

### 3.3V 32K x 32 Fast CMOS Synchronous Static RAM with Burst Counter and Output Register

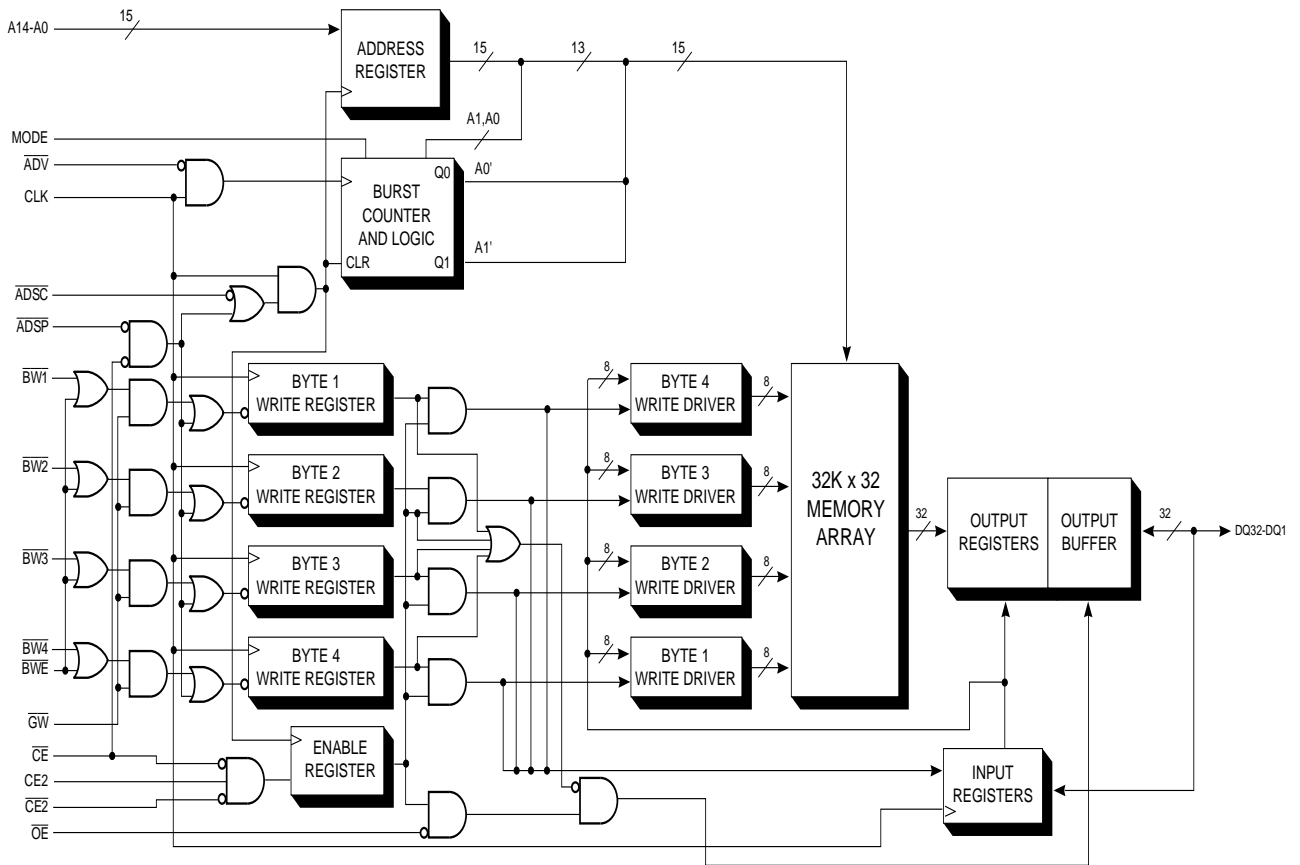
#### Features

- Interfaces directly with the x86, Pentium<sup>™</sup>, 680X0 and PowerPC<sup>™</sup> processors (100, 80, 66, 60, 50 MHz)
- Single 3.3V power supply
- Mode selectable for interleaved or linear burst:  
Interleaved for x86 and Pentium  
Linear for 680x0 and PowerPC
- High-speed clock cycle times:  
10, 12.5, 15, 16.7 and 20 ns
- High-density 32K x 32 architecture with burst address counter and output register
- Fully registered inputs and outputs for pipelined operation
- High-output drive: 30 pF at rated T<sub>A</sub>
- Asynchronous output enable
- Self-timed write cycle
- Separate byte write enables and one global write enable
- Internal burst read / write address counter
- Internal registers for address, data, controls
- Output data register
- Burst mode selectable
- Sleep mode
- Packages:  
100-pin QFP - (Q)  
100-pin TQFP - (TQ)

