
Document Title

512Kx36 & 1Mx18-Bit Synchronous Pipelined Burst SRAM

Revision History

| <u>Rev. No.</u> | <u>History</u> | <u>Draft Date</u> | <u>Remark</u> |
|-----------------|---|-------------------|---------------|
| 0.0 | Initial draft | Jan. 18. 1999 | Preliminary |
| 0.1 | 1. Update ICC & ISB values. 2. Remove tCYC 117MHz (-85) | May. 27. 1999 | Preliminary |
| 0.2 | 1. Change ISB value from 150mA to 110mA at -67. 2. Change ISB value from 130mA to 90mA at -72 . 3. Change ISB value from 120mA to 80mA at -10 . | Sep. 04. 1999 | Preliminary |
| 0.3 | 1. Changed DC condition at Icc and parameters Icc ; from 420mA to 400mA at -67, from 400mA to 380mA at -72, from 350mA to 320mA at -10, | Nov. 19. 1999 | Preliminary |
| 1.0 | 1. Final Spec Release. | Dec. 08. 1999 | Final |
| 2.0 | 1.Remove tCYC 100MHz . | Feb. 23. 2001 | Final |
| 3.0 | 1. Change Access time(tCD & tOE) tCD & tOE ; from 3.8ns to 3.0ns at -15 from 4.0ns to 3.5ns at -14 | May. 23. 2001 | Final |
| 4.0 | 1. Add tCYC 167MHz (-16) | May. 30. 2001 | Final |

The attached data sheets are prepared and approved by SAMSUNG Electronics. SAMSUNG Electronics CO., LTD. reserve the right to change the specifications. SAMSUNG Electronics will evaluate and reply to your requests and questions on the parameters of this device. If you have any questions, please contact the SAMSUNG branch office near your office, call or contact Headquarters.

K7A163601M K7A161801M

512Kx36 & 1Mx18 Synchronous SRAM

512Kx36 & 1Mx18-Bit Synchronous Pipelined Burst SRAM

FEATURES

- Synchronous Operation.
- 2 Stage Pipelined operation with 4 Burst.
- On-Chip Address Counter.
- Self-Timed Write Cycle.
- On-Chip Address and Control Registers.
- $V_{DD} = 3.3V \pm 0.165V / -0.165V$ Power Supply.
- I/O Supply Voltage $3.3V \pm 0.165V / -0.165V$ for 3.3V I/O or $2.5V \pm 0.4V / -0.125V$ for 2.5V I/O.
- 5V Tolerant Inputs Except I/O Pins.
- Byte Writable Function.
- Global Write Enable Controls a full bus-width write.
- Power Down State via ZZ Signal.
- LBO Pin allows a choice of either a interleaved burst or a linear burst.
- Three Chip Enables for simple depth expansion with No Data Contention ; 2cycle Enable, 2cycle Disable.
- Asynchronous Output Enable Control.
- \overline{ADSP} , \overline{ADSC} , \overline{ADV} Burst Control Pins.
- TTL-Level Three-State Output.
- 100-TQFP-1420A Package

FAST ACCESS TIMES

| PARAMETER | Symbol | -16 | -15 | -14 | Unit |
|---------------------------|--------|-----|-----|-----|------|
| Cycle Time | tcyc | 6.0 | 6.7 | 7.2 | ns |
| Clock Access Time | tcd | 3.0 | 3.0 | 3.5 | ns |
| Output Enable Access Time | toe | 3.0 | 3.0 | 3.5 | ns |

GENERAL DESCRIPTION

The K7A163601M and K7A161801M are 18,874,368-bit Synchronous Static Random Access Memory designed for high performance second level cache of Pentium and Power PC based System.

It is organized as 512K(1M) words of 36(18) bits and integrates address and control registers, a 2-bit burst address counter and added some new functions for high performance cache RAM applications; \overline{GW} , \overline{BW} , \overline{LBO} , ZZ. Write cycles are internally self-timed and synchronous.

Full bus-width write is done by \overline{GW} , and each byte write is performed by the combination of \overline{WE}_x and \overline{BW} when \overline{GW} is high. And with \overline{CS}_1 high, \overline{ADSP} is blocked to control signals.

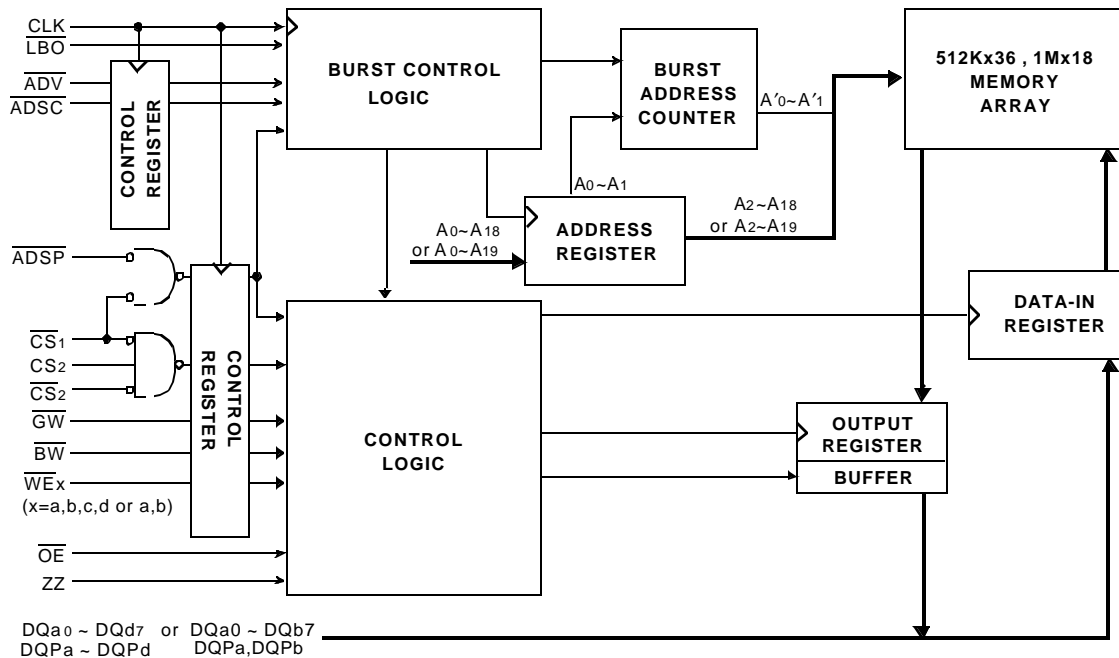
Burst cycle can be initiated with either the address status processor (\overline{ADSP}) or address status cache controller (\overline{ADSC}) inputs. Subsequent burst addresses are generated internally in the system's burst sequence and are controlled by the burst address advance (\overline{ADV}) input.

\overline{LBO} pin is DC operated and determines burst sequence (linear or interleaved).

ZZ pin controls Power Down State and reduces Stand-by current regardless of CLK.

The K7A163601M and K7A161801M are fabricated using SAMSUNG's high performance CMOS technology and is available in a 100pin TQFP package. Multiple power and ground pins are utilized to minimize ground bounce.

