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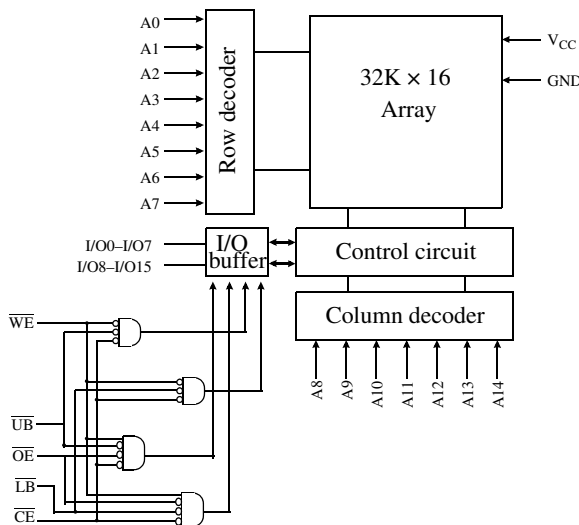


3.3V 32Kx16 CMOS SRAM

**Features**

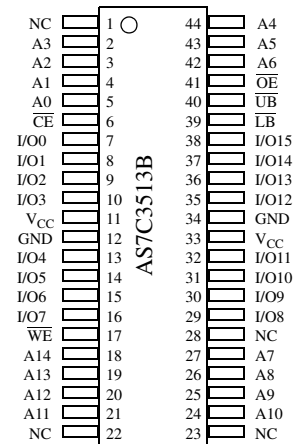
- Industrial and commercial temperature
- Organization: 32,768 words x 16 bits
- Center power and ground pins
- High speed
- 10/12/15/20 ns address access time
- 5, 6, 7, 8 ns output enable access time
- Low power consumption: ACTIVE
- 288 mW / max @ 10 ns
- Low power consumption: STANDBY
- 18 mW / max CMOS
- 6T 0.18m CMOS Technology
- Easy memory expansion with  $\overline{CE}$ ,  $\overline{OE}$  inputs
- TTL-compatible, three-state I/O
- 44-pin JEDEC standard package
- 400 mil SOJ
- 400 mil TSOP 2
- ESD protection  $\geq 2000$  volts
- Latch-up current  $\geq 200$  mA

**Logic block diagram**



**Pin arrangement**

44-Pin SOJ, TSOP 2 (400 mil)



**Selection guide**

|                                   | -10 | -12 | -15 | -20 | Unit |
|-----------------------------------|-----|-----|-----|-----|------|
| Maximum address access time       | 10  | 12  | 15  | 20  | ns   |
| Maximum output enable access time | 5   | 6   | 7   | 8   | ns   |
| Maximum operating current         | 80  | 75  | 70  | 65  | mA   |
| Maximum CMOS standby current      | 5   | 5   | 5   | 5   | mA   |



## Functional description

The AS7C3513B is a high performance CMOS 524,288-bit Static Random Access Memory (SRAM) device organized as 32,768 words  $\times$  16 bits. They are designed for memory applications where fast data access, low power, and simple interfacing are desired.

Equal address access and cycle times ( $t_{AA}$ ,  $t_{RC}$ ,  $t_{WC}$ ) of 10/12/15/20 ns with output enable access times ( $t_{OE}$ ) of 5, 6, 7, 8 ns are ideal for high performance applications. The chip enable input  $\overline{CE}$  permits easy memory expansion with multiple-bank memory systems.

When  $\overline{CE}$  is high, the device enters standby mode. If inputs are still toggling, the device consumes  $I_{SB}$  power. If the bus is static, then the full standby power is reached ( $I_{SB1}$ ). The AS7C3513B is guaranteed not to exceed 18mW power consumption under nominal full standby conditions.

A write cycle is accomplished by asserting write enable ( $\overline{WE}$ ), ( $\overline{UB}$ ) and/or ( $\overline{LB}$ ), and chip enable ( $\overline{CE}$ ). Data on the input pins I/O0 - I/O7, and/or I/O8 - I/O15, is written on the rising edge of  $\overline{WE}$  (write cycle 1) or  $\overline{CE}$  (write cycle 2). To avoid bus contention, external devices should drive I/O pins only after outputs have been disabled with output enable ( $\overline{OE}$ ) or write enable ( $\overline{WE}$ ).

