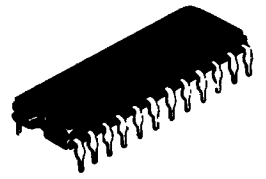
2048-word x 8-bit High Speed CMOS Static RAM

■FEATURES

- Single 5V Supply
- High speed: Fast Access Time 120ns/150ns/200ns (max.)
- Low Power Standby and Low Power Operation
  - Standby: 100μW (typ.)
    10μW (typ.) (L-version)
  - Operation: 200mW (typ.)
    175mW (typ.) (L-version)
- Completely Static RAM: No clock or Timing Strobe Required
- Directly TTL Compatible: All Input and Output
- Pin Out Compatible with Standard 16K EPROM/MASK ROM
- Equal Access and Cycle Time
- Capability of Battery Back Up Operation (L-version)

HM6116P Series



(DP-24)

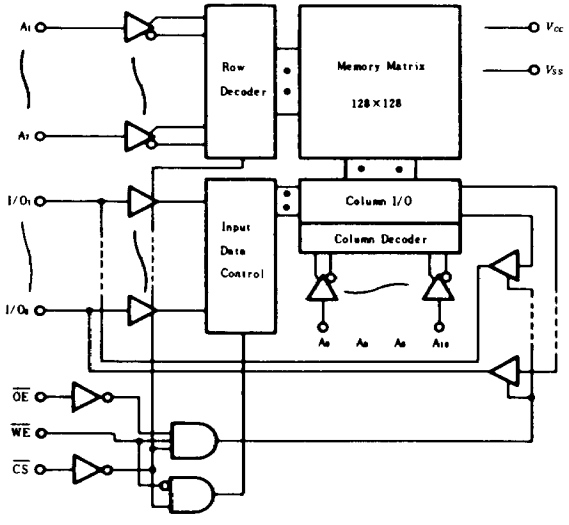
HM6116FP Series

(FP-24D)

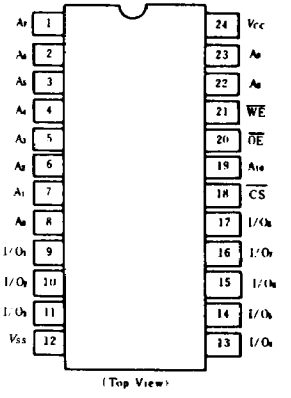
■ORDERING INFORMATION

Type No.	Access Time	Package
HM6116P-2 HM6116P-3 HM6116P-4	120ns 150ns 200ns	600mil 24pin Plastic DIP
HM6116LP-2 HM6116LP-3 HM6116LP-4	120 ns 150 ns 200 ns	
HM6116FP-2 HM6116FP-3 HM6114FP-4	120 ns 150 ns 200 ns	24pin Plastic SOP
HM6116LFP-2 HM6116LFP-3 HM6116LFP-4	120 ns 150 ns 200 ns	

■FUNCTIONAL BLOCK DIAGRAM



■PIN ARRANGEMENT



(Top View)

Note) This device is not available for new application.

■ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Rating	Unit
Voltage on Any Pin Relative to V_{SS}	V_T	−0.5*1 to +7.0	V
Operating Temperature	T_{opr}	0 to +70	°C
Storage Temperature	T_{stg}	−55 to +125	°C
Storage Temperature Under Bias	T_{bias}	−10 to +85	°C
Power Dissipation	P_T	1.0	W

Note) *1. −3.5V for pulse width≦50ns

■TRUTH TABLE

$\overline{CS}$	$\overline{OE}$	$\overline{WE}$	Mode	V_{CC} Current	I/O Pin	Ref. Cycle
H	×	×	Not Selected	I_{SB}, I_{SB1}	High Z	
L	L	H	Read	I_{CC}	Dout	Read Cycle (1)~(3)
L	H	L	Write	I_{CC}	Din	Write Cycle (1)
L	L	L	Write	I_{CC}	Din	Write Cycle (2)

■RECOMMENDED DC OPERATING CONDITIONS (Ta=0 to +70°C)

Item	Symbol	min	typ	max	Unit
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
	V_{SS}	0	0	0	V
Input Voltage	V_{IH}	2.2	3.5	6.0	V
	V_{IL}	−0.3*1	—	0.8	V

Note) *1. −3.0V for pulse width≦50ns.