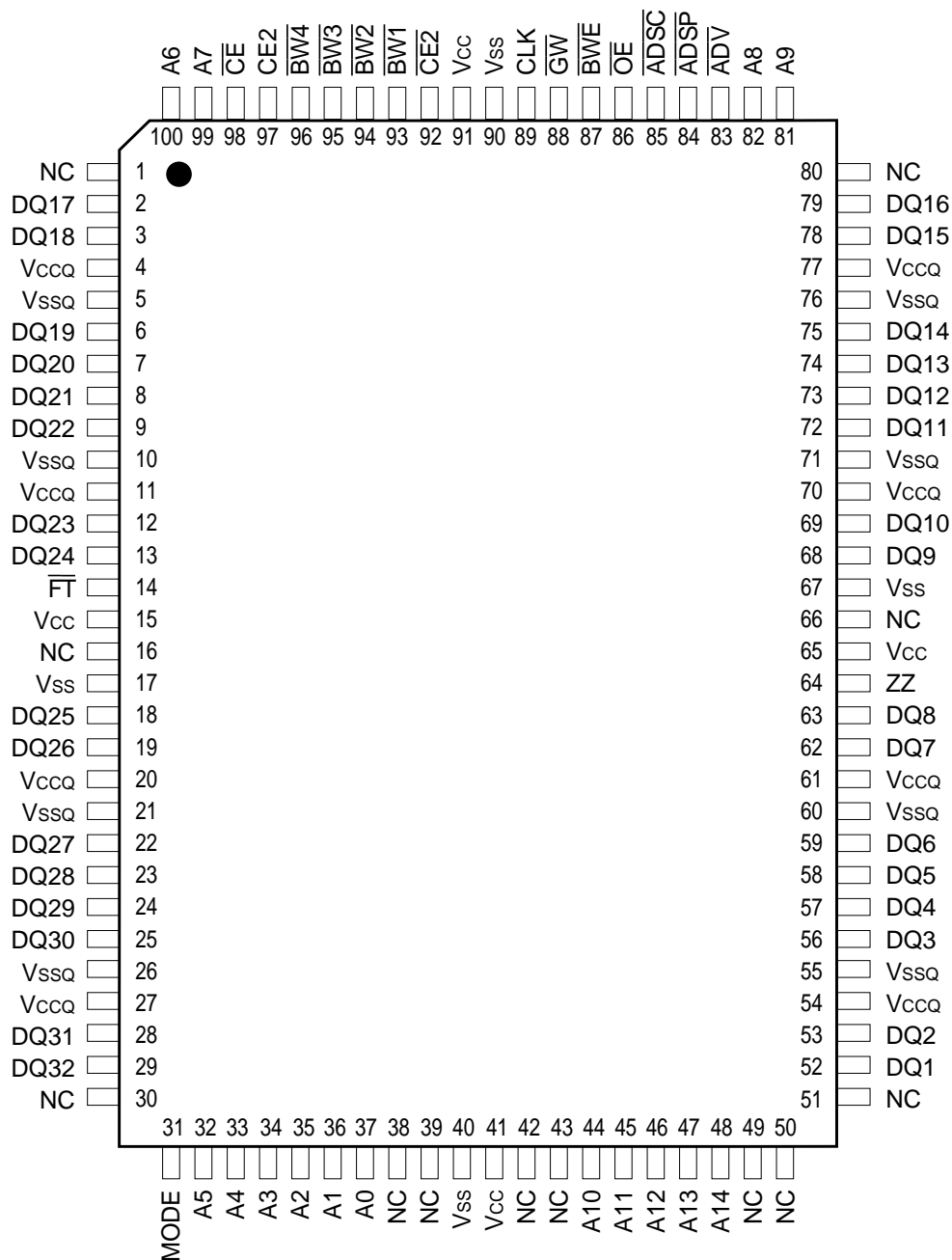
#### Description

The PDM34078 is a 1,048,576 bit synchronous random access memory organized as 32,768 x 32 bits. This device designed with burst mode capability and interface controls to provide high-performance in second level cache designs for x86, Pentium, 680x0, and PowerPC microprocessors. Addresses, write data and all control signals except output enable are controlled through positive edge-triggered registers. Write cycles are self-timed and are also initiated by the rising edge of the clock. Controls are provided to allow burst reads and writes of up to four words in length. A 2-bit burst address counter controls the two least-significant bits of the address during burst reads and writes. The burst address counter selectively uses the 2-bit counting scheme required by the x86 and Pentium or 680x0 and PowerPC microprocessors as controlled by the mode pin. Individual write strobes provide byte write for the four 8-bit bytes of data. An asynchronous output enable simplifies interface to high-speed buses.

Functional Block Diagram



PDM34078 Pinout



## Pinout

| Name                           | I/O | Description                            | Name                                    | I/O | Description                       |
|--------------------------------|-----|--|---|-----|-----------------------------------|
| A14-A2                         | I   | Address Inputs A14-A2                  | $\overline{CE}$ , CE2, $\overline{CE2}$ | I   | Chip Enables                      |
| A1, A0                         | I   | Address Inputs A1 & A0                 | $\overline{BWE}$                        | I   | Byte Write Enable                 |
| DQ1-DQ32                       | I/O | Read/Write Data                        | $\overline{BW1}$ - $\overline{BW4}$     | I   | Byte Write Enables                |
| NC                             | —   | No Connect                             | $\overline{OE}$                         | I   | Output Enable                     |
| MODE <sup>(1)</sup>            | I   | Burst Sequence Select                  | CLK                                     | I   | Clock                             |
| $\overline{ADV}$               | I   | Burst Counter Advance                  | ZZ                                      | I   | Sleep Mode                        |
| $\overline{ADSC}$              | I   | Controller Address Status              | V <sub>CC</sub>                         | —   | Power Supply (+3.3V)              |
| $\overline{ADSP}$              | I   | Processor Address Status               | V <sub>CCQ</sub>                        | —   | Output Power for DQ's (+3.3V ±5%) |
| $\overline{GW}$                | I   | Global Write                           | V <sub>SS</sub>                         | —   | Array Ground                      |
| $\overline{FT}$ <sup>(1)</sup> | I   | Must be tied HIGH for proper operation | V <sub>SSQ</sub>                        | —   | Output Ground for DQ's            |

NOTE: 1.MODE and  $\overline{FT}$  are DC operated pins. Do not alter input state while device is operating.

## Burst Sequence Table

| Burst Sequence    | Interleaved <sup>(1)</sup><br>Mode = NC or<br>V <sub>CC</sub> | Linear <sup>(2)</sup><br>Mode = V <sub>SS</sub> |            |            |            |
|-------------------|---|---|------------|------------|------------|
|                   |   | A14-A2,0,0                                      | A14-A2,0,1 | A14-A2,1,0 | A14-A2,1,1 |
| External Address  | A14-A2, A1, A0  | A14-A2,0,0                                      | A14-A2,0,1 | A14-A2,1,0 | A14-A2,1,1 |
| 1st Burst Address | A14-A2, A1, $\overline{A0}$                                   | A14-A2,0,1                                      | A14-A2,1,0 | A14-A2,1,1 | A14-A2,0,0 |
| 2nd Burst Address | A14-A2, $\overline{A1}$ , A0                                  | A14-A2,1,0                                      | A14-A2,1,1 | A14-A2,0,0 | A14-A2,0,1 |
| 3rd Burst Address | A14-A2, $\overline{A1}$ , $\overline{A0}$                     | A14-A2,1,1                                      | A14-A2,0,0 | A14-A2,0,1 | A14-A2,1,0 |

- Note: 1. Interleaved = x86 and Pentium.  
2. Linear = 680x0 and Power PC compatible.

