

# M5M5116P, -15

## 16384-BIT (2048-WORD BY 8-BIT) CMOS STATIC RAM

### DESCRIPTION

The M5M5116P series of 2048-word by 8-bit asynchronous silicon gate CMOS static RAM operates on a single 5V power supply and is designed for easy use in applications requiring battery backup.

Two chip select inputs are available:  $\overline{S_2}$  provides the minimum standby current with battery back-up while  $\overline{S_1}$  enables high-speed memory access.

The series is packaged in a standard 24-pin plastic DIL package.

### FEATURES

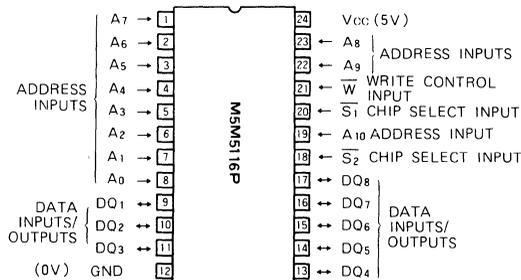
Type name	Access time (max)	$\overline{S_1}$ access time (max)	Current consumption	
			Active (max)	Stand-by (max)
M5M5116P-15	150ns	80ns	50mA	15 $\mu$ A
M5M5116P	200ns	100ns		

- Single 5V power supply.
- External clock and refresh operation not required.
- Data can be held with 2V supply voltage.
- All inputs and outputs are directly TTL compatible.
- All outputs are 3-state with OR-tie capability.
- Easy expansion of memory capacity with chip select signal.
- Common input/output for data pins.

### APPLICATIONS

Battery drive, small-capacity memory units with battery back-up

### PIN CONFIGURATION (TOP VIEW)



Outline 24 P4

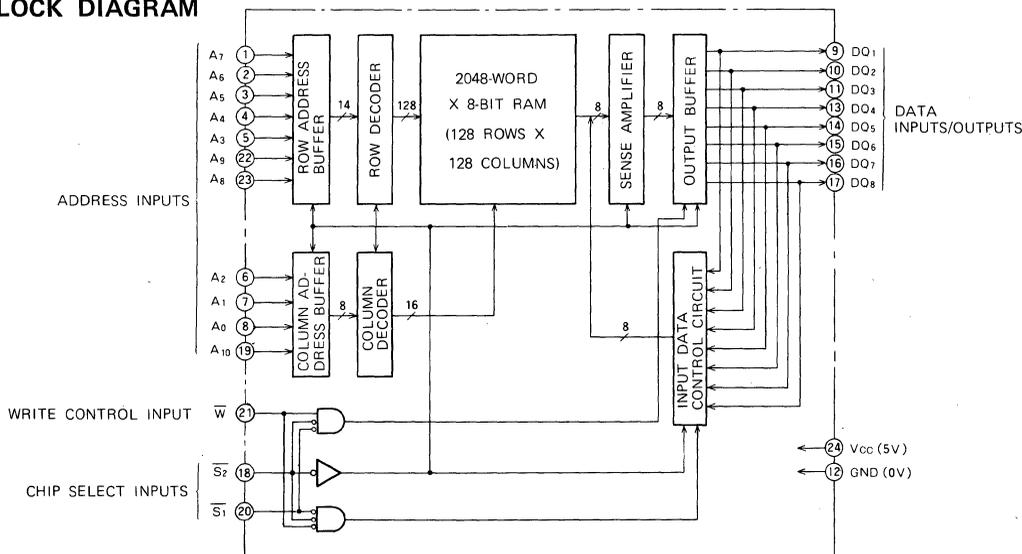
### FUNCTION

The M5M5116P series has a 2048-word by 8-bit configuration. It operates on a single 5V supply and its inputs/outputs are directly TTL compatible. Its completely static circuitry obviates the need for external clock and refresh operations and makes it very easy to use.

The data of the DQ pin are written when the address is designated by address signals  $A_0 \sim A_{10}$ , the  $\overline{S_1}$  and  $\overline{S_2}$  signals turn low-level, and the  $\overline{W}$  signal is set low.

When for the reading operation the  $\overline{W}$  signal is set high,

### BLOCK DIAGRAM



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the  $\overline{S_1}$  and  $\overline{S_2}$  signals are set low, pin DQ is set to the output mode and the address is designated by signals  $A_0 \sim A_{10}$ , the data of the designated address are output to pin DQ.

When signal  $\overline{S_1}$  or  $\overline{S_2}$  is set high, the chip is set to a non-select status in which neither reading nor writing is possible. Since the output floats (high-impedance state), OR-tie is possible with the other chip output pins.