A read cycle is accomplished by asserting output enable ( $\overline{OE}$ ), ( $\overline{UB}$ ) and ( $\overline{LB}$ ), and chip enable ( $\overline{CE}$ ), with write enable ( $\overline{WE}$ ) high. The chips drive I/O pins with the data word referenced by the input address. When either chip enable or output enable is inactive, or write enable is active, or ( $\overline{UB}$ ) and ( $\overline{LB}$ ), output drivers stay in high-impedance mode.

The devices provide multiple center power and ground pins, and separate byte enable controls, allowing individual bytes to be written and read.  $\overline{LB}$  controls the lower bits, I/O0 - I/O7, and  $\overline{UB}$  controls the higher bits, I/O8 - I/O15.

All chip inputs and outputs are TTL-compatible. The AS7C3513B is packaged in common industry standard packages.

## Absolute maximum ratings

| Parameter                                 | Symbol     | Min   | Max             | Unit        |
|---|------------|-------|-----------------|-------------|
| Voltage on $V_{CC}$ relative to GND       | $V_{t1}$   | -0.50 | +5.0            | V           |
| Voltage on any pin relative to GND        | $V_{t2}$   | -0.50 | $V_{CC} + 0.50$ | V           |
| Power dissipation                         | $P_D$      | -     | 1.0             | W           |
| Storage temperature (plastic)             | $T_{stg}$  | -65   | +150            | $^{\circ}C$ |
| Ambient temperature with $V_{CC}$ applied | $T_{bias}$ | -55   | +125            | $^{\circ}C$ |
| DC current into outputs (low)             | $I_{OUT}$  | -     | 20              | mA          |

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 outside those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## Truth table

| $\overline{CE}$ | $\overline{WE}$ | $\overline{OE}$ | $\overline{LB}$ | $\overline{UB}$ | I/O0-I/O7 | I/O8-I/O15 | Mode                             |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------|------------|----------------------------------|
| H               | X               | X               | X               | X               | High Z    | High Z     | Standby ( $I_{SB}$ , $I_{SB1}$ ) |
| L               | H               | L               | L               | H               | $D_{OUT}$ | High Z     | Read I/O0-I/O7 ( $I_{CC}$ )      |
| L               | H               | L               | H               | L               | High Z    | $D_{OUT}$  | Read I/O8-I/O15 ( $I_{CC}$ )     |
| L               | H               | L               | L               | L               | $D_{OUT}$ | $D_{OUT}$  | Read I/O0-I/O15 ( $I_{CC}$ )     |
| L               | L               | X               | L               | L               | $D_{IN}$  | $D_{IN}$   | Write I/O0-I/O15 ( $I_{CC}$ )    |
| L               | L               | X               | L               | H               | $D_{IN}$  | High Z     | Write I/O0-I/O7 ( $I_{CC}$ )     |
| L               | L               | X               | H               | L               | High Z    | $D_{IN}$   | Write I/O8-I/O15 ( $I_{CC}$ )    |
| L               | H               | H               | X               | X               | High Z    | High Z     | Output disable ( $I_{CC}$ )      |
| L               | X               | X               | H               | H               | High Z    | High Z     |                                  |

Key: X = Don't care; L = Low; H = High



### Recommended operating conditions

| Parameter                     | Symbol     | Min   | Typical | Max            | Unit |    |
|-------------------------------|------------|-------|---------|----------------|------|----|
| Supply voltage                | $V_{CC}$   | 3.0   | 3.3     | 3.6            | V    |    |
| Input voltage                 | $V_{IH}$   | 2.0   | -       | $V_{CC} + 0.5$ |      |    |
|                               | $V_{IL}$   | -0.5  | -       | 0.8            | V    |    |
| Ambient operating temperature | commercial | $T_A$ | 0       | -              | 70   | °C |
|                               | industrial | $T_A$ | -40     | -              | 85   | °C |

