





## Functional description

The AS7C1026 and AS7C31026 are high-performance CMOS 1,048,576-bit Static Random Access Memory (SRAM) devices organized as 65,536 words x 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 12/15/20 ns with output enable access times ( $t_{OE}$ ) of 6,7,8 ns are ideal for high-performance applications.

When  $\overline{CE}$  is high the devices enter standby mode. The AS7C1026 is guaranteed not to exceed 28 mW power consumption in CMOS standby mode. The devices also offer 2.0V data retention.

A write cycle is accomplished by asserting write enable ( $\overline{WE}$ ) and chip enable ( $\overline{CE}$ ). Data on the input pins I/O0–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 ( $\overline{OE}$ ) 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, 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, and operation is from a single 5V supply (AS7C1026) or 3.3V supply (AS7C31026). the device is packaged in common industry standard packages. Chip scale BGA packaging, easy to use in manufacturing, provides the smallest possible footprint. This 48-ball JEDEC-registered package has a ball pitch of 0.75 mm and external dimensions of 8 mm × 6 mm.

## Absolute maximum ratings

| Parameter                            |           | Symbol     | Min   | Max             | Unit |
|--------------------------------------|-----------|------------|-------|-----------------|------|
| Voltage on $V_{CC}$ relative to GND  | AS7C1026  | $V_{t1}$   | −0.50 | +7.0            | V    |
|                                      | AS7C31026 | $V_{t1}$   | −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            | °C   |
| Ambient temperature with VCC applied |           | $T_{bias}$ | −55   | +125            | °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 ( $I_{SB}$ , $I_{SBI}$ ) |
| 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 ( $I_{CC}$ )     |



| $\overline{CE}$ | $\overline{WE}$ | $\overline{OE}$ | $\overline{LB}$ | $\overline{UB}$ | I/O0–I/O7 | I/O8–I/O15      | Mode                                |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------|-----------------|-------------------------------------|
| L               | L               | X               | H               | L               | High Z    | D <sub>IN</sub> | Write I/O8–I/O15 (I <sub>CC</sub> ) |
| L               | H               | H               | X               | X               | High Z    | High Z          | Output disable (I <sub>CC</sub> )   |
| L               | X               | X               | H               | H               | High Z    | High Z          | Output disable (I <sub>CC</sub> )   |

Key: H = High, L = Low, X = don't care.

### Recommended operating conditions

| Parameter                     | Device               | Symbol          | Min               | Typ | Max                   | Unit |
|-------------------------------|----------------------|-----------------|-------------------|-----|-----------------------|------|
| Supply voltage                | AS7C1026             | V <sub>CC</sub> | 4.5               | 5.0 | 5.5                   | V    |
|                               | AS7C31026 (–10)      | V <sub>CC</sub> | 3.15              | 3.3 | 3.6                   | V    |
|                               | AS7C31026 (12/15/20) | V <sub>CC</sub> | 3.0               | 3.3 | 3.6                   | V    |
| Input voltage                 | AS7C1026             | V <sub>IH</sub> | 2.2               | –   | V <sub>CC</sub> + 0.5 | V    |
|                               | AS7C31026            | V <sub>IH</sub> | 2.0               | –   | V <sub>CC</sub> + 0.5 | V    |
|                               |                      | V <sub>IL</sub> | –0.5 <sup>†</sup> | –   | 0.8                   | V    |
| Ambient operating temperature | commercial           | T <sub>A</sub>  | 0                 | –   | 70                    | °C   |
|                               | industrial           | T <sub>A</sub>  | –40               | –   | 85                    | °C   |

<sup>†</sup> V<sub>IL</sub> min = –3.0V for pulse width less than t<sub>RC</sub>/2.

