



## LC3564B, BS, BM, BT-70/10

**64K (8192-word × 8-bit) SRAM with  $\overline{OE}$ ,  $\overline{CE1}$ , and CE2 Control Pins**

### Overview

The LC3564B, LC3564BS, LC3564BM, and LC3564BT are 8192-word × 8-bit asynchronous silicon gate CMOS SRAMs. These are full CMOS type SRAMs that adopt a six-transistor memory cell and feature fast access times, low operating power dissipation, and an ultralow standby current. These SRAMs provide three control signal inputs: an  $\overline{OE}$  input for high-speed memory access, and two chip enable lines,  $\overline{CE1}$  and CE2, for low power mode and device selection. These means that these SRAMs are ideal for systems that require low power and battery backup, and that they support easy memory expansion. The ultralow standby current that is a feature of these SRAMs allows them to be used with capacitor backup as well. Since these SRAMs support 3-V operation, they are also appropriate for use in portable battery operated systems.

### Features

- Supply voltage range: 2.7 to 5.5 V
  - In 5-V operation mode: 5.0 V ±10%
  - In 3-V operation mode: 3.0 V ±10%
- Address access time ( $t_{AA}$ )
  - In 5-V operation mode:
    - LC3564B, BS, BM, and BT-70: 70 ns (max)
    - LC3564B, BS, BM, and BT-10: 100 ns (max)
  - In 3-V operation mode:
    - LC3564B, BS, BM, and BT-70: 200 ns (max)
    - LC3564B, BS, BM, and BT-10: 500 ns (max)
- Ultralow standby current
  - In 5-V operation mode: 1.0  $\mu$ A ( $T_a \leq 70^\circ\text{C}$ ),  
3.0  $\mu$ A ( $T_a \leq 85^\circ\text{C}$ )
  - In 3-V operation mode: 0.8  $\mu$ A ( $T_a \leq 70^\circ\text{C}$ ),  
2.5  $\mu$ A ( $T_a \leq 85^\circ\text{C}$ )
- Operating temperature range
  - In 5-V operation mode:  $-40$  to  $85^\circ\text{C}$
  - In 3-V operation mode:  $-40$  to  $85^\circ\text{C}$
- Data retention supply voltage: 2.0 to 5.5 V
- All input and output levels:
  - In 5-V operation mode: TTL compatible levels
  - In 3-V operation mode:  $V_{CC} - 0.2$  V/0.2 V

- Three control inputs:  $\overline{OE}$ ,  $\overline{CE1}$ , and CE2
- Shared input and output pins, three-state outputs
- No clock required
- Packages

28-pin DIP (600 mil) plastic package: LC3564B

28-pin DIP (300 mil) plastic package: LC3564BS

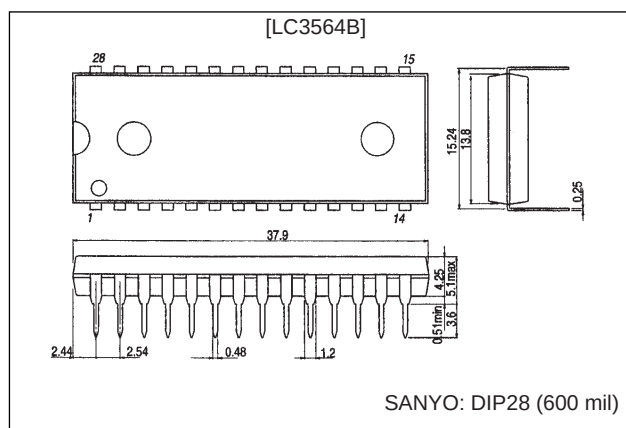
28-pin SOP (450 mil) plastic package: LC3564BM

28-pin TSOP (8 × 13.4 mm) plastic package: LC3564BT

### Package Dimensions

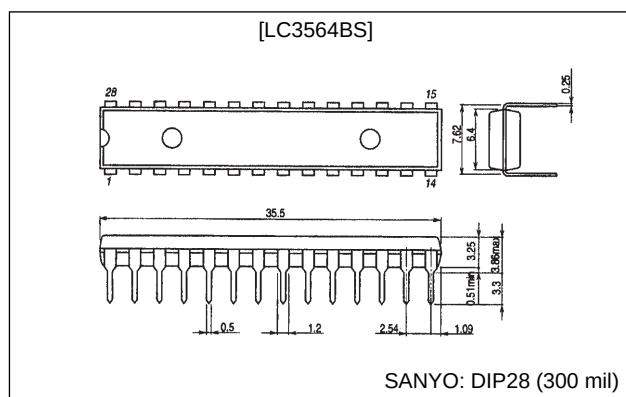
unit: mm

#### 3012A-DIP28 (600 mil)



unit: mm

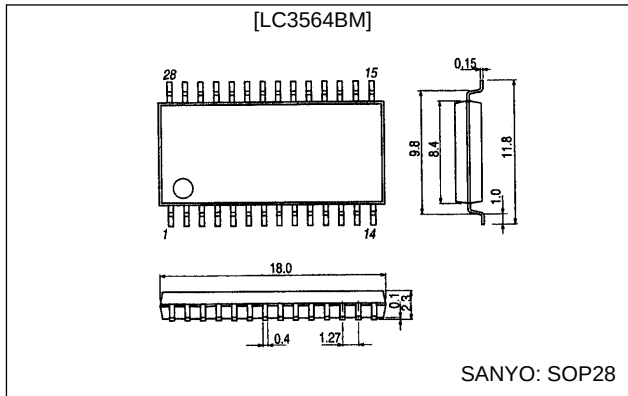
#### 3133-DIP28 (300 mil)