$V_{IL} = -1.0V$  for pulse width less than 5ns

$V_{IH} = V_{CC} + 1.5V$  for pulse width less than 5ns

### DC operating characteristics (over the operating range)<sup>1</sup>

| Parameter                      | Sym        | Test conditions   | -10 |     | -12 |     | -15 |     | -20 |     | Unit          |
|--------------------------------|------------|---|-----|-----|-----|-----|-----|-----|-----|-----|---------------|
|                                |            |   | Min | Max | Min | Max | Min | Max | Min | Max |               |
| Input leakage current          | $ I_{LI} $ | $V_{CC} = \text{Max}$<br>$V_{IN} = \text{GND to } V_{CC}$   | -   | 1   | -   | 1   | -   | 1   | -   | 1   | $\mu\text{A}$ |
| Output leakage current         | $ I_{LO} $ | $V_{CC} = \text{Max}$<br>$V_{OUT} = \text{GND to } V_{CC}$  | -   | 1   | -   | 1   | -   | 1   | -   | 1   | $\mu\text{A}$ |
| Operating power supply current | $I_{CC}$   | $V_{CC} = \text{Max}, \overline{CE} \leq V_{IL}$<br>$f = f_{\text{Max}}, I_{OUT} = 0\text{mA}$                            | -   | 80  | -   | 75  | -   | 70  | -   | 65  | mA            |
| Standby power supply current   | $I_{SB}$   | $V_{CC} = \text{Max}, \overline{CE} \geq V_{IH}$<br>$f = f_{\text{Max}}$  | -   | 30  | -   | 25  | -   | 20  | -   | 20  | mA            |
|                                | $I_{SB1}$  | $V_{CC} = \text{Max}, \overline{CE} \geq V_{CC} - 0.2V$<br>$V_{IN} \leq 0.2V$ or $V_{IN} \geq V_{CC} - 0.2V$ ,<br>$f = 0$ | -   | 5   | -   | 5   | -   | 5   | -   | 5   | mA            |
| Output voltage                 | $V_{OL}$   | $I_{OL} = 8\text{ mA}, V_{CC} = \text{Min}$   | -   | 0.4 | -   | 0.4 | -   | 0.4 | -   | 0.4 | V             |
|                                | $V_{OH}$   | $I_{OH} = -4\text{ mA}, V_{CC} = \text{Min}$  | 2.4 | -   | 2.4 | -   | 2.4 | -   | 2.4 | -   | V             |

### Capacitance ( $f = 1\text{MHz}$ , $T_a = 25^\circ\text{C}$ , $V_{CC} = \text{NOMINAL}$ )<sup>2</sup>


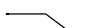

| Parameter         | Symbol    | Signals  | Test conditions         | Max | Unit |
|-------------------|-----------|--|-------------------------|-----|------|
| Input capacitance | $C_{IN}$  | A, $\overline{CE}$ , $\overline{WE}$ , $\overline{OE}$ , $\overline{LB}$ , $\overline{UB}$ | $V_{in} = 0V$           | 5   | pF   |
| I/O capacitance   | $C_{I/O}$ | I/O  | $V_{in} = V_{out} = 0V$ | 7   | pF   |



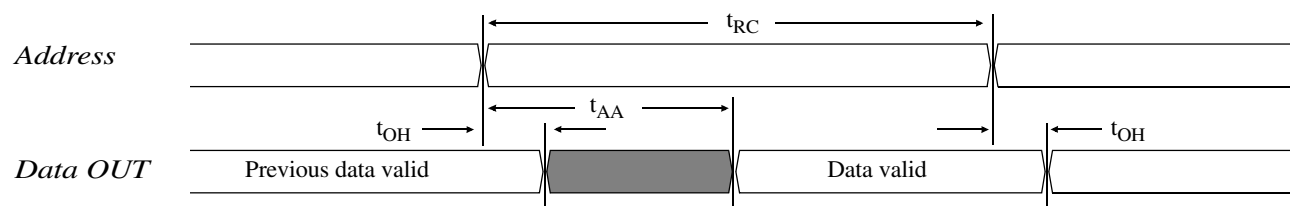
### Read cycle (over the operating range)<sup>3,9</sup>