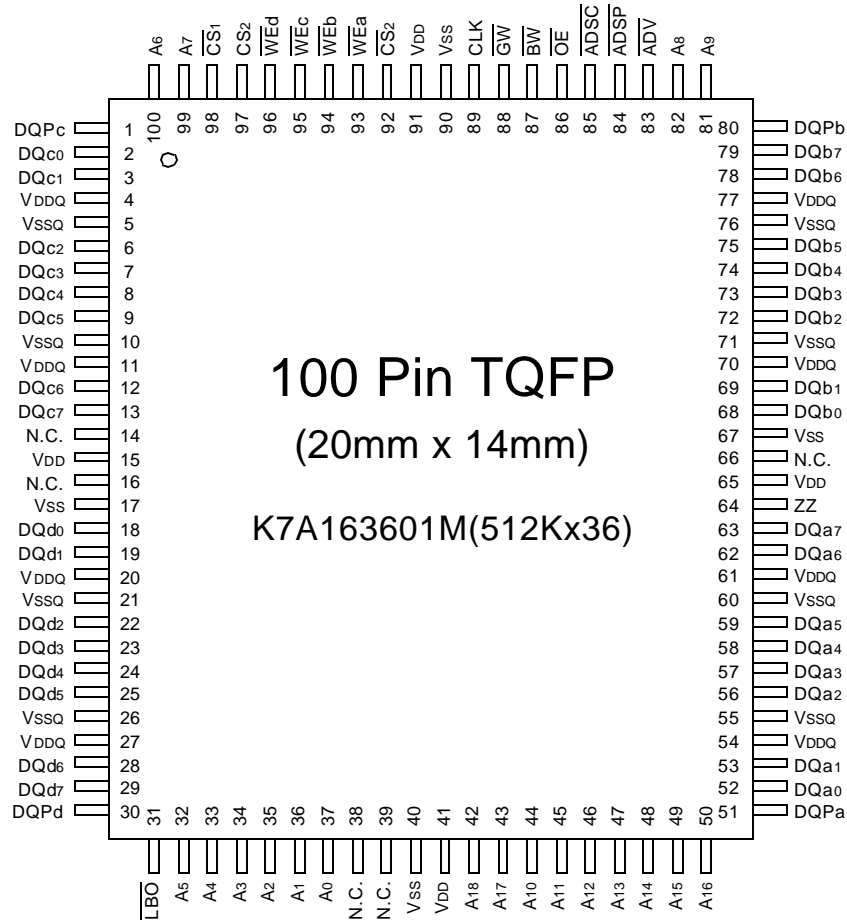
LOGIC BLOCK DIAGRAM



**K7A163601M
K7A161801M**

512Kx36 & 1Mx18 Synchronous SRAM

PIN CONFIGURATION(TOP VIEW)



PIN NAME

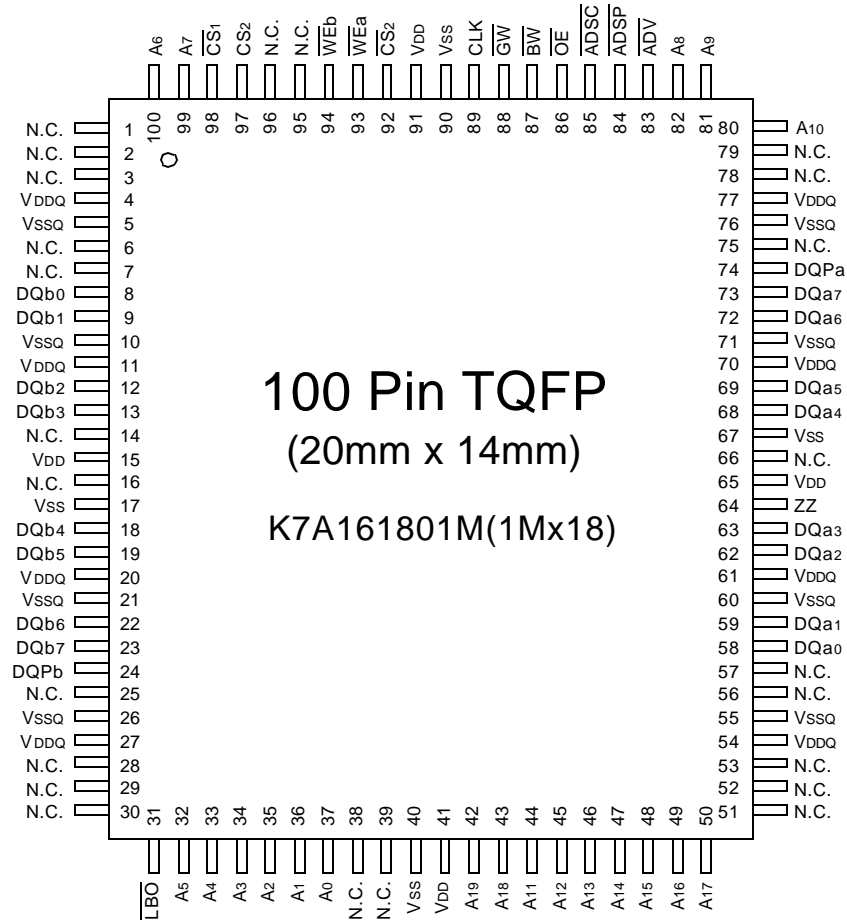
| SYMBOL | PIN NAME | TQFP PIN NO. | SYMBOL | PIN NAME | TQFP PIN NO. |
|----------------------------------|---------------------------|---|----------------------------------|---------------------------------------|-------------------------|
| A ₀ - A ₁₈ | Address Inputs | 32,33,34,35,36,37,42 43,44,45,46,47,48,49 50,81,82,99,100 | VDD | Power Supply(+3.3V) | 15,41,65,91 |
| | | | VSS | Ground | 17,40,67,90 |
| ADV | Burst Address Advance | 83 | N.C. | No Connect | 14,16,38,39,66 |
| ADSP | Address Status Processor | 84 | DQa ₀ -a ₇ | Data Inputs/Outputs | 52,53,56,57,58,59,62,63 |
| ADSC | Address Status Controller | 85 | DQb ₀ -b ₇ | | 68,69,72,73,74,75,78,79 |
| CLK | Clock | 89 | DQc ₀ -c ₇ | | 2,3,6,7,8,9,12,13 |
| CS ₁ | Chip Select | 98 | DQd ₀ -d ₇ | | 18,19,22,23,24,25,28,29 |
| CS ₂ | Chip Select | 97 | DQPa~Pd | | 51,80,1,30 |
| CS ₂ | Chip Select | 92 | | | |
| WE _x (x=a,b,c,d) | Byte Write Inputs | 93,94,95,96 | VDDQ | Output Power Supply (3.3V or 2.5V) | 4,11,20,27,54,61,70,77 |
| OE | Output Enable | 86 | VSSQ | Output Ground | 5,10,21,26,55,60,71,76 |
| GW | Global Write Enable | 88 | | | |
| BW | Byte Write Enable | 87 | | | |
| ZZ | Power Down Input | 64 | | | |
| LBO | Burst Mode Control | 31 | | | |

Note : 1. A₀ and A₁ are the two least significant bits(LSB) of the address field and set the internal burst counter if burst is desired.

**K7A163601M
K7A161801M**

512Kx36 & 1Mx18 Synchronous SRAM

PIN CONFIGURATION(TOP VIEW)



PIN NAME

| SYMBOL | PIN NAME | TQFP PIN NO. | SYMBOL | PIN NAME | TQFP PIN NO. |
|-----------|---------------------------|--|-----------|---------------------------------------|--|
| A0 - A19 | Address Inputs | 32,33,34,35,36,37,42 43,44,45,46,47,48,49 50 80,81,82,99,100 | VDD | Power Supply(+3.3V) | 15,41,65,91 |
| | | | VSS | Ground | 17,40,67,90 |
| ADV | Burst Address Advance | 83 | N.C. | No Connect | 1,2,3,6,7,14,16,25,28,29 30,38,39,51,52,53,56,57 66,75,78,79,95,96 |
| ADSP | Address Status Processor | 84 | | | |
| ADSC | Address Status Controller | 85 | | | |
| CLK | Clock | 89 | | | |
| CS1 | Chip Select | 98 | DQa0 ~ a7 | Data Inputs/Outputs | 58,59,62,63,68,69,72,73 |
| CS2 | Chip Select | 97 | DQb0 ~ b7 | | 8,9,12,13,18,19,22,23 |
| CS2 | Chip Select | 92 | DQPa, Pb | | 74,24 |
| WE(x=a,b) | Byte Write Inputs | 93,94 | VDDQ | Output Power Supply (3.3V or 2.5V) | 4,11,20,27,54,61,70,77 |
| OE | Output Enable | 86 | VSSQ | Output Ground | 5,10,21,26,55,60,71,76 |
| GW | Global Write Enable | 88 | | | |
| BW | Byte Write Enable | 87 | | | |
| ZZ | Power Down Input | 64 | | | |
| LBO | Burst Mode Control | 31 | | | |

Note : 1. A₀ and A₁ are the two least significant bits(LSB) of the address field and set the internal burst counter if burst is desired.

FUNCTION DESCRIPTION

The K7A163601M and K7A161801M are synchronous SRAM designed to support the burst address accessing sequence of the Power PC based microprocessor. All inputs (with the exception of \overline{OE} , \overline{LBO} and \overline{ZZ}) are sampled on rising clock edges. The start and duration of the burst access is controlled by \overline{ADSC} , \overline{ADSP} and \overline{ADV} and chip select pins.

The accesses are enabled with the chip select signals and output enabled signals. Wait states are inserted into the access with \overline{ADV} .

When \overline{ZZ} is pulled high, the SRAM will enter a Power Down State. At this time, internal state of the SRAM is preserved. When \overline{ZZ} returns to low, the SRAM normally operates after 2cycles of wake up time. \overline{ZZ} pin is pulled down internally.

