



1024K X 16 BIT LOW POWER CMOS SRAM

FEATURES

- Process Technology : 0.15µm Full CMOS
- Organization : 1M x 16 bit
- Power Supply Voltage : 2.7V ~ 3.6V
- Low Data Retention Voltage : 1.5V(Min.)
- Three state output and TTL Compatible
- Package Type : 48-FPBGA

GENERAL DESCRIPTION

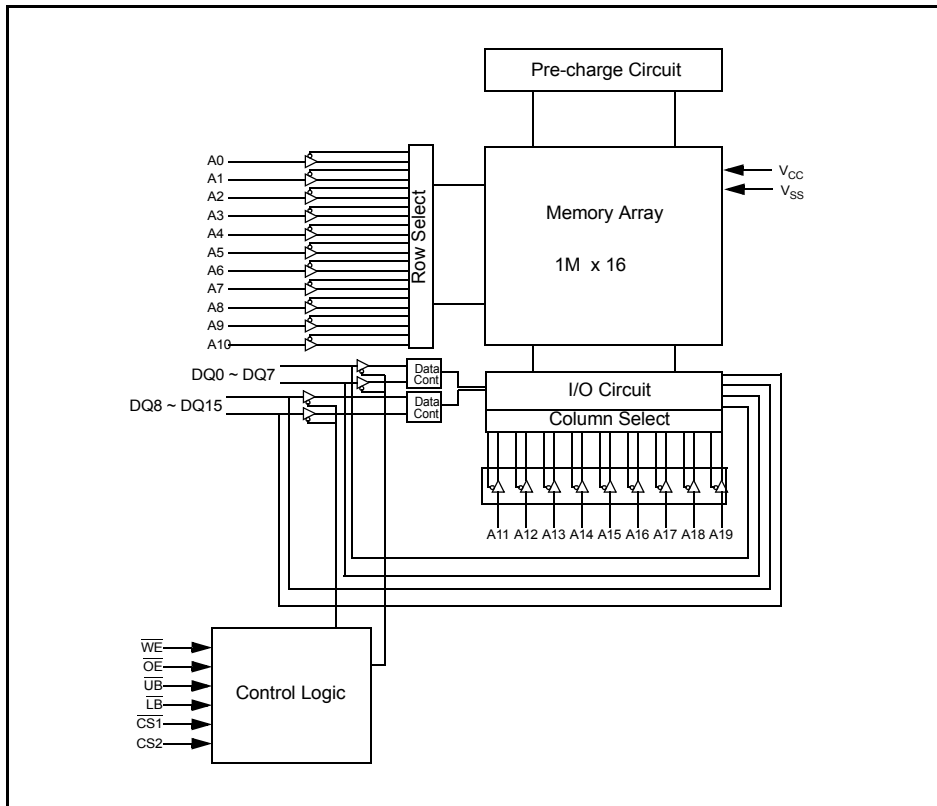
The AS6C1616A - 55 is fabricated by Alliance's advanced full CMOS process technology. The device supports industrial temperature range and Chip Scale Package for user flexibility of system design. The device also supports low data retention voltage for battery back-up operation with low data retention current.

PRODUCT FAMILY

| | Operating Temperature | Vcc Range | Speed | Power Dissipation | | PKG Type |
|--------------------|-------------------------|-------------|-------|-----------------------------------|------------------------------------|----------|
| | | | | Standby (I _{SB1} , Typ.) | Operating (I _{CC1} -Max.) | |
| AS6C1616A - 55 BIN | Industrial (-40 ~ 85°C) | 2.7 ~ 3.6 V | 55ns | 4 µA ¹⁾ | 8 mA | 48-FPBGA |

1. Typical values are measured at Vcc=3.3V, T_A=25°C and not 100% tested.

FUNCTIONAL BLOCK DIAGRAM





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PIN CONFIGURATIONS

FPBGA-48 : Top view(ball down)

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|------------------------|------------------------|-----|-----|-------------------------|-----------------|
| A | $\overline{\text{LB}}$ | $\overline{\text{OE}}$ | A0 | A1 | A2 | CS2 |
| B | DQ8 | $\overline{\text{UB}}$ | A3 | A4 | $\overline{\text{CS1}}$ | DQ0 |
| C | DQ9 | DQ10 | A5 | A6 | DQ1 | DQ2 |
| D | V _{SS} | DQ11 | A17 | A7 | DQ3 | V _{CC} |
| E | V _{CC} | DQ12 | NC | A16 | DQ4 | V _{SS} |
| F | DQ14 | DQ13 | A14 | A15 | DQ5 | DQ6 |
| G | DQ15 | A19 | A12 | A13 | $\overline{\text{WE}}$ | DQ7 |
| H | A18 | A8 | A9 | A10 | A11 | NC |

PIN DESCRIPTION

| | Function | Name | Function |
|-------------------------------|---------------------|------------------------|-----------------------|
| $\overline{\text{CS1}}$, CS2 | Chip Select inputs | V _{CC} | Power Supply |
| $\overline{\text{OE}}$ | Output Enable input | V _{SS} | Ground |
| $\overline{\text{WE}}$ | Write Enable input | $\overline{\text{UB}}$ | Upper Byte (DQ8~DQ15) |
| A0~A19 | Address inputs | $\overline{\text{LB}}$ | Lower Byte (DQ0~DQ7) |
| DQ0~DQ15 | Data inputs/outputs | NC | No Connection |



