



## Description

The GM71C(S)17800C/CL is the new generation dynamic RAM organized 2,097,152 x 8 bit. GM71C(S)17800C/CL has realized higher density, higher performance and various functions by utilizing advanced CMOS process technology. The GM71C(S)17800C/CL offers Fast Page Mode as a high speed access mode. Multiplexed address inputs permit the GM71C(S)17800C/CL to be packaged in standard 400 mil 28pin plastic SOJ, and standard 400mil 28 pin plastic TSOP II. The package size provides high system bit densities and is compatible with widely available automated testing and insertion equipment.

## Features

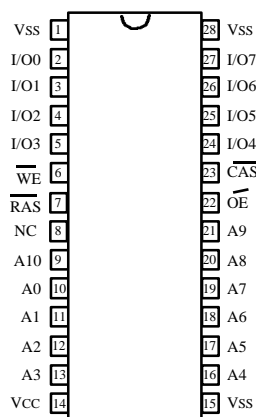
- \* 2,097,152 Words x 8 Bit Organization
- \* Fast Page Mode Capability
- \* Single Power Supply (5V+/-10%)
- \* Fast Access Time & Cycle Time (Unit: ns)

	t <sub>RAC</sub>	t <sub>CAC</sub>	t <sub>RC</sub>	t <sub>PC</sub>
GM71C(S)17800C/CL-5	50	13	90	35
GM71C(S)17800C/CL-6	60	15	110	40
GM71C(S)17800C/CL-7	70	18	130	45

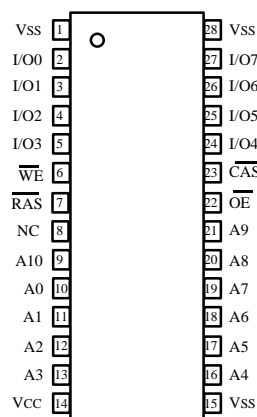
- \* Low Power  
 Active : 715/660/605mW (MAX)  
 Standby : 11mW (CMOS level : MAX)  
 0.83mW (L-version : MAX)
- \* RAS Only Refresh, CAS before RAS Refresh,  
 Hidden Refresh Capability
- \* All inputs and outputs TTL Compatible
- \* 2048 Refresh Cycles/32ms
- \* 2048 Refresh Cycles/128ms (L- version)
- \* Battery Back Up Operation (L- version)
- \* Self Refresh Operation (L-version)

## Pin Configuration

**28 SOJ**



**28 TSOP II**



(Top View)



### Pin Description

Pin	Function	Pin	Function
A0-A10	Address Inputs	$\overline{WE}$	Read/Write Enable
A0-A10	Refresh Address Inputs	$\overline{OE}$	Output Enable
I/O0-I/O7	Data-In/Out	V <sub>CC</sub>	Power (+5V)
$\overline{RAS}$	Row Address Strobe	V <sub>SS</sub>	Ground
$\overline{CAS}$	Column Address Strobe	NC	No Connection

### Ordering Information

Type No.	Access Time	Package
GM71C(S)17800CJ/CLJ -5 GM71C(S)17800CJ/CLJ -6 GM71C(S)17800CJ/CLJ -7	50ns 60ns 70ns	400 Mil 28 Pin Plastic SOJ
GM71C(S)17800CT/CLT -5 GM71C(S)17800CT/CLT -6 GM71C(S)17800CT/CLT -7	50ns 60ns 70ns	400 Mil 28 Pin Plastic TSOP II

### Absolute Maximum Ratings\*

Symbol	Parameter	Rating	Unit
T <sub>A</sub>	Ambient Temperature under Bias	0 ~ +70	C
T <sub>STG</sub>	Storage Temperature (Plastic)	-55 ~ +125	C
V <sub>IN/OUT</sub>	Voltage on any Pin Relative to V <sub>SS</sub>	-1.0 ~ +7.0V	V
V <sub>CC</sub>	Voltage on V <sub>CC</sub> Relative to V <sub>SS</sub>	-1.0 ~ +7.0V	V
I <sub>OUT</sub>	Short Circuit Output Current	50	mA
P <sub>T</sub>	Power Dissipation	1.0	W

Note: Operation at or above Absolute Maximum Ratings can adversely affect device reliability.

### Recommended DC Operating Conditions (T<sub>A</sub> = 0 ~ +70C)

Symbol	Parameter	Min	Typ	Max	Unit
V <sub>CC</sub>	Supply Voltage	4.5	5.0	5.5	V
V <sub>IH</sub>	Input High Voltage	2.4	-	6.0	V
V <sub>IL</sub>	Input Low Voltage	-1.0	-	0.8	V

Note: All voltage referred to V<sub>SS</sub>.