## Asynchronous Truth Table

| Operation  | ZZ | $\overline{OE}$ | I/O Status            |
|------------|----|-----------------|-----------------------|
| Read       | L  | L               | Data Out              |
| Read       | L  | H               | High-Z                |
| Write      | L  | X               | High-Z: Write Data In |
| Deselected | L  | X               | High-Z                |
| Sleep      | H  | X               | High-Z                |

- NOTE: 1. L = Low, H = High, X = Don't Care.  
2. For a write operation following a read operation,  $\overline{OE}$  must be high before the input data required setup time and held high through the input data hold time.  
3. This device contains circuitry that will ensure the outputs will be in high-Z during powerup.

## Partial Truth Table for Writes

| GW | BWE | $\overline{BW1}$ | $\overline{BW2}$ | $\overline{BW3}$ | $\overline{BW4}$ | Function        |
|----|-----|------------------|------------------|------------------|------------------|-----------------|
| H  | H   | X                | X                | X                | X                | READ            |
| H  | L   | H                | H                | H                | H                | READ            |
| H  | L   | L                | H                | H                | H                | WRITE Byte 1    |
| H  | L   | L                | L                | L                | L                | WRITE All Bytes |
| L  | X   | X                | X                | X                | X                | WRITE All Bytes |

- NOTE: 1. L = Low, H = High, X = Don't Care.  
2. Using BWE and  $\overline{BW1}$  through  $\overline{BW4}$ , any one or more bytes may be written.

**Synchronous Truth Table (See Notes 1 through 3)**

| CE | CE2 | CE2 | ADSP | ADSC | ADV | BW $\bar{x}$ | CLK | Address  | Operation                   |
|----|-----|-----|------|------|-----|--------------|-----|----------|-----------------------------|
| H  | X   | X   | X    | L    | X   | X            | ↑   | N/A      | Deselected                  |
| L  | X   | L   | L    | X    | X   | X            | ↑   | N/A      | Deselected                  |
| L  | H   | X   | L    | X    | X   | X            | ↑   | N/A      | Deselected                  |
| L  | X   | L   | H    | L    | X   | X            | ↑   | N/A      | Deselected                  |
| L  | H   | X   | H    | L    | X   | X            | ↑   | N/A      | Deselected                  |
| L  | L   | H   | L    | X    | X   | X            | ↑   | External | Read Cycle, Begin Burst     |
| L  | L   | H   | H    | L    | X   | X            | ↑   | External | Read Cycle, Begin Burst     |
| X  | X   | X   | H    | H    | L   | H            | ↑   | Next     | Read Cycle, Continue Burst  |
| H  | X   | X   | X    | H    | L   | H            | ↑   | Next     | Read Cycle, Continue Burst  |
| X  | X   | X   | H    | H    | H   | H            | ↑   | Current  | Read Cycle, Suspend Burst   |
| H  | X   | X   | X    | H    | H   | H            | ↑   | Current  | Read Cycle, Suspend Burst   |
| L  | L   | H   | H    | L    | X   | L            | ↑   | External | Write Cycle, Begin Burst    |
| X  | X   | X   | H    | H    | L   | L            | ↑   | Next     | Write Cycle, Continue Burst |
| H  | X   | X   | X    | H    | L   | L            | ↑   | Next     | Write Cycle, Continue Burst |
| X  | X   | X   | H    | H    | H   | L            | ↑   | Current  | Write Cycle, Suspend Burst  |
| H  | X   | X   | H    | H    | H   | L            | ↑   | Current  | Write Cycle, Suspend Burst  |

NOTES:

1. X = Don't Care, H = logic High, L = logic Low,  $\overline{BWx}$  = any one or more byte write enable signals ( $\overline{BW1}$ ,  $\overline{BW2}$ ,  $\overline{BW3}$ ,  $\overline{BW4}$ ) and  $\overline{BWE}$  are low, or  $\overline{GW}$  is low.
2.  $\overline{BW1}$  enables  $\overline{BWx}$  to Byte 1 (DQ1-DQ8).  $\overline{BW2}$  enables  $\overline{BWx}$  to Byte 2 (DQ9-DQ16).  $\overline{BW3}$  enables  $\overline{BWx}$  to Byte 3 (DQ17-DQ24),  $\overline{BW4}$  enables  $\overline{BWx}$  to Byte 4 (DQ25-DQ32).
3.  $\overline{ADV}$  must always be high at the rising edge of the first clock after an  $\overline{ADSP}$  cycle is initiated if a write cycle is desired (to ensure use of correct address).

## Burst Mode Operation

This is a synchronous part. All activities are initiated by the positive, low-to-high edge of the clock (CLK). This part can perform burst reads and writes with burst lengths of up to four words. The four-word burst is created by using a burst counter to drive the two least-significant bits of the internal RAM address. The burst counter is loaded at the start of the burst and is incremented for each word of the burst. The sequence is given in the Burst Sequence Table.

Burst transfers are initiated by the  $\overline{ADSC}$  or  $\overline{ADSP}$  signals. When the  $\overline{ADSP}$  and  $\overline{CE}$  signals are sampled low, a read cycle is started (independent of  $\overline{BW1}$ ,  $\overline{BW2}$ ,  $\overline{BW3}$ , or  $\overline{BW4}$ ;  $\overline{BWE}$ ,  $\overline{GW}$  and  $\overline{ADSC}$ ), and prior burst activity is terminated.  $\overline{ADSP}$  is gated by  $\overline{CE}$ , so both must be active for  $\overline{ADSP}$  to load the address register and to initiate a read cycle. The address and the chip enable input ( $\overline{CE}$ ) are sampled by the same edge that samples  $\overline{ADSP}$ . Read data is valid at the output after the specified delay from the clock edge.