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ABSOLUTE MAXIMUM RATINGS¹⁾

| | Symbol | Ratings | Unit |
|---|------------------------------------|-------------|------|
| Voltage on Any Pin Relative to V _{SS} | V _{IN} , V _{OUT} | -0.2 to 4.0 | V |
| Voltage on V _{CC} supply relative to V _{SS} | V _{CC} | -0.2 to 4.0 | V |
| Power Dissipation | P _D | 1.0 | W |
| Operating Temperature | T _A | -40 to 85 | °C |

1. Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. Functional operation should be restricted to recommended operating condition. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

FUNCTIONAL DESCRIPTION

| $\overline{\text{CS1}}$ | $\overline{\text{CS2}}$ | $\overline{\text{OE}}$ | $\overline{\text{WE}}$ | $\overline{\text{LB}}$ | $\overline{\text{UB}}$ | DQ0~7 | | | Power |
|-------------------------|-------------------------|------------------------|------------------------|------------------------|------------------------|----------|----------|------------------|----------|
| H | X | X | X | X | X | High-Z | High-Z | Deselected | Stand by |
| X | L | X | X | X | X | High-Z | High-Z | Deselected | Stand by |
| X | X | X | X | H | H | High-Z | High-Z | Deselected | Stand by |
| L | H | H | H | L | X | High-Z | High-Z | Output Disabled | Active |
| L | H | H | H | X | L | High-Z | High-Z | Output Disabled | Active |
| L | H | L | H | L | H | Data Out | High-Z | Lower Byte Read | Active |
| L | H | L | H | H | L | High-Z | Data Out | Upper Byte Read | Active |
| L | H | L | H | L | L | Data Out | Data Out | Word Read | Active |
| L | H | X | L | L | H | Data In | High-Z | Lower Byte Write | Active |
| L | H | X | L | H | L | High-Z | Data In | Upper Byte Write | Active |
| L | H | X | L | L | L | Data In | Data In | Word Write | Active |

NOTE : X means don't care. (Must be low or high state)



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RECOMMENDED DC OPERATING CONDITIONS ¹⁾

| | Symbol | Min | Typ | Max | Unit |
|--------------------|----------|-------------|-----|---------------------|------|
| Supply voltage | V_{CC} | 2.7 | 3.3 | 3.6 | V |
| Ground | V_{SS} | 0 | 0 | 0 | V |
| Input high voltage | V_{IH} | 2.2 | - | $V_{CC} + 0.2^{2)}$ | V |
| Input low voltage | V_{IL} | $-0.2^{3)}$ | - | 0.6 | V |

1. $T_A = -40$ to 85°C , otherwise specified
2. Overshoot: $V_{CC} + 2.0$ V in case of pulse width ≤ 20 ns
3. Undershoot: -2.0 V in case of pulse width ≤ 20 ns
4. Overshoot and undershoot are sampled, not 100% tested.

CAPACITANCE ¹⁾ ($f = 1\text{MHz}$, $T_A = 25^\circ\text{C}$)

| Item | Symbol | Test Condition | Min | Max | Unit |
|--------------------------|----------|----------------------|-----|-----|------|
| Input capacitance | C_{IN} | $V_{IN} = 0\text{V}$ | - | 8 | pF |
| Input/Output capacitance | C_{IO} | $V_{IO} = 0\text{V}$ | - | 10 | pF |