**DC Electrical Characteristics** ( $V_{CC} = 5V \pm 10\%$ ,  $V_{SS} = 0V$ ,  $T_A = 0 \sim 70C$ )

Symbol	Parameter	Min	Max	Unit	Note	
$V_{OH}$	Output Level Output "H" Level Voltage ( $I_{OUT} = -5mA$ )	2.4	$V_{CC}$	V		
$V_{OL}$	Output Level Output "L" Level Voltage ( $I_{OUT} = 4.2mA$ )	0	0.4	V		
$I_{CC1}$	Operating Current Average Power Supply Operating Current ( $\overline{RAS}$ , $\overline{CAS}$ Cycling: $t_{RC} = t_{RC \min}$ )	50ns	-	110	mA	1, 2
		60ns	-	100		
		70ns	-	90		
$I_{CC2}$	Standby Current (TTL) Power Supply Standby Current ( $\overline{RAS}$ , $\overline{CAS} = V_{IH}$ , $D_{OUT} = High-Z$ )	-	2	mA		
$I_{CC3}$	$\overline{RAS}$ Only Refresh Current Average Power Supply Current $\overline{RAS}$ Only Refresh Mode ( $t_{RC} = t_{RC \min}$ )	50ns	-	110	mA	2
		60ns	-	100		
		70ns	-	90		
$I_{CC4}$	Fast Page Mode Current Average Power Supply Current Fast Page Mode ( $t_{PC} = t_{PC \min}$ )	50ns	-	100	mA	1, 3
		60ns	-	90		
		70ns	-	85		
$I_{CC5}$	Standby Current (CMOS) Power Supply Standby Current ( $\overline{RAS}$ , $\overline{CAS} \geq V_{CC} - 0.2V$ , $D_{OUT} = High-Z$ )	-	1	mA		
		-	150	uA	5	
$I_{CC6}$	$\overline{CAS}$ -before- $\overline{RAS}$ Refresh Current ( $t_{RC} = t_{RC \min}$ )	50ns	-	110	mA	
		60ns	-	100		
		70ns	-	90		
$I_{CC7}$	Battery Back Up Operating Current (Standby with CBR Refresh) ( $t_{RC}=62.5\mu s$ , $t_{RAS} \leq 0.3\mu s$ , $D_{OUT}=High-Z$ )	-	500	uA	4,5	
$I_{CC8}$	Standby Current $\overline{RAS} = V_{IH}$ $\overline{CAS} = V_{IL}$ $D_{OUT} = Enable$	-	5	mA	1	
$I_{CC9}$	Self-Refresh Mode Current ( $\overline{RAS}$ , $\overline{CAS} \leq 0.2V$ , $D_{OUT}=High-Z$ )	-	300	uA	5	
$I_{L(I)}$	Input Leakage Current Any Input ( $0V \leq V_{IN} \leq 6V$ )	-10	10	uA		
$I_{L(O)}$	Output Leakage Current ( $D_{OUT}$ is Disabled, $0V \leq V_{OUT} \leq 6V$ )	-10	10	uA		

Note: 1.  $I_{CC}$  depends on output load condition when the device is selected.

$I_{CC(max)}$  is specified at the output open condition.

- Address can be changed once or less while  $\overline{RAS} = V_{IL}$ .
- Address can be changed once or less while  $\overline{CAS} = V_{IH}$ .
- $\overline{CAS} = L$  ( $\leq 0.2$ ) while  $\overline{RAS} = L$  ( $\leq 0.2$ ).
- L-version.

**Capacitance** ( $V_{CC} = 5V \pm 10\%$ ,  $T_A = 25^\circ C$ )

Symbol	Parameter	Min	Max	Unit	Note
C <sub>I1</sub>	Input Capacitance (Address)	-	5	pF	1
C <sub>I2</sub>	Input Capacitance (Clocks)	-	7	pF	1
C <sub>I/O</sub>	Output Capacitance (Data-In/Out)	-	7	pF	1, 2

Note: 1. Capacitance measured with Boonton Meter or effective capacitance measuring method.  
 2. CAS = V<sub>IH</sub> to disable D<sub>OUT</sub>.