# LC3564B, BS, BM, BT-70/10

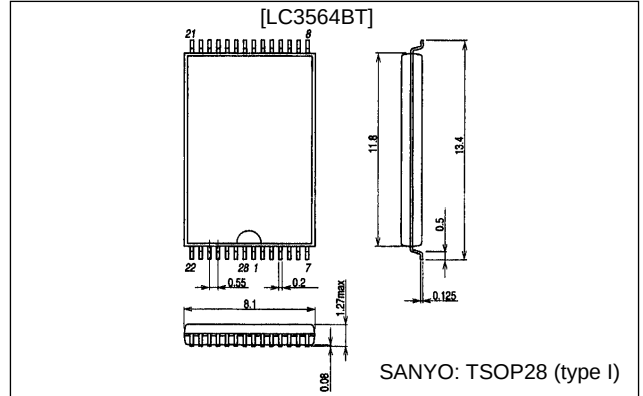
unit: mm

## 3187-SOP28

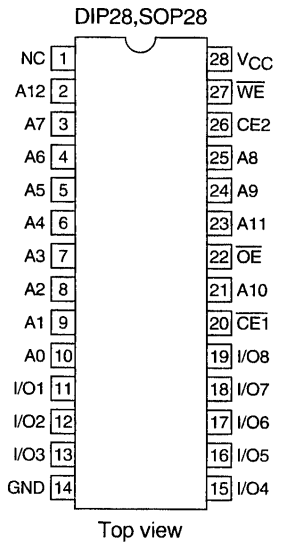


unit: mm

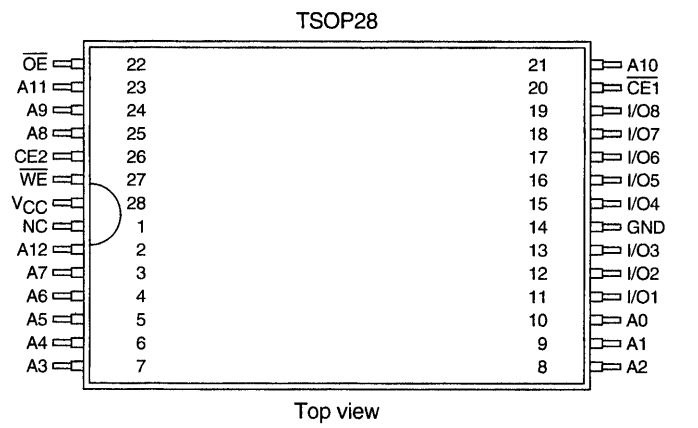
## 3221-TSOP28 (type I)



## Pin Assignments

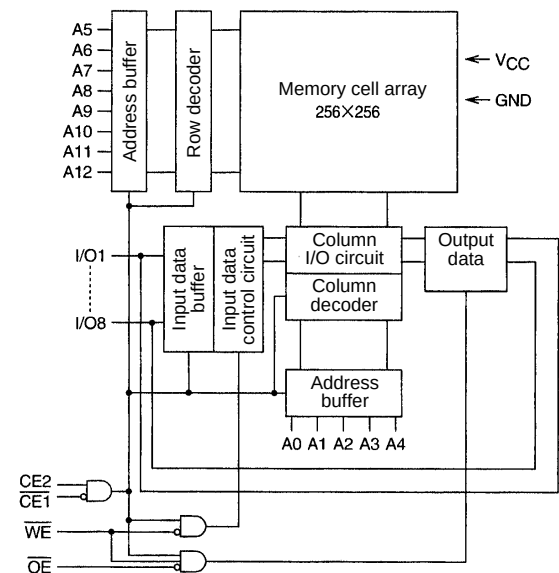


A09261



A09262

## Block Diagram



A09263

## Pin Functions

|                                     |                          |
|-------------------------------------|--------------------------|
| A0 to A12                           | Address inputs           |
| $\overline{WE}$                     | Read/write control input |
| $\overline{OE}$                     | Output enable input      |
| $\overline{CE1}$ , $\overline{CE2}$ | Chip enable inputs       |
| I/O1 to I/O8                        | Data I/O                 |
| VCC, GND                            | Power supply and ground  |

## Function Table

| Mode           | $\overline{CE1}$ | $\overline{CE2}$ | $\overline{OE}$ | $\overline{WE}$ | I/O            | Supply current |
|----------------|------------------|------------------|-----------------|-----------------|----------------|----------------|
| Read cycle     | L                | H                | L               | H               | Data output    | $I_{CCA}$      |
| Write cycle    | L                | H                | X               | L               | Data input     | $I_{CCA}$      |
| Output disable | L                | H                | H               | H               | High impedance | $I_{CCA}$      |
| Not selected   | H                | X                | X               | X               | High impedance | $I_{CCS}$      |
|                | X                | L                | X               | X               | High impedance | $I_{CCS}$      |

X : H or L

## Specifications

### Absolute Maximum Ratings at Ta = 25°C

| Parameter              | Symbol              | Conditions | Ratings                        | Unit |
|------------------------|---------------------|------------|--------------------------------|------|
| Maximum supply voltage | V <sub>CC</sub> max |            | 7.0                            | V    |
| Input voltage          | V <sub>IN</sub>     |            | −0.3* to V <sub>CC</sub> + 0.3 | V    |
| I/O voltage            | V <sub>I/O</sub>    |            | −0.3 to V <sub>CC</sub> + 0.3  | V    |
| Operating temperature  | T <sub>opr</sub>    |            | −40 to +85                     | °C   |
| Storage temperature    | T <sub>stg</sub>    |            | −55 to +125                    | °C   |