The standby mode is established when signal  $\overline{S_2}$  is set to  $V_{CC}$ . The supply current is now reduced to the very low level of 15 $\mu$ A (max) and the data in the memory are

retained even if the supply voltage falls to 2V, permitting power-down during non-operation or battery back-up during power failures.

**OPERATION MODES**

$\overline{S_1}$	$\overline{S_2}$	$\overline{W}$	Mode	DQ	$I_{CC}$
X	H	X	Non-select	High impedance	Standby
H	L	X	Non-select	High impedance	Active
L	L	L	Write	D <sub>IN</sub>	Active
L	L	H	Read	D <sub>OUT</sub>	Active

**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Conditions	Limits	Unit
$V_{CC}$	Supply voltage	With respect to GND	-0.3 ~ 7	V
$V_I$	Input voltage		-0.3 ~ $V_{CC} + 0.3$	V
$V_O$	Output voltage		0 ~ $V_{CC}$	V
$P_d$	Power dissipation	$T_a = 25^\circ\text{C}$	700	mW
$T_{opr}$	Operating free-air ambient temperature		0 ~ 70	$^\circ\text{C}$
$T_{stg}$	Storage temperature		-65 ~ 150	$^\circ\text{C}$

**RECOMMENDED OPERATING CONDITIONS** ( $T_a = 0 \sim 70^\circ\text{C}$ , unless otherwise noted)

Symbol	Parameter	Limits			Unit
		Min	Typ	Max	
$V_{CC}$	Supply voltage	4.5	5	5.5	V
GND	Supply voltage		0		V
$V_{IL}$	Low-level input voltage	-0.3		0.8	V
$V_{IH}$	High-level input voltage	2.2		$V_{CC} + 0.3$	V

**ELECTRICAL CHARACTERISTICS** ( $T_a = 0 \sim 70^\circ\text{C}$ ,  $V_{CC} = 5V \pm 10\%$ , unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$V_{IH}$	High-level input voltage		2.2		$V_{CC} + 0.3$	V
$V_{IL}$	Low-level input voltage		-0.3		0.8	V
$V_{OH}$	High-level output voltage	$I_{OH} = -1\text{mA}$	2.4			V
$V_{OL}$	Low-level output voltage	$I_{OL} = 2.1\text{mA}$			0.4	V
$I_I$	Input current	$V_I = 0 \sim V_{CC}$			$\pm 1$	$\mu\text{A}$
$I_{OZH}$	Off-state high-level output current	$\overline{S_1}$ or $\overline{S_2} = V_{IH}$ , $V_O = 2.4V \sim V_{CC}$			1	$\mu\text{A}$
$I_{OZL}$	Off-state low-level output current	$\overline{S_1}$ or $\overline{S_2} = V_{IH}$ , $V_O = 0V$			-1	$\mu\text{A}$
$I_{CC1}$	Supply current	<b>M5M5116P-15</b>	$V_1(\overline{S_1}) = V_1(\overline{S_2}) = 0V$ Output pin open Other inputs = $V_{CC}$ or 0V		45	mA
		<b>M5M5116P</b>			30	
$I_{CC2}$	Supply current	<b>M5M5116P-15</b>	$V_1(\overline{S_1}) = V_1(\overline{S_2}) = V_{IL}$ Output pin open Other inputs = $V_{IH}$		50	mA
		<b>M5M5116P</b>			35	
$I_{CC3}$	Standby supply current	$\overline{S_2} = V_{CC} - 0.2V$ , Other inputs = 0 ~ $V_{CC}$			15	$\mu\text{A}$
$I_{CC4}$	Standby supply current	$\overline{S_2} = V_{IH}$ , Other inputs = 0 ~ $V_{CC}$			2	mA
$C_i$	Input capacitance ( $T_a = 25^\circ\text{C}$ )	$V_i = \text{GND}$ , $V_i = 25\text{mVrms}$ , $f = 1\text{MHz}$			6	pF
$C_o$	Output capacitance ( $T_a = 25^\circ\text{C}$ )	$V_O = \text{GND}$ , $V_O = 25\text{mVrms}$ , $f = 1\text{MHz}$			8	pF

Note 1: Current flowing into an IC shall be positive (no sign).

2: Typical values:  $V_{CC} = 5V$ ,  $T_a = 25^\circ\text{C}$ .