**AC Characteristics** ( $V_{CC} = 5V \pm 10\%$ ,  $T_A = 0 \sim +70^\circ C$ ,  $V_{SS} = 0V$ , Note 1, 2, 18)

**Test Conditions**

Input rise and fall times : 5 ns

Output timing reference levels : 0.4V, 2.4V

Input timing reference levels : 0.8V, 2.4V

 Output load : 2TTL gate + C<sub>L</sub> (100 pF)  
 (Including scope and jig)

**Read, Write, Read-Modify-Write and Refresh Cycles (Common Parameters)**

Symbol	Parameter	GM71C(S)17800 C/CL-5		GM71C(S)17800 C/CL-6		GM71C(S)17800 C/CL-7		Unit	Note
		Min	Max	Min	Max	Min	Max		
t <sub>RC</sub>	Random Read or Write Cycle Time	90	-	110	-	130	-	ns	
t <sub>RP</sub>	$\overline{\text{RAS}}$ Precharge Time	30	-	40	-	50	-	ns	
t <sub>CP</sub>	$\overline{\text{CAS}}$ Precharge Time	7	-	10	-	10	-	ns	
t <sub>RAS</sub>	$\overline{\text{RAS}}$ Pulse Width	50	10,000	60	10,000	70	10,000	ns	
t <sub>CAS</sub>	$\overline{\text{CAS}}$ Pulse Width	13	10,000	15	10,000	18	10,000	ns	
t <sub>ASR</sub>	Row Address Set up Time	0	-	0	-	0	-	ns	
t <sub>RAH</sub>	Row Address Hold Time	7	-	10	-	10	-	ns	
t <sub>ASC</sub>	Column Address Set-up Time	0	-	0	-	0	-	ns	
t <sub>CAH</sub>	Column Address Hold Time	7	-	10	-	15	-	ns	
t <sub>RCD</sub>	$\overline{\text{RAS}}$ to $\overline{\text{CAS}}$ Delay Time	17	45	20	45	20	52	ns	3
t <sub>RAD</sub>	$\overline{\text{RAS}}$ to Column Address Delay Time	12	30	15	30	15	35	ns	4
t <sub>RSH</sub>	$\overline{\text{RAS}}$ Hold Time	13	-	15	-	18	-	ns	
t <sub>CSH</sub>	$\overline{\text{CAS}}$ Hold Time	50	-	60	-	70	-	ns	
t <sub>CRP</sub>	$\overline{\text{CAS}}$ to $\overline{\text{RAS}}$ Precharge Time	5	-	5	-	5	-	ns	
t <sub>ODD</sub>	$\overline{\text{OE}}$ to D <sub>IN</sub> Delay Time	13	-	15	-	18	-	ns	5
t <sub>DZO</sub>	$\overline{\text{OE}}$ Delay Time from D <sub>IN</sub>	0	-	0	-	0	-	ns	6
t <sub>DZC</sub>	$\overline{\text{CAS}}$ Delay Time from D <sub>IN</sub>	0	-	0	-	0	-	ns	6
t <sub>T</sub>	Transition Time (Rise and Fall)	3	50	3	50	3	50	ns	7

**Read Cycle**

Symbol	Parameter	GM71C(S)17800 C/CL-5		GM71C(S)17800 C/CL-6		GM71C(S)17800 C/CL-7		Unit	Note
		Min	Max	Min	Max	Min	Max		
t <sub>RAC</sub>	Access Time from $\overline{\text{RAS}}$	-	50	-	60	-	70	ns	8,9
t <sub>CAC</sub>	Access Time from $\overline{\text{CAS}}$	-	13	-	15	-	18	ns	9,10,17
t <sub>AA</sub>	Access Time from Address	-	25	-	30	-	35	ns	9,11,17
t <sub>OAC</sub>	Access Time from $\overline{\text{OE}}$	-	13	-	15	-	18	ns	9
t <sub>RCS</sub>	Read Command Setup Time	0	-	0	-	0	-	ns	
t <sub>RCH</sub>	Read Command Hold Time to $\overline{\text{CAS}}$	0	-	0	-	0	-	ns	12
t <sub>RRH</sub>	Read Command Hold Time to $\overline{\text{RAS}}$	5	-	5	-	5	-	ns	12
t <sub>RAL</sub>	Column Address to $\overline{\text{RAS}}$ Lead Time	25	-	30	-	35	-	ns	
t <sub>CAL</sub>	Column Address to $\overline{\text{CAS}}$ Lead Time	25	-	30	-	35	-	ns	
t <sub>CLZ</sub>	$\overline{\text{CAS}}$ to Output in Low-Z	0	-	0	-	0	-	ns	
t <sub>OH</sub>	Output Data Hold Time	3	-	3	-	3	-	ns	
t <sub>OH0</sub>	Output Data Hold Time from $\overline{\text{OE}}$	3	-	3	-	3	-	ns	
t <sub>OFF</sub>	Output Buffer Turn-off Time	-	13	-	15	-	15	ns	13
t <sub>OEZ</sub>	Output Buffer Turn-off Time to $\overline{\text{OE}}$	-	13	-	15	-	15	ns	13
t <sub>CDD</sub>	$\overline{\text{CAS}}$ to D <sub>IN</sub> Delay Time	13	-	15	-	18	-	ns	5