Note: For pulse widths less than 30 ns: −3.0 V

### Input and Output Capacitances at Ta = 25°C, f = 1 MHz

| Parameter             | Symbol           | Conditions             | Ratings |     |     | Unit |
|-----------------------|------------------|------------------------|---------|-----|-----|------|
|                       |                  |                        | min     | typ | max |      |
| I/O pin capacitance   | C <sub>I/O</sub> | V <sub>I/O</sub> = 0 V |         | 6   | 10  | pF   |
| Input pin capacitance | C <sub>IN</sub>  | V <sub>IN</sub> = 0 V  |         | 6   | 10  | pF   |

Note: These parameters are sampled, and are not measured for every unit.

### [5-V Operation]

### DC Allowable Operating Ranges at Ta = −40 to +85°C, V<sub>CC</sub> = 4.5 to 5.5 V

| Parameter      | Symbol          | Conditions | Ratings |     |                       | Unit |
|----------------|-----------------|------------|---------|-----|-----------------------|------|
|                |                 |            | min     | typ | max                   |      |
| Supply voltage | V <sub>CC</sub> |            | 4.5     | 5.0 | 5.5                   | V    |
| Input voltage  | V <sub>IH</sub> |            | 2.2     |     | V <sub>CC</sub> + 0.3 | V    |
|                | V <sub>IL</sub> |            | −0.3*   |     | +0.8                  | V    |

Note: For pulse widths less than 30 ns: −3.0 V

### DC Electrical Characteristics at Ta = −40 to +85°C, V<sub>CC</sub> = 4.5 to 5.5 V

| Parameter                   |                                      | Symbol            | Conditions                                                                                                                                                                                   |           |                       | Ratings |       |      | Unit |
|-----------------------------|--------------------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------------------|---------|-------|------|------|
|                             |                                      |                   |                                                                                                                                                                                              |           |                       | min     | typ * | max  |      |
| Input leakage current       |                                      | I <sub>LI</sub>   | V <sub>IN</sub> = 0 to V <sub>CC</sub>                                                                                                                                                       |           |                       | −1.0    |       | +1.0 | μA   |
| I/O leakage current         |                                      | I <sub>LO</sub>   | V <sub>CE1</sub> = V <sub>IH</sub> or V <sub>CE2</sub> = V <sub>IL</sub> or V <sub>OE</sub> = V <sub>IH</sub> or V <sub>WE</sub> = V <sub>IL</sub> ; V <sub>I/O</sub> = 0 to V <sub>CC</sub> |           |                       | −1.0    |       | +1.0 | μA   |
| Output high-level voltage   |                                      | V <sub>OH</sub>   | I <sub>OH</sub> = −1.0 mA                                                                                                                                                                    |           |                       | 2.4     |       |      | V    |
| Output low-level voltage    |                                      | V <sub>OL</sub>   | I <sub>OL</sub> = 2.0 mA                                                                                                                                                                     |           |                       |         |       | 0.4  | V    |
| Operating supply current    | V <sub>CC</sub> − 0.2 V/0.2 V inputs | I <sub>CCA1</sub> | V <sub>CE1</sub> ≤ 0.2 V, V <sub>CE2</sub> ≥ V <sub>CC</sub> − 0.2 V, I <sub>I/O</sub> = 0 mA, V <sub>IN</sub> ≤ 0.2 V or V <sub>IN</sub> ≥ V <sub>CC</sub> − 0.2 V                          |           | Ta ≤ 70°C             |         | 0.01  | 1.0  | μA   |
|                             |                                      |                   |                                                                                                                                                                                              |           | Ta ≤ 85°C             |         |       | 3.0  |      |
|                             |                                      | I <sub>CCA4</sub> | V <sub>CE1</sub> ≤ 0.2 V, V <sub>CE2</sub> ≥ V <sub>CC</sub> − 0.2 V, I <sub>I/O</sub> = 0 mA, DUTY = 100%                                                                                   | min cycle | LC3564B,BS, BM, BT-70 |         |       | 35   | mA   |
|                             |                                      |                   |                                                                                                                                                                                              |           | LC3564B,BS,BM,BT-10   |         |       | 30   |      |
|                             |                                      |                   | 1 μs cycle                                                                                                                                                                                   |           |                       | 4       |       |      | mA   |
|                             | TTL inputs                           | I <sub>CCA2</sub> | V <sub>CE1</sub> = V <sub>IL</sub> , V <sub>CE2</sub> = V <sub>IH</sub> , I <sub>I/O</sub> = 0 mA, V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                      |           |                       |         |       | 7    | mA   |
|                             |                                      | I <sub>CCA3</sub> | V <sub>CE1</sub> = V <sub>IL</sub> , V <sub>CE2</sub> = V <sub>IH</sub> , I <sub>I/O</sub> = 0 mA, DUTY = 100%                                                                               | min cycle | LC3564B,BS, BM, BT-70 |         |       | 40   | mA   |
|                             |                                      |                   |                                                                                                                                                                                              |           | LC3564B,BS,BM,BT-10   |         |       | 35   |      |
| Standby mode supply current | V <sub>CC</sub> − 0.2 V/0.2 V inputs | I <sub>CCS1</sub> | V <sub>CE2</sub> ≤ 0.2 V or V <sub>CE1</sub> ≥ V <sub>CC</sub> − 0.2 V V <sub>CE2</sub> ≥ V <sub>CC</sub> − 0.2 V                                                                            |           | Ta ≤ 70°C             |         | 0.01  | 1.0  | μA   |
|                             |                                      |                   |                                                                                                                                                                                              |           | Ta ≤ 85°C             |         |       | 3.0  |      |
|                             | TTL inputs                           | I <sub>CC2</sub>  | V <sub>CE2</sub> = V <sub>IL</sub> or V <sub>CE1</sub> = V <sub>IH</sub> , V <sub>IN</sub> = 0 to V <sub>CC</sub>                                                                            |           |                       |         |       | 2.0  | mA   |
|                             |                                      |                   |                                                                                                                                                                                              |           |                       |         |       |      |      |

