12	CY7C164−12PC	P9	22-Lead (300-Mil) Molded DIP	Commercial
	CY7C164−12VC	V13	24-Lead Molded SOJ	
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
12	CY7C166−12PC	P13	24-Lead (300-Mil) Molded DIP	Commercial
	CY7C166−12VC	V13	24-Lead Molded SOJ	
15	CY7C166−15PC	P13	24-Lead (300-Mil) Molded DIP	Commercial
	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	

Shaded areas contain advanced information.

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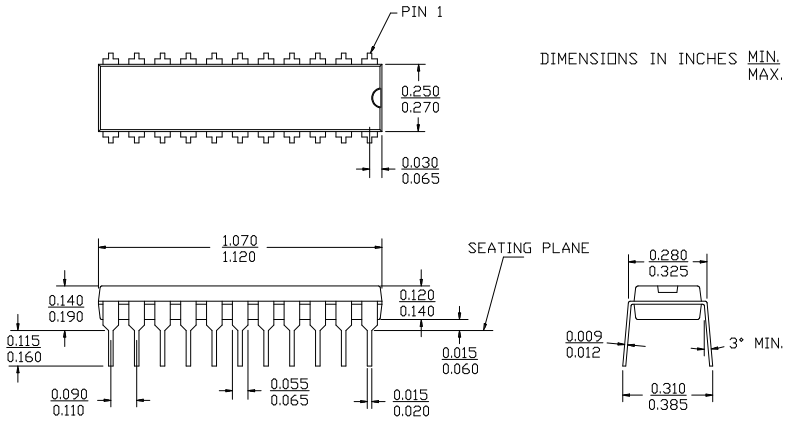
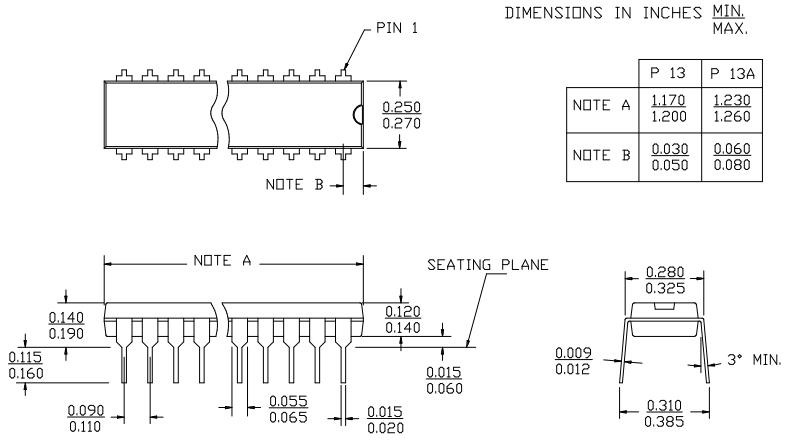
CY7C164
CY7C166

Package Diagrams

22-Lead (300-Mil) Molded DIP P9



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



	P 13	P 13A
NOTE A	1.170 1.200	1.230 1.260
NOTE B	0.030 0.050	0.060 0.080

24-Lead Molded SOJ V13