When  $\overline{ADSC}$  is sampled low and  $\overline{ADSP}$  is sampled high, a read or write cycle is started depending on the state of  $\overline{BW1}$ ,  $\overline{BW2}$ ,  $\overline{BW3}$  or  $\overline{BW4}$ ;  $\overline{BWE}$ , and  $\overline{GW}$ . If  $\overline{BW1}$ ,  $\overline{BW2}$ ,  $\overline{BW3}$ ,  $\overline{BW4}$ ,  $\overline{BWE}$ , and  $\overline{GW}$  are all sampled high, a read cycle is started, as described above. If  $\overline{BW1}$ ,  $\overline{BW2}$ ,  $\overline{BW3}$ , or  $\overline{BW4}$ ;  $\overline{BWE}$ , and  $\overline{GW}$  is sampled low, a write cycle is begun. The address, write data, and the chip enable inputs ( $\overline{CE}$ ,  $\overline{CE2}$  and  $\overline{CE2}$ ) are sampled by the same edge that samples  $\overline{ADSC}$  and  $\overline{BW1}$ – $\overline{BW4}$ ,  $\overline{BWE}$  and  $\overline{GW}$ . The  $\overline{ADV}$  line is held high for this clock edge to maintain the correct address for the internal write operation which will follow this second clock edge.

After the first cycle of the write burst, the state of  $\overline{BW1}$ – $\overline{BW4}$ ,  $\overline{BWE}$  and  $\overline{GW}$  determines whether the next cycle is a read or write cycle, and  $\overline{ADV}$  controls the advance of the address counter. The  $\overline{ADV}$  signal advances the address counter. This increments the address to the next available RAM address. You write the next word in the burst by taking  $\overline{ADV}$  low and presenting the write data at the positive edge of the clock. If  $\overline{ADV}$  is sampled low, the burst counter advances and the write data (which is sampled by the same clock) is written into the internal RAM during the time following the clock edge.

## Absolute Maximum Ratings <sup>(1)</sup>

| Symbol            | Rating   | Com'l.       | Ind.         | Unit |
|-------------------|--|--------------|--------------|------|
| V <sub>TERM</sub> | Terminal Voltage with Respect to V <sub>SS</sub> | -0.5 to +4.6 | -0.5 to +4.6 | V    |
| T <sub>BIAS</sub> | Temperature Under Bias                           | -55 to +125  | -65 to +135  | °C   |
| T <sub>STG</sub>  | Storage Temperature                              | -55 to +125  | -65 to +150  | °C   |
| P <sub>T</sub>    | Power Dissipation                                | 1.0          | 1.0          | W    |
| I <sub>OUT</sub>  | DC Output Current                                | 50           | 50           | mA   |
| T <sub>j</sub>    | Maximum Junction Temperature <sup>(2)</sup>      | 125          | 125          | °C   |

- NOTE: 1. Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
2. Appropriate thermal calculations should be performed in all cases and specifically for those where the chosen package has a large thermal resistance (e.g., TSOP). The calculation should be of the form:  $T_j = T_a + P * \theta_{ja}$  where  $T_a$  is the ambient temperature, P is average operating power and  $\theta_{ja}$  the thermal resistance of the package. For this product, use the following  $\theta_{ja}$  values:

TQFP: 50° C/W  
 QFP: 50° C/W

## Recommended DC Operating Conditions

| Symbol           | Description         | Min. | Typ. | Max. | Unit |
|------------------|---------------------|------|------|------|------|
| V <sub>CC</sub>  | Supply Voltage      | 3.0  | 3.3  | 3.6  | V    |
| V <sub>CCQ</sub> | Supply voltage      | 3.0  | 3.3  | 3.6  | V    |
| V <sub>SS</sub>  | Supply Voltage      | 0    | 0    | 0    | V    |
| Commercial       | Ambient Temperature | 0    | 25   | 70   | °C   |

## DC Electrical Characteristics (V<sub>CC</sub> = 3.3V ± 0.3V, All Temperature Ranges)

| Symbol           | Description                      | Test Conditions  | Min. | Max.                 | Unit |
|------------------|----------------------------------|--|------|----------------------|------|
| I <sub>L</sub>   | Input Leakage Current            | V <sub>IN</sub> = 0V to V <sub>CC</sub>                    | -2   | 2                    | μA   |
| I <sub>L</sub> O | Output Leakage Current           | Outputs Disabled, V <sub>I/O</sub> = 0V to V <sub>CC</sub> | -2   | 2                    | μA   |
| V <sub>OL</sub>  | Output Low Voltage               | V <sub>CC</sub> = Min., I <sub>OL</sub> = 8 mA             | —    | 0.4                  | V    |
| V <sub>OH</sub>  | Output High Voltage              | V <sub>CC</sub> = Min., I <sub>OH</sub> = -5 mA            | 2.4  | —                    | V    |
| V <sub>IH</sub>  | Input HIGH Voltage               |  | 2.0  | V <sub>CC</sub> +0.3 | V    |
| V <sub>IL</sub>  | Input LOW Voltage <sup>(1)</sup> |  | -0.3 | 0.8                  | V    |

- NOTES: 1. Undershoots to -2.0 for 10 ns are allowed once per cycle.  
2. MODE, FT and ZZ pins have an internal pullup and exhibit an input leakage current of ±400 μA.