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**SWITCHING CHARACTERISTICS** ( $T_a = 0 \sim 70^\circ\text{C}$ ,  $V_{CC} = 5V \pm 10\%$ , unless otherwise noted)

**READ CYCLE**

Symbol	Parameter	M5M5116P-15			M5M5116P			Unit
		Limits			Limits			
		Min	Typ	Max	Min	Typ	Max	
$t_{CR}$	Read cycle time	150			200			ns
$t_a(A)$	Address access time			150			200	ns
$t_a(S_1)$	Chip select 1 access time			80			100	ns
$t_a(S_2)$	Chip select 2 access time			150			200	ns
$t_{dis}(S_1)$	Output disable time from S1			50			60	ns
$t_{dis}(S_2)$	Output disable time from S2			50			60	ns
$t_{en}(S_1)$	Output enable time from S1	15			15			ns
$t_{en}(S_2)$	Output enable time from S2	15			15			ns
$t_V(A)$	Data valid time from address	20			20			ns

**TIMING REQUIREMENTS** ( $T_a = 0 \sim 70^\circ\text{C}$ ,  $V_{CC} = 5V \pm 10\%$ , unless otherwise noted)

**WRITE CYCLE**

Symbol	Parameter	M5M5116P-15			M5M5116P			Unit
		Limits			Limits			
		Min	Typ	Max	Min	Typ	Max	
$t_{CW}$	Write cycle time	150			200			ns
$t_W(W)$	Write pulse width	90			120			ns
$t_{SU}(A)$	Address set-up time	0			0			ns
$t_{SU}(S)$	Chip select set-up time	90			120			ns
$t_{SU}(D)$	Data set-up time	40			60			ns
$t_H(D)$	Data hold time	0			0			ns
$t_{rec}(W)$	Write recovery time	10			10			ns
$t_{dis}(W)$	Output disable time from write			50			60	ns
$t_{en}(W)$	Output enable time from write	15			15			ns

**POWER-DOWN CHARACTERISTICS**

**ELECTRICAL CHARACTERISTICS** ( $T_a = 0 \sim 70^\circ\text{C}$ , unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$V_{CC}(PD)$	Power-down supply voltage		2			V
$V_I(S_2)$	Chip select input voltage	$2.2V \leq V_{CC}(PD)$	2.2			V
		$2V \leq V_{CC}(PD) \leq 2.2V$		$V_{CC}(PD)$		V
$I_{CC}(PD)$	Power-down supply current	$V_{CC} = 3V$ , Other inputs = 3V			10	$\mu\text{A}$

Note 3: When  $S_2$  is operated at 2.2V ( $V_{IH}$  min), the supply current at which  $V_{CC}(PD)$  is between 4.5V and 2.4V, is specified by  $I_{CC4}$ .

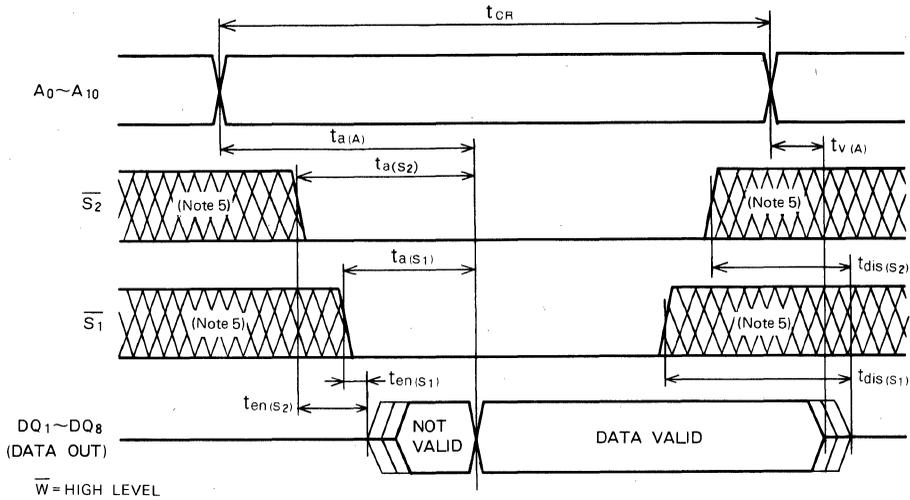
**TIMING REQUIREMENTS** ( $T_a = 0 \sim 70^\circ\text{C}$ , unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min	Typ	Max	
$t_{SU}(PD)$	Power-down set-up time		0			ns
$t_{rec}(PD)$	Power-down recovery time		$t_{CR}$			ns