Note \*: Reference values at V<sub>CC</sub> = 5 V, Ta = 25°C

## LC3564B, BS, BM, BT-70/10

### AC Electrical Characteristics at Ta = -40 to +85°C, V<sub>CC</sub> = 4.5 to 5.5 V

| Parameter                     | Conditions                                                                       |
|-------------------------------|----------------------------------------------------------------------------------|
| [AC Test Conditions]          |                                                                                  |
| Input pulse voltage           | V <sub>IH</sub> = 2.4 V, V <sub>IL</sub> = 0.6 V                                 |
| Input rise and fall times     | 5 ns                                                                             |
| Input and output timing level | 1.5 V                                                                            |
| Output load                   | LC3564B, BS, BM, and BT-70: 30 pF + 1 TTL gate (Including the jig capacitance.)  |
|                               | LC3564B, BS, BM, and BT-10: 100 pF + 1 TTL gate (Including the jig capacitance.) |

### Read Cycle

| Parameter                                   | Symbol            | LC3564B, BS, BM, BT |     |     |     | Unit |
|---------------------------------------------|-------------------|---------------------|-----|-----|-----|------|
|                                             |                   | -70                 |     | -10 |     |      |
|                                             |                   | min                 | max | min | max |      |
| Read cycle time                             | t <sub>RC</sub>   | 70                  |     | 100 |     | ns   |
| Address access time                         | t <sub>AA</sub>   |                     | 70  |     | 100 | ns   |
| $\overline{\text{CE1}}$ access time         | t <sub>CA1</sub>  |                     | 70  |     | 100 | ns   |
| CE2 access time                             | t <sub>CA2</sub>  |                     | 70  |     | 100 | ns   |
| $\overline{\text{OE}}$ access time          | t <sub>OA</sub>   |                     | 35  |     | 50  | ns   |
| Output hold time                            | t <sub>OH</sub>   | 10                  |     | 10  |     | ns   |
| $\overline{\text{CE1}}$ output enable time  | t <sub>COE1</sub> | 10                  |     | 10  |     | ns   |
| CE2 output enable time                      | t <sub>COE2</sub> | 10                  |     | 10  |     | ns   |
| $\overline{\text{OE}}$ output enable time   | t <sub>OOE</sub>  | 5                   |     | 5   |     | ns   |
| $\overline{\text{CE1}}$ output disable time | t <sub>COD1</sub> |                     | 30  |     | 35  | ns   |
| CE2 output disable time                     | t <sub>COD2</sub> |                     | 30  |     | 35  | ns   |
| $\overline{\text{OE}}$ output disable time  | t <sub>OOD</sub>  |                     | 25  |     | 25  | ns   |

### Write Cycle

| Parameter                                   | Symbol           | LC3564B, BS, BM, BT |     |     |     | Unit |
|---------------------------------------------|------------------|---------------------|-----|-----|-----|------|
|                                             |                  | -70                 |     | -10 |     |      |
|                                             |                  | min                 | max | min | max |      |
| Write cycle time                            | t <sub>WC</sub>  | 70                  |     | 100 |     | ns   |
| Address setup time                          | t <sub>AS</sub>  | 0                   |     | 0   |     | ns   |
| Write pulse width                           | t <sub>WP</sub>  | 50                  |     | 55  |     | ns   |
| $\overline{\text{CE1}}$ setup time          | t <sub>CW1</sub> | 60                  |     | 65  |     | ns   |
| CE2 setup time                              | t <sub>CW2</sub> | 60                  |     | 65  |     | ns   |
| Write recovery time                         | t <sub>WR</sub>  | 0                   |     | 0   |     | ns   |
| $\overline{\text{CE1}}$ write recovery time | t <sub>WR1</sub> | 0                   |     | 0   |     | ns   |
| CE2 write recovery time                     | t <sub>WR2</sub> | 0                   |     | 0   |     | ns   |
| Data setup time                             | t <sub>DS</sub>  | 35                  |     | 40  |     | ns   |
| Data hold time                              | t <sub>DH</sub>  | 0                   |     | 0   |     | ns   |
| $\overline{\text{CE1}}$ data hold time      | t <sub>DH1</sub> | 0                   |     | 0   |     | ns   |
| CE2 data hold time                          | t <sub>DH2</sub> | 0                   |     | 0   |     | ns   |
| $\overline{\text{WE}}$ output enable time   | t <sub>WOE</sub> | 5                   |     | 5   |     | ns   |
| $\overline{\text{WE}}$ output disable time  | t <sub>WOD</sub> |                     | 30  |     | 35  | ns   |

# LC3564B, BS, BM, BT-70/10

[3-V Operation]

