CY7C164A
CY7C166A

CYPRESS SEMICONDUCTOR

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.

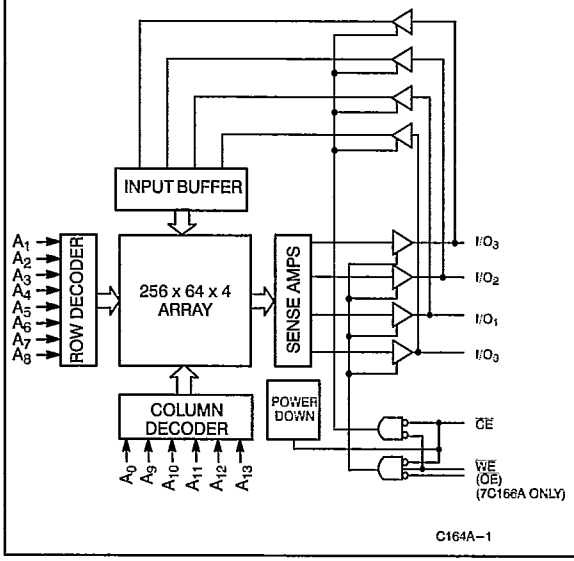
Writing to the device is accomplished when the chip enable ($\overline{CE}$) and write enable ($\overline{WE}$) inputs are both LOW (and the output enable ($\overline{OE}$) is LOW for the 7C166A). Data on the four input/output pins (I/O_0 through I/O_3) is written into the memory location specified on 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).

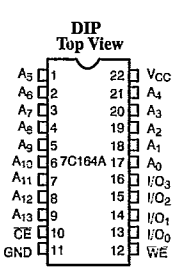
A die coat is used to insure alpha immunity.

Logic Block Diagram

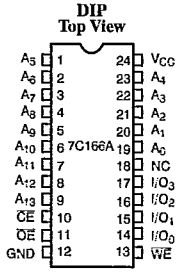


C164A-1

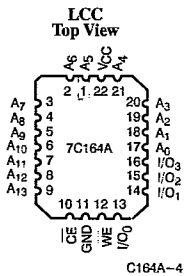
Pin Configurations



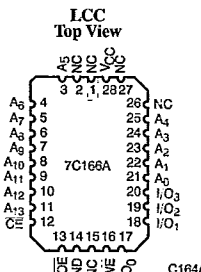
C164A-2



C164A-3



C164A-4



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Selection Guide[1]

		7C164A–15 7C166A–15	7C164A–20 7C164A–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 advanced information.

Note:

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

CYPRESS SEMICONDUCTOR

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}
Military[3]	− 55°C to +125°C	5V ± 10%

Electrical Characteristics Over the Operating Range[4]

Parameter	Description	Test Conditions		7C164A−15 7C166A−15 Min.	7C164A−15 7C166A−15 Max.	7C164A−20 7C166A−20 Min.	7C164A−20 7C166A−20 Max.	Unit
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		160		100	mA
I_{SB1}	Automatic $\overline{CE}$[6] Power Down Current	Max. V_{CC}, $\overline{CE}$ ≥ V_{IH} Min. Duty Cycle = 100%	Military		40		40	mA
I_{SB2}	Automatic $\overline{CE}$[6] Power Down Current	Max. V_{CC}, $\overline{CE}$ ≥ V_{IH} − 0.3V V_{IN} ≥ V_{CC} − 0.3V or V_{IN} ≤ 0.3V	Military		20		20	mA

Shaded area contains advanced information.

Notes:

2. Minimum voltage is equal to − 3.0V for pulse durations less than 30 ns.
3. T_A is the "instant on" case temperature.
4. See the last page of this specification for Group A subgroup testing information.;
5. Not more than 1 output should be shorted at one time. Duration of the short circuit should not exceed 30 seconds.
6. 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.

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

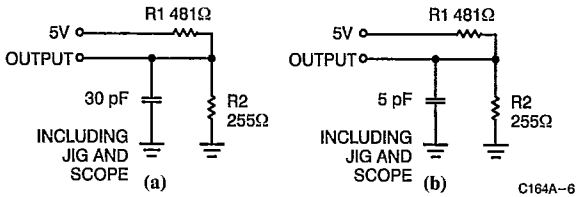
Parameter	Description	Test Conditions		7C164A–25 7C166A–25 Min.	7C164A–25 7C166A–25 Max.	7C164A–35 7C166A–35 Min.	7C164A–35 7C166A–35 Max.	Unit
V_{OH}	Output HIGH Voltage	V_{CC} = Min., I_{OH} = − 4.0 mA		2.4		2.4		V
V_{OL}	Output LOW Voltage	V_{CC} = Min., I_{OL} = 8.0 mA			0.4		0.4	V
V_{IH}	Input HIGH 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		100	mA
I_{SB1}	Automatic $\overline{CE}$[6] Power Down Current	Max. V_{CC}, $\overline{CE}$ ≥ V_{IH} Min. Duty Cycle = 100%	Military		40		30	mA
I_{SB2}	Automatic $\overline{CE}$[6] Power Down Current	Max. V_{CC}, $\overline{CE}$ ≥ V_{IH} − 0.3V V_{IN} ≥ V_{CC} − 0.3V or V_{IN} ≤ 0.3V	Military		20		20	mA