| Parameter                                     | Symbol    | -10 |     | -12 |     | -15 |     | -20 |     | Unit | Notes |
|---|-----------|-----|-----|-----|-----|-----|-----|-----|-----|------|-------|
|   |           | Min | Max | Min | Max | Min | Max | Min | Max |      |       |
| Read cycle time                               | $t_{RC}$  | 10  | –   | 12  | –   | 15  | –   | 20  | –   | ns   |       |
| Address access time                           | $t_{AA}$  | –   | 10  | –   | 12  | –   | 15  | –   | 20  | ns   | 3     |
| Chip enable ( $\overline{CE}$ ) access time   | $t_{ACE}$ | –   | 10  | –   | 12  | –   | 15  | –   | 20  | ns   | 3     |
| Output enable ( $\overline{OE}$ ) access time | $t_{OE}$  | –   | 5   | –   | 6   | –   | 7   | –   | 8   | ns   |       |
| Output hold from address change               | $t_{OH}$  | 3   | –   | 3   | –   | 3   | –   | 3   | –   | ns   | 5     |
| $\overline{CE}$ low to output in low Z        | $t_{CLZ}$ | 3   | –   | 3   | –   | 3   | –   | 3   | –   | ns   | 4, 5  |
| $\overline{CE}$ high to output in high Z      | $t_{CHZ}$ | –   | 3   | –   | 3   | –   | 4   | –   | 5   | ns   | 4, 5  |
| $\overline{OE}$ low to output in low Z        | $t_{OLZ}$ | 0   | –   | 0   | –   | 0   | –   | 0   | –   | ns   | 4, 5  |
| Byte select access time                       | $t_{BA}$  | –   | 5   | –   | 6   | –   | 7   | –   | 8   | ns   |       |
| Byte select Low to low Z                      | $t_{BLZ}$ | 0   | –   | 0   | –   | 0   | –   | 0   | –   | ns   | 4, 5  |
| Byte select High to high Z                    | $t_{BHZ}$ | –   | 5   | –   | 6   | –   | 6   | –   | 8   | ns   | 4, 5  |
| $\overline{OE}$ high to output in high Z      | $t_{OHZ}$ | –   | 5   | –   | 6   | –   | 7   | –   | 8   | ns   | 4, 5  |
| Power up time                                 | $t_{PU}$  | 0   | –   | 0   | –   | 0   | –   | 0   | –   | ns   | 4, 5  |
| Power down time                               | $t_{PD}$  | –   | 10  | –   | 12  | –   | 15  |     | 20  | ns   | 4, 5  |

### Key to switching waveforms

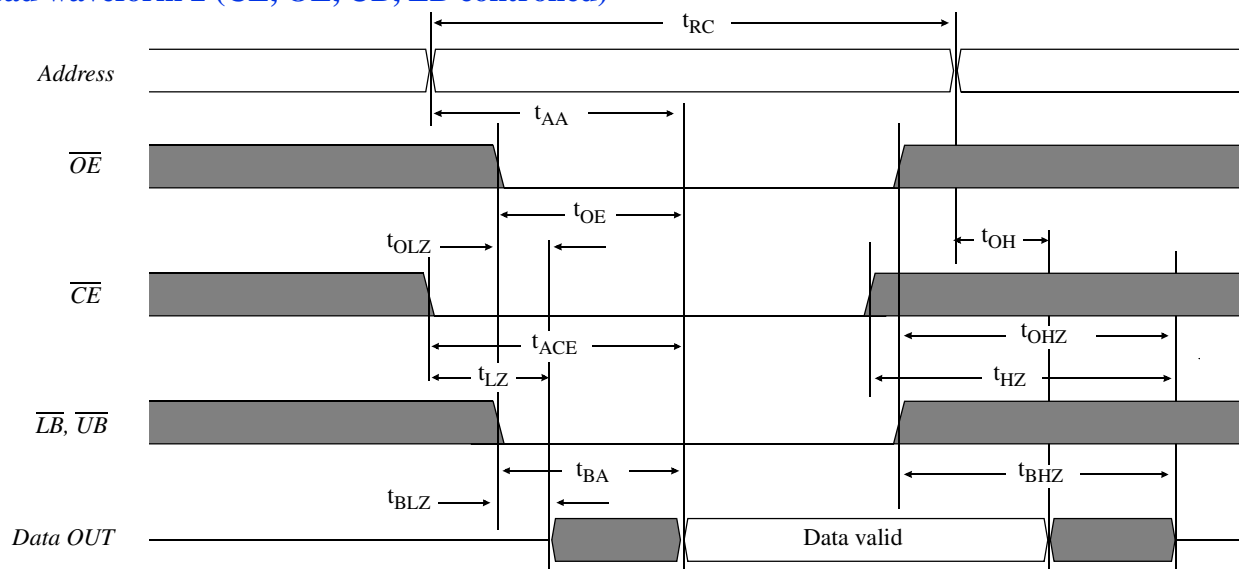
 Rising input     
  Falling input     
  Undefined output/don't care