Read cycles are initiated with \overline{ADSP} (regardless of \overline{WEx} and \overline{ADSC})using the new external address clocked into the on-chip address register whenever \overline{ADSP} is sampled low, the chip selects are sampled active, and the output buffer is enabled with \overline{OE} . In read operation the data of cell array accessed by the current address, registered in the Data-out registers by the positive edge of \overline{CLK} , are carried to the Data-out buffer by the next positive edge of \overline{CLK} . The data, registered in the Data-out buffer, are projected to the output pins. \overline{ADV} is ignored on the clock edge that samples \overline{ADSP} asserted, but is sampled on the subsequent clock edges. The address increases internally for the next access of the burst when \overline{WEx} are sampled High and \overline{ADV} is sampled low. And \overline{ADSP} is blocked to control signals by disabling $\overline{CS1}$.

All byte write is done by \overline{GW} (regardless of \overline{BW} and \overline{WEx}), and each byte write is performed by the combination of \overline{BW} and \overline{WEx} when \overline{GW} is high.

Write cycles are performed by disabling the output buffers with \overline{OE} and asserting \overline{WEx} . \overline{WEx} are ignored on the clock edge that samples \overline{ADSP} low, but are sampled on the subsequent clock edges. The output buffers are disabled when \overline{WEx} are sampled Low(regardless of \overline{OE}). Data is clocked into the data input register when \overline{WEx} sampled Low. The address increases internally to the next address of burst, if both \overline{WEx} and \overline{ADV} are sampled Low. Individual byte write cycles are performed by any one or more byte write enable signals(\overline{WEa} , \overline{WEb} , \overline{WEc} or \overline{WEd}) sampled low. The \overline{WEa} control $\overline{DQa0} \sim \overline{DQa7}$ and $\overline{DQP a}$, \overline{WEb} controls $\overline{DQb0} \sim \overline{DQb7}$ and $\overline{DQP b}$, \overline{WEc} controls $\overline{DQc0} \sim \overline{DQc7}$ and $\overline{DQP c}$, and \overline{WEd} control $\overline{DQd0} \sim \overline{DQd7}$ and $\overline{DQP d}$. Read or write cycle may also be initiated with \overline{ADSC} , instead of \overline{ADSP} . The differences between cycles initiated with \overline{ADSC} and \overline{ADSP} as are follows;

\overline{ADSP} must be sampled high when \overline{ADSC} is sampled low to initiate a cycle with \overline{ADSC} .

\overline{WEx} are sampled on the same clock edge that sampled \overline{ADSC} low(and \overline{ADSP} high).

Addresses are generated for the burst access as shown below, The starting point of the burst sequence is provided by the external address. The burst address counter wraps around to its initial state upon completion. The burst sequence is determined by the state of the \overline{LBO} pin. When this pin is Low, linear burst sequence is selected. When this pin is High, Interleaved burst sequence is selected.

BURST SEQUENCE TABLE

(Interleaved Burst)

| \overline{LBO} PIN | HIGH | Case 1 | | Case 2 | | Case 3 | | Case 4 | |
|--------------------------------------|------|--------|----|--------|----|--------|----|--------|----|
| | | A1 | A0 | A1 | A0 | A1 | A0 | A1 | A0 |
| First Address ↓ Fourth Address | | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| | | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 |
| | | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| | | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |

(Linear Burst)

| \overline{LBO} PIN | LOW | Case 1 | | Case 2 | | Case 3 | | Case 4 | |
|--------------------------------------|-----|--------|----|--------|----|--------|----|--------|----|
| | | A1 | A0 | A1 | A0 | A1 | A0 | A1 | A0 |
| First Address ↓ Fourth Address | | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| | | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| | | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| | | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 |

Note : 1. \overline{LBO} pin must be tied to High or Low, and Floating State must not be allowed.

ASYNCHRONOUS TRUTH TABLE

| OPERATION | \overline{ZZ} | \overline{OE} | I/O Status |
|------------|-----------------|-----------------|-------------|
| Sleep Mode | H | X | High-Z |
| Read | L | L | DQ |
| | L | H | High-Z |
| Write | L | X | Din, High-Z |
| Deselected | L | X | High-Z |

Notes

1. X means "Don't Care".
2. \overline{ZZ} pin is pulled down internally
3. For write cycles that following read cycles, the output buffers must be disabled with \overline{OE} , otherwise data bus contention will occur.
4. Sleep Mode means power down state of which stand-by current does not depend on cycle time.
5. Deselected means power down state of which stand-by current depends on cycle time.

TRUTH TABLES
SYNCHRONOUS TRUTH TABLE

| CS ₁ | CS ₂ | CS ₂ | ADSP | ADSC | ADV | WRITE | CLK | ADDRESS ACCESSED | Operation |
|-----------------|-----------------|-----------------|------|------|-----|-------|-----|------------------|----------------------------|
| H | X | X | X | L | X | X | ↑ | N/A | Not Selected |
| L | L | X | L | X | X | X | ↑ | N/A | Not Selected |
| L | X | H | L | X | X | X | ↑ | N/A | Not Selected |
| L | L | X | X | L | X | X | ↑ | N/A | Not Selected |
| L | X | H | X | L | X | X | ↑ | N/A | Not Selected |
| L | H | L | L | X | X | X | ↑ | External Address | Begin Burst Read Cycle |
| L | H | L | H | L | X | L | ↑ | External Address | Begin Burst Write Cycle |
| L | H | L | H | L | X | H | ↑ | External Address | Begin Burst Read Cycle |
| X | X | X | H | H | L | H | ↑ | Next Address | Continue Burst Read Cycle |
| H | X | X | X | H | L | H | ↑ | Next Address | Continue Burst Read Cycle |
| X | X | X | H | H | L | L | ↑ | Next Address | Continue Burst Write Cycle |
| H | X | X | X | H | L | L | ↑ | Next Address | Continue Burst Write Cycle |
| X | X | X | H | H | H | H | ↑ | Current Address | Suspend Burst Read Cycle |
| H | X | X | X | H | H | H | ↑ | Current Address | Suspend Burst Read Cycle |
| X | X | X | H | H | H | L | ↑ | Current Address | Suspend Burst Write Cycle |
| H | X | X | X | H | H | L | ↑ | Current Address | Suspend Burst Write Cycle |

- Notes :** 1. X means "Don't Care". 2. The rising edge of clock is symbolized by ↑.
3. WRITE = L means Write operation in WRITE TRUTH TABLE.
WRITE = H means Read operation in WRITE TRUTH TABLE.
4. Operation finally depends on status of asynchronous input pins(ZZ and OE).

WRITE TRUTH TABLE^(x36)

| GW | BW | WE _a | WE _b | WE _c | WE _d | OPERATION |
|----|----|-----------------|-----------------|-----------------|-----------------|--------------------|
| H | H | X | X | X | X | READ |
| H | L | H | H | H | H | READ |
| H | L | L | H | H | H | WRITE BYTE a |
| H | L | H | L | H | H | WRITE BYTE b |
| H | L | H | H | L | L | WRITE BYTE c and d |
| H | L | L | L | L | L | WRITE ALL BYTEs |
| L | X | X | X | X | X | WRITE ALL BYTEs |

- Notes :** 1. X means "Don't Care".
2. All inputs in this table must meet setup and hold time around the rising edge of CLK(↑).

WRITE TRUTH TABLE^(x18)

| GW | BW | WE _a | WE _b | OPERATION |
|----|----|-----------------|-----------------|-----------------|
| H | H | X | X | READ |
| H | L | H | H | READ |
| H | L | L | H | WRITE BYTE a |
| H | L | H | L | WRITE BYTE b |
| H | L | L | L | WRITE ALL BYTEs |
| L | X | X | X | WRITE ALL BYTEs |

- Notes :** 1. X means "Don't Care".
2. All inputs in this table must meet setup and hold time around the rising edge of CLK(↑).

