
R1LP0408C-I Series

Wide Temperature Range Version
4M SRAM (512-kword \times 8-bit)

REJ03C0067-0200Z

Rev. 2.00

May.26.2004

Description

The R1LP0408C-I is a 4-Mbit static RAM organized 512-kword \times 8-bit. R1LP0408C-I Series has realized higher density, higher performance and low power consumption by employing CMOS process technology (6-transistor memory cell). The R1LP0408C-I Series offers low power standby power dissipation; therefore, it is suitable for battery backup systems. It has packaged in 32-pin SOP, 32-pin TSOP II.

Features

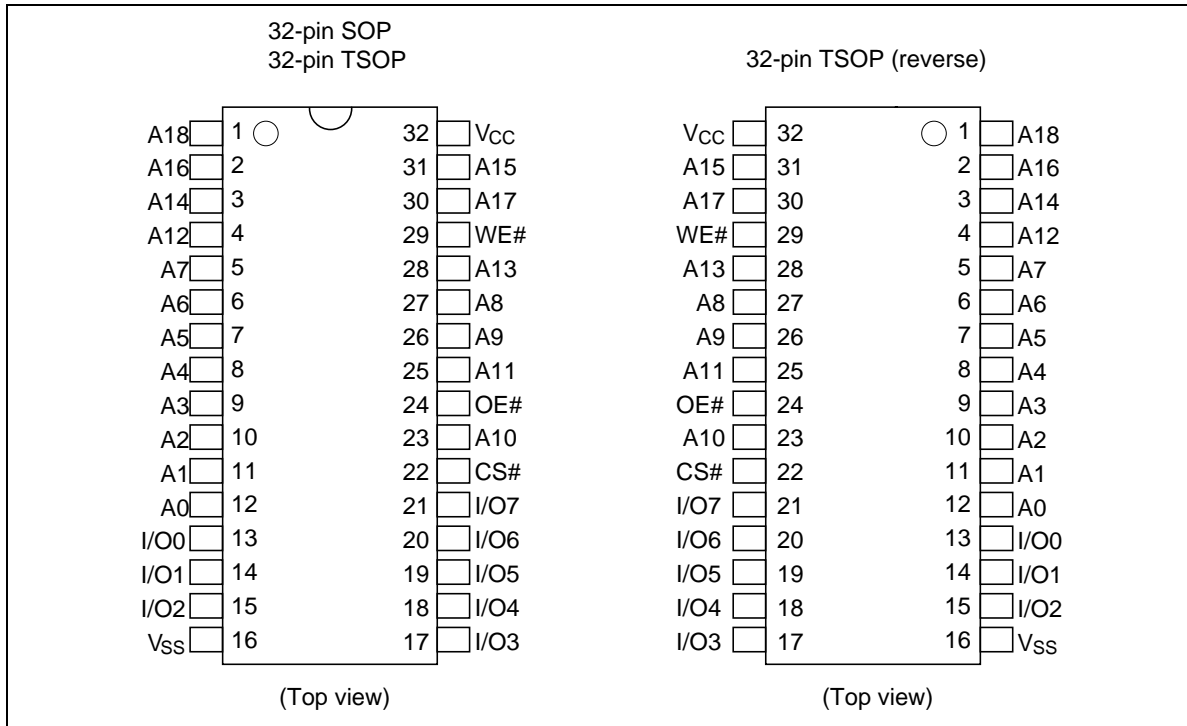
- Single 5 V supply: 5 V \pm 10%
- Access time: 55/70 ns (max)
- Power dissipation:
 - Active: 10 mW/MHz (typ)
 - Standby: 4 μ W (typ)
- Completely static memory.
 - No clock or timing strobe required
- Equal access and cycle times
- Common data input and output.
 - Three state output
- Directly TTL compatible.
 - All inputs and outputs
- Battery backup operation.
- Operating temperature: -40 to $+85^{\circ}\text{C}$