### Read waveform 1 (address controlled)<sup>3,6,7,9</sup>





### Read waveform 2 ( $\overline{CE}$ , $\overline{OE}$ , $\overline{UB}$ , $\overline{LB}$ controlled)<sup>3,6,8,9</sup>

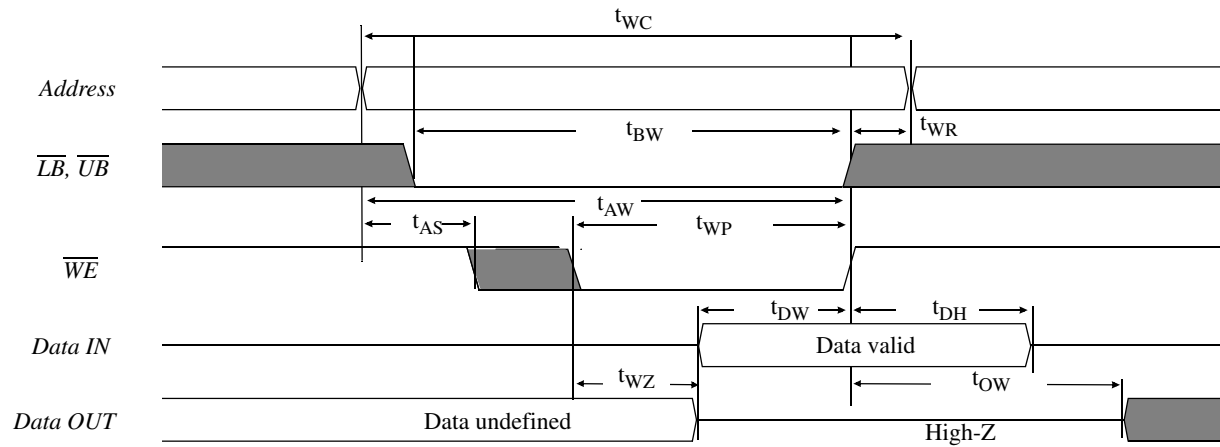


### Write cycle (over the operating range)<sup>11</sup>

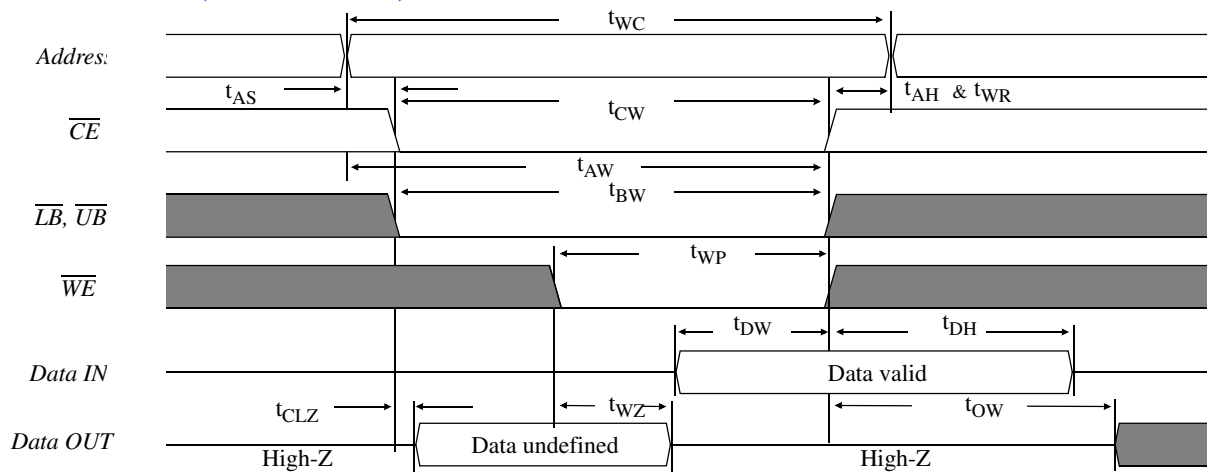
| Parameter                                    | Symbol   | -10 |     | -12 |     | -15 |     | -20 |     | Unit | Notes |
|--|----------|-----|-----|-----|-----|-----|-----|-----|-----|------|-------|
|  |          | Min | Max | Min | Max | Min | Max | Min | Max |      |       |
| Write cycle time                             | $t_{WC}$ | 10  | –   | 12  | –   | 15  | –   | 20  | –   | ns   |       |
| Chip enable ( $\overline{CE}$ ) to write end | $t_{CW}$ | 8   | –   | 9   | –   | 10  | –   | 12  | –   | ns   |       |
| Address setup to write end                   | $t_{AW}$ | 8   | –   | 9   | –   | 10  | –   | 12  | –   | ns   |       |
| Address setup time                           | $t_{AS}$ | 0   | –   | 0   | –   | 0   | –   | 0   | –   | ns   |       |
| Write pulse width                            | $t_{WP}$ | 7   | –   | 8   | –   | 9   | –   | 12  | –   | ns   |       |
| Write recovery time                          | $t_{WR}$ | 0   | –   | 0   | –   | 0   | –   | 0   | –   | ns   |       |
| Address hold from end of write               | $t_{AH}$ | 0   | –   | 0   | –   | 0   | –   | 0   | –   | ns   |       |
| Data valid to write end                      | $t_{DW}$ | 5   | –   | 6   | –   | 8   | –   | 10  | –   | ns   |       |
| Data hold time                               | $t_{DH}$ | 0   | –   | 0   | –   | 0   | –   | 0   | –   | ns   | 5     |
| Write enable to output in high Z             | $t_{WZ}$ | –   | 5   | –   | 6   | –   | 7   | –   | 8   | ns   | 4, 5  |
| Output active from write end                 | $t_{OW}$ | 1   | –   | 1   | –   | 1   | –   | 2   | –   | ns   | 4, 5  |
| Byte select low to end of write              | $t_{BW}$ | 7   | –   | 8   | –   | 9   | –   | 9   | –   | ns   |       |