■DC AND OPERATING CHARACTERISTICS (V_{CC}=5V±10%, V_{SS}=0V, Ta=0 to +70°C)

Item	Symbol	Test Conditions	HM6116-2			HM6116-3/-4			Unit
			min	typ*1	max	min	typ*1	max	
Input Leakage Current	$\|I_{LI}\|$	V_{CC}=5.5V, V_{IN}=V_{SS} to V_{CC}	—	—	10	—	—	10	μA
			—	—	2*3	—	—	2*3	
Output Leakage Current	$\|I_{LO}\|$	$\overline{CS}$=V_{IH} or $\overline{OE}$=V_{IH}, $V_{I/O}$=V_{SS} to V_{CC}	—	—	10	—	—	10	μA
			—	—	2*3	—	—	2*3	
Operating Power Supply Current	I_{CC}	$\overline{CS}$=V_{IL}, $I_{I/O}$=0mA	—	40	80	—	35	70	mA
			—	35*3	70*3	—	30*3	60*3	
	I_{CC1}*2	V_{IH}=3.5V, V_{IL}=0.6V, $I_{I/O}$=0mA	—	35	—	—	30	—	mA
			—	30*3	—	—	25*3	—	
Average Operating Current	I_{CC2}	Min. cycle, duty=100% $I_{I/O}$=0mA	—	40	80	—	35	70	mA
			—	35*3	70*3	—	30*3	60*3	
Standby Power Supply Current	I_{SB}	$\overline{CS}$=V_{IH}	—	5	15	—	5	15	mA
			—	4*3	12*3	—	4*3	12*3	
	I_{SB1}	$\overline{CS}$≧V_{CC}−0.2V, 0V≦V_{IN}≦0.2V or V_{CC}−0.2V≦V_{IN}	—	0.02	2	—	0.02	2	μA
			—	2*3	50*3	—	2*3	50*3	
Output Voltage	V_{OL}	I_{OL}=4mA	—	—	0.4	—	—	—	V
		I_{OL}=2.1mA	—	—	—	—	—	0.4	V
	V_{OH}	I_{OH}=−1.0mA	2.4	—	—	2.4	—	—	V

Notes) *1. V_{CC}=5V, Ta=25°C
*2. Reference Only
*3. This characteristics are guaranteed only for L-version.

■CAPACITANCE (f=1MHz, Ta=25°C)

Item	Symbol	Test Conditions	typ	max	Unit
Input Capacitance	C_{in}	V_{in}=0V	3	5	pF
Input/Output Capacitance	$C_{I/O}$	$V_{I/O}$=0V	5	7	pF

Note) This parameter is sampled and not 100% tested.

■AC CHARACTERISTICS (V_{CC}=5V±10%, Ta=0 to +70°C)

●AC TEST CONDITIONS

Input Pulse Levels: 0.8 to 2.4V
Input Rise and Fall Times: 10 ns
Input and Output Timing Reference Levels: 1.5V
Output Load: 1TTL Gate and C_L (100pF) (including scope and jig)

●READ CYCLE

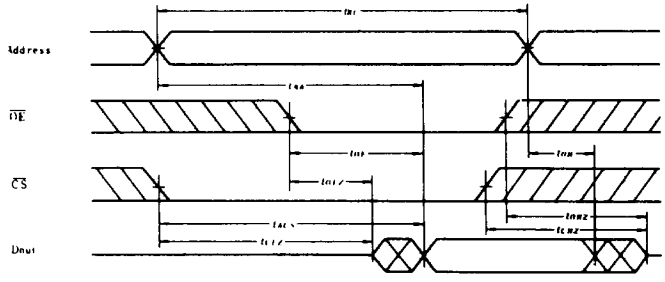
Item	Symbol	HM6116-2		HM6116-3		HM6116-4		Unit
		min	max	min	max	min	max	
Read Cycle Time	t_{RC}	120	—	150	—	200	—	ns
Address Access Time	t_{AA}	—	120	—	150	—	200	ns
Chip Select Access Time	t_{ACS}	—	120	—	150	—	200	ns
Chip Selection to Output in Low Z	t_{CLZ}	10	—	15	—	15	—	ns
Output Enable to Output Valid	t_{OE}	—	80	—	100	—	120	ns
Output Enable to Output in Low Z	t_{OLZ}	10	—	15	—	15	—	ns
Chip Deselection to Output in High Z	t_{CHZ}	0	40	0	50	0	60	ns
Chip Disable to Output in High Z	t_{OHZ}	0	40	0	50	0	60	ns
Output Hold from Address Change	t_{OH}	10	—	15	—	15	—	ns

●WRITE CYCLE

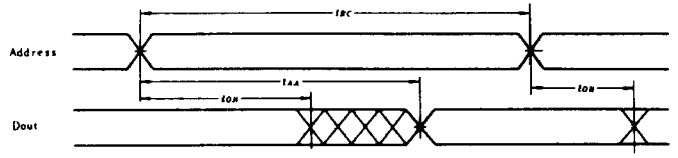
Item	Symbol	HM6116-2		HM6116-3		HM6116-4		Unit
		min	max	min	max	min	max	
Write Cycle Time	t_{WC}	120	—	150	—	200	—	ns
Chip Selection to End of Write	t_{CW}	70	—	90	—	120	—	ns
Address Valid to End of Write	t_{AW}	105	—	120	—	140	—	ns
Address Set Up Time	t_{AS}	20	—	20	—	20	—	ns
Write Pulse Width	t_{WP}	70	—	90	—	120	—	ns
Write Recovery Time	t_{WR}	5	—	10	—	10	—	ns
Output Disable to Output in High Z	t_{OHZ}	0	40	0	50	0	60	ns
Write to Output in High Z	t_{WHZ}	0	50	0	60	0	60	ns
Data to Write Time Overlap	t_{DW}	35	—	40	—	60	—	ns
Data Hold from Write Time	t_{DH}	5	—	10	—	10	—	ns
Output Active from End of Write	t_{OW}	5	—	10	—	10	—	ns