R1LP0408C-I Series

Ordering Information

| Type No. | Access time | Package |
|-----------------|-------------|--------------------------------------------------|
| R1LP0408CSP-5SI | 55 ns | 525-mil 32-pin plastic SOP (32P2M-A) |
| R1LP0408CSP-7LI | 70 ns | |
| R1LP0408CSB-5SI | 55 ns | 400-mil 32-pin plastic TSOP II (32P3Y-H) |
| R1LP0408CSB-7LI | 70 ns | |
| R1LP0408CSC-5SI | 55 ns | 400-mil 32-pin plastic TSOP II reverse (32P3Y-J) |
| R1LP0408CSC-7LI | 70 ns | |

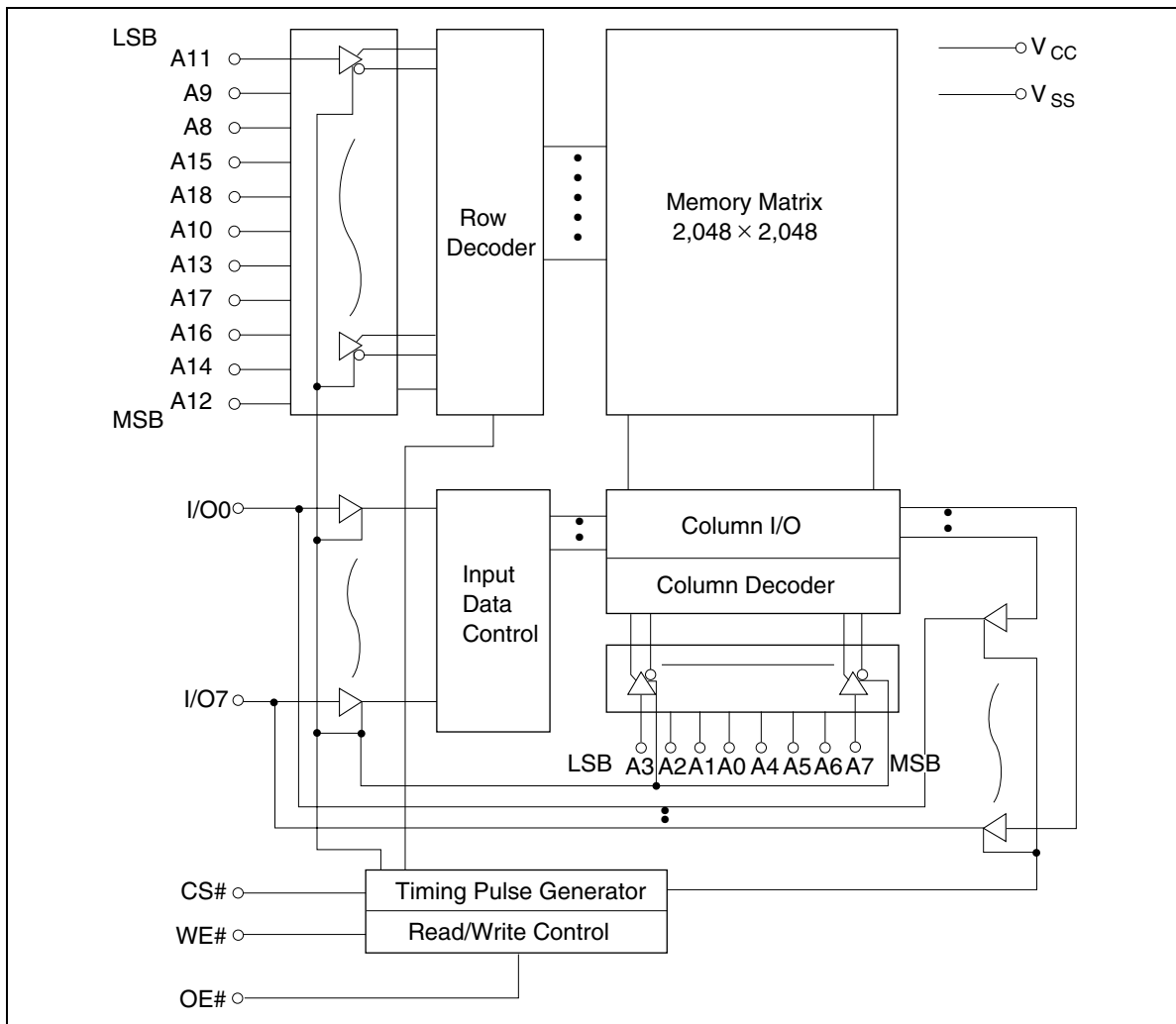
Pin Arrangement



Pin Description

| Pin name | Function |
|-----------------|-------------------|
| A0 to A18 | Address input |
| I/O0 to I/O7 | Data input/output |
| CS# (CS) | Chip select |
| OE# (OE) | Output enable |
| WE# (WE) | Write enable |
| V _{CC} | Power supply |
| V _{SS} | Ground |

Block Diagram



Operation Table

| WE# | CS# | OE# | Mode | V _{CC} current | I/O0 to I/O7 | Ref. cycle |
|-----|-----|-----|----------------|------------------------------------|--------------|-----------------|
| × | H | × | Not selected | I _{SB} , I _{SB1} | High-Z | — |
| H | L | H | Output disable | I _{CC} | High-Z | — |
| H | L | L | Read | I _{CC} | Dout | Read cycle |
| L | L | H | Write | I _{CC} | Din | Write cycle (1) |