### Write waveform 1 ( $\overline{WE}$ controlled)<sup>11</sup>



### Write waveform 2 ( $\overline{CE}$ controlled)<sup>11</sup>





## AC test conditions

- Output load: see Figure B.
- Input pulse level: GND to 3.0V. See Figure A.
- Input rise and fall times: 2 ns. See Figure A.
- Input and output timing reference levels: 1.5V.

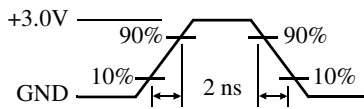


Figure A: Input pulse

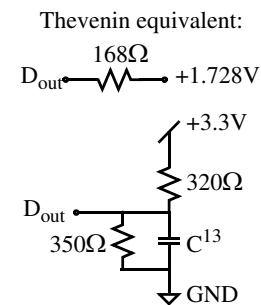


Figure B: 3.3V Output load

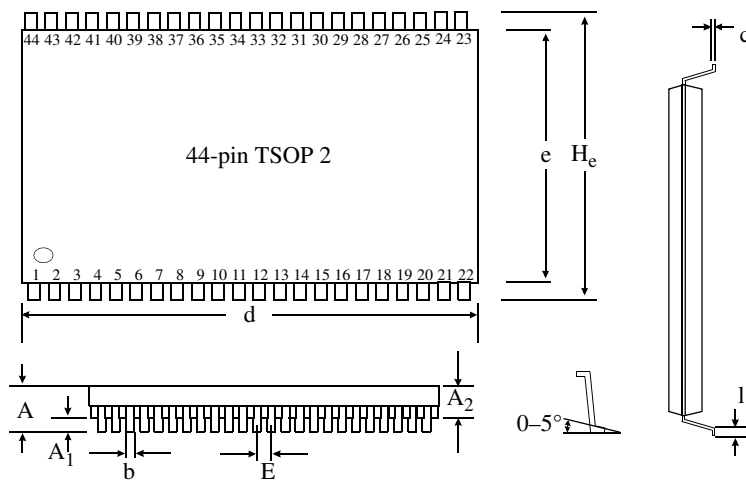
## Notes

- 1 During  $V_{CC}$  power-up, a pull-up resistor to  $V_{CC}$  on  $\overline{CE}$  is required to meet  $I_{SB}$  specification.
- 2 This parameter is sampled, but not 100% tested.
- 3 For test conditions, see *AC Test Conditions*, Figures A and B.
- 4 These parameters are specified with  $C_L = 5\text{pF}$ , as in Figure B. Transition is measured  $\pm 500\text{mV}$  from steady-state voltage.
- 5 This parameter is guaranteed, but not 100% tested.
- 6  $\overline{WE}$  is High for read cycle.
- 7  $\overline{CE}$  and  $\overline{OE}$  are Low for read cycle.
- 8 Address valid prior to or coincident with  $\overline{CE}$  transition Low.
- 9 All read cycle timings are referenced from the last valid address to the first transitioning address.
- 10 Not applicable.
- 11 All write cycle timings are referenced from the last valid address to the first transitioning address.
- 12 Not applicable.
- 13  $C = 30\text{pF}$ , except on High Z and Low Z parameters, where  $C = 5\text{pF}$ .