## Power Supply Characteristics

| Symbol           | Description                    | Test Conditions  | -6 ns | -7 ns | -8 ns | -10 ns | -12 ns | Unit |
|------------------|--------------------------------|--|-------|-------|-------|--------|--------|------|
| I <sub>CC</sub>  | Active Supply Current          | Device Deselected<br>V <sub>IN</sub> ≤ V <sub>IL</sub> or ≥ V <sub>IH</sub> , I <sub>I/O</sub> = 0       | 350   | 300   | 250   | 230    | 210    | mA   |
| I <sub>SB</sub>  | Standby Current:               | Device Deselected<br>V <sub>IN</sub> ≤ V <sub>IL</sub> or ≥ V <sub>IH</sub> , 0 MHz<br>All inputs static | 20    | 20    | 20    | 20     | 20     | mA   |
| I <sub>SB1</sub> | Standby Current:               | Device Deselected<br>V <sub>IN</sub> ≤ 0.2V or ≥ V <sub>CC</sub> - 0.2V<br>All inputs static, 0 MHz      | 3     | 3     | 3     | 3      | 3      | mA   |
| I <sub>SB2</sub> | Standby Current:               | Device Deselected<br>V <sub>IN</sub> ≤ V <sub>IL</sub> or ≥ V <sub>IH</sub> ,<br>All inputs static       | 60    | 55    | 50    | 45     | 40     | mA   |
| I <sub>SB3</sub> | Sleep Mode<br>Standby Current: | Device Deselected<br>ZZ ≥ V <sub>CCQ</sub> - 0.2V  | 3     | 3     | 3     | 3      | 3      | mA   |

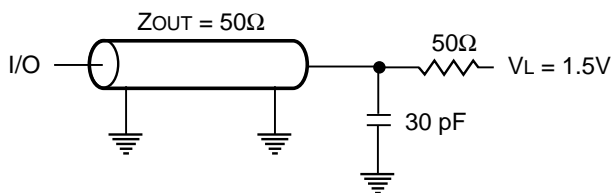
**Capacitance** ( $T_A = +25^\circ\text{C}$ ,  $f = 1.0\text{ MHz}$ )

| Symbol    | Parameter          | Conditions     | Max. | Unit |
|-----------|--------------------|----------------|------|------|
| $C_{IN}$  | Input Capacitance  | $V_{IN} = 0V$  | 6    | pF   |
| $C_{OUT}$ | Output Capacitance | $V_{OUT} = 0V$ | 8    | pF   |

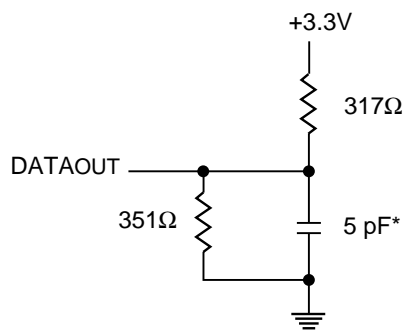
NOTES: 1. Characterized values, not currently tested.

**AC Test Conditions**

|                               |                     |
|-------------------------------|---------------------|
| Input pulse levels            | $V_{SS}$ to 3.0V    |
| Input rise and fall times     | 1.5 ns              |
| Input timing reference levels | 1.5V                |
| Output reference levels       | 1.5V                |
| Output load                   | See Figures 1 and 2 |



**Figure 1. Output Load**



**Figure 2. Output Load**

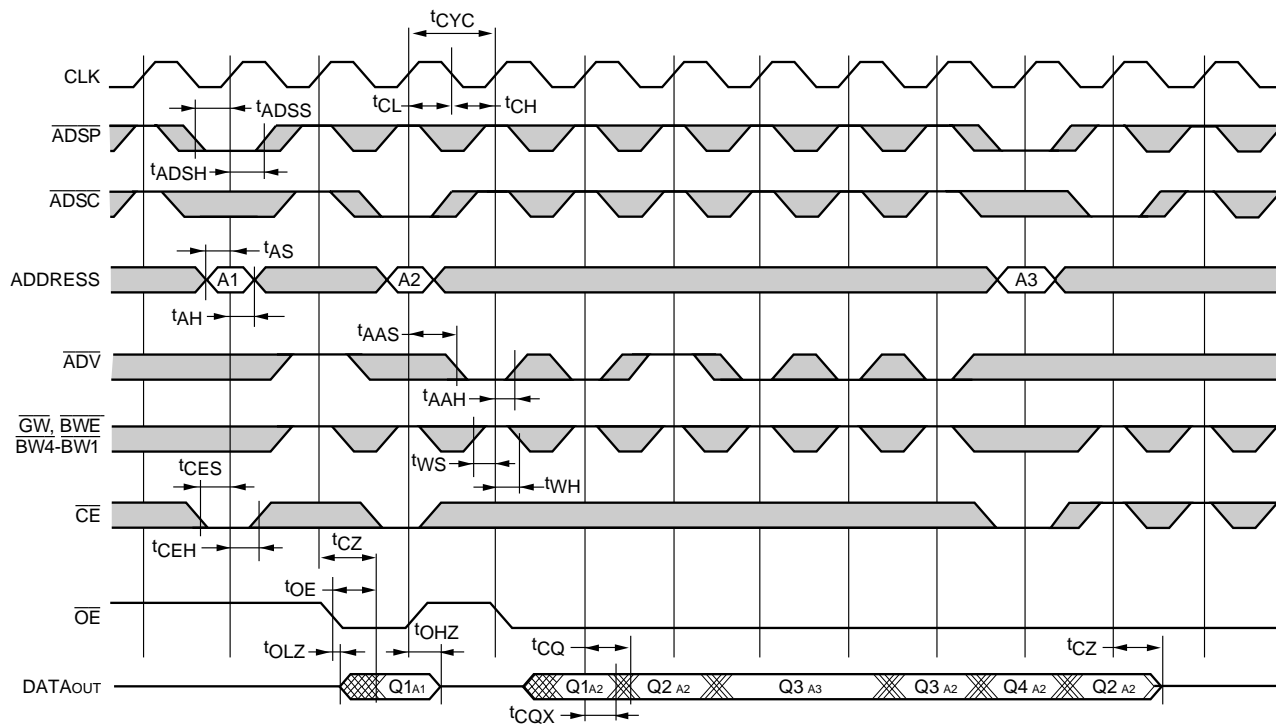
$t_{CQ}$ ,  $t_{OLZ}$ ,  $t_{OHZ}$ ,  $t_{CZ}$



