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

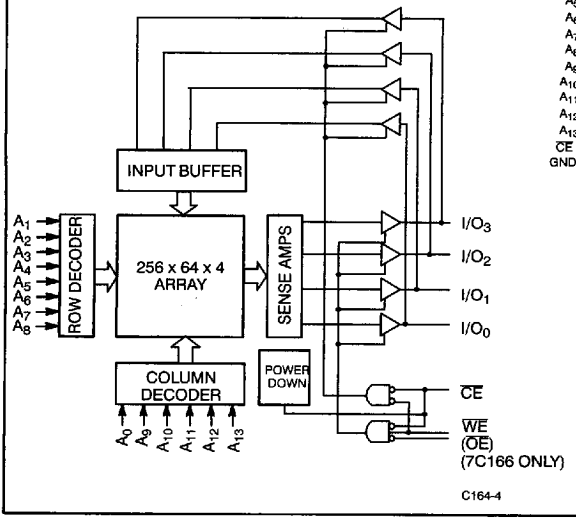
The CY7C164 and CY7C166 are high-performance CMOS static RAMs organized as 16,384 by 4 bits. Easy memory expansion is provided by an active LOW chip enable ($\overline{CE}$) and three-state drivers. The CY7C166 has an active low output enable ($\overline{OE}$) feature. Both devices have an automatic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

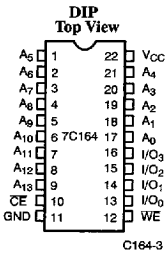
The I/O pins stay in a high-impedance state when chip enable ($\overline{CE}$) is HIGH (or output enable ($\overline{OE}$) is HIGH for 7C166). A die coat is used to insure alpha immunity.

Logic Block Diagram

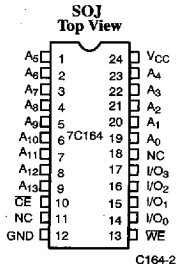


C164-4

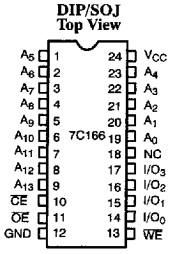
Pin Configurations



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 preliminary 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 preliminary information.

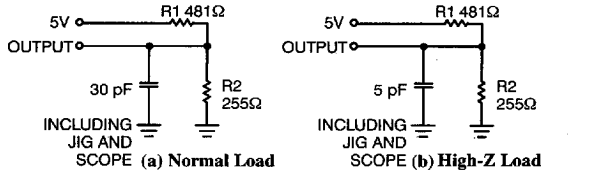
Capacitance[5]

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



Switching Characteristics Over the Operating Range[6]

Parameter	Description		7C164–12 7C166–12 Min.	7C164–12 7C166–12 Max.	7C164–15 7C166–15 Min.	7C164–15 7C166–15 Max.	7C164–20 7C166–20 Min.	7C164–20 7C166–20 Max.	7C164–25 7C166–25 Min.	7C164–25 7C166–25 Max.	7C164–35 7C166–35 Min.	7C164–35 7C166–35 Max.	Unit
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

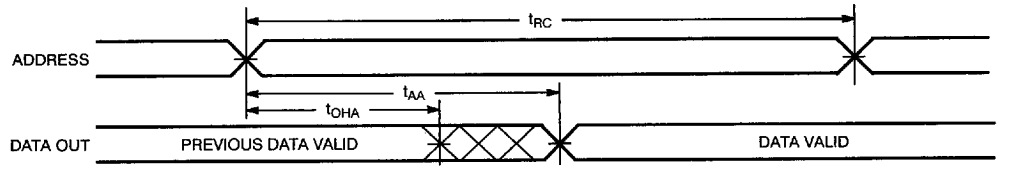
Shaded area contains preliminary information.