1. Capacitance is sampled, not 100% tested

DC AND OPERATING CHARACTERISTICS

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Unit | |
|---------------------------|-----------|--|------|-----|-----------------|---------------|---------------|
| Input leakage current | I_{LI} | $V_{IN} = V_{SS}$ to V_{CC} | -1 | - | 1 | μA | |
| Output leakage current | I_{LO} | $\overline{CS1} = V_{IH}$ or $CS2 = V_{IL}$ or $\overline{OE} = V_{IH}$ or $\overline{WE} = V_{IL}$ or $\overline{LB} = \overline{UB} = V_{IH}$ $V_{IO} = V_{SS}$ to V_{CC} | -1 | - | 1 | μA | |
| Operating power supply | I_{CC} | $I_{IO} = 0\text{mA}$, $\overline{CS1} = V_{IL}$, $CS2 = \overline{WE} = V_{IH}$, $V_{IN} = V_{IH}$ or V_{IL} | - | - | 4 | mA | |
| Average operating current | I_{CC1} | Cycle time = $1\mu\text{s}$, 100% duty, $I_{IO} = 0\text{mA}$, $\overline{CS1} \leq 0.2\text{V}$, $CS2 \geq V_{CC} - 0.2\text{V}$, $\overline{LB} \leq 0.2\text{V}$ or/and $\overline{UB} \leq 0.2\text{V}$, $V_{IN} \leq 0.2\text{V}$ or $V_{IN} \geq V_{CC} - 0.2\text{V}$ | - | - | 8 | mA | |
| | I_{CC2} | Cycle time = Min, $I_{IO} = 0\text{mA}$, 100% duty, $\overline{CS1} = V_{IL}$, $CS2 = V_{IH}$, $\overline{LB} = V_{IL}$ or/and $\overline{UB} = V_{IL}$, $V_{IN} = V_{IL}$ or V_{IH} | 55ns | - | - | 70 | mA |
| Output low voltage | V_{OL} | $I_{OL} = 2.1\text{mA}$ | - | - | 0.4 | V | |
| Output high voltage | V_{OH} | $I_{OH} = -1.0\text{mA}$ | 2.4 | - | - | V | |
| Standby Current (TTL) | I_{SB} | $\overline{CS1} = V_{IH}$, $CS2 = V_{IL}$, Other inputs = V_{IH} or V_{IL} | - | - | 1.0 | mA | |
| Standby Current (CMOS) | I_{SB1} | $\overline{CS1} \geq V_{CC} - 0.2\text{V}$, $CS2 \geq V_{CC} - 0.2\text{V}$ ($\overline{CS1}$ controlled) or $0\text{V} \leq CS2 \leq 0.2\text{V}$ ($CS2$ controlled), Other inputs = $0 \sim V_{CC}$ (Typ. condition : $V_{CC} = 3.3\text{V}$ @ 25°C) (Max. condition : $V_{CC} = 3.6\text{V}$ @ 85°C) | LF | - | 4 ¹⁾ | 30 | μA |

1. Typical values are measured at $V_{CC} = 3.3\text{V}$, $T_A = 25^\circ\text{C}$ and not 100% tested.



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AC OPERATING CONDITIONS**Test Conditions** (Test Load and Test Input/Output Reference)

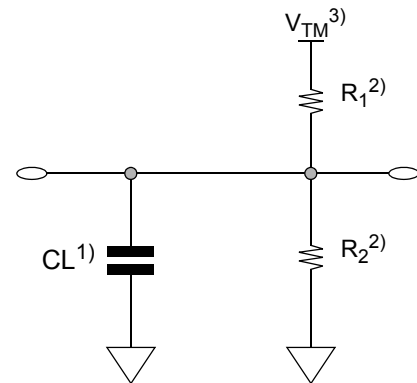
Input Pulse Level : 0.4 to 2.4V

Input Rise and Fall Time : 5ns

Input and Output reference Voltage : 1.5V

Output Load (See right) : $CL^{(1)} = 100\text{pF} + 1\text{ TTL}(70\text{nsec})$ $CL^{(1)} = 30\text{pF} + 1\text{ TTL}(45\text{ns}/55\text{ns})$

1. Including scope and Jig capacitance

2. $R_1=3070\Omega$, $R_2=3150\Omega$ 3. $V_{TM}=2.8\text{V}$ 4. $CL = 5\text{pF} + 1\text{ TTL}$ (measurement with t_{LZ} , t_{HZ} , t_{OLZ} , t_{OHZ} , t_{WHZ})**READ CYCLE** ($V_{CC}=2.7$ to 3.6V , $Gnd = 0\text{V}$, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$)

| | Symbol | 55ns | | Unit |
|---|-----------------------|------|-----|------|
| | | Min | Max | |
| Read cycle time | t_{RC} | 55 | - | ns |
| Address access time | t_{AA} | - | 55 | ns |
| Chip select to output | t_{CO1} , t_{CO2} | - | 55 | ns |
| Output enable to valid output | t_{OE} | - | 35 | ns |
| \overline{UB} , \overline{LB} access time | t_{BA} | | 55 | ns |
| Chip select to low-Z output | t_{LZ1} , t_{LZ2} | 5 | - | ns |
| \overline{UB} , \overline{LB} enable to low-Z output | t_{BLZ} | 5 | - | ns |
| Output enable to low-Z output | t_{OLZ} | 5 | - | ns |
| Chip disable to high-Z output | t_{HZ1} , t_{HZ2} | 0 | 20 | ns |
| \overline{UB} , \overline{LB} disable to low-Z output | t_{BHZ} | 0 | 20 | ns |
| Output disable to high-Z output | t_{OHZ} | 0 | 20 | ns |
| Output hold from address change | t_{OH} | 10 | - | ns |

WRITE CYCLE ($V_{CC}=2.7$ to 3.6V , $Gnd = 0\text{V}$, $T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$)