**Write Cycle**

Symbol	Parameter	GM71C(S)17800 C/CL-5		GM71C(S)17800 C/CL-6		GM71C(S)17800 C/CL-7		Unit	Note
		Min	Max	Min	Max	Min	Max		
t <sub>WCS</sub>	Write Command Setup Time	0	-	0	-	0	-	ns	14
t <sub>WCH</sub>	Write Command Hold Time	7	-	10	-	15	-	ns	
t <sub>WP</sub>	Write Command Pulse Width	7	-	10	-	10	-	ns	
t <sub>RWL</sub>	Write Command to $\overline{\text{RAS}}$ Lead Time	13	-	15	-	18	-	ns	
t <sub>CWL</sub>	Write Command to $\overline{\text{CAS}}$ Lead Time	13	-	15	-	18	-	ns	
t <sub>DS</sub>	Data-in Setup Time	0	-	0	-	0	-	ns	15
t <sub>DH</sub>	Data-in Hold Time	7	-	10	-	15	-	ns	15

### Read- Modify-Write Cycle

Symbol	Parameter	GM71C(S)17800 C/CL-5		GM71C(S)17800 C/CL-6		GM71C(S)17800 C/CL-7		Unit	Note
		Min	Max	Min	Max	Min	Max		
t <sub>RWC</sub>	Read-Modify-Write Cycle Time	131	-	155	-	181	-	ns	
t <sub>RWD</sub>	$\overline{\text{RAS}}$ to $\overline{\text{WE}}$ Delay Time	73	-	85	-	98	-	ns	14
t <sub>CWD</sub>	$\overline{\text{CAS}}$ to $\overline{\text{WE}}$ Delay Time	36	-	40	-	46	-	ns	14
t <sub>AWD</sub>	Column Address to $\overline{\text{WE}}$ Delay Time	48	-	55	-	63	-	ns	14
t <sub>OEH</sub>	$\overline{\text{OE}}$ Hold Time from $\overline{\text{WE}}$	13	-	15	-	18	-	ns	

### Refresh Cycle

Symbol	Parameter	GM71C(S)17800 C/CL-5		GM71C(S)17800 C/CL-6		GM71C(S)17800 C/CL-7		Unit	Note
		Min	Max	Min	Max	Min	Max		
t <sub>CSR</sub>	$\overline{\text{CAS}}$ Setup Time ( $\overline{\text{CAS}}$ -before-RAS Refresh Cycle)	5	-	5	-	5	-	ns	
t <sub>CHR</sub>	$\overline{\text{CAS}}$ Hold Time ( $\overline{\text{CAS}}$ -before-RAS Refresh Cycle)	10	-	10	-	10	-	ns	
t <sub>WRP</sub>	$\overline{\text{WE}}$ Setup Time ( $\overline{\text{CAS}}$ -before-RAS Refresh Cycle)	0	-	0	-	0	-	ns	
t <sub>WRH</sub>	$\overline{\text{WE}}$ Hold Time ( $\overline{\text{CAS}}$ -before-RAS Refresh Cycle)	7	-	10	-	10	-	ns	
t <sub>RPC</sub>	$\overline{\text{RAS}}$ Precharge to $\overline{\text{CAS}}$ Hold Time	5	-	5	-	5	-	ns	

### Fast Page Mode Cycle

Symbol	Parameter	GM71C(S)17800 C/CL-5		GM71C(S)17800 C/CL-6		GM71C(S)17800 C/CL-7		Unit	Note
		Min	Max	Min	Max	Min	Max		
t <sub>PC</sub>	Fast Page Mode Cycle Time	35	-	40	-	45	-	ns	
t <sub>RASP</sub>	Fast Page Mode $\overline{\text{RAS}}$ Pulse Width	-	100,000	-	100,000	-	100,000	ns	16
t <sub>ACP</sub>	Access Time from $\overline{\text{CAS}}$ Precharge	-	30	-	35	-	40	ns	9,17
t <sub>RHCP</sub>	$\overline{\text{RAS}}$ Hold Time from $\overline{\text{CAS}}$ Precharge	30	-	35	-	40	-	ns	