### AC Electrical Characteristics

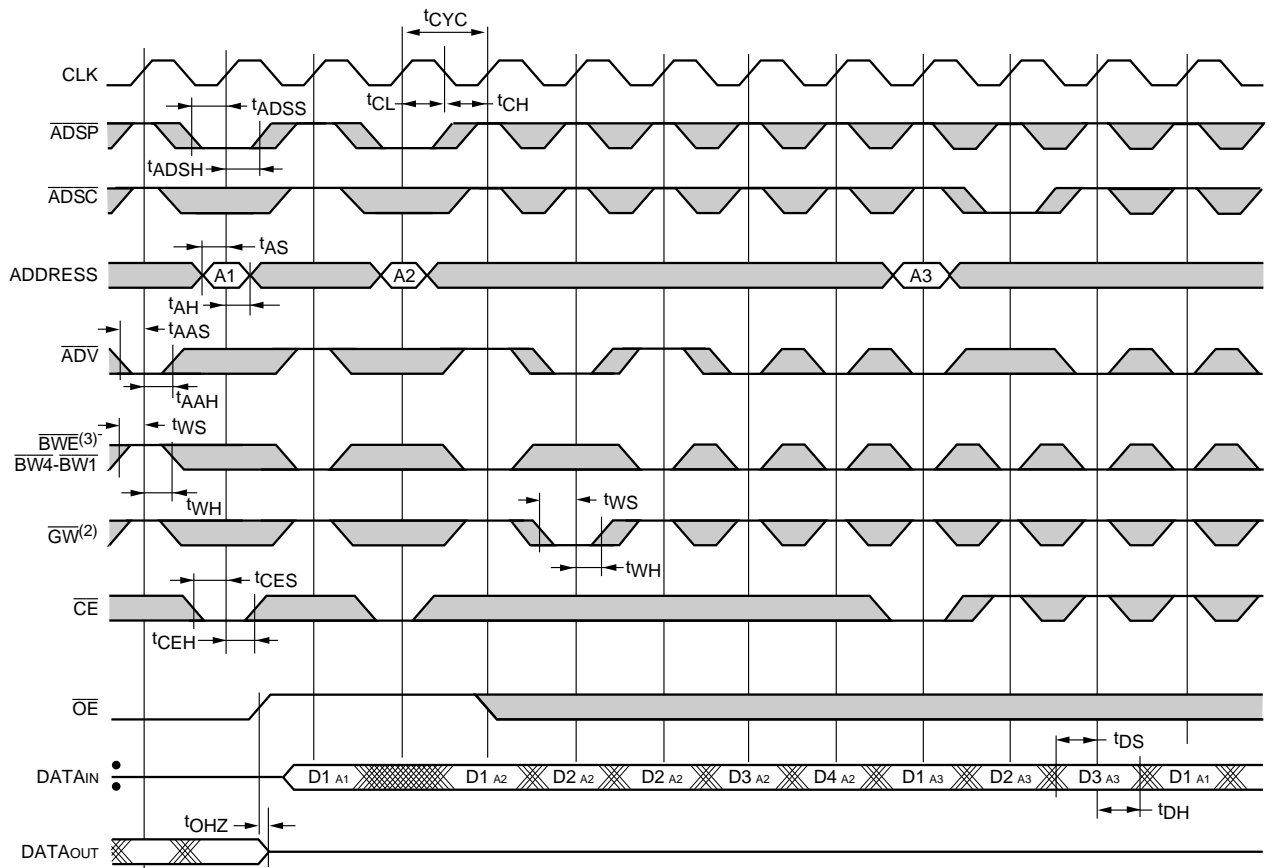
| Parameter   | Symbol      | -6 ns | -7 ns | -8 ns | -10 ns | -12 ns | Type | Units |
|---|-------------|-------|-------|-------|--------|--------|------|-------|
| Cycle time  | $t_{CYC}$   | 10    | 12.5  | 15    | 16.7   | 20     | Min. | ns    |
| Clock access time (0 pF load)                               | $t_{CQ0}$   | 5     | 6     | 7     | 9      | 11     | Max. | ns    |
| Clock to output valid (Std. load)                           | $t_{CQ}$    | 6     | 7     | 8     | 10     | 12     | Max. | ns    |
| Clock to output invalid                                     | $t_{CQX}$   | 2     | 2     | 2     | 2      | 2      | Min. | ns    |
| Clock to output high-Z                                      | $t_{CHZ}$   | 2     | 2     | 2     | 2      | 2      | Min. | ns    |
|   |             | 10    | 12.5  | 15    | 16.7   | 20     | Max. |       |
| Clock pulse width high                                      | $t_{CH}$    | 4     | 5     | 5     | 6      | 6      | Min. | ns    |
| Clock pulse width low                                       | $t_{CL}$    | 4     | 5     | 5     | 6      | 6      | Min. | ns    |
| $\overline{OE}$ to output valid                             | $t_{OE}$    | 5     | 5     | 5     | 6      | 6      | Min. | ns    |
| $\overline{OE}$ to output low-Z                             | $t_{OLZ}$   | 0     | 0     | 0     | 0      | 0      | Min. | ns    |
| $\overline{OE}$ to output high-Z                            | $t_{OHZ}$   | 5     | 5     | 5     | 6      | 6      | Max. | ns    |
| ZZ standby time   | $t_{ZZS}$   | 100   | 100   | 100   | 100    | 100    | Max. | ns    |
| ZZ recovery time  | $t_{ZZREC}$ | 100   | 100   | 100   | 100    | 100    | Min. | ns    |
| <b>SETUP TIMES</b>  |             |       |       |       |        |        |      |       |
| Address   | $t_{AS}$    | 2.5   | 2.5   | 2.5   | 2.5    | 3      | Min. | ns    |
| Address status ( $\overline{ADSC}$ , $\overline{ADSP}$ )    | $t_{AAS}$   | 2.5   | 2.5   | 2.5   | 2.5    | 3      | Min. | ns    |
| Address advance setup ( $\overline{ADV}$ )                  | $t_{AAS}$   | 2.5   | 2.5   | 2.5   | 2.5    | 3      | Min. | ns    |
| Write signals ( $\overline{BWx}$ , $\overline{GW}$ )        | $t_{WS}$    | 2.5   | 2.5   | 2.5   | 2.5    | 3      | Min. | ns    |
| Data in   | $t_{DS}$    | 2.5   | 2.5   | 2.5   | 2.5    | 3      | Min. | ns    |
| Chip enables ( $\overline{CE}$ , $\overline{CE2}$ , $CE2$ ) | $t_{CES}$   | 2.5   | 2.5   | 2.5   | 2.5    | 3      | Min. | ns    |
| <b>HOLD TIMES</b>   |             |       |       |       |        |        |      |       |
| Address   | $t_{AH}$    | 0.5   | 0.5   | 0.5   | 0.5    | 0.5    | Min. | ns    |
| Address status ( $\overline{ADSC}$ , $\overline{DSP}$ )     | $t_{ADSH}$  | 0.5   | 0.5   | 0.5   | 0.5    | 0.5    | Min. | ns    |
| Address advance ( $\overline{ADV}$ )                        | $t_{AAH}$   | 0.5   | 0.5   | 0.5   | 0.5    | 0.5    | Min. | ns    |
| Write eignals ( $\overline{BWx}$ , $\overline{GW}$ )        | $t_{WH}$    | 0.5   | 0.5   | 0.5   | 0.5    | 0.5    | Min. | ns    |
| Data in   | $t_{DH}$    | 0.5   | 0.5   | 0.5   | 0.5    | 0.5    | Min. | ns    |
| Chip enables ( $\overline{CE}$ , $\overline{CE2}$ , $CE2$ ) | $t_{CEH}$   | 0.5   | 0.5   | 0.5   | 0.5    | 0.5    | Min. | ns    |