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PASS-THROUGH TRUTH TABLE

| PREVIOUS CYCLE | | PRESENT CYCLE | | | | NEXT CYCLE |
|---|-------|--|-----------------|-------|----|-------------------------------------|
| OPERATION | WRITE | OPERATION | CS ₁ | WRITE | OE | |
| Write Cycle, All bytes Address=An-1, Data=Dn-1 | All L | Initiate Read Cycle Address=An Data=Qn-1 for all bytes | L | H | L | Read Cycle Data=Qn |
| Write Cycle, All bytes Address=An-1, Data=Dn-1 | All L | No new cycle Data=Qn-1 for all bytes | H | H | L | No carryover from previous cycle |
| Write Cycle, All bytes Address=An-1, Data=Dn-1 | All L | No new cycle Data=High-Z | H | H | H | No carryover from previous cycle |
| Write Cycle, One byte Address=An-1, Data=Dn-1 | One L | Initiate Read Cycle Address=An Data=Qn-1 for one byte | L | H | L | Read Cycle Data=Qn |
| Write Cycle, One byte Address=An-1, Data=Dn-1 | One L | No new cycle Data=Qn-1 for one byte | H | H | L | No carryover from previous cycle |

Note : 1. This operation makes written data immediately available at output during a read cycle preceded by a write cycle.

ABSOLUTE MAXIMUM RATINGS*

| PARAMETER | SYMBOL | RATING | UNIT |
|--|-------------------|-------------------------------|------|
| Voltage on V _{DD} Supply Relative to V _{SS} | V _{DD} | -0.3 to 4.6 | V |
| Voltage on V _{DDQ} Supply Relative to V _{SS} | V _{DDQ} | V _{DD} | V |
| Voltage on Input Pin Relative to V _{SS} | V _{IN} | -0.3 to 4.6 | V |
| Voltage on I/O Pin Relative to V _{SS} | V _{IO} | -0.3 to V _{DDQ} +0.5 | V |
| Power Dissipation | P _D | 1.6 | W |
| Storage Temperature | T _{STG} | -65 to 150 | °C |
| Operating Temperature | T _{OPR} | 0 to 70 | °C |
| Storage Temperature Range Under Bias | T _{BIAS} | -10 to 85 | °C |

***Note** : 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 operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

OPERATING CONDITIONS at 3.3V I/O(0°C ≤ T_A ≤ 70°C)

| PARAMETER | SYMBOL | MIN | Typ. | Max | Unit |
|----------------|------------------|-------|------|-------|------|
| Supply Voltage | V _{DD} | 3.135 | 3.3 | 3.465 | V |
| | V _{DDQ} | 3.135 | 3.3 | 3.465 | V |
| Ground | V _{SS} | 0 | 0 | 0 | V |

OPERATING CONDITIONS at 2.5V I/O(0°C ≤ T_A ≤ 70°C)

| PARAMETER | SYMBOL | MIN | Typ. | Max | Unit |
|----------------|------------------|-------|------|-------|------|
| Supply Voltage | V _{DD} | 3.135 | 3.3 | 3.465 | V |
| | V _{DDQ} | 2.375 | 2.5 | 2.9 | V |
| Ground | V _{SS} | 0 | 0 | 0 | V |

CAPACITANCE*(T_A=25°C, f=1MHz)

| PARAMETER | SYMBOL | TEST CONDITION | Min | Max | Unit |
|--------------------|------------------|----------------------|-----|-----|------|
| Input Capacitance | C _{IN} | V _{IN} =0V | - | 7 | pF |
| Output Capacitance | C _{OUT} | V _{OUT} =0V | - | 9 | pF |

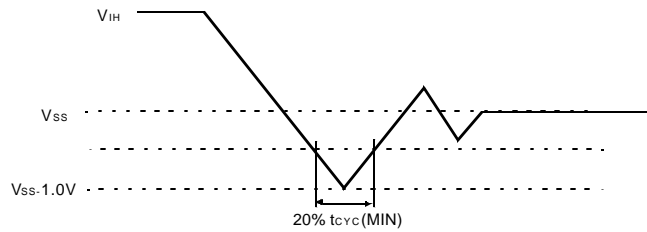
***Note** : Sampled not 100% tested.



DC ELECTRICAL CHARACTERISTICS($V_{DD}=3.3V+0.165V/-0.165V$, $T_A=0^{\circ}C$ to $+70^{\circ}C$)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | MAX | UNIT | NOTES | |
|----------------------------------|--|---|-------|------------------------|---------|-------|-----|
| Input Leakage Current(except ZZ) | I _{IL} | $V_{DD} = \text{Max}$; $V_{IN} = V_{SS}$ to V_{DD} | -2 | +2 | μA | | |
| Output Leakage Current | I _{OL} | Output Disabled, $V_{OUT} = V_{SS}$ to V_{DDQ} | -2 | +2 | μA | | |
| Operating Current | I _{CC} | Device Selected, I _{OUT} =0mA, ZZ \leq V _{IL} , Cycle Time \geq t _{cyC} Min | -16 | - | 420 | mA | 1,2 |
| | | | -15 | - | 400 | | |
| | | | -14 | - | 380 | | |
| Standby Current | I _{SB} | Device deselected, I _{OUT} =0mA, ZZ \leq V _{IL} , f=Max, All Inputs \leq 0.2V or \geq V _{DD} -0.2V | -16 | - | 120 | mA | |
| | | | -15 | - | 110 | | |
| | | | -14 | - | 90 | | |
| | I _{SB1} | Device deselected, I _{OUT} =0mA, ZZ \leq 0.2V, f=0, All Inputs=fixed (V _{DD} -0.2V or 0.2V) | - | - | 30 | mA | |
| I _{SB2} | Device deselected, I _{OUT} =0mA, ZZ \geq V _{DD} -0.2V, f=Max, All Inputs \leq V _{IL} or \geq V _{IH} | - | - | 30 | mA | | |
| Output Low Voltage(3.3V I/O) | V _{OL} | I _{OL} =8.0mA | - | 0.4 | V | | |
| Output High Voltage(3.3V I/O) | V _{OH} | I _{OH} =-4.0mA | 2.4 | - | V | | |
| Output Low Voltage(2.5V I/O) | V _{OL} | I _{OL} =1.0mA | - | 0.4 | V | | |
| Output High Voltage(2.5V I/O) | V _{OH} | I _{OH} =-1.0mA | 2.0 | - | V | | |
| Input Low Voltage(3.3V I/O) | V _{IL} | | -0.3* | 0.8 | V | | |
| Input High Voltage(3.3V I/O) | V _{IH} | | 2.0 | V _{DD} +0.5** | V | 3 | |
| Input Low Voltage(2.5V I/O) | V _{IL} | | -0.3* | 0.7 | V | | |
| Input High Voltage(2.5V I/O) | V _{IH} | | 2.0 | V _{DD} +0.5** | V | 3 | |

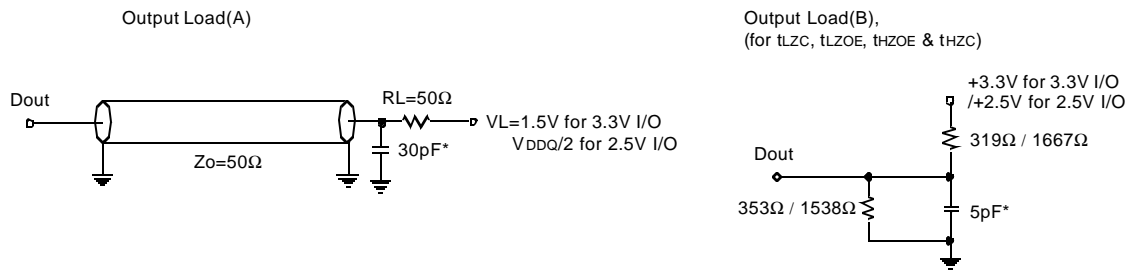
Notes : 1. Reference AC Operating Conditions and Characteristics for input and timing.
2. Data states are all zero.
3. In Case of I/O Pins, the Max. V_{IH}=V_{DDQ}+0.3V



TEST CONDITIONS

($V_{DD}=3.3V+0.165V/-0.165V$, $V_{DDQ}=3.3V+0.165V/-0.165V$ or $V_{DD}=3.3V+0.165V/-0.165V$, $V_{DDQ}=2.5V+0.4V/-0.125V$, $T_A=0$ to $70^{\circ}C$)

| Parameter | Value |
|---|---------------------|
| Input Pulse Level(for 3.3V I/O) | 0 to 3.0V |
| Input Pulse Level(for 2.5V I/O) | 0 to 2.5V |
| Input Rise and Fall Time(Measured at 20% to 80% for 3.3V I/O) | 1.0V/ns |
| Input Rise and Fall Time(Measured at 20% to 80% for 2.5V I/O) | 1.0V/ns |
| Input and Output Timing Reference Levels for 3.3V I/O | 1.5V |
| Input and Output Timing Reference Levels for 2.5V I/O | V _{DDQ} /2 |
| Output Load | See Fig. 1 |