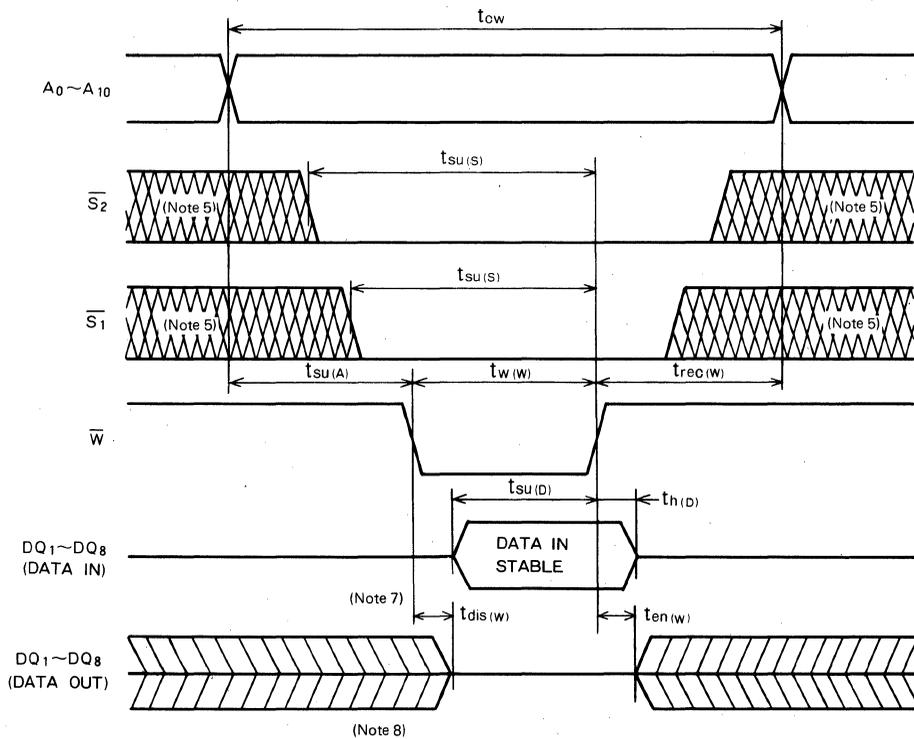
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TIMING DIAGRAM

Read cycle

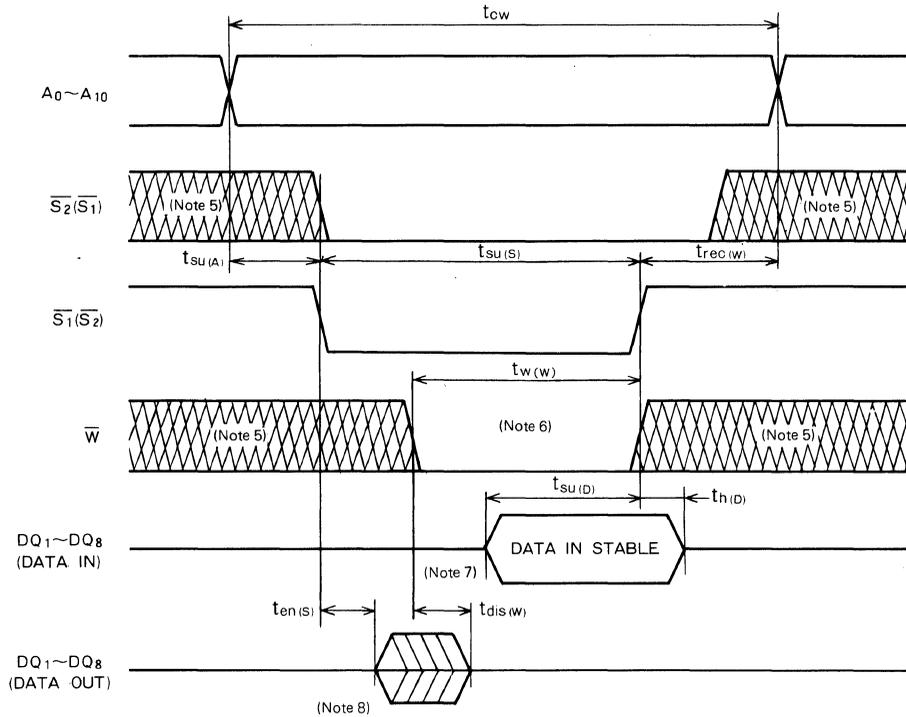


Write cycle ( $\bar{W}$  control)



**16384-BIT (2048-WORD BY 8-BIT) CMOS STATIC RAM**

**Write cycle ( $\overline{S}$  control)**



Note 4: Test conditions  
 Input pulse level: 0.4 ~ 2.4V  
 Input pulse risetime and falltime: 10ns  
 Load: 1 TTL,  $C_L = 100\text{pF}$   
 Reference level: 1.5V

Note 5: Hatching indicates the don't care inputs.  
 Note 6: Writing is performed while  $\overline{S}$  and  $\overline{W}$  are in the low-level overlap period.  
 Note 7: The output is kept in the high-impedance state when  $\overline{W}$  falls simultaneously with, or before, the  $\overline{S}$  falls.  
 Note 8: A reverse-phase signal should not be supplied when DQ is in the output mode.

**POWER-DOWN CHARACTERISTICS**