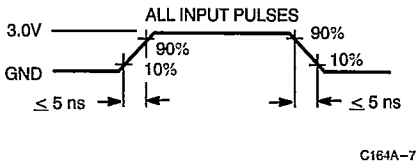
Capacitance[7]

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

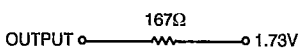
Note:
7. Tested initially and after any design or process changes that may affect these parameters.

AC Test Loads and Waveforms





Equivalent to: THÉVENIN EQUIVALENT



Switching Characteristics Over the Operating Range[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}	$\overline{CE}$ LOW to Data Valid		15		20		25		35	ns
t_{DOE}	$\overline{OE}$ LOW to Data Valid (7C166A)		7		10		12		15	ns
t_{LZOE}	$\overline{OE}$ LOW to Low Z (7C166A)	0		3		3		3		ns
t_{HZOE}	$\overline{OE}$ HIGH to High Z (7C166A)		8		8		10		12	ns
t_{LZCE}	$\overline{CE}$ LOW to Low Z[9]	3		5		5		5		ns
t_{HZCE}	$\overline{CE}$ HIGH to High Z[9, 10]		8		8		10		15	ns
t_{PU}	$\overline{CE}$ LOW to Power-Up	0		0		0		0		ns
t_{PD}	$\overline{CE}$ HIGH to Power-Down		15		20		20		20	ns
WRITE CYCLE[11]										
t_{WC}	Write Cycle Time	15		20		20		25		ns
t_{SCE}	$\overline{CE}$ 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}	$\overline{WE}$ 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}	$\overline{WE}$ HIGH to Low Z[9]	3		5		5		5		ns
t_{HZWE}	$\overline{WE}$ LOW to High Z[9, 10]		7		7		7		10	ns

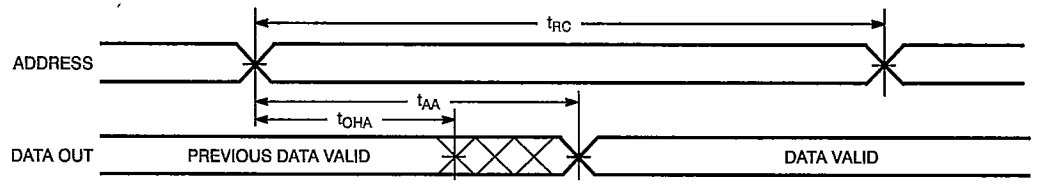
Shaded area contains advanced information.

Notes:

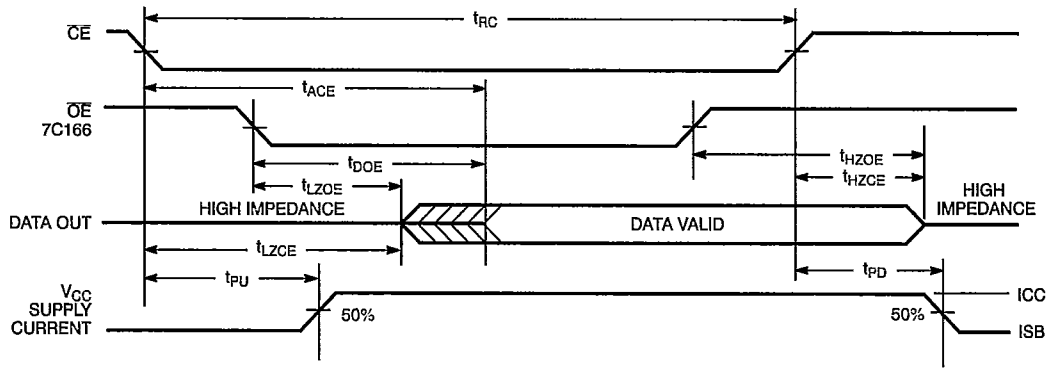
8. Test conditions assume signal transition time of 5 ns or less, timing reference levels of 1.5V, input pulse levels of 0 to 3.0V, and output loading of the specified I_{OL}/I_{OH} and 30-pF load capacitance.
9. At any given temperature and voltage condition, t_{HZCE} is less than t_{LZCE} for any given device. These parameters are guaranteed 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 $\overline{CE}$ 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