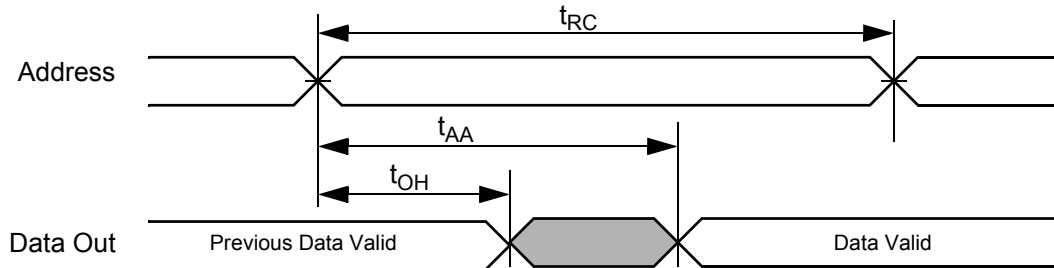
| Parameter | Symbol | 55ns | | Unit |
|---|-----------------------|------|-----|------|
| | | Min | Max | |
| Write cycle time | t_{WC} | 55 | - | ns |
| Chip select to end of write | t_{CW1} , t_{CW2} | 45 | - | ns |
| Address setup time | t_{AS} | 0 | - | ns |
| Address valid to end of write | t_{AW} | 45 | - | ns |
| \overline{UB} , \overline{LB} valid to end of write | t_{BW} | 45 | - | ns |
| Write pulse width | t_{WP} | 45 | - | ns |
| Write recovery time | t_{WR} | 0 | - | ns |
| Write to output high-Z | t_{WHZ} | 0 | 20 | ns |
| Data to write time overlap | t_{DW} | 25 | | ns |
| Data hold from write time | t_{DH} | 0 | - | ns |
| End write to output low-Z | t_{OW} | 5 | - | ns |



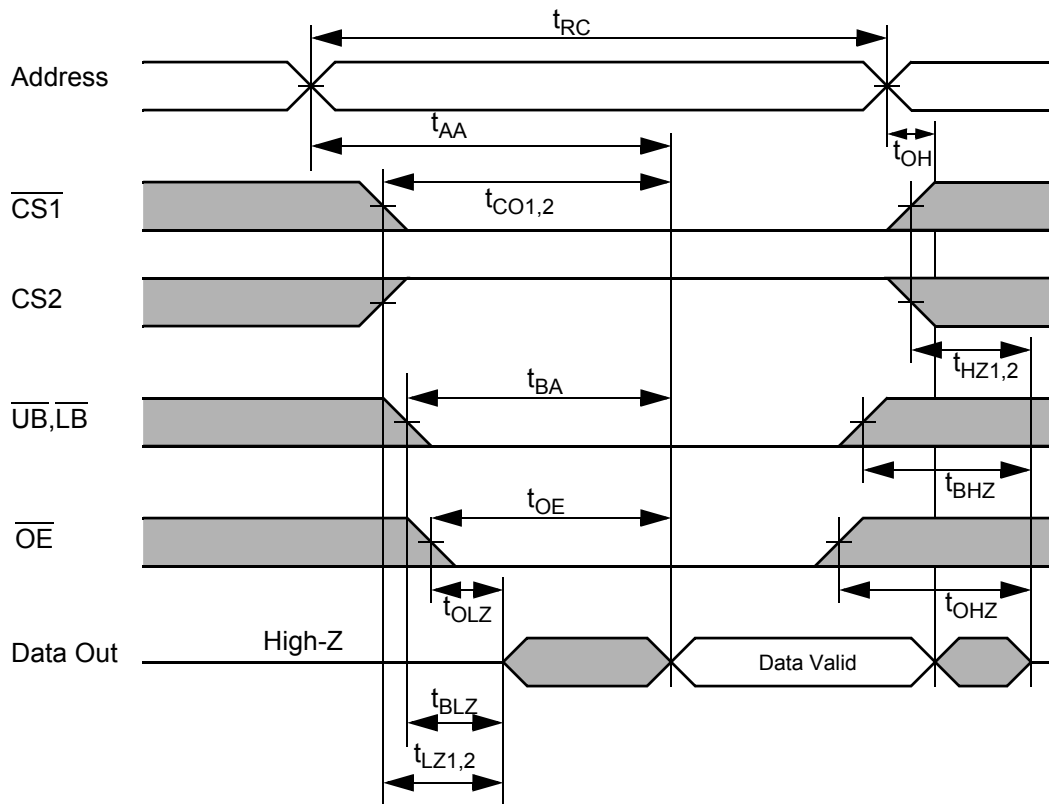
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TIMING DIAGRAMS

TIMING WAVEFORM OF READ CYCLE(1) (Address Controlled, $\overline{CS1}=\overline{OE}=V_{IL}$, $CS2=\overline{WE}=V_{IH}$, \overline{UB} or/and $\overline{LB}=V_{IL}$)



TIMING WAVEFORM OF READ CYCLE(2) ($\overline{WE} = V_{IH}$)