| L | L | L | Write | I _{CC} | Din | Write cycle (2) |

Note: H: V_{IH}, L: V_{IL}, ×: V_{IH} or V_{IL}

Absolute Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---------------------------------------------------------|-------------------|-----------------------------------------------------------|------|
| Power supply voltage relative to V _{SS} | V _{CC} | −0.5 to +7.0 | V |
| Terminal voltage on any pin relative to V _{SS} | V _T | −0.5* ¹ to V _{CC} + 0.3* ² | V |
| Power dissipation | P _T | 0.7 | W |
| Operating temperature | T _{opr} | −40 to +85 | °C |
| Storage temperature range | T _{stg} | −65 to +150 | °C |
| Storage temperature range under bias | T _{bias} | −40 to +85 | °C |

Notes: 1. V_T min: −3.0 V for pulse half-width ≤ 30 ns.

2. Maximum voltage is +7.0 V.

DC Operating Conditions

(T_a = −40 to +85°C)

| Parameter | Symbol | Min | Typ | Max | Unit |
|--------------------|-----------------|--------------------|-----|-----------------------|------|
| Supply voltage | V _{CC} | 4.5 | 5.0 | 5.5 | V |
| | V _{SS} | 0 | 0 | 0 | V |
| Input high voltage | V _{IH} | 2.2 | — | V _{CC} + 0.3 | V |
| Input low voltage | V _{IL} | −0.3* ¹ | — | 0.8 | V |

Note: 1. V_{IL} min: −3.0 V for pulse half-width ≤ 30 ns.