**Fast Page Mode Read-Modify-Write Cycle**

Symbol	Parameter	GM71C(S)17800 C/CL-5		GM71C(S)17800 C/CL-6		GM71C(S)17800 C/CL-7		Unit	Note
		Min	Max	Min	Max	Min	Max		
t <sub>PRWC</sub>	Fast Page Mode Read-Modify-Write Cycle Time	76	-	85	-	96	-	ns	
t <sub>CPW</sub>	$\overline{\text{WE}}$ Delay Time from $\overline{\text{CAS}}$ Precharge	53	-	60	-	68	-	ns	14

**Self Refresh Mode ( L-version )**

Symbol	Parameter	GM71CS17800 CL-5		GM71CS17800 CL-6		GM71CS17800 CL-7		Unit	Note
		Min	Max	Min	Max	Min	Max		
t <sub>RASS</sub>	$\overline{\text{RAS}}$ Pulse Width ( Self-refresh )	100	-	100	-	100	-	μs	
t <sub>RPS</sub>	$\overline{\text{RAS}}$ Precharge Time ( Self-refresh )	90	-	110	-	130	-	ns	
t <sub>CHS</sub>	$\overline{\text{CAS}}$ Hold Time ( Self-refresh )	-50	-	-50	-	-50	-	ns	