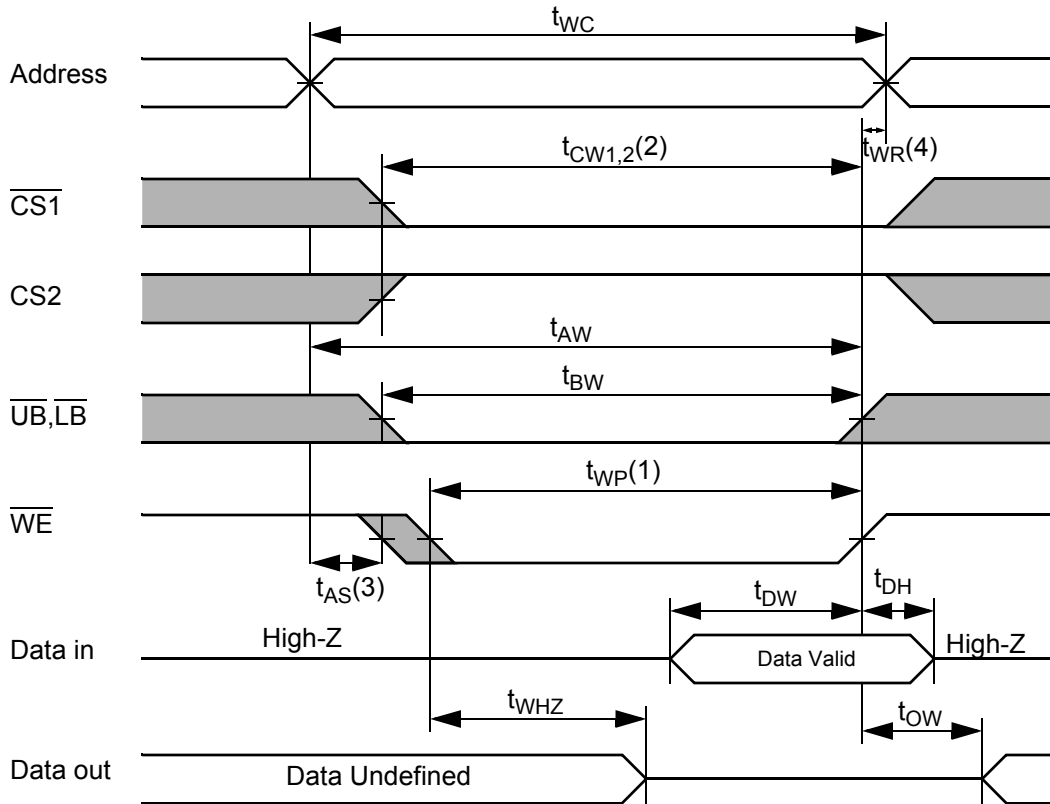
NOTES (READ CYCLE)

1. $t_{HZ1,2}$ and t_{OHZ} are defined as the outputs achieve the open circuit conditions and are not referenced to output voltage levels.
2. At any given temperature and voltage condition, $t_{HZ1,2}(\text{Max.})$ is less than $t_{LZ1,2}(\text{Min.})$ both for a given device and from device to device interconnection.

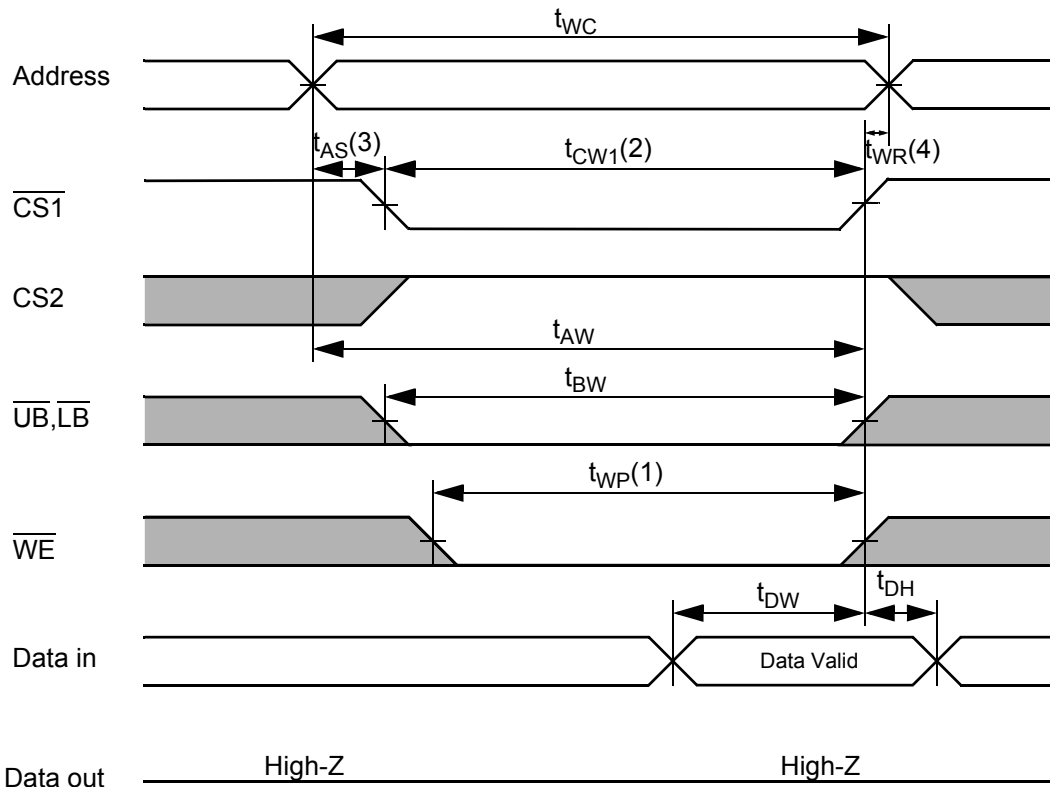


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TIMING WAVEFORM OF WRITE CYCLE(1) (\overline{WE} Controlled)