* Including Scope and Jig Capacitance

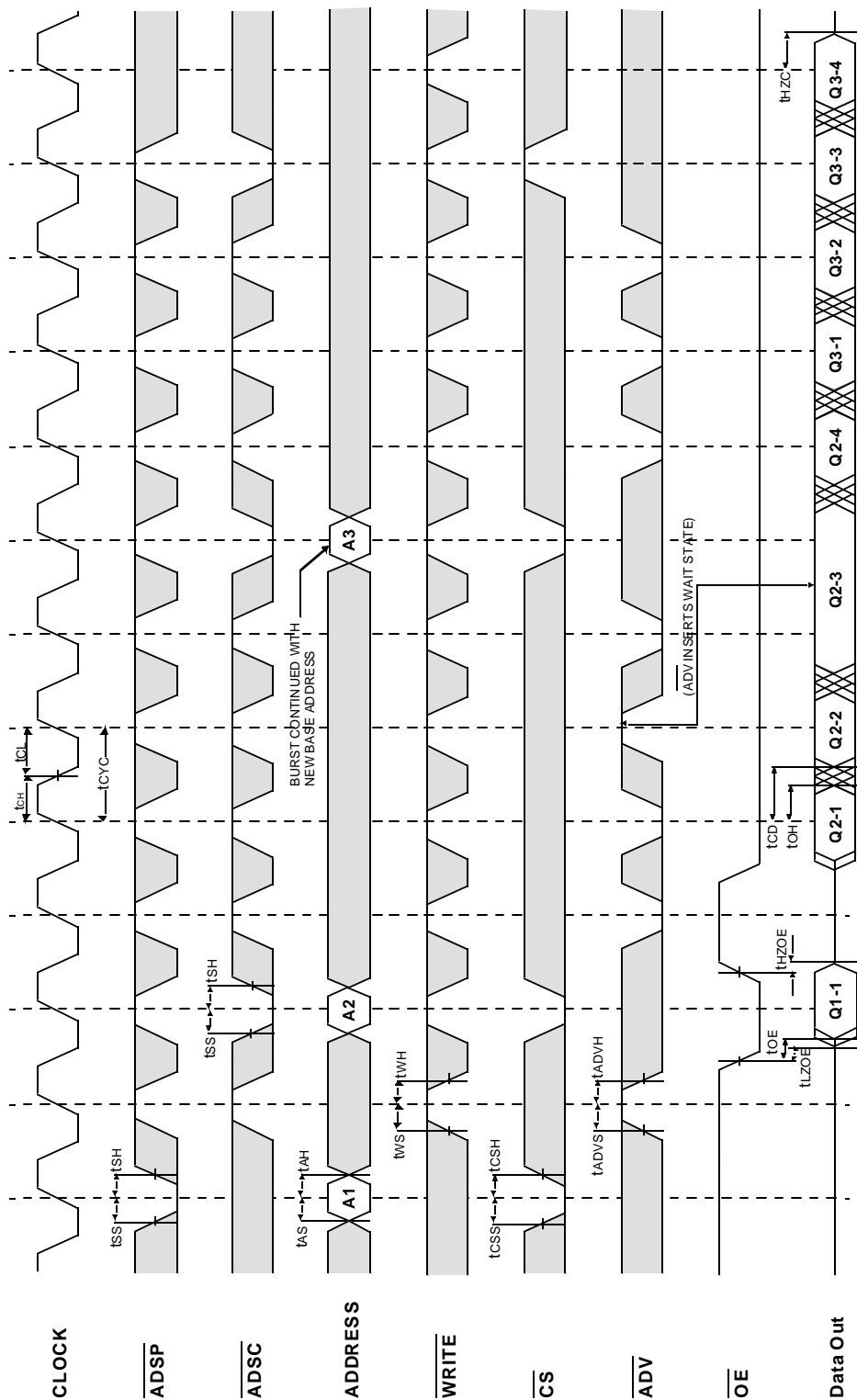
Fig. 1

AC TIMING CHARACTERISTICS(VDD=3.3V+0.165V/-0.165V, TA=0°C to +70°C)

| PARAMETER | SYMBOL | -16 | | -15 | | -14 | | UNIT |
|---|--------|-----|-----|-----|-----|-----|-----|-------|
| | | Min | Max | MIN | MAX | MIN | MAX | |
| Cycle Time | tCYC | 6.0 | - | 6.7 | - | 7.2 | - | ns |
| Clock Access Time | tCD | - | 3.0 | - | 3.0 | - | 3.5 | ns |
| Output Enable to Data Valid | tOE | - | 3.0 | - | 3.0 | - | 3.5 | ns |
| Clock High to Output Low-Z | tLZC | 0 | - | 0 | - | 0 | - | ns |
| Output Hold from Clock High | tOH | 1.5 | - | 1.5 | - | 1.5 | - | ns |
| Output Enable Low to Output Low-Z | tLZOE | 0 | - | 0 | - | 0 | - | ns |
| Output Enable High to Output High-Z | tHZOE | - | 3.0 | - | 3.0 | - | 3.5 | ns |
| Clock High to Output High-Z | tHZC | 1.5 | 3.0 | 1.5 | 3.0 | 1.5 | 3.5 | ns |
| Clock High Pulse Width | tCH | 2.1 | - | 2.3 | - | 2.5 | - | ns |
| Clock Low Pulse Width | tCL | 2.1 | - | 2.3 | - | 2.5 | - | ns |
| Address Setup to Clock High | tAS | 1.5 | - | 1.5 | - | 2.0 | - | ns |
| Address Status Setup to Clock High | tSS | 1.5 | - | 1.5 | - | 2.0 | - | ns |
| Data Setup to Clock High | tDS | 1.5 | - | 1.5 | - | 2.0 | - | ns |
| Write Setup to Clock High (\overline{GW} , \overline{BW} , \overline{WEx}) | tWS | 1.5 | - | 1.5 | - | 2.0 | - | ns |
| Address Advance Setup to Clock High | tADVS | 1.5 | - | 1.5 | - | 2.0 | - | ns |
| Chip Select Setup to Clock High | tCSS | 1.5 | - | 1.5 | - | 2.0 | - | ns |
| Address Hold from Clock High | tAH | 0.5 | - | 0.5 | - | 0.5 | - | ns |
| Address Status Hold from Clock High | tSH | 0.5 | - | 0.5 | - | 0.5 | - | ns |
| Data Hold from Clock High | tDH | 0.5 | - | 0.5 | - | 0.5 | - | ns |
| Write Hold from Clock High (\overline{GW} , \overline{BW} , \overline{WEx}) | tWH | 0.5 | - | 0.5 | - | 0.5 | - | ns |
| Address Advance Hold from Clock High | tADVH | 0.5 | - | 0.5 | - | 0.5 | - | ns |
| Chip Select Hold from Clock High | tCSH | 0.5 | - | 0.5 | - | 0.5 | - | ns |
| ZZ High to Power Down | tPDS | 2 | - | 2 | - | 2 | - | cycle |
| ZZ Low to Power Up | tPUS | 2 | - | 2 | - | 2 | - | cycle |