Notes:

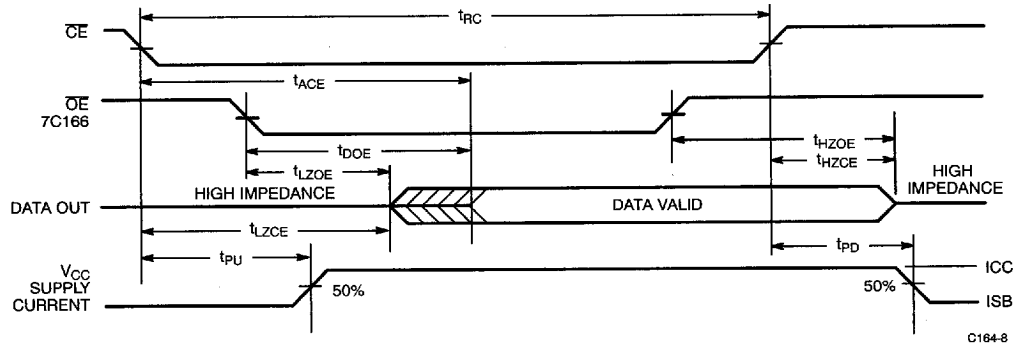
6. Test conditions assume signal transition time of 5 ns or less, timing reference levels of 1.5V, input pulse levels of 0 to 3.0V, and output loading of the specified I_{OL}/I_{OH} and 30-pF load capacitance.
7. At any given temperature and voltage condition, t_{HZCE} is less than t_{LZCE} for any given 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

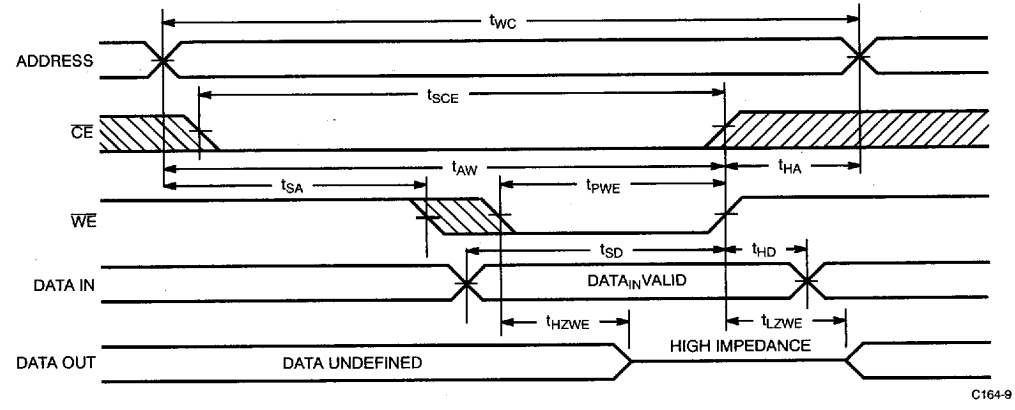
Read Cycle No. 1[10, 11]



Read Cycle No. 2[10, 12]



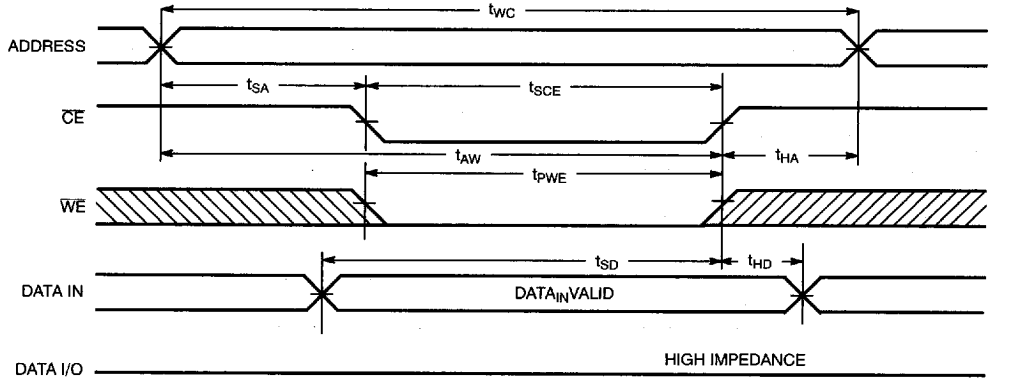
Write Cycle No. 1 ($\overline{WE}$ Controlled)[9, 13]



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)