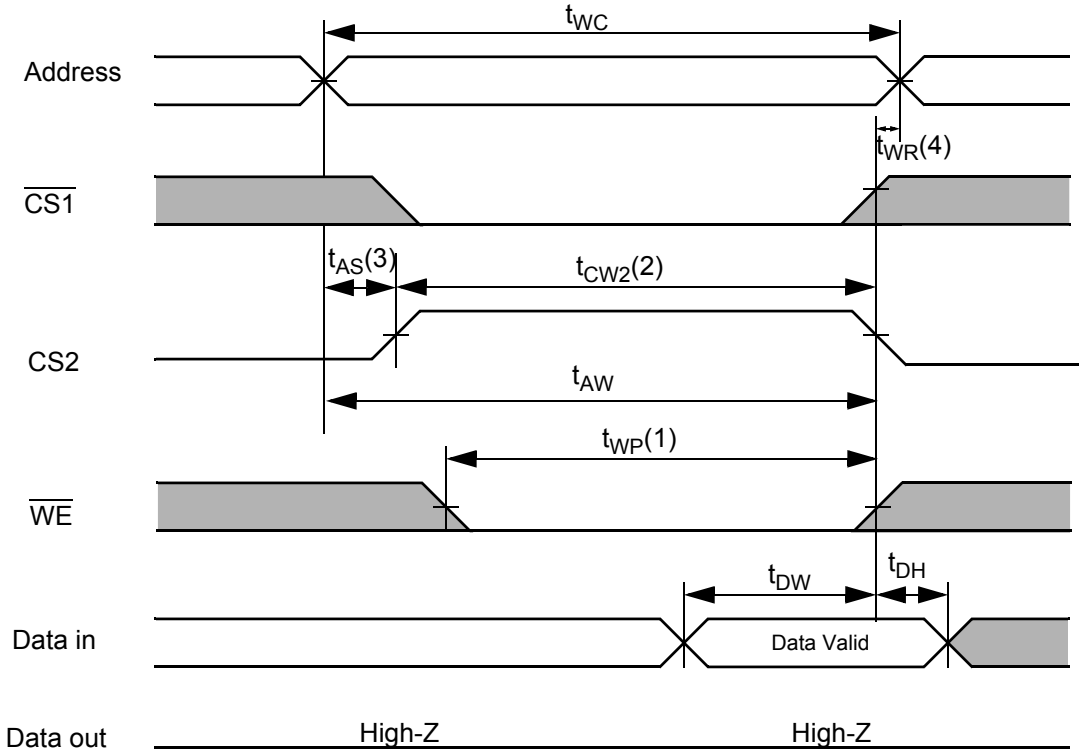
TIMING WAVEFORM OF WRITE CYCLE(2) ($\overline{CS1}$ Controlled)





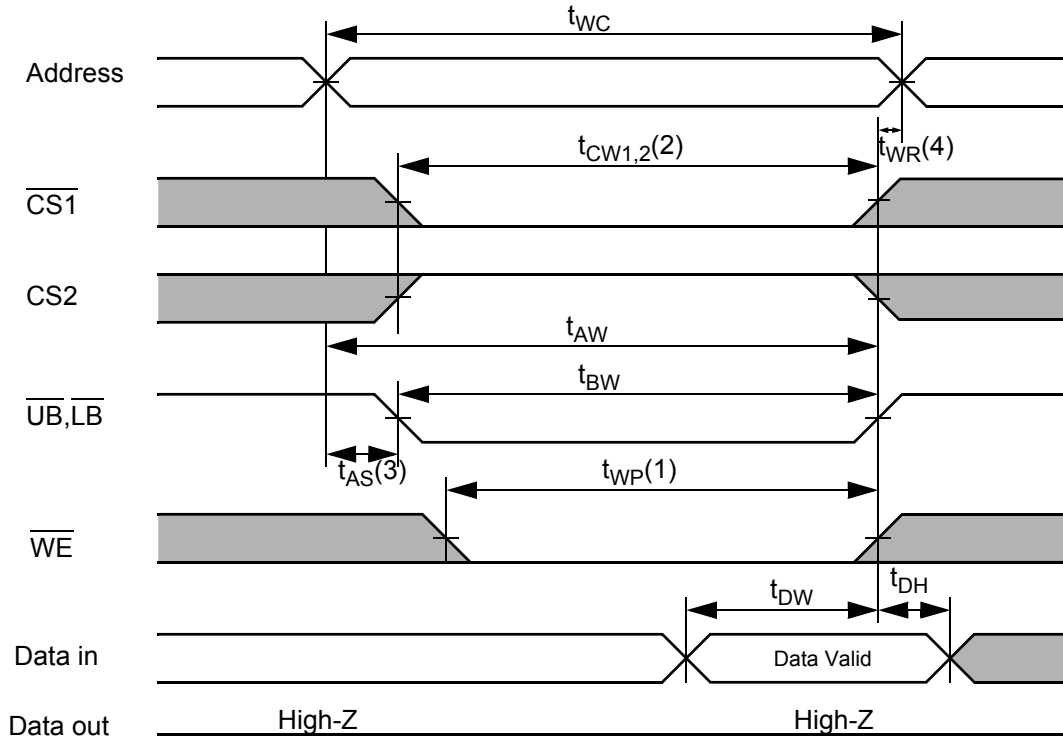
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TIMING WAVEFORM OF WRITE CYCLE(3) (CS2 Controlled)