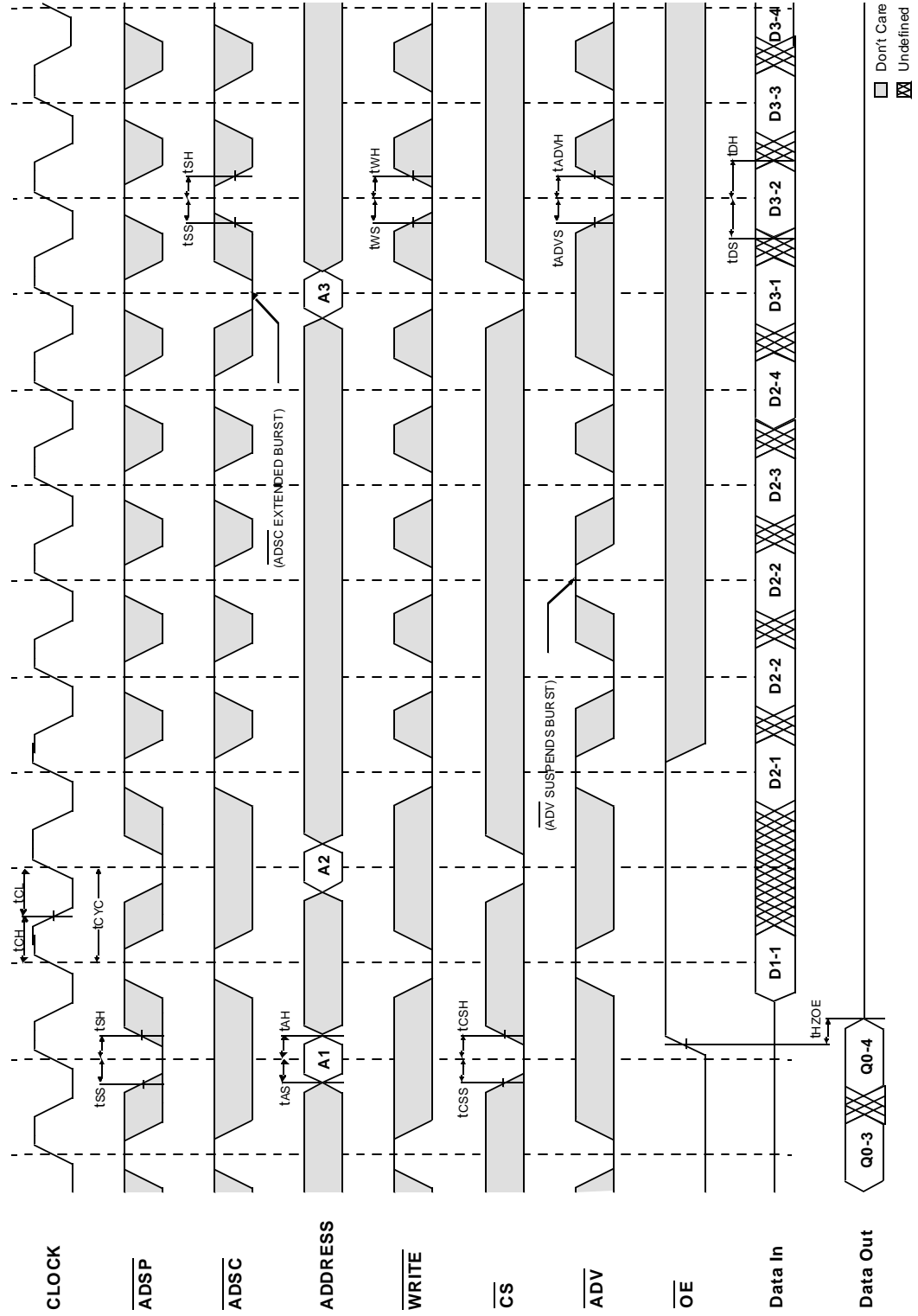
- Notes :**
1. All address inputs must meet the specified setup and hold times for all rising clock edges whenever ADSC and/or ADSP is sampled low and CS is sampled low. All other synchronous inputs must meet the specified setup and hold times whenever this device is chip selected.
 2. Both chip selects must be active whenever ADSC or ADSP is sampled low in order for the this device to remain enabled.
 3. ADSC or ADSP must not be asserted for at least 2 Clock after leaving ZZ state.
 4. At any given voltage and temperature, t_{HZC} is less than t_{LZC}

TIMING WAVEFORM OF READ CYCLE

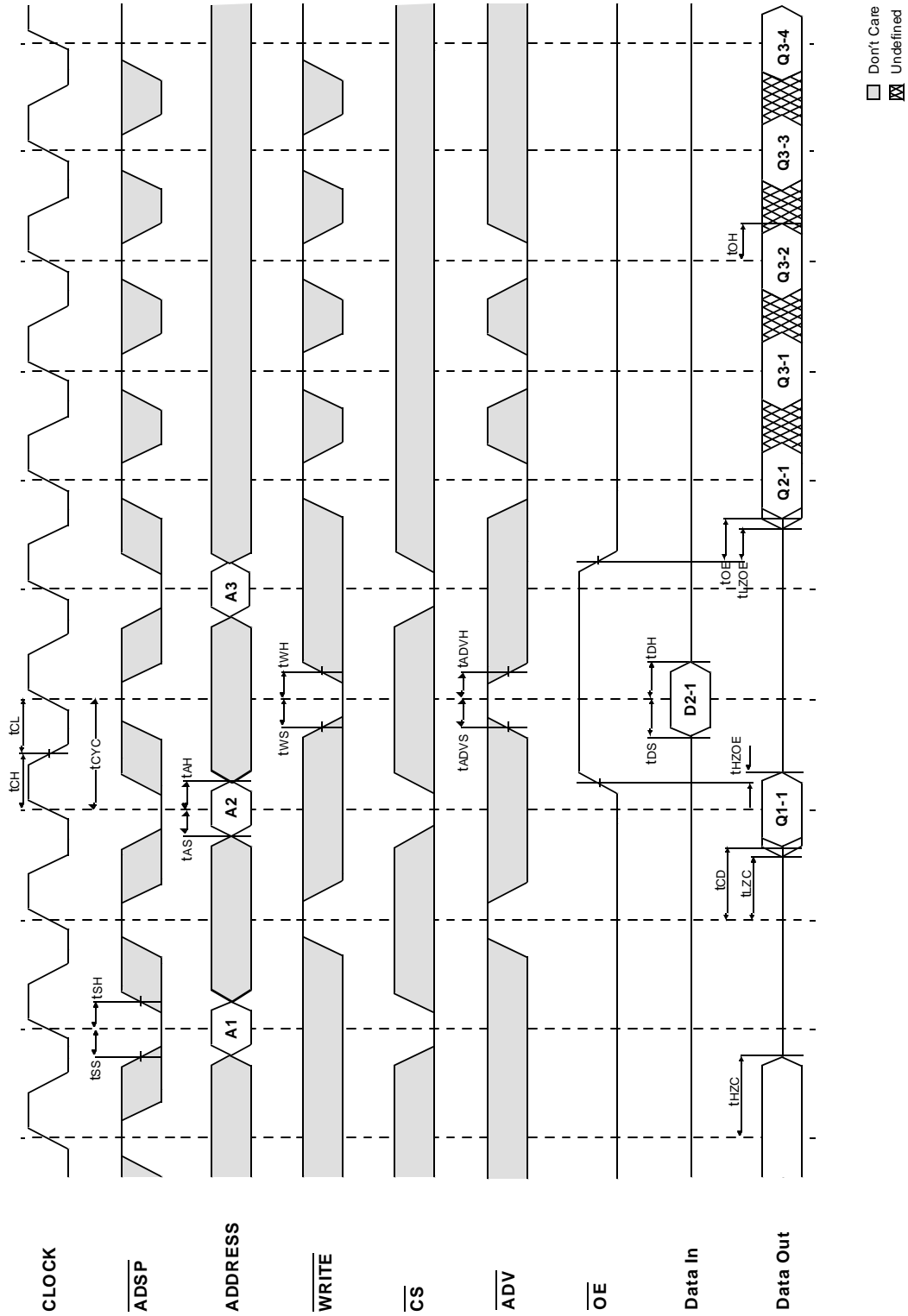


□ Don't Care
 ⊠ Undefined
 NOTES : WRITE = L means GW = L, or GW = H, BW = L, WE_x = L
CS₁ = L means CS₁ = L, CS₂ = H and CS₂ = L
CS = H means CS₁ = H, or CS₁ = L and CS₂ = H, or CS₁ = L, and CS₂ = L