## DC Allowable Operating Ranges at Ta = -40 to +85°C, VCC = 2.7 to 3.3 V

| Parameter      | Symbol          | Conditions | Ratings               |     |                 | Unit |
|----------------|-----------------|------------|-----------------------|-----|-----------------|------|
|                |                 |            | min                   | typ | max             |      |
| Supply voltage | V <sub>CC</sub> |            | 2.7                   | 3.0 | 3.3             | V    |
| Input voltage  | V <sub>IH</sub> |            | V <sub>CC</sub> - 0.2 |     | V <sub>CC</sub> | V    |
|                | V <sub>IL</sub> |            | 0                     |     | 0.2             | V    |

## DC Electrical Characteristics at Ta = -40 to +85°C, VCC = 2.7 to 3.3 V

| Parameter                   |                                      | Symbol            | Conditions                                                                                                                                                                                   |            | Ratings               |       |      | Unit |
|-----------------------------|--------------------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------------------|-------|------|------|
|                             |                                      |                   |                                                                                                                                                                                              |            | min                   | typ * | max  |      |
| Input leakage current       |                                      | I <sub>LI</sub>   | V <sub>IN</sub> = 0 to V <sub>CC</sub>                                                                                                                                                       |            | -1.0                  |       | +1.0 | μA   |
| I/O leakage current         |                                      | I <sub>LO</sub>   | V <sub>CE1</sub> = V <sub>IH</sub> or V <sub>CE2</sub> = V <sub>IL</sub> or V <sub>OE</sub> = V <sub>IH</sub> or V <sub>WE</sub> = V <sub>IL</sub> , V <sub>I/O</sub> = 0 to V <sub>CC</sub> |            | -1.0                  |       | +1.0 | μA   |
| Output high-level voltage   |                                      | V <sub>OH</sub>   | I <sub>OH</sub> = -0.5 mA                                                                                                                                                                    |            | V <sub>CC</sub> - 0.2 |       |      | V    |
| Output low-level voltage    |                                      | V <sub>OL</sub>   | I <sub>OL</sub> = 1.0 mA                                                                                                                                                                     |            |                       |       | 0.2  | V    |
| Operation supply current    | V <sub>CC</sub> - 0.2 V/0.2 V inputs | I <sub>CCA1</sub> | V <sub>CE1</sub> ≤ V <sub>IL</sub> , V <sub>CE2</sub> ≥ V <sub>IH</sub> , I <sub>I/O</sub> = 0 mA, V <sub>IN</sub> ≤ V <sub>IL</sub> or V <sub>IN</sub> ≥ V <sub>IH</sub>                    | Ta ≤ 70°C  |                       | 0.01  | 0.8  | μA   |
|                             |                                      |                   |                                                                                                                                                                                              | Ta ≤ 85°C  |                       |       | 2.5  |      |
|                             |                                      | I <sub>CCA4</sub> | V <sub>CE1</sub> ≤ V <sub>IL</sub> , V <sub>CE2</sub> ≥ V <sub>IH</sub> , I <sub>I/O</sub> = 0 mA, DUTY = 100%                                                                               | min cycle  | LC3564B,BS,BM,BT-70   |       | 20   | mA   |
|                             |                                      |                   |                                                                                                                                                                                              | 1 μs cycle | LC3564B,BS,BM,BT-10   |       | 10   |      |
|                             |                                      |                   |                                                                                                                                                                                              |            |                       | 3     |      | mA   |
| Standby mode supply current | V <sub>CC</sub> - 0.2 V/0.2 V inputs | I <sub>CCS1</sub> | V <sub>CE2</sub> ≤ 0.2 V or V <sub>CE1</sub> ≥ V <sub>IH</sub> , V <sub>CE2</sub> ≥ V <sub>IH</sub>                                                                                          | Ta ≤ 70°C  |                       | 0.01  | 0.8  | μA   |
|                             |                                      |                   |                                                                                                                                                                                              | Ta ≤ 85°C  |                       |       | 2.5  |      |

Note \*: Reference values at V<sub>CC</sub> = 3 V, Ta = 25°C

## LC3564B, BS, BM, BT-70/10

### AC Electrical Characteristics at Ta = -40 to +85°C, V<sub>CC</sub> = 2.7 to 3.3 V

| Parameter                     | Conditions                                                         |
|-------------------------------|--------------------------------------------------------------------|
| [AC Test Conditions]          |                                                                    |
| Input pulse voltage           | V <sub>IH</sub> = V <sub>CC</sub> - 0.2 V, V <sub>IL</sub> = 0.2 V |
| Input rise and fall times     | 10 ns                                                              |
| Input and output timing level | 1.5 V                                                              |
| Output load                   | LC3564B, BS, BM, BT-70 : 30pF (Including the jig capacitance.)     |
|                               | LC3564B, BS, BM, BT-10 : 100pF (Including the jig capacitance.)    |