DC Characteristics

| Parameter | Symbol | Min | Typ | Max | Unit | Test conditions | |
|---------------------------|------------|----------|------------|-----|------------|---------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|
| Input leakage current | $ I_{LI} $ | — | — | 1 | μA | $V_{in} = V_{SS}$ to V_{CC} | |
| Output leakage current | $ I_{LO} $ | — | — | 1 | μA | $CS\# = V_{IH}$ or $OE\# = V_{IH}$ or $WE\# = V_{IL}$ or $V_{I/O} = V_{SS}$ to V_{CC} | |
| Operating current | I_{CC} | — | 1.5^{*1} | 3 | mA | $CS\# = V_{IL}$, Others = V_{IH}/V_{IL} , $I_{I/O} = 0$ mA | |
| Average operating current | I_{CC1} | — | 8^{*1} | 25 | mA | Min. cycle, duty = 100%, $CS\# = V_{IL}$, Others = V_{IH}/V_{IL} , $I_{I/O} = 0$ mA | |
| | I_{CC2} | — | 2^{*1} | 5 | mA | Cycle time = 1 μs , duty = 100%, $I_{I/O} = 0$ mA, $CS\# \leq 0.2$ V, $V_{IH} \geq V_{CC} - 0.2$ V, $V_{IL} \leq 0.2$ V | |
| Standby current | I_{SB} | — | 0.1^{*1} | 0.5 | mA | $CS\# = V_{IH}$ | |
| Standby current | -5SI | to +85°C | I_{SB1} | — | 10 | μA | $V_{in} \geq 0$ V, $CS\# \geq V_{CC} - 0.2$ V |
| | | to +70°C | I_{SB1} | — | 8 | μA | |
| | | to +40°C | I_{SB1} | — | 1.0^{*2} | 3 | μA |
| | | to +25°C | I_{SB1} | — | 0.8^{*1} | 3 | μA |
| | -7LI | to +85°C | I_{SB1} | — | 20 | μA | |
| | | to +70°C | I_{SB1} | — | 16 | μA | |
| | | to +40°C | I_{SB1} | — | 1.0^{*2} | 10 | μA |
| | | to +25°C | I_{SB1} | — | 0.8^{*1} | 10 | μA |
| Output low voltage | V_{OL} | — | — | 0.4 | V | $I_{OL} = 2.1$ mA | |
| Output high voltage | V_{OH} | 2.4 | — | — | V | $I_{OH} = -1.0$ mA | |
| | V_{OH2} | 2.6 | — | — | V | $I_{OH} = -0.1$ mA | |

Notes: 1. Typical values are at $V_{CC} = 5.0 \text{ V}$, $T_a = +25^\circ\text{C}$ and specified loading, and not guaranteed.
2. Typical values are at $V_{CC} = 5.0 \text{ V}$, $T_a = +40^\circ\text{C}$ and specified loading, and not guaranteed.

Capacitance

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

| Parameter | Symbol | Min | Typ | Max | Unit | Test conditions | Note |
|--------------------------|-----------|-----|-----|-----|------|-------------------------|------|
| Input capacitance | C_{in} | — | — | 8 | pF | $V_{in} = 0 \text{ V}$ | 1 |
| Input/output capacitance | $C_{I/O}$ | — | — | 10 | pF | $V_{I/O} = 0 \text{ V}$ | 1 |

Note: 1. This parameter is sampled and not 100% tested.

R1LP0408C-I Series

AC Characteristics

(Ta = -40 to +85°C, V_{CC} = 5 V ± 10%, unless otherwise noted.)

Test Conditions

- Input pulse levels: V_{IL} = 0.4 V, V_{IH} = 2.4 V
- Input rise and fall time: 5 ns
- Input and output timing reference levels: 1.5 V
- Output load: 1 TTL Gate + C_L (50 pF) (R1LP0408C-5SI)
1 TTL Gate + C_L (100 pF) (R1LP0408C-7LI)
(Including scope and jig)

Read Cycle

| Parameter | Symbol | R1LP0408C-I | | | | Unit | Notes |
|------------------------------------|------------------|-------------|-----|------|-----|------|-------|
| | | -5SI | | -7LI | | | |
| | | Min | Max | Min | Max | | |
| Read cycle time | t _{RC} | 55 | — | 70 | — | ns | |
| Address access time | t _{AA} | — | 55 | — | 70 | ns | |
| Chip select access time | t _{CO} | — | 55 | — | 70 | ns | |
| Output enable to output valid | t _{OE} | — | 25 | — | 35 | ns | |
| Chip select to output in low-Z | t _{LZ} | 10 | — | 10 | — | ns | 2 |
| Output enable to output in low-Z | t _{OLZ} | 5 | — | 5 | — | ns | 2 |
| Chip deselect to output in high-Z | t _{HZ} | 0 | 20 | 0 | 25 | ns | 1, 2 |
| Output disable to output in high-Z | t _{OHZ} | 0 | 20 | 0 | 25 | ns | 1, 2 |
| Output hold from address change | t _{OH} | 10 | — | 10 | — | ns | |