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

| Parameter                      | Sym              | Test conditions                                                                                                                                | Device    | –12 |     | –15 |     | –20 |     | Unit |
|--------------------------------|------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----|-----|-----|-----|-----|-----|------|
|                                |                  |                                                                                                                                                |           | Min | Max | Min | Max | Min | Max |      |
| Input leakage current          | I <sub>LI</sub>  | V <sub>CC</sub> = Max<br>V <sub>IN</sub> = GND to V <sub>CC</sub>                                                                              |           | –   | 1   | –   | 1   | –   | 1   | μA   |
| Output leakage current         | I <sub>LO</sub>  | V <sub>CC</sub> = Max<br>$\overline{CE} = V_{IH}$ ,<br>V <sub>OUT</sub> = GND to V <sub>CC</sub>                                               |           | –   | 1   | –   | 1   | –   | 1   | μA   |
| Operating power supply current | I <sub>CC</sub>  | V <sub>CC</sub> = Max, $\overline{CE} \leq V_{IL}$ ,<br>outputs open,<br>f = f <sub>Max</sub> = 1/t <sub>RC</sub>                              | AS7C1026  | –   | 160 | –   | 150 | –   | 140 | mA   |
|                                |                  |                                                                                                                                                | AS7C31026 | –   | 110 | –   | 100 | –   | 90  | mA   |
| Standby power supply current   | I <sub>SB</sub>  | V <sub>CC</sub> = Max, $\overline{CE} \leq V_{IL}$ ,<br>outputs open,<br>f = f <sub>Max</sub> = 1/t <sub>RC</sub>                              | AS7C1026  | –   | 50  | –   | 50  | –   | 50  | mA   |
|                                |                  |                                                                                                                                                | AS7C31026 | –   | 35  | –   | 35  | –   | 35  |      |
|                                | I <sub>SB1</sub> | V <sub>CC</sub> = Max, $\overline{CE} \geq V_{CC}-0.2V$ ,<br>V <sub>IN</sub> ≤ GND + 0.2V or<br>V <sub>IN</sub> ≥ V <sub>CC</sub> –0.2V, f = 0 | AS7C1026  | –   | 10  | –   | 10  | –   | 15  | mA   |
|                                |                  |                                                                                                                                                | AS7C31026 | –   | 10  | –   | 10  | –   | 15  |      |
| Output voltage                 | V <sub>OL</sub>  | I <sub>OL</sub> = 8 mA, V <sub>CC</sub> = Min                                                                                                  |           | –   | 0.4 | –   | 0.4 | –   | 0.4 | V    |
|                                | V <sub>OH</sub>  | I <sub>OH</sub> = –4 mA, V <sub>CC</sub> = Min                                                                                                 |           | 2.4 | –   | 2.4 | –   | 2.4 | –   | V    |

Shaded areas indicate preliminary information.

### Capacitance (f = 1MHz, T<sub>a</sub> = 25 °C, V<sub>CC</sub> = NOMINAL)<sup>2</sup>

| Parameter         | Symbol           | Signals                                                                                    | Test conditions                         | Max | Unit |
|-------------------|------------------|--------------------------------------------------------------------------------------------|-----------------------------------------|-----|------|
| Input capacitance | C <sub>IN</sub>  | A, $\overline{CE}$ , $\overline{WE}$ , $\overline{OE}$ , $\overline{LB}$ , $\overline{UB}$ | V <sub>IN</sub> = 0V                    | 5   | pF   |
| I/O capacitance   | C <sub>I/O</sub> | I/O                                                                                        | V <sub>IN</sub> = V <sub>OUT</sub> = 0V | 7   | pF   |

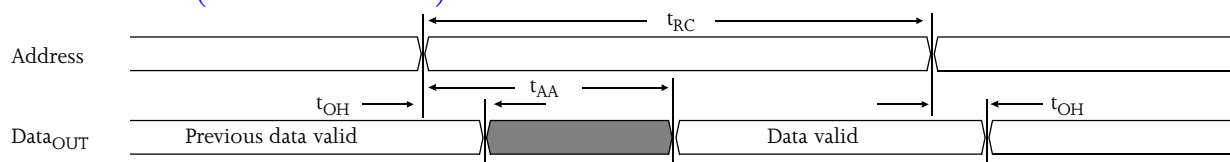
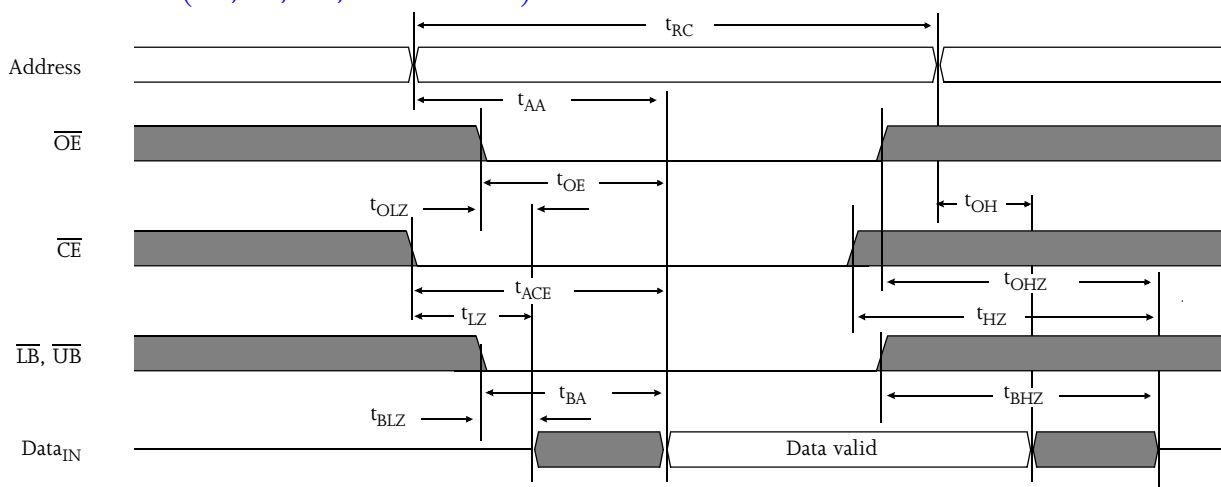
Read cycle (over the operating range)<sup>3,9</sup>

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

Shaded areas indicate preliminary information.