### Read Cycle

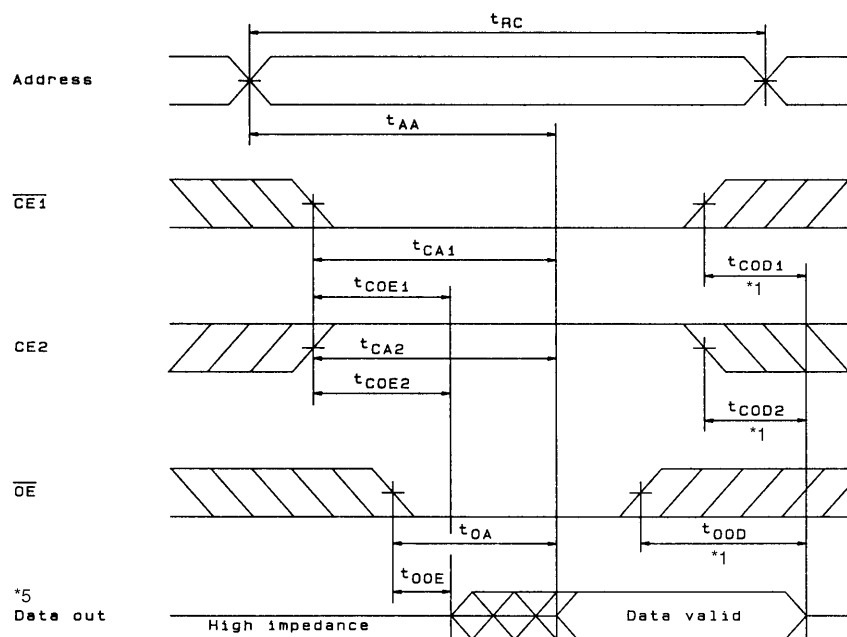
| Parameter                                   | Symbol            | LC3564B, BS, BM, BT |     |     |     | Unit |
|---------------------------------------------|-------------------|---------------------|-----|-----|-----|------|
|                                             |                   | -70                 |     | -10 |     |      |
|                                             |                   | min                 | max | min | max |      |
| Read cycle time                             | t <sub>RC</sub>   | 200                 |     | 500 |     | ns   |
| Address access time                         | t <sub>AA</sub>   |                     | 200 |     | 500 | ns   |
| $\overline{\text{CE1}}$ access time         | t <sub>CA1</sub>  |                     | 200 |     | 500 | ns   |
| CE2 access time                             | t <sub>CA2</sub>  |                     | 200 |     | 500 | ns   |
| $\overline{\text{OE}}$ access time          | t <sub>OA</sub>   |                     | 100 |     | 250 | ns   |
| Output hold time                            | t <sub>OH</sub>   | 20                  |     | 20  |     | ns   |
| $\overline{\text{CE1}}$ output enable time  | t <sub>COE1</sub> | 20                  |     | 20  |     | ns   |
| CE2 output enable time                      | t <sub>COE2</sub> | 20                  |     | 20  |     | ns   |
| $\overline{\text{OE}}$ output enable time   | t <sub>OOE</sub>  | 10                  |     | 10  |     | ns   |
| $\overline{\text{CE1}}$ output disable time | t <sub>COD1</sub> |                     | 60  |     | 120 | ns   |
| CE2 output disable time                     | t <sub>COD2</sub> |                     | 60  |     | 120 | ns   |
| $\overline{\text{OE}}$ output disable time  | t <sub>OOD</sub>  |                     | 50  |     | 100 | ns   |

### Write Cycle

| Parameter                                   | Symbol           | LC3564B, BS, BM, BT |     |     |     | Unit |
|---------------------------------------------|------------------|---------------------|-----|-----|-----|------|
|                                             |                  | -70                 |     | -10 |     |      |
|                                             |                  | min                 | max | min | max |      |
| Write cycle time                            | t <sub>WC</sub>  | 200                 |     | 500 |     | ns   |
| Address setup time                          | t <sub>AS</sub>  | 0                   |     | 0   |     | ns   |
| Write pulse width                           | t <sub>WP</sub>  | 140                 |     | 200 |     | ns   |
| $\overline{\text{CE1}}$ setup time          | t <sub>CW1</sub> | 150                 |     | 250 |     | ns   |
| CE2 setup time                              | t <sub>CW2</sub> | 0                   |     | 250 |     | ns   |
| Write recovery time                         | t <sub>WR</sub>  | 0                   |     | 0   |     | ns   |
| $\overline{\text{CE1}}$ write recovery time | t <sub>WR1</sub> | 0                   |     | 0   |     | ns   |
| CE2 write recovery time                     | t <sub>WR2</sub> | 130                 |     | 0   |     | ns   |
| Data setup time                             | t <sub>DS</sub>  | 0                   |     | 180 |     | ns   |
| Data hold time                              | t <sub>DH</sub>  | 0                   |     | 0   |     | ns   |
| $\overline{\text{CE1}}$ data hold time      | t <sub>DH1</sub> | 0                   |     | 0   |     | ns   |
| CE2 data hold time                          | t <sub>DH2</sub> | 10                  |     | 0   |     | ns   |
| $\overline{\text{WE}}$ output enable time   | t <sub>WOE</sub> |                     |     | 10  |     | ns   |
| $\overline{\text{WE}}$ output disable time  | t <sub>WOD</sub> |                     | 60  |     | 120 | ns   |