■TIMING WAVEFORM

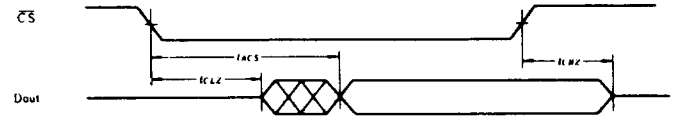
●READ CYCLE (1)[1]



● **READ CYCLE (2)** [1][2][4]

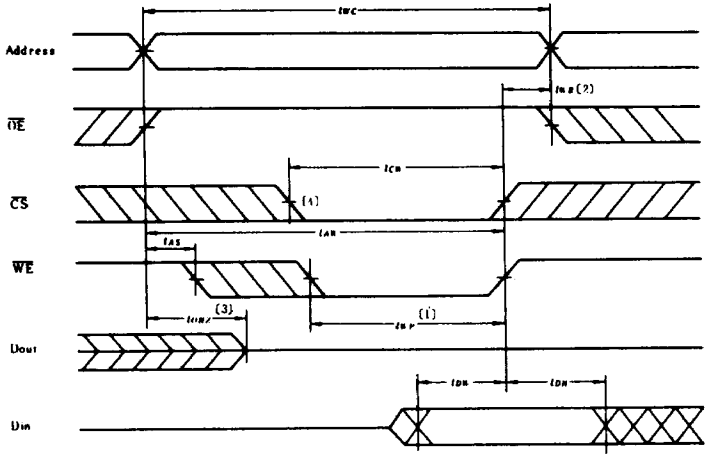


● **READ CYCLE (3)** [1][3][4]

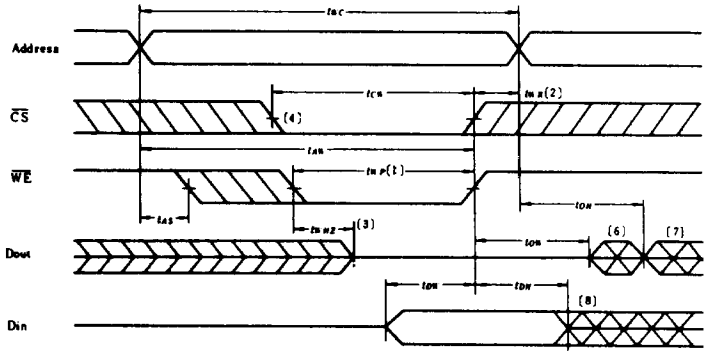


NOTES: 1. $\overline{WE}$ is High for Read Cycle.
2. Device is continuously selected, $\overline{CS} = V_{IL}$.
3. Address Valid prior to or coincident with $\overline{CS}$ transition Low.
4. $\overline{OE} = V_{IL}$.

● **WRITE CYCLE (1)**



●WRITE CYCLE (2)[5]



NOTES:
1. A write occurs during the overlap (t_{WP}) of a low $\overline{CS}$ and a low $\overline{WE}$.
2. t_{WR} is measured from the earlier of $\overline{CS}$ or $\overline{WE}$ going high to the end of write cycle.
3. During this period, I/O pins are in the output state so that the input signals of opposite phase to the outputs must not be applied.
4. If the $\overline{CS}$ low transition occurs simultaneously with the $\overline{WE}$ low transitions or after the $\overline{WE}$ transition, output remain in a high impedance state.
5. $\overline{OE}$ is continuously low. ($\overline{OE} = V_{IL}$)
6. D_{out} is the same phase of write data of this write cycle.
7. D_{out} is the read data of next address.
8. If $\overline{CS}$ is Low during this period, I/O pins are in the output state. Then the data input signals of opposite phase to the outputs must not be applied to them.

■LOW Vcc DATA RETENTION CHARACTERISTICS ($Ta = 0$ to $+70°C$)

This characteristics are guaranteed only for L-version.

Item	Symbol	Test Conditions	min	typ	max	Unit
V_{CC} for Data Retention	V_{DR}	$\overline{CS} \geq V_{CC} - 0.2V$, $V_{in} \geq V_{CC} - 0.2V$ or $V_{in} \leq 0.2V$	2.0	—	—	V
Data Retention Current	I_{CCDR} *1	$V_{CC} = 3.0V$, $\overline{CS} \geq 2.8V$, $V_{IH} \geq 2.8V$ or $0V \leq V_{IN} \leq 0.2V$	—	—	30	μA
Chip Deselect to Data Retention Time	t_{CDR}	See Retention Waveform	0	—	—	ns
Operation Recovery Time	t_R		t_{RC} *2	—	—	ns

Notes) *1. 10μA max at $Ta = 0°C$ to $+40°C$, V_{IL} min $= -0.3V$
*2. t_{RC} = Read Cycle Time.

●Low Vcc Data Retention Waveform