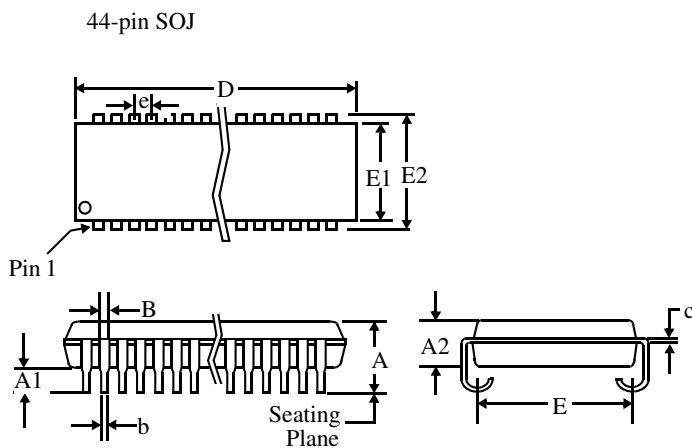




Package dimensions



| Symbol         | 44-pin TSOP 2  |          |
|----------------|----------------|----------|
|                | Min (mm)       | Max (mm) |
| A              |                | 1.2      |
| A <sub>1</sub> | 0.05           | 0.15     |
| A <sub>2</sub> | 0.95           | 1.05     |
| b              | 0.3            | 0.45     |
| c              | 0.12           | 0.21     |
| d              | 18.31          | 18.52    |
| e              | 10.06          | 10.26    |
| H <sub>e</sub> | 11.68          | 11.94    |
| E              | 0.80 (typical) |          |
| l              | 0.40           | 0.60     |



| Symbol         | 44-pin SOJ<br>400 mil |       |
|----------------|-----------------------|-------|
|                | Min                   | Max   |
| A              | 0.128                 | 0.148 |
| A <sub>1</sub> | 0.025                 | -     |
| A <sub>2</sub> | 0.105                 | 0.115 |
| B              | 0.026                 | 0.032 |
| b              | 0.015                 | 0.020 |
| c              | 0.007                 | 0.013 |
| D              | 1.120                 | 1.130 |
| E              | 0.370 NOM             |       |
| E <sub>1</sub> | 0.395                 | 0.405 |
| E <sub>2</sub> | 0.435                 | 0.445 |
| e              | 0.050 NOM             |       |



## Ordering codes

| Package\Access time  |            | 10 ns          | 12 ns          | 15 ns          | 20 ns          |
|----------------------|------------|----------------|----------------|----------------|----------------|
| Plastic SOJ, 400 mil | Commercial | AS7C3513B-10JC | AS7C3513B-12JC | AS7C3513B-15JC | AS7C3513B-20JC |
|                      | Industrial | AS7C3513B-10JI | AS7C3513B-12JI | AS7C3513B-15JI | AS7C3513B-20JI |
| TSOP 2, 18.4x10.2 mm | Commercial | AS7C3513B-10TC | AS7C3513B-12TC | AS7C3513B-15TC | AS7C3513B-20TC |
|                      | Industrial | AS7C3513B-10TI | AS7C3513B-12TI | AS7C3513B-15TI | AS7C3513B-20TI |

Note:

Add suffix 'N' to the above part number for lead free parts (Ex. AS7C3513B-10JCN)

## Part numbering system

| AS7C        | 3                     | 513B          | -XX         | X  | C  | X                |
|-------------|-----------------------|---------------|-------------|--|--|------------------|
| SRAM prefix | Voltage:<br>3.3V CMOS | Device number | Access time | Package:<br>J = SOJ 400 mil<br>T = TSOP 2 18.4x10.2 mm | Temperature range:<br>C = Commercial, 0°C to 70°C<br>I = Industrial, -40°C to 85°C | N=Lead Free Part |



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