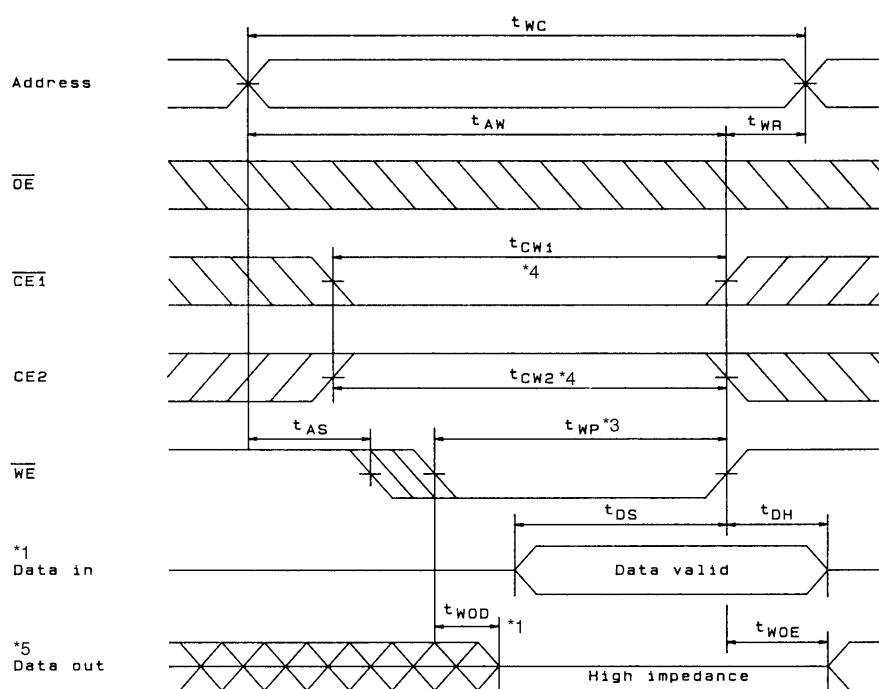
## Timing Charts

## Read Cycle \*1



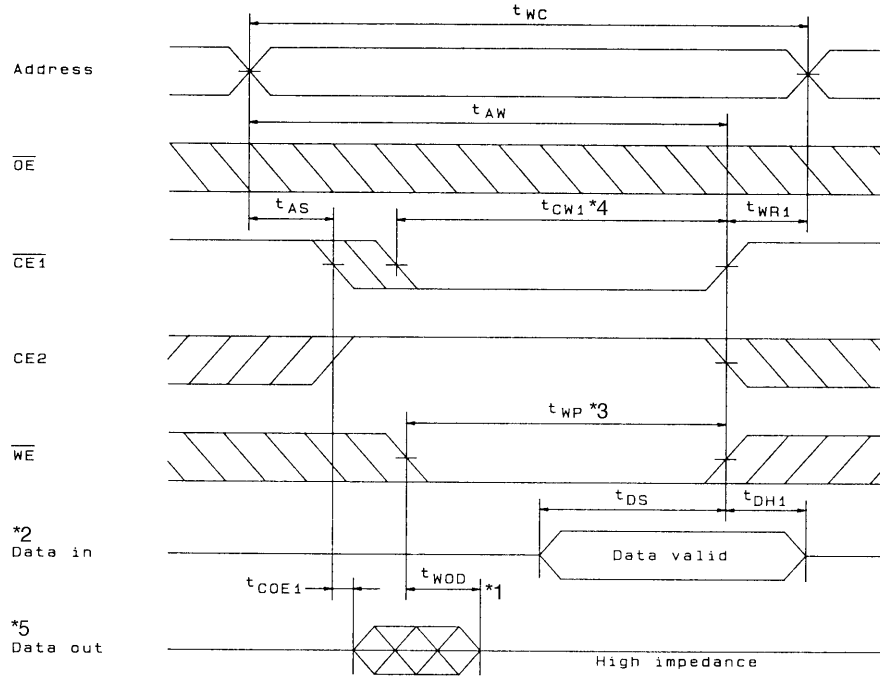
A05775

## Write Cycle (1): WE Write \*6



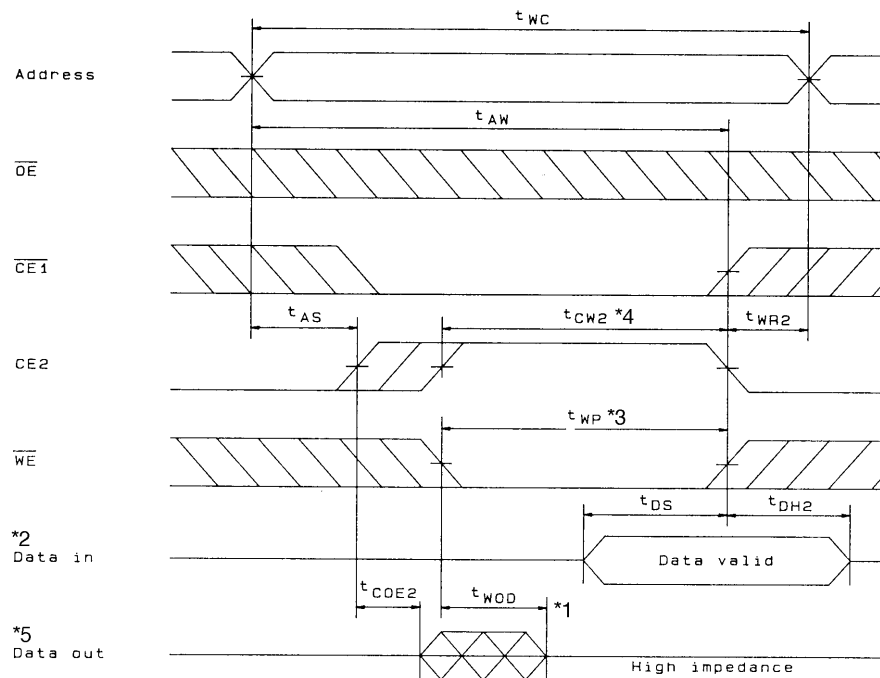
A05776

Write Cycle (2):  $\overline{\text{CE1}}$  Write \*6



A05777

Write Cycle (3):  $\text{CE2}$  Write \*6



A05778

- Notes:
1. Hold  $\overline{\text{WE}}$  high during the read cycle.
  2. Applications must not apply reverse phase signals to the  $\text{D}_{\text{OUT}}$  pins when those pins are in the output state.
  3. The time  $t_{WP}$  is the period when  $\overline{\text{CE1}}$  and  $\overline{\text{WE}}$  are low and  $\text{CE2}$  is high, and is defined as the time from the fall of  $\overline{\text{WE}}$  until either  $\overline{\text{CE1}}$  or  $\overline{\text{WE}}$  rises, or  $\text{CE2}$  falls, whichever occurs first.
  4. The times  $t_{CW1}$  and  $t_{CW2}$  are periods when  $\overline{\text{CE1}}$  and  $\overline{\text{WE}}$  are low and  $\text{CE2}$  is high. They are defined as the times from the fall of  $\overline{\text{CE1}}$  or the rise of  $\text{CE2}$  to the rise of  $\overline{\text{CE1}}$  and  $\overline{\text{WE}}$ , or the fall of  $\text{CE2}$ , whichever occurs first.
  5. The  $\text{D}_{\text{OUT}}$  pins will be in the high-impedance state if either  $\overline{\text{OE}}$  is high,  $\overline{\text{CE1}}$  is high,  $\text{CE2}$  is low, or  $\overline{\text{WE}}$  is low.
  6.  $\overline{\text{OE}}$  must be held either at  $V_{\text{IH}}$  or  $V_{\text{IL}}$  during the write cycle.
  7. The  $\text{D}_{\text{OUT}}$  pins have the same phase as the write cycle write data.

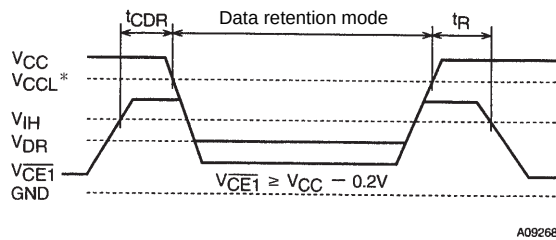


# Data Retention Characteristics at Ta = -40 to +85°C

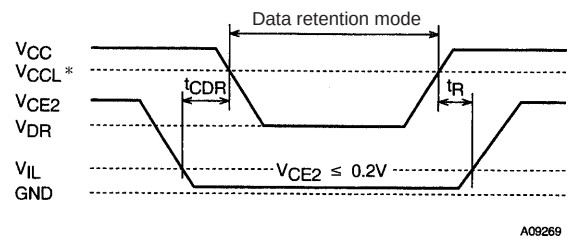
| Parameter                     | Symbol     | Conditions                                                                                                                                   | Ratings    |     |     | Unit          |
|-------------------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------|-----|-----|---------------|
|                               |            |                                                                                                                                              | min        | typ | max |               |
| Data retention supply voltage | $V_{DR}$   | $V_{CE2} \leq 0.2 \text{ V}$ or<br>$V_{CE1} \geq V_{CC} - 0.2 \text{ V}$ , $V_{CE2} \geq V_{CC} - 0.2 \text{ V}$                             | 2.0        |     | 5.5 | $\mu\text{A}$ |
| Data retention supply current | $I_{CCDR}$ | $V_{CC} = 3\text{V}$ , $V_{CE2} \leq 0.2 \text{ V}$ ,<br>or $V_{CE1} \geq V_{CC} - 0.2 \text{ V}$ ,<br>$V_{CE2} \geq V_{CC} - 0.2 \text{ V}$ |            |     | 0.8 | $\mu\text{A}$ |