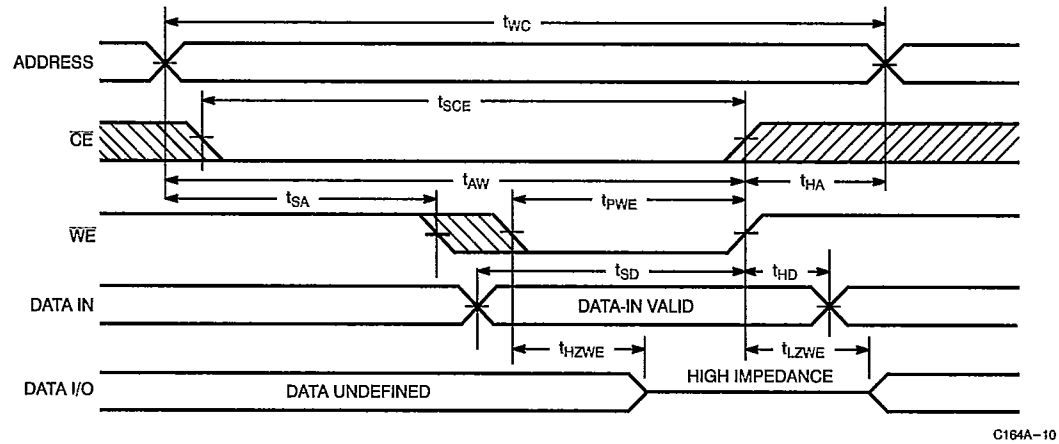
Read Cycle No. 1[12, 13]



Read Cycle No. 2[12, 14]



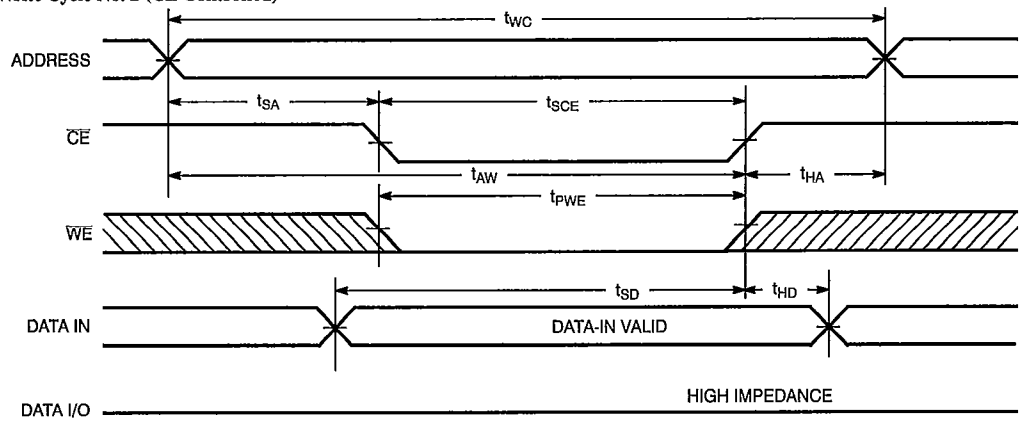
Write Cycle No. 1 ($\overline{WE}$ Controlled)[11, 15]



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)

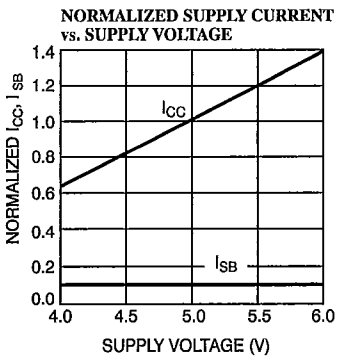
Write Cycle No. 2 ($\overline{CE}$ Controlled)[11, 15, 16]

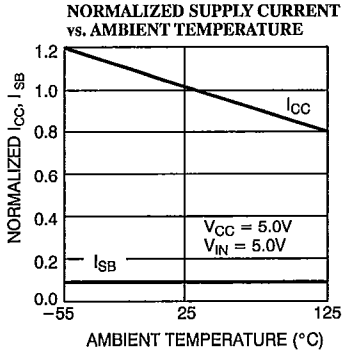


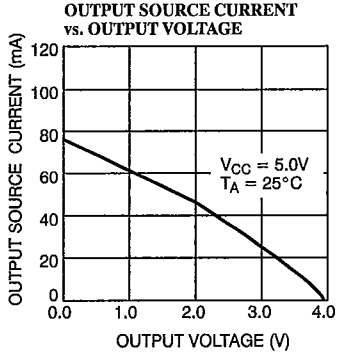
C164A–11

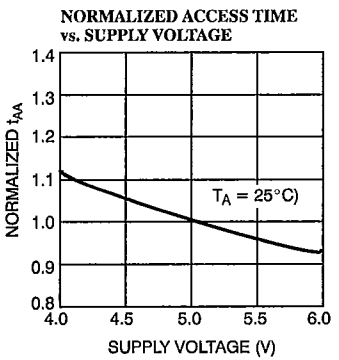
Note:
16. If $\overline{CE}$ goes HIGH simultaneously with $\overline{WE}$ HIGH, the output remains in a high-impedance state.