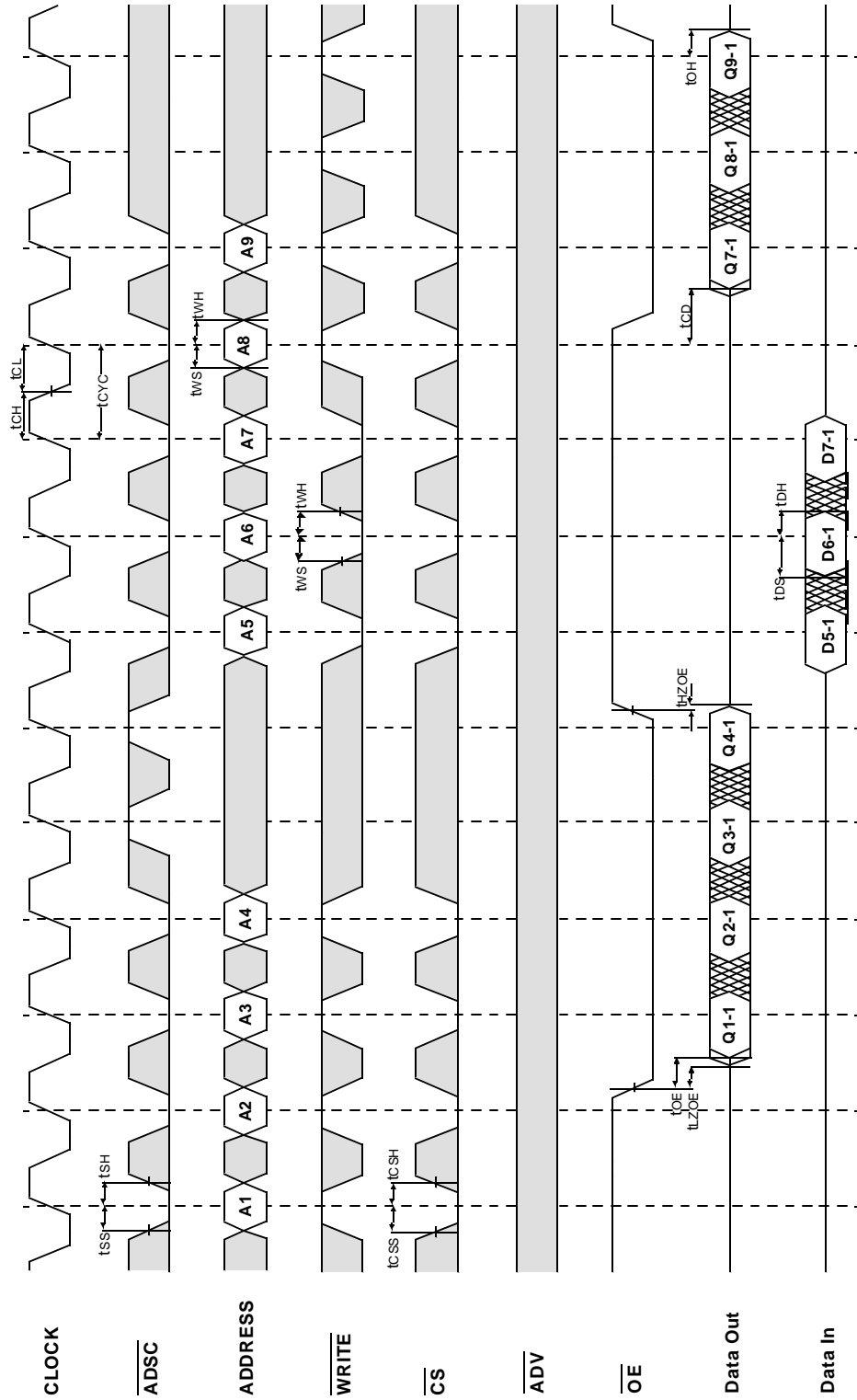
TIMING WAVEFORM OF WRTE CYCLE



TIMING WAVEFORM OF COMBINATION READ/WRITE CYCLE(ADSP CONTROLLED, $\overline{\text{ADSC}}=\text{HIGH}$)

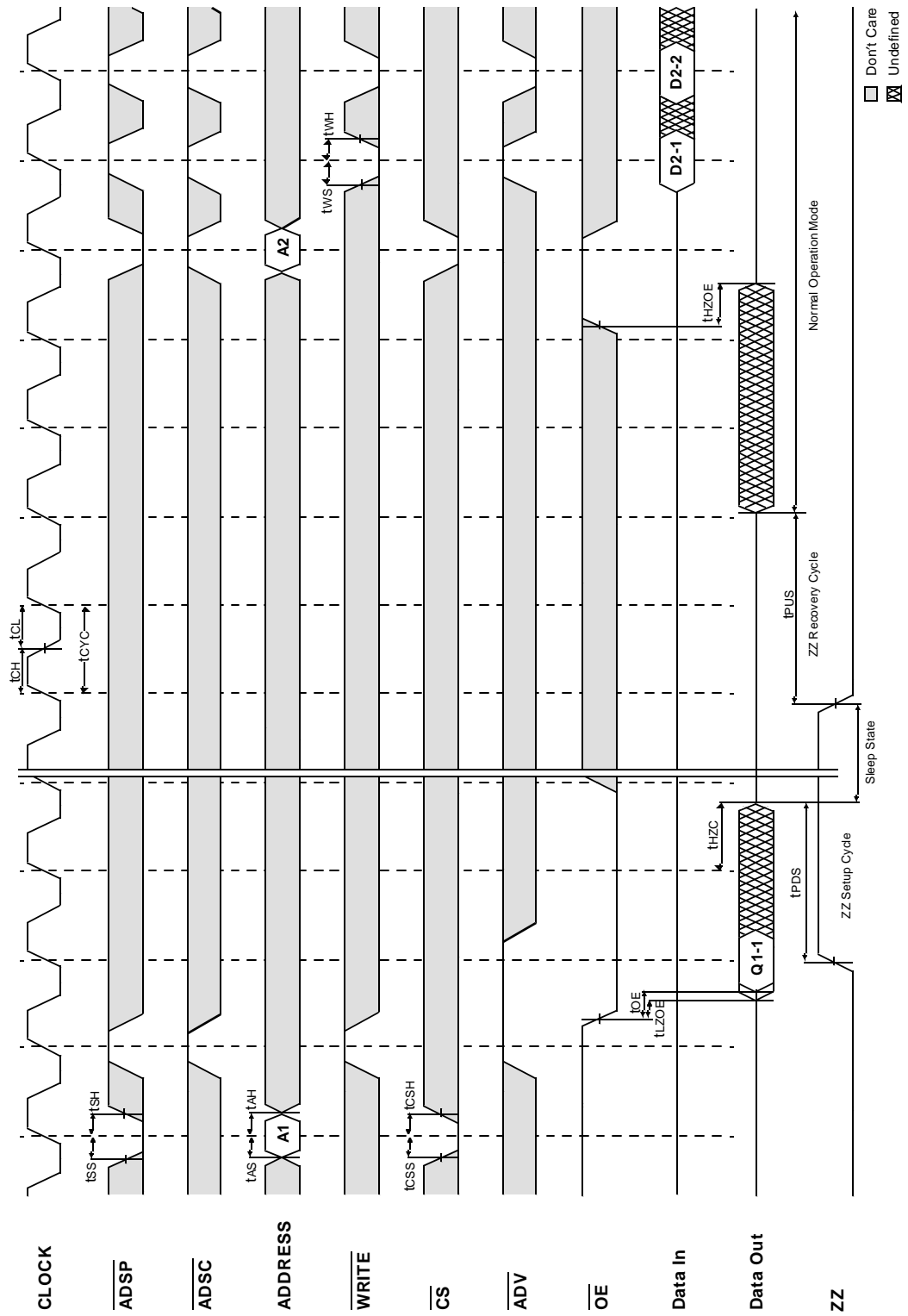


TIMING WAVEFORM OF SINGLE READWRITE CYCLE(ADSC CONTROLLED , ADSP=HIGH)