Read Timing Diagram



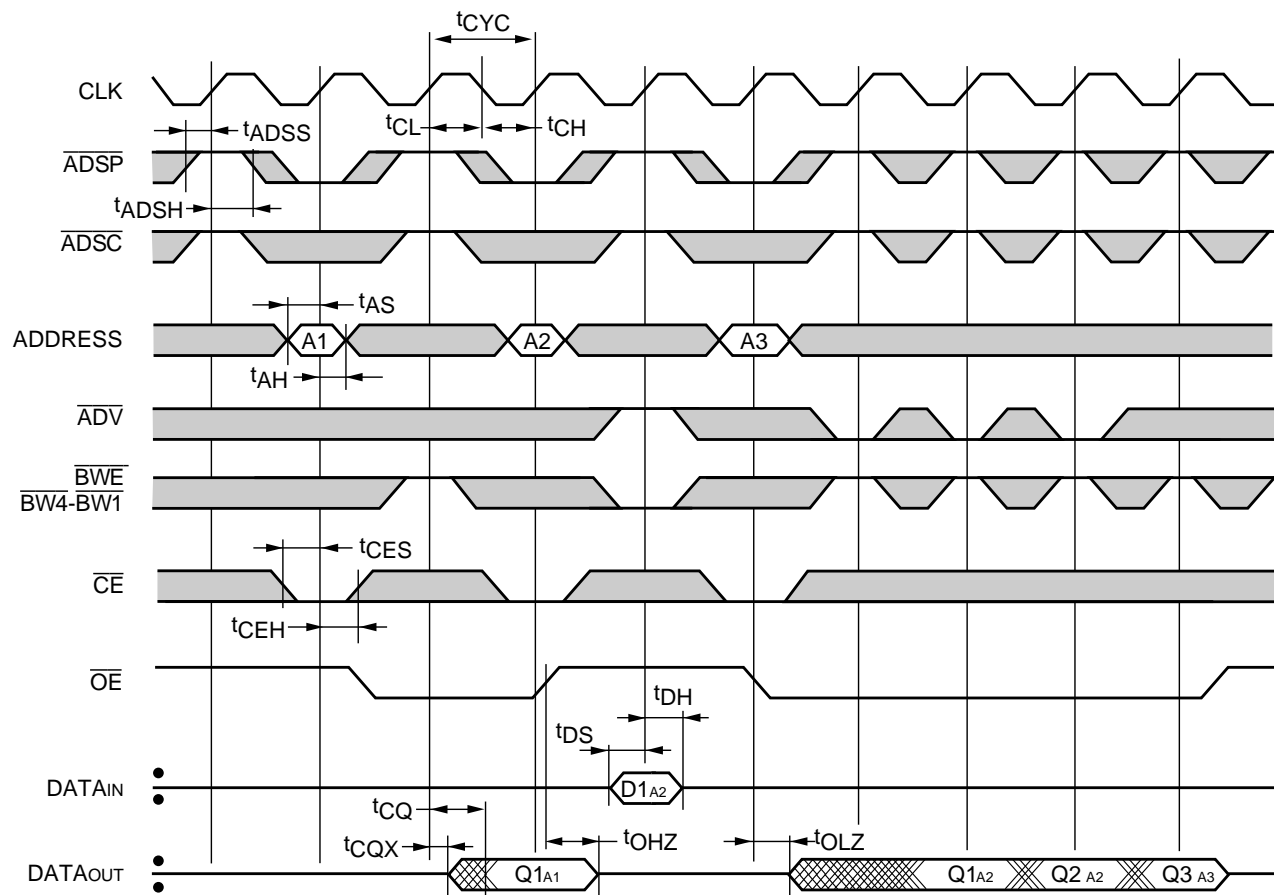
- NOTES: 1. Qn(A2) refers to output from address A2. Q1–4 refers to outputs according to burst sequence.  
 2.  $\overline{CE2}$  and CE2 have timing identical to  $\overline{CE}$ . In this diagram, when  $\overline{CE}$  is low,  $\overline{CE2}$  is low and CE2 is high. When  $\overline{CE}$  is high, CE2 is high and CE2 is low.