R1LP0408C-I Series

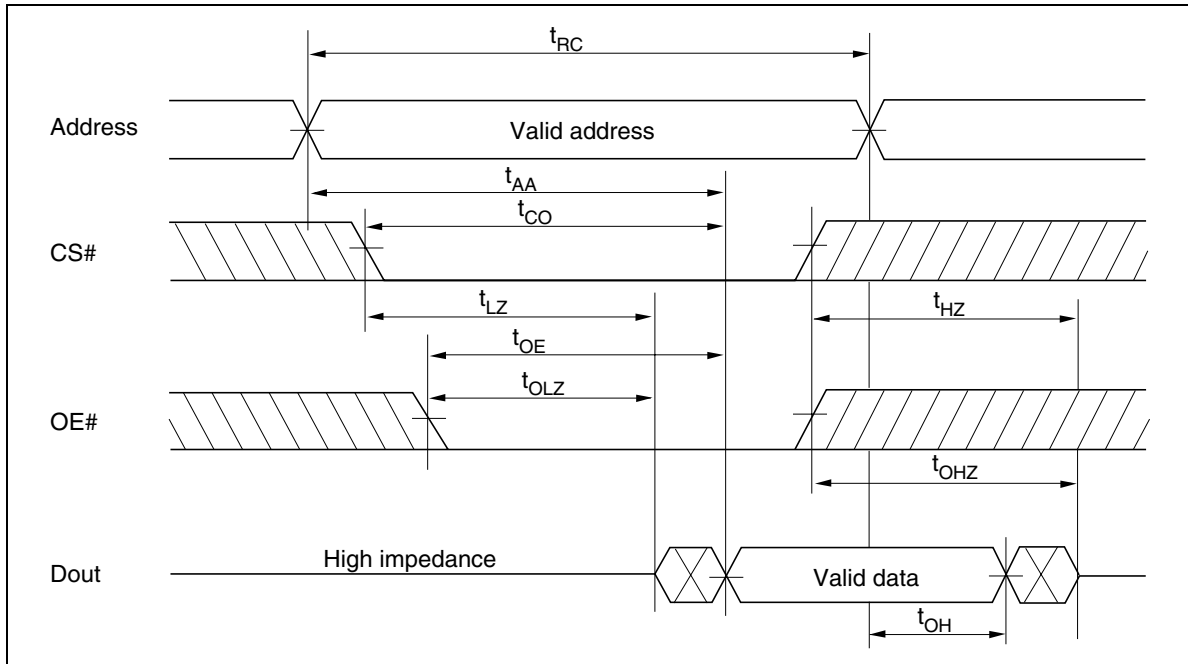
Write Cycle

| | | R1LP0408C-I | | | | | |
|------------------------------------|------------------|-------------|-----|------|-----|------|---------|
| | | -5SI | | -7LI | | | |
| Parameter | Symbol | Min | Max | Min | Max | Unit | Notes |
| Write cycle time | t _{WC} | 55 | — | 70 | — | ns | |
| Chip selection to end of write | t _{CW} | 50 | — | 60 | — | ns | 4 |
| Address setup time | t _{AS} | 0 | — | 0 | — | ns | 5 |
| Address valid to end of write | t _{AW} | 50 | — | 60 | — | ns | |
| Write pulse width | t _{WP} | 40 | — | 50 | — | ns | 3, 12 |
| Write recovery time | t _{WR} | 0 | — | 0 | — | ns | 6 |
| Write to output in high-Z | t _{WHZ} | 0 | 20 | 0 | 25 | ns | 1, 2, 7 |
| Data to write time overlap | t _{DW} | 25 | — | 30 | — | ns | |
| Data hold from write time | t _{DH} | 0 | — | 0 | — | ns | |
| Output active from end of write | t _{OW} | 5 | — | 5 | — | ns | 2 |
| Output disable to output in high-Z | t _{OHZ} | 0 | 20 | 0 | 25 | ns | 1, 2, 7 |