□ Don't Care
▨ Undefined

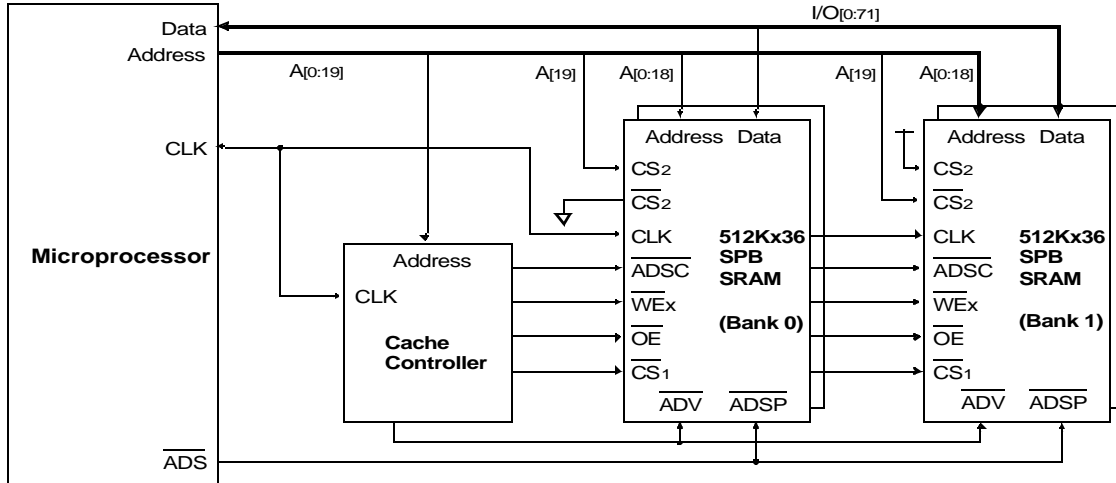
TIMING WAVEFORM OF POWER DOWN CYCLE



APPLICATION INFORMATION

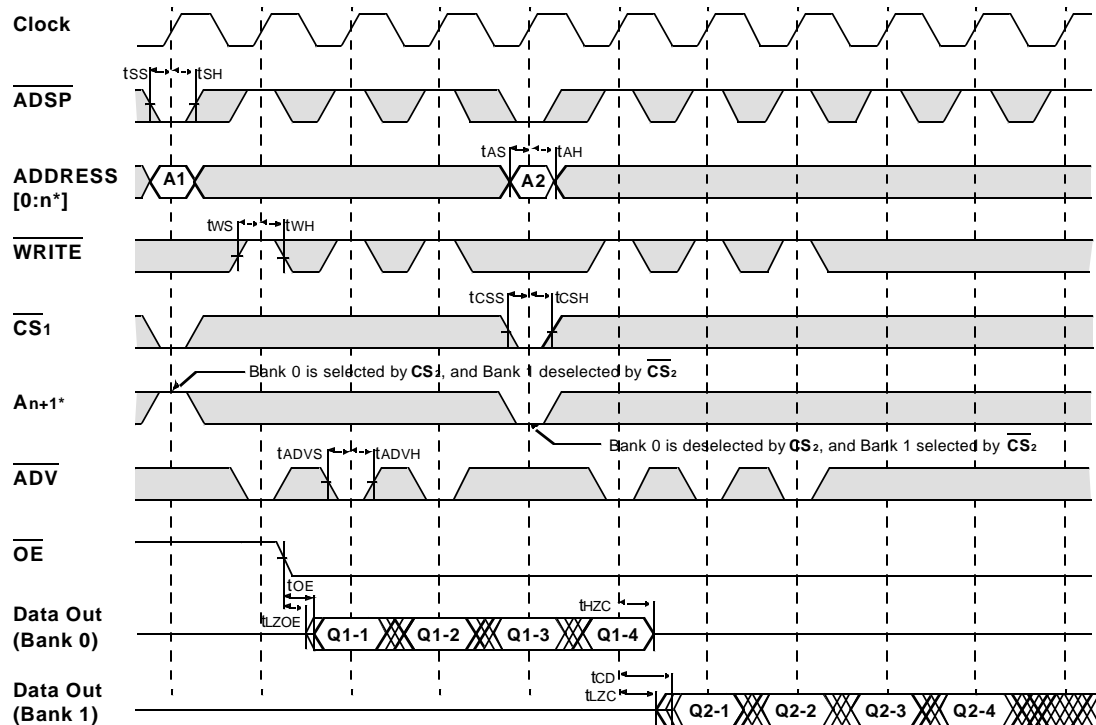
DEPTH EXPANSION

The Samsung 512Kx36 Synchronous Pipelined Burst SRAM has two additional chip selects for simple depth expansion. This permits easy secondary cache upgrades from 512K depth to 1M depth without extra logic.



INTERLEAVE READ TIMING (Refer to non-interleave write timing for interleave write timing)

(ADSP CONTROLLED , ADSC=HIGH)



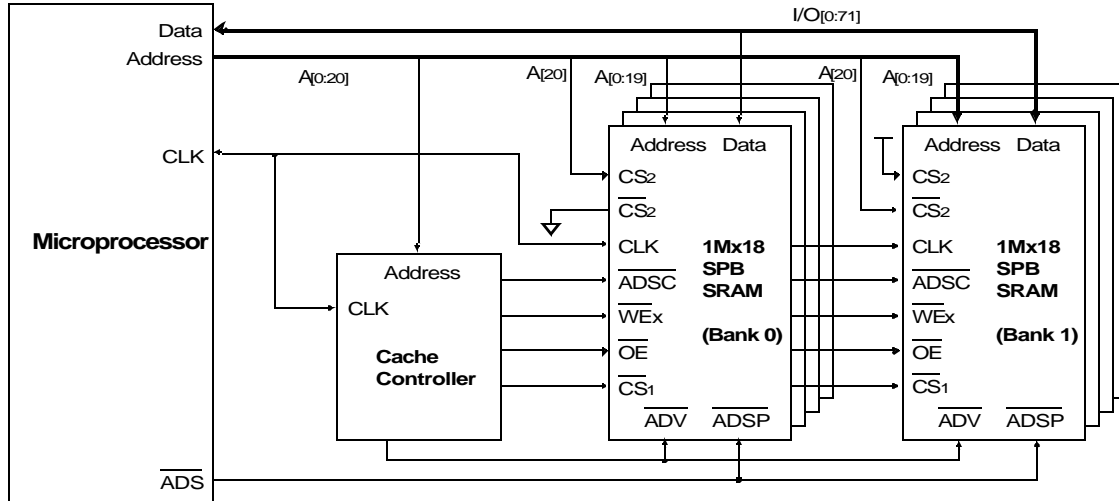
*Notes : n = 14 32K depth , 15 64K depth
16 128K depth , 17 256K depth
18 512K depth , 19 1M depth

□ Don't Care ⊗ Undefined

APPLICATION INFORMATION

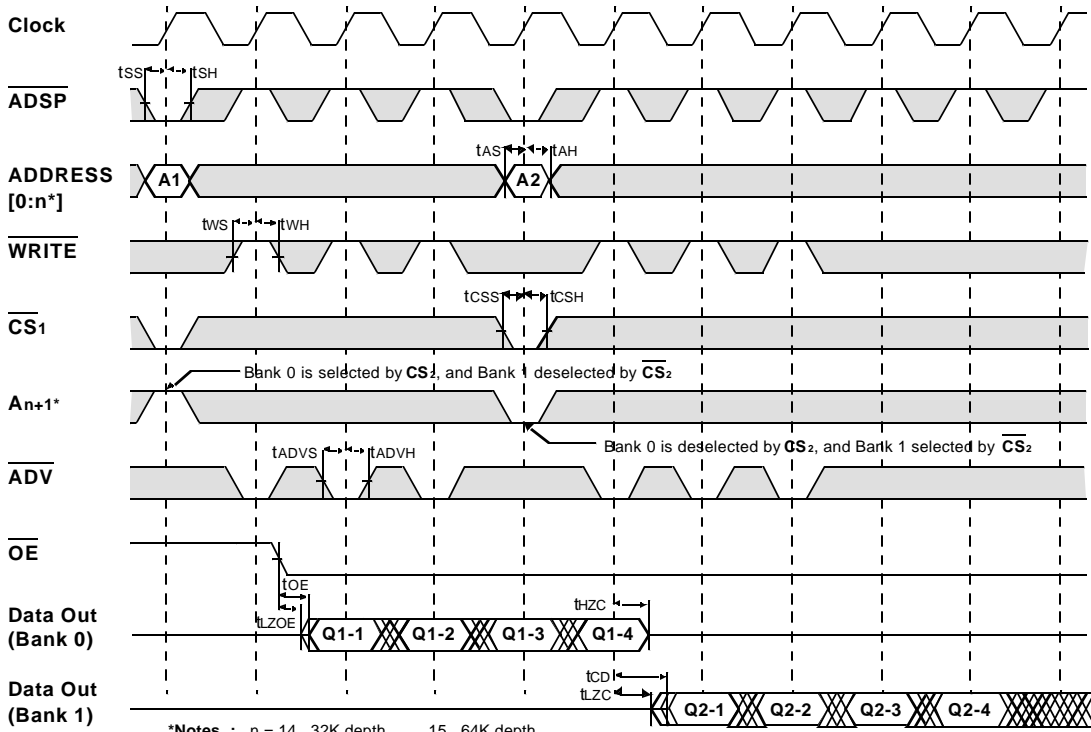
DEPTH EXPANSION

The Samsung 1Mx18 Synchronous Pipelined Burst SRAM has two additional chip selects for simple depth expansion. This permits easy secondary cache upgrades from 1M depth to 2M depth without extra logic.



INTERLEAVE READ TIMING (Refer to non-interleave write timing for interleave write timing)

(ADSP CONTROLLED, ADSC=HIGH)



*Notes : n = 14 32K depth, 15 64K depth
 16 128K depth, 17 256K depth
 18 512K depth, 19 1M depth
 20 2M depth

□ Don't Care ⊗ Undefined

K7A163601M
K7A161801M

512Kx36 & 1Mx18 Synchronous SRAM

PACKAGE DIMENSIONS