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

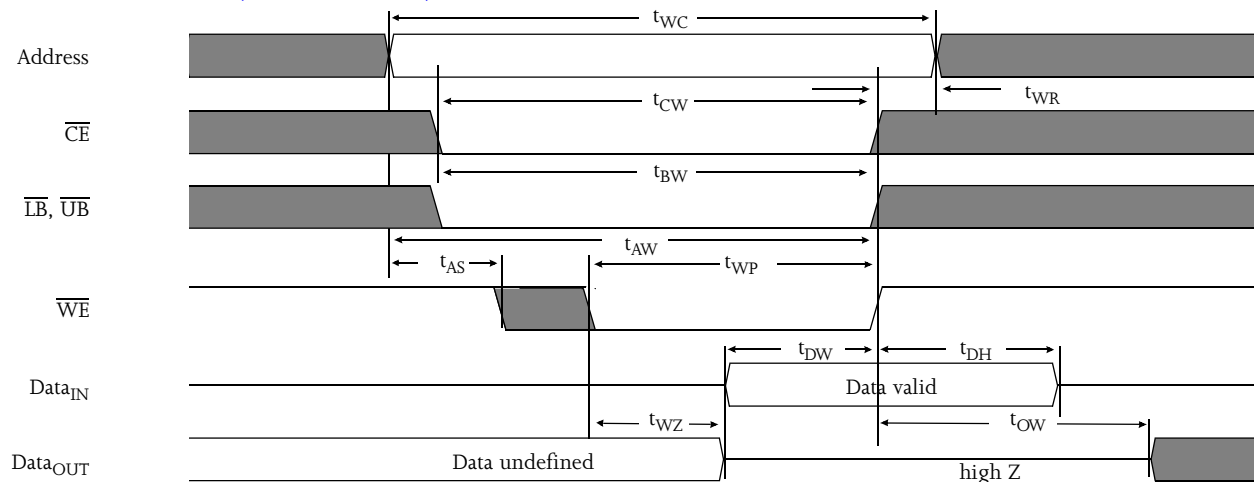


### Write cycle (over the operating range) <sup>11</sup>

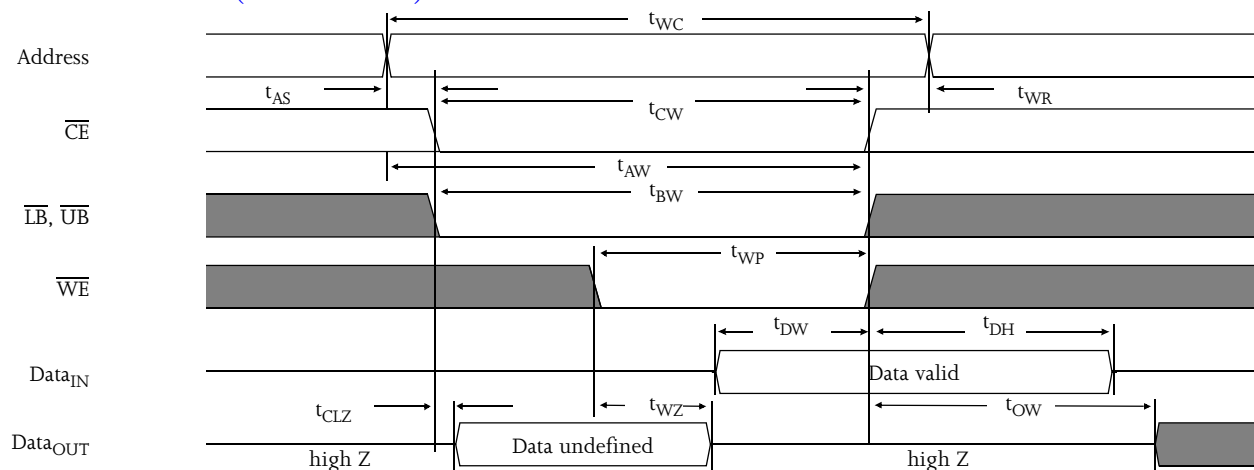
| Parameter                                    | Symbol   | -12 |     | -15 |     | -20 |     | Unit | Notes |
|----------------------------------------------|----------|-----|-----|-----|-----|-----|-----|------|-------|
|                                              |          | Min | Max | Min | Max | Min | Max |      |       |
| Write cycle time                             | $t_{WC}$ | 12  | —   | 15  | —   | 20  | —   | ns   |       |
| Chip enable ( $\overline{CE}$ ) to write end | $t_{CW}$ | 8   | —   | 12  | —   | 13  | —   | ns   |       |
| Address setup to write end                   | $t_{AW}$ | 9   | —   | 10  | —   | 12  | —   | ns   |       |
| Address setup time                           | $t_{AS}$ | 0   | —   | 0   | —   | 0   | —   | ns   |       |
| Write pulse width                            | $t_{WP}$ | 8   | —   | 10  | —   | 12  | —   | ns   |       |
| Address hold from end of write               | $t_{AH}$ | 0   | —   | 0   | —   | 0   | —   | ns   |       |
| Data valid to write end                      | $t_{DW}$ | 6   | —   | 8   | —   | 10  | —   | ns   |       |
| Data hold time                               | $t_{DH}$ | 0   | —   | 0   | —   | 0   | —   | ns   | 5     |
| Write enable to output in high Z             | $t_{WZ}$ | —   | 6   | —   | 6   | —   | 8   | ns   | 4, 5  |
| Output active from write end                 | $t_{OW}$ | 1   | —   | 1   | —   | 2   | —   | ns   | 4, 5  |
| Byte select low to end of write              | $t_{BW}$ | 8   | —   | 9   | —   | 12  | —   | ns   |       |