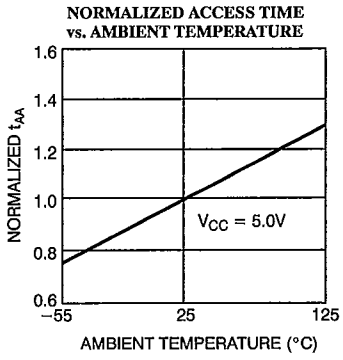
Typical DC and AC Characteristics

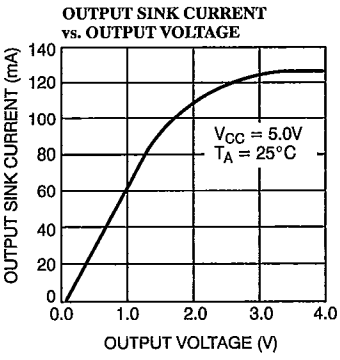




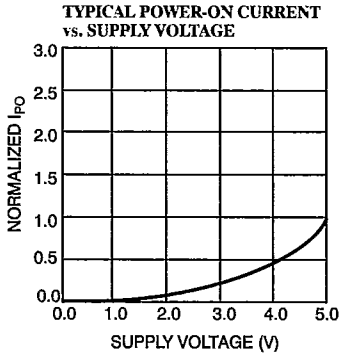


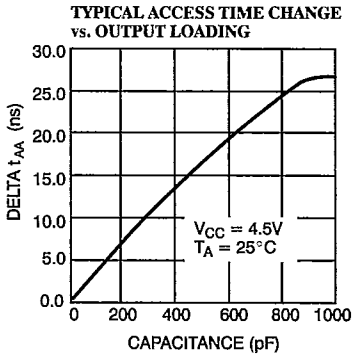


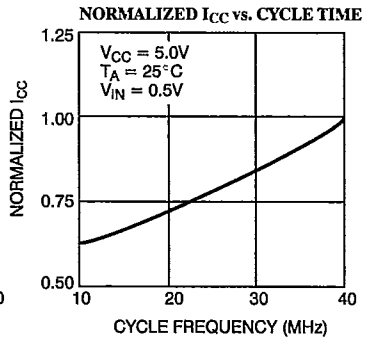




Typical DC and AC Characteristics (continued)







CY7C164A Truth Table

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

CY7C166A Truth Table

$\overline{CE}$	$\overline{WE}$	$\overline{OE}$	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
	CY7C164A–15LMB	L52	22-Pin Rectangular Leadless Chip Carrier	
20	CY7C164A–20DMB	D10	22-Lead (300-Mil) CerDIP	Military
	CY7C164A–20LMB	L52	22-Pin Rectangular Leadless Chip Carrier	
25	CY7C164A–25DMB	D10	22-Lead (300-Mil) CerDIP	Military
	CY7C164A–25LMB	L52	22-Pin Rectangular Leadless Chip Carrier	
35	CY7C164A–35DMB	D10	22-Lead (300-Mil) CerDIP	Military
	CY7C164A–35LMB	L52	22-Pin Rectangular Leadless Chip Carrier	

Speed (ns)	Ordering Code	Package Type	Package Type	Operating Range
15	CY7C166A–15DMB	D14	24-Lead (300-Mil) CerDIP	Military
	CY7C166A–15LMB	L54	28-Pin Rectangular Leadless Chip Carrier	
20	CY7C166A–20DMB	D14	24-Lead (300-Mil) CerDIP	Military
	CY7C166A–20LMB	L54	28-Pin Rectangular Leadless Chip Carrier	
25	CY7C166A–25DMB	D14	24-Lead (300-Mil) CerDIP	Military
	CY7C166A–25LMB	L54	28-Pin Rectangular Leadless Chip Carrier	
35	CY7C166A–35DMB	D14	24-Lead (300-Mil) CerDIP	Military
	CY7C166A–35LMB	L54	28-Pin Rectangular Leadless Chip Carrier	

Shaded area contains advanced 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.