|                               |            | $T_a \leq 70^\circ\text{C}$<br>$T_a \leq 85^\circ\text{C}$                                                                                   |            |     | 2.5 |               |
| Chip enable setup time        | $t_{CDR}$  |                                                                                                                                              | 0          |     |     | ns            |
| Chip enable hold time         | $t_R$      |                                                                                                                                              | $t_{RC}^*$ |     |     | ns            |

Note \*:  $t_{RC}$  is the read cycle time.

## Data Retention Waveforms (1): CE1 Control



## Data Retention Waveforms (2): CE2 Control



Note \*: In 5-V operation: 4.5 V  
In 3-V operation: 2.7 V

## Notes on Circuit Design

When actually design a circuit using these devices, take the following points into consideration and design the circuit so that none of the maximum rating items are ever exceeded.

- Variations in the supply voltage
- Variations in the electrical characteristics of components such as semiconductor devices, resistors, and capacitors.
- Ambient temperature
- Variations in input and clock signals
- Possible application of abnormal pulses

Also, these devices must be operated within the ranges stipulated in the allowable operating ranges.

If CMOS IC input pins are left open, intermediate potential input voltages may occur leading to incorrect operation due to through currents or other phenomenon. Applications must handle unused input pins appropriately.

- No products described or contained herein are intended for use in surgical implants, life-support systems, aerospace equipment, nuclear power control systems, vehicles, disaster/crime-prevention equipment and the like, the failure of which may directly or indirectly cause injury, death or property loss.
- Anyone purchasing any products described or contained herein for an above-mentioned use shall:
  - ① Accept full responsibility and indemnify and defend SANYO ELECTRIC CO., LTD., its affiliates, subsidiaries and distributors and all their officers and employees, jointly and severally, against any and all claims and litigation and all damages, cost and expenses associated with such use:
  - ② Not impose any responsibility for any fault or negligence which may be cited in any such claim or litigation on SANYO ELECTRIC CO., LTD., its affiliates, subsidiaries and distributors or any of their officers and employees jointly or severally.
- Information (including circuit diagrams and circuit parameters) herein is for example only; it is not guaranteed for volume production. SANYO believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.

This catalog provides information as of May, 1998. Specifications and information herein are subject to change without notice.