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TIMING WAVEFORM OF WRITE CYCLE(4) (\overline{UB} , \overline{LB} Controlled)

NOTES (WRITE CYCLE)

1. A write occurs during the overlap (t_{WP}) of low $\overline{CS1}$, a high CS2 and low \overline{WE} . A write begins at the latest transition among $\overline{CS1}$ goes low, CS2 goes high and \overline{WE} goes low. A write ends at the earliest transition among $\overline{CS1}$ goes high, CS2 goes low and \overline{WE} goes high. The t_{WP} is measured from the beginning of write to the end of write.
2. t_{CW} is measured from the $\overline{CS1}$ going low or CS2 going high to end of write.
3. t_{AS} is measured from the address valid to the beginning of write.
4. t_{WR} is measured from the end of write to the address change. t_{WR} applied in case a write ends as $\overline{CS1}$ or \overline{WE} going high or CS2 going low.



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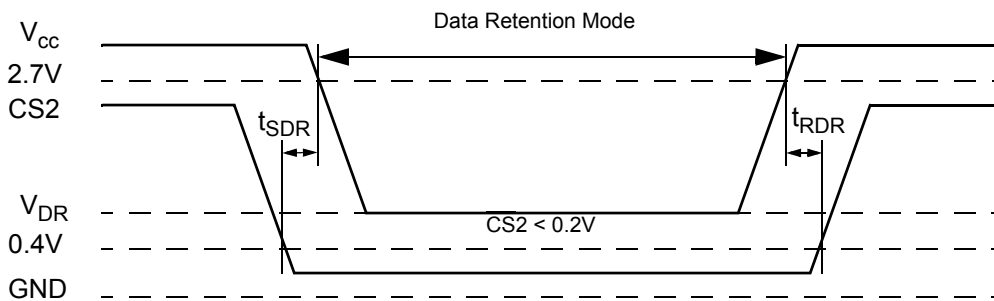
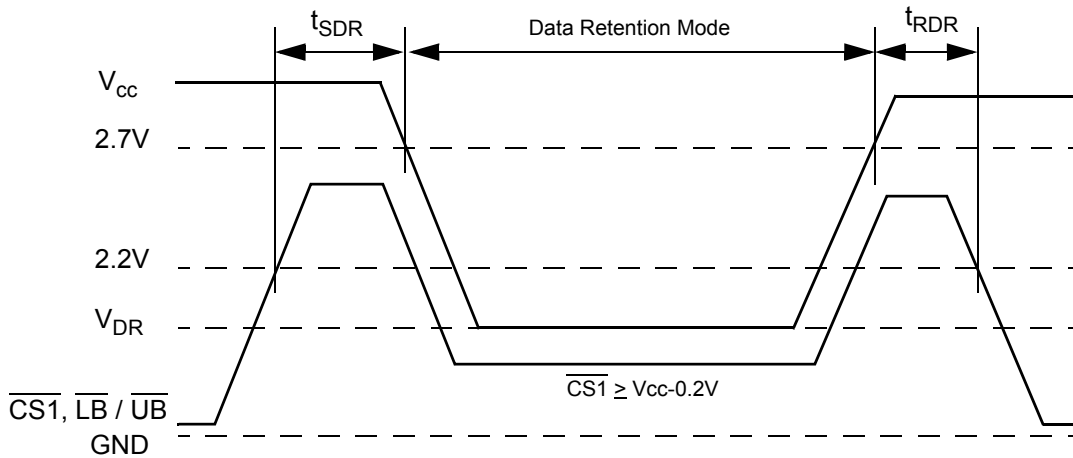
DATA RETENTION CHARACTERISTICS

| | Symbol | Test Condition | Min | Typ | Max | Unit |
|--------------------------------------|-----------|--|----------|-----|-----|---------|
| V_{CC} for Data Retention | V_{DR} | I_{SB1} Test Condition (Chip Disabled) ¹⁾ | 1.5 | - | 3.6 | V |
| Data Retention Current | I_{DR} | $V_{CC}=1.5V$, I_{SB1} Test Condition (Chip Disabled) ¹⁾ | - | - | 8 | μA |
| Chip Deselect to Data Retention Time | t_{SDR} | See data retention wave form | 0 | - | - | ns |
| Operation Recovery Time | t_{RDR} | | t_{RC} | - | - | |