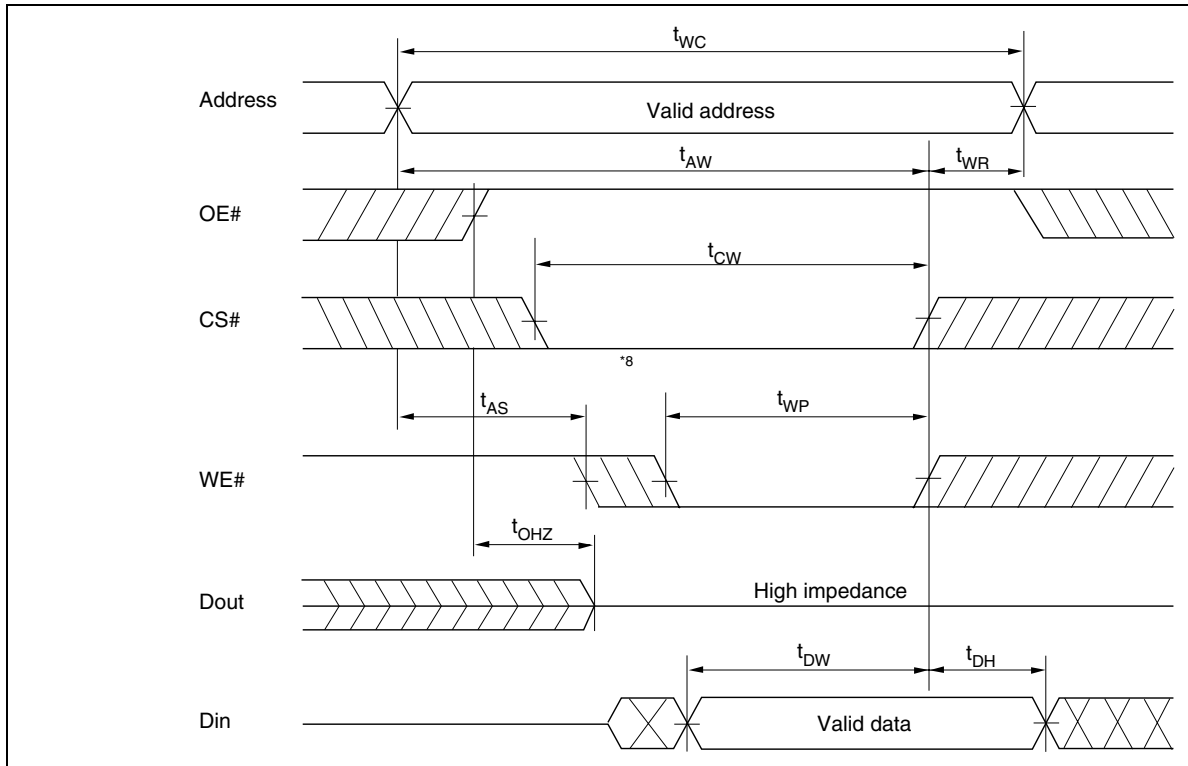
- Notes:
1. t_{HZ} , t_{OHZ} and t_{WHZ} are defined as the time at which the outputs achieve the open circuit conditions and are not referred to output voltage levels.
 2. This parameter is sampled and not 100% tested.
 3. A write occurs during the overlap (t_{WP}) of a low CS# and a low WE#. A write begins at the later transition of CS# going low or WE# going low. A write ends at the earlier transition of CS# going high or WE# going high. t_{WP} is measured from the beginning of write to the end of write.
 4. t_{CW} is measured from CS# going low to the end of write.
 5. t_{AS} is measured from the address valid to the beginning of write.
 6. t_{WR} is measured from the earlier of WE# or CS# going high to the end of write cycle.
 7. During this period, I/O pins are in the output state so that the input signals of the opposite phase to the outputs must not be applied.
 8. If the CS# low transition occurs simultaneously with the WE# low transition or after the WE# transition, the output remain in a high impedance state.
 9. Dout is the same phase of the write data of this write cycle.
 10. Dout is the read data of next address.
 11. If CS# is low during this period, I/O pins are in the output state. Therefore, the input signals of the opposite phase to the outputs must not be applied to them.
 12. In the write cycle with OE# low fixed, t_{WP} must satisfy the following equation to avoid a problem of data bus contention. $t_{WP} \geq t_{DW} \text{ min} + t_{WHZ} \text{ max}$