### Write Timing Diagram



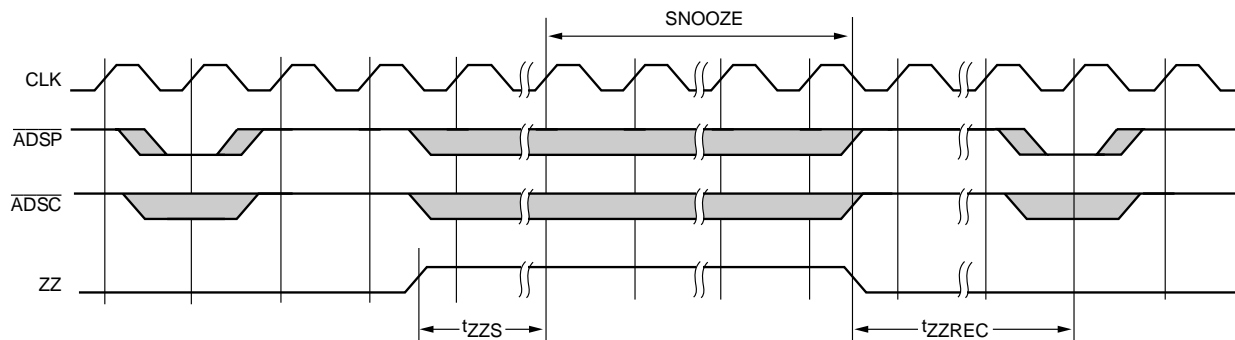
- NOTES: 1.  $\overline{CE2}$  and CE2 have timing identical to  $\overline{CE}$ . On this diagram, when  $\overline{CE}$  is low,  $\overline{CE2}$  is low and CE2 is high. When  $\overline{CE}$  is high, CE2 is high and CE2 is low.
2. Full width write can be initiated by  $\overline{GW}$  low or  $\overline{GW}$  high and  $\overline{BWE}$ ,  $\overline{BW1-BW4}$  low.
3.  $\overline{BWE}$  is low when any one or more byte write enables ( $\overline{BW1-BW4}$ ) are low in this diagram.

Read/Write Timing Diagram



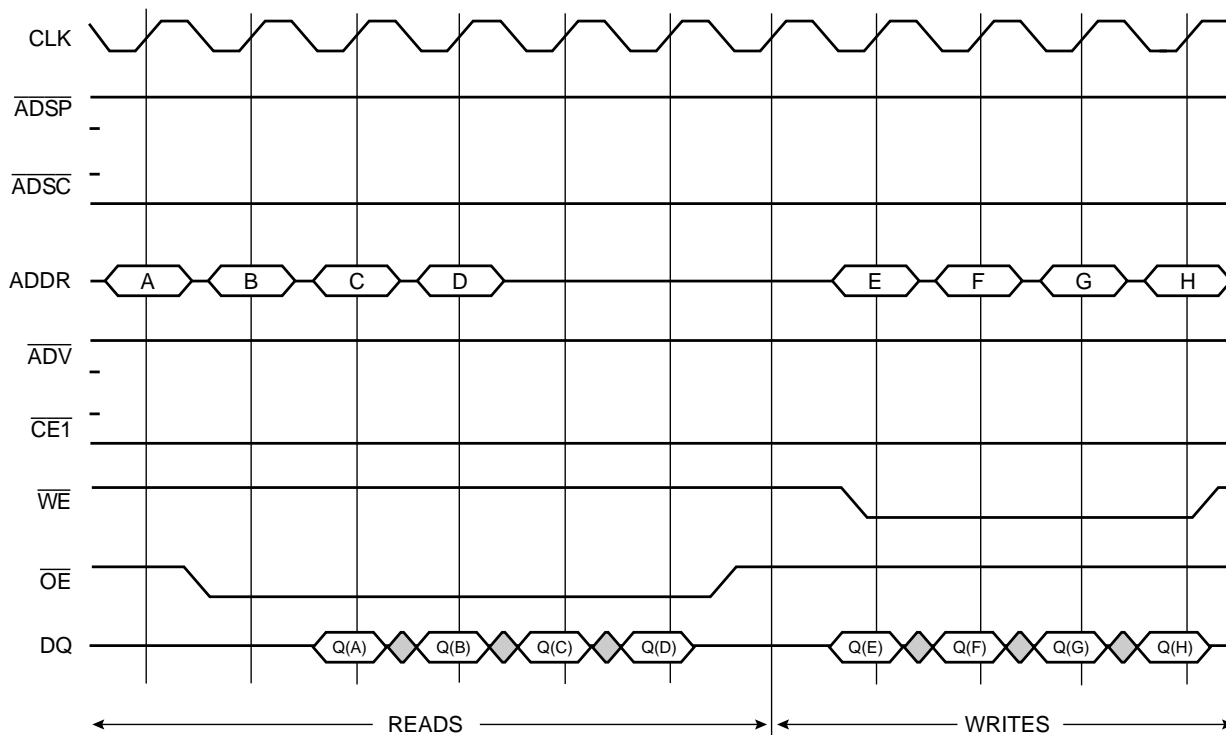
- NOTES: 1.  $\overline{CE2}$  and CE2 have timing identical to  $\overline{CE}$ . On this diagram, when  $\overline{CE}$  is low,  $\overline{CE2}$  is low and CE2 is high. When  $\overline{CE}$  is high,  $\overline{CE2}$  is high and CE2 is low.  
 2.  $\overline{GW}$  is high.

### Sleep Mode Timing Diagram



- NOTES: 1. Data retention is guaranteed when ZZ is asserted and clock remains active.  
 2. ADSC and ADSP must not be asserted for at least 100 ns after leaving ZZ state.

### Sequential Non-burst Read and Write Timing Diagram



NOTES:

1.  $\overline{ADSP} = \text{high}$ ,  $\overline{ADSC} = \text{low}$ ,  $\overline{ADV} = \text{high}$ ,  $\overline{CE1} = \text{low}$ .  
 2.  $H \geq V_{IH}$ ,  $L \leq V_{IL}$ .

Ordering Information