Shaded areas indicate preliminary information.

### Write waveform 1 ( $\overline{WE}$ controlled) <sup>10,11</sup>



### Write waveform 2 ( $\overline{CE}$ controlled) <sup>10,11</sup>

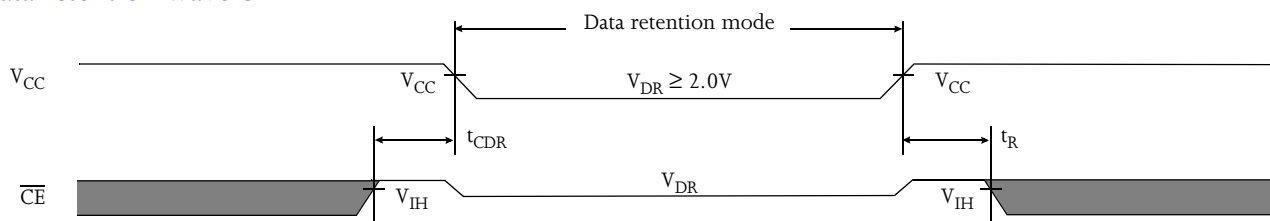




### Data retention characteristics (over the operating range)<sup>13</sup>

| Parameter                            | Symbol     | Test conditions                                                                                               | Min      | Max | Unit    |
|--------------------------------------|------------|---------------------------------------------------------------------------------------------------------------|----------|-----|---------|
| $V_{CC}$ for data retention          | $V_{DR}$   | $V_{CC} = 2.0V$<br>$\overline{CE} \geq V_{CC} - 0.2V$<br>$V_{IN} \geq V_{CC} - 0.2V$ or<br>$V_{IN} \leq 0.2V$ | 2.0      | —   | V       |
| Data retention current               | $I_{CCDR}$ |                                                                                                               | —        | 1   | ma      |
| Chip deselect to data retention time | $t_{CDR}$  |                                                                                                               | 0        | —   | ns      |
| Operation recovery time              | $t_R$      |                                                                                                               | $t_{RC}$ | —   | ns      |
| Input leakage current                | $ I_{LI} $ |                                                                                                               | —        | 1   | $\mu A$ |

### Data retention waveform



### AC test conditions

- Output load: see Figure B or Figure C, except as noted.
- 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.

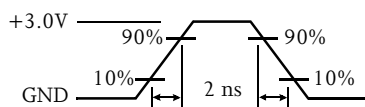


Figure A: Input pulse

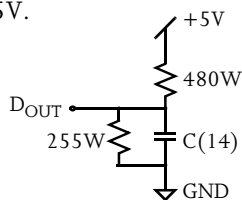


Figure B: 5V Output load

Thevenin Equivalent:  
 $D_{OUT} \xrightarrow{168W} +1.728V$  (5V and 3.3V)

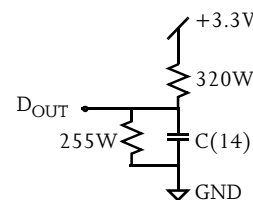