Timing Waveform

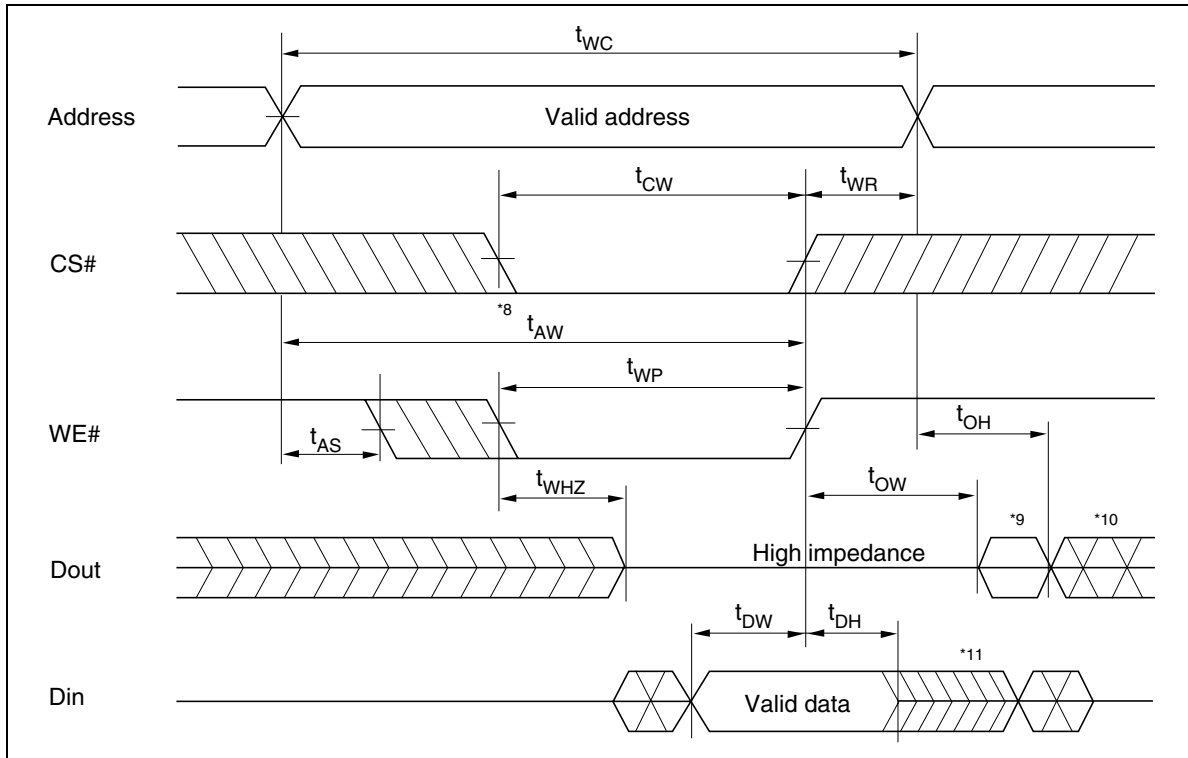
Read Timing Waveform (WE# = V_{IH})



Write Timing Waveform (1) (OE# Clock)



Write Timing Waveform (2) (OE# Low Fixed)