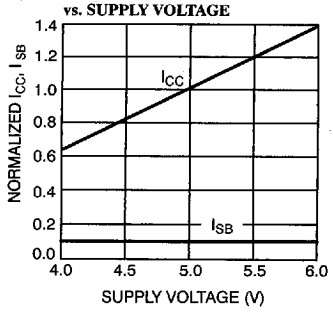
Write Cycle No. 2 ($\overline{CE}$ Controlled)[9, 13, 14]



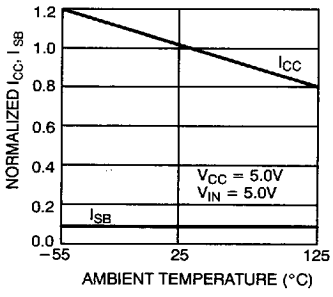
Note:
14. If $\overline{CE}$ goes HIGH simultaneously with $\overline{WE}$ HIGH, the output remains in a high-impedance state.

Typical DC and AC Characteristics

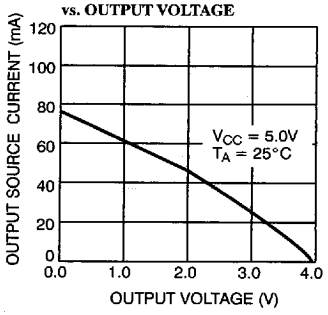
NORMALIZED SUPPLY CURRENT vs. SUPPLY VOLTAGE



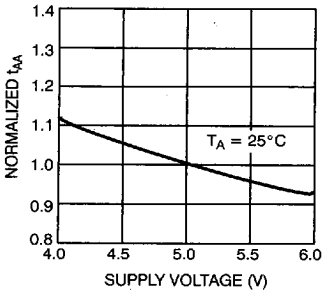
NORMALIZED SUPPLY CURRENT vs. AMBIENT TEMPERATURE



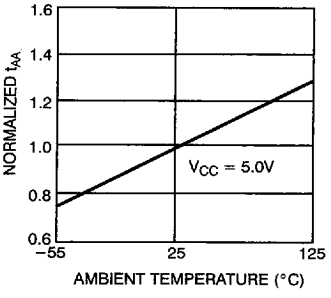
OUTPUT SOURCE CURRENT vs. OUTPUT VOLTAGE



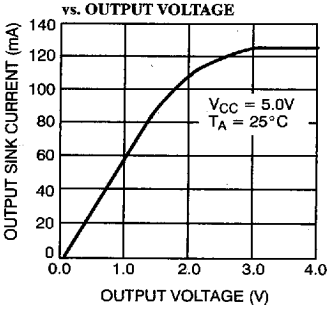
NORMALIZED ACCESS TIME vs. SUPPLY VOLTAGE



NORMALIZED ACCESS TIME vs. AMBIENT TEMPERATURE

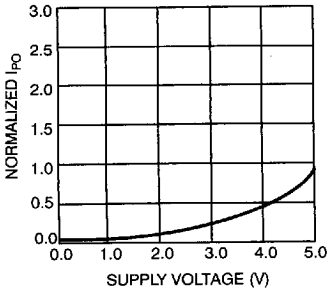


OUTPUT SINK CURRENT vs. OUTPUT VOLTAGE

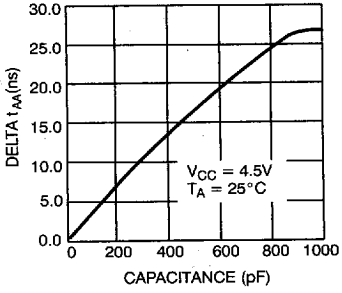


Typical DC and AC Characteristics (continued)

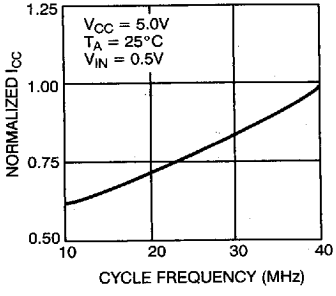
TYPICAL POWER-ON CURRENT vs. SUPPLY VOLTAGE



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 preliminary information.

Document #: 38–00032–I