NOTES

1. See the I_{SB1} measurement condition of datasheet page 4.

DATA RETENTION WAVE FORM



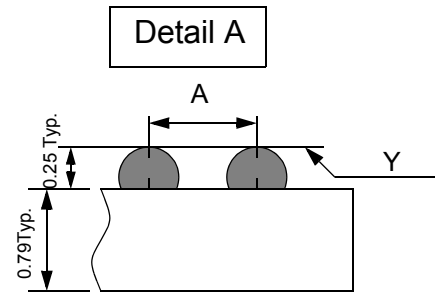
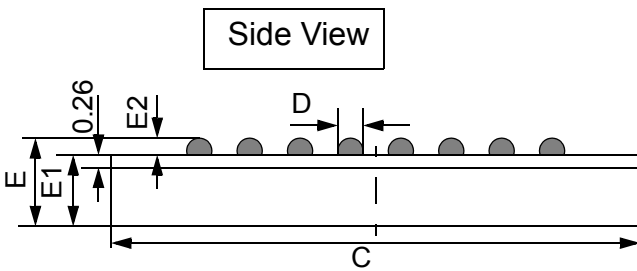
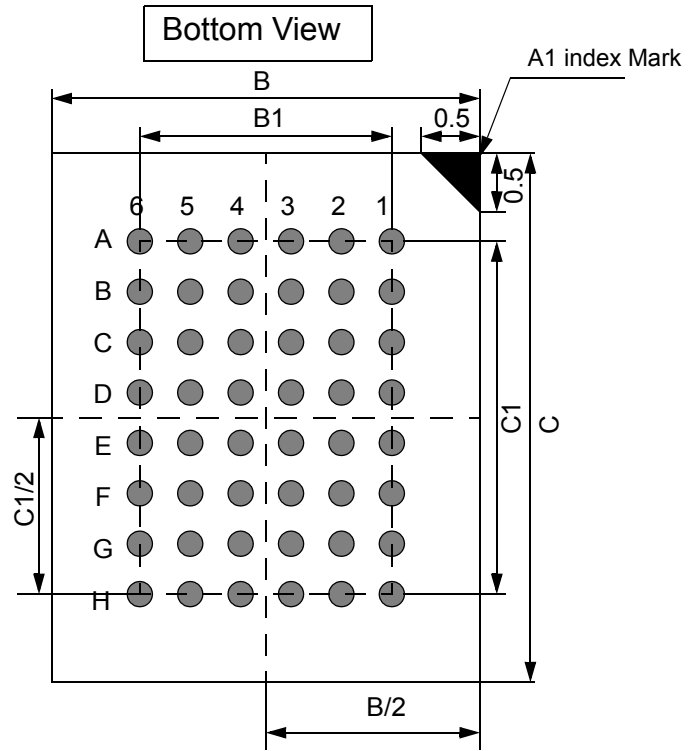
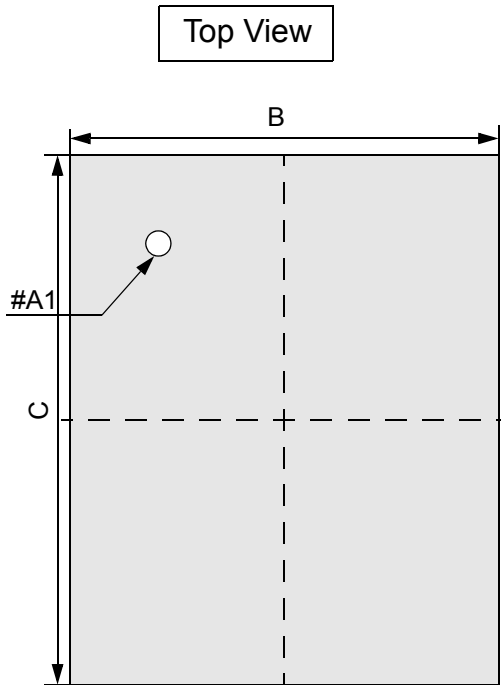


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PACKAGE DIMENSION

48 Ball Fine Pitch BGA (0.75mm ball pitch)

Unit: millimeters



| | Min | Typ | Max |
|----|------|-------|-------|
| A | - | 0.75 | - |
| B | 7.95 | 8.00 | 8.05 |
| B1 | - | 3.75 | - |
| C | 9.95 | 10.00 | 10.05 |
| C1 | - | 5.25 | - |
| D | 0.30 | 0.35 | 0.40 |
| E | - | - | 1.00 |
| E1 | - | - | 0.70 |
| E2 | 0.20 | 0.25 | 0.30 |
| Y | - | - | 0.08 |

NOTES.

1. Bump counts : 48(8row x 6column)
2. Bump pitch : (x,y)=(0.75x0.75) (typ.)
3. All tolerance are +/-0.050 unless otherwise specified.
4. Typ : Typical
5. Y is coplanarity : 0.08(Max)



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ORDERING INFORMATION

| Alliance | Organization | VCC Range | Package | Operating Temp | Speed ns |
|-------------------|--------------|------------|----------|---------------------------|----------|
| AS6C1616A -55 BIN | 1024K x 16 | 2.7 - 3.6V | 48 FPBGA | Industrial ~ -40 C - 85 C | 55 |

PART NUMBERING SYSTEM

| AS6C | 1616 | -55 | X | X | N |
|-----------------------|---------------------------------------|-------------|------------------------------------|--|---|
| Low power SRAM prefix | Device Number 16 = 16M 16 = x16 | Access Time | Package Option B = 48ball FPBGA | Temperature Range I = Industrial (-40 to + 85 C) | N = Lead Free RoHS compliant part |



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