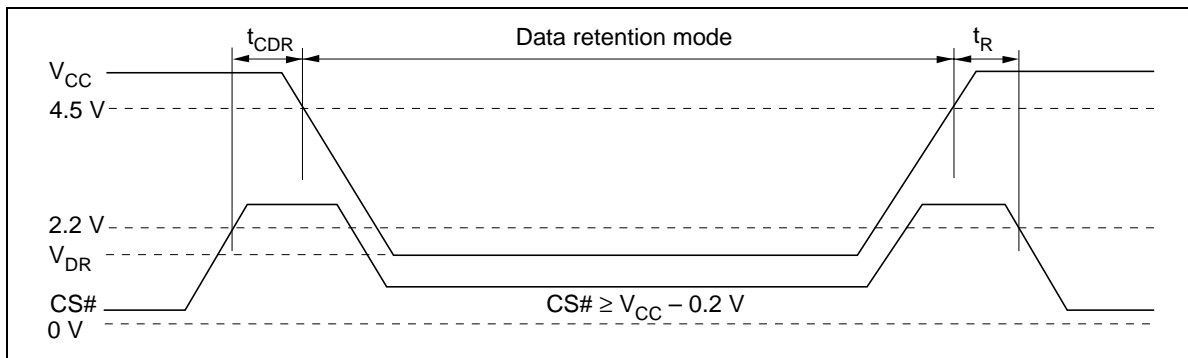


Low V_{CC} Data Retention Characteristics

($T_a = -40$ to $+85^\circ\text{C}$)

| Parameter | Symbol | Min | Typ | Max | Unit | Test conditions* ³ |
|--------------------------------------|-----------|------------------------|------------|-----|------------|--------------------------------------------------------------------|
| V_{CC} for data retention | V_{DR} | 2 | — | — | V | $CS\# \geq V_{CC} - 0.2\text{ V}$, $V_{in} \geq 0\text{ V}$ |
| Data retention current | -5SI | to $+85^\circ\text{C}$ | I_{CCDR} | — | 10 | μA , $V_{CC} = 3.0\text{ V}$, $V_{in} \geq 0\text{ V}$ |
| | | to $+70^\circ\text{C}$ | I_{CCDR} | — | 8 | μA , $CS\# \geq V_{CC} - 0.2\text{ V}$ |
| | | to $+40^\circ\text{C}$ | I_{CCDR} | — | 1.0^{*2} | 3 μA |
| | | to $+25^\circ\text{C}$ | I_{CCDR} | — | 0.8^{*1} | 3 μA |
| | -7LI | to $+85^\circ\text{C}$ | I_{CCDR} | — | 20 | μA |
| | | to $+70^\circ\text{C}$ | I_{CCDR} | — | 16 | μA |
| | | to $+40^\circ\text{C}$ | I_{CCDR} | — | 1.0^{*2} | 10 μA |
| | | to $+25^\circ\text{C}$ | I_{CCDR} | — | 0.8^{*1} | 10 μA |
| Chip deselect to data retention time | t_{CDR} | 0 | — | — | ns | See retention waveform |
| Operation recovery time | t_R | t_{RC}^{*4} | — | — | ns | |

- Notes: 1. Typical values are at $V_{CC} = 3.0\text{ V}$, $T_a = +25^\circ\text{C}$ and specified loading, and not guaranteed.
2. Typical values are at $V_{CC} = 3.0\text{ V}$, $T_a = +40^\circ\text{C}$ and specified loading, and not guaranteed.
3. $CS\#$ controls address buffer, $WE\#$ buffer, $OE\#$ buffer, and Din buffer. In data retention mode, V_{in} levels (address, $WE\#$, $OE\#$, I/O) can be in the high impedance state.
4. t_{RC} = read cycle time.

Low V_{CC} Data Retention Timing Waveform ($CS\#$ Controlled)


Revision History

R1LP0408C-I Series Data Sheet

| Rev. | Date | Contents of Modification | |
|------|-------------|--------------------------|----------------------------------------------------------------------------------------------|
| | | Page | Description |
| 1.00 | Aug.01.2003 | — | Initial issue |
| 2.00 | May.26.2004 | 6 | DC characteristics –5SI and –7LI items' description are divided. |
| | | 12 | Low V_{CC} Data Retention Characteristics –5SI and –7LI items' description are divided. |
| | | 12 | Low V_{CC} Data Retention Timing Waveform 2.4 V to 2.2 V |

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