**Notes:**

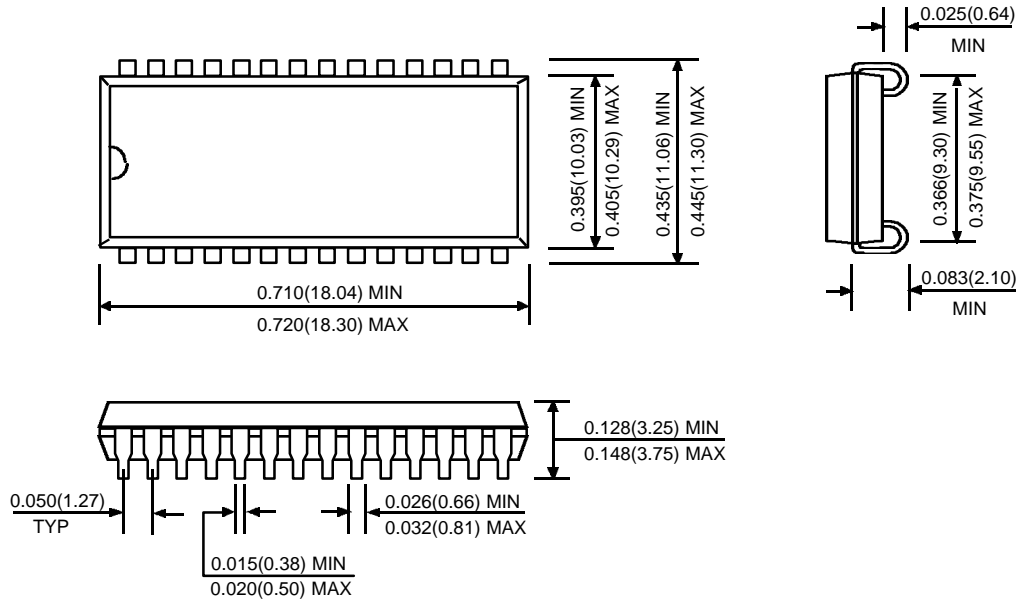
1. AC Measurements assume  $t_r = 5\text{ns}$ .
2. An initial pause of  $200\ \mu\text{s}$  is required after power up followed by a minimum of eight initialization cycles (any combination of cycles containing  $\overline{\text{RAS}}$ -only refresh or  $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  refresh). If the internal refresh counter is used, a minimum of eight  $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  refresh cycles are required.
3. Operation with the  $t_{\text{RCD}}(\text{max})$  limit insures that  $t_{\text{RAC}}(\text{max})$  can be met,  $t_{\text{RCD}}(\text{max})$  is specified as a reference point only; if  $t_{\text{RCD}}$  is greater than the specified  $t_{\text{RCD}}(\text{max})$  limit, then access time is controlled exclusively by  $t_{\text{CAC}}$ .
4. Operation with the  $t_{\text{RAD}}(\text{max})$  limit insures that  $t_{\text{RAC}}(\text{max})$  can be met,  $t_{\text{RAD}}(\text{max})$  is specified as a reference point only; if  $t_{\text{RAD}}$  is greater than the specified  $t_{\text{RAD}}(\text{max})$  limit, then access time is controlled exclusively by  $t_{\text{AA}}$ .
5. Either  $t_{\text{ODD}}$  or  $t_{\text{CDD}}$  must be satisfied.
6. Either  $t_{\text{DZO}}$  or  $t_{\text{DZC}}$  must be satisfied.
7.  $V_{\text{IH}}(\text{min})$  and  $V_{\text{IL}}(\text{max})$  are reference levels for measuring timing of input signals. Also, transition times are measured between  $V_{\text{IH}}(\text{min})$  and  $V_{\text{IL}}(\text{max})$ .
8. Assumes that  $t_{\text{RCD}} \leq t_{\text{RCD}}(\text{max})$  and  $t_{\text{RAD}} \leq t_{\text{RAD}}(\text{max})$ . If  $t_{\text{RCD}}$  or  $t_{\text{RAD}}$  is greater than the maximum recommended value shown in this table,  $t_{\text{RAC}}$  exceeds the value shown.
9. Measured with a load circuit equivalent to 2TTL loads and 100pF. ( $V_{\text{OH}}=2.4\text{V}$ ,  $V_{\text{OL}}=0.4\text{V}$ )
10. Assumes that  $t_{\text{RCD}} \geq t_{\text{RCD}}(\text{max})$  and  $t_{\text{RAD}} \leq t_{\text{RAD}}(\text{max})$ .
11. Assumes that  $t_{\text{RCD}} \leq t_{\text{RCD}}(\text{max})$  and  $t_{\text{RAD}} \geq t_{\text{RAD}}(\text{max})$ .
12. Either  $t_{\text{RCH}}$  or  $t_{\text{RRH}}$  must be satisfied for a read cycles.
13.  $t_{\text{OFF}}(\text{max})$  and  $t_{\text{OEZ}}(\text{max})$  define the time at which the outputs achieve the open circuit condition and are not referred to output voltage levels.
14.  $t_{\text{WCS}}$ ,  $t_{\text{RWD}}$ ,  $t_{\text{CWD}}$  and  $t_{\text{AWD}}$  and  $t_{\text{CPW}}$  are not restrictive operating parameters. They are included in the data sheet as electrical characteristics only; if  $t_{\text{WCS}} \geq t_{\text{WCS}}(\text{min})$ , the cycle is an early write cycle and the data out pin will remain open circuit (high impedance) throughout the entire cycle; if  $t_{\text{RWD}} \geq t_{\text{RWD}}(\text{min})$ ,  $t_{\text{CWD}} \geq t_{\text{CWD}}(\text{min})$ , and  $t_{\text{AWD}} \geq t_{\text{AWD}}(\text{min})$  or  $t_{\text{CWD}} \geq t_{\text{CWD}}(\text{min})$ ,  $t_{\text{AWD}} \geq t_{\text{AWD}}(\text{min})$ , and  $t_{\text{CPW}} \geq t_{\text{CPW}}(\text{min})$ , the cycle is a read-modify-write and the data output will contain data read from the selected cell; if neither of the above sets of conditions is satisfied, the condition of the data out (at access time) is indeterminate.
15. These parameters are referred to  $\overline{\text{CAS}}$  leading edge in early write cycle and to  $\overline{\text{WE}}$  leading edge in a delayed write or a read modify write cycle.
16.  $t_{\text{RASP}}$  defines  $\overline{\text{RAS}}$  pulse width in fast page mode cycles.
17. Access time is determined by the longer of  $t_{\text{AA}}$  or  $t_{\text{CAC}}$  or  $t_{\text{ACP}}$ .
18. In delayed write or read-modify-write cycles,  $\overline{\text{OE}}$  must disable output buffer prior to applying data to the device. After  $\overline{\text{RAS}}$  is reset, if  $t_{\text{OEH}} \geq t_{\text{CWL}}$ , the I/O pin will remain open circuit (high impedance); if  $t_{\text{OEH}} \leq t_{\text{CWL}}$ , invalid data will be out at each I/O.



**Package Dimensions**

Unit: Inches (mm)

**28 SOJ**



**28 TSOP (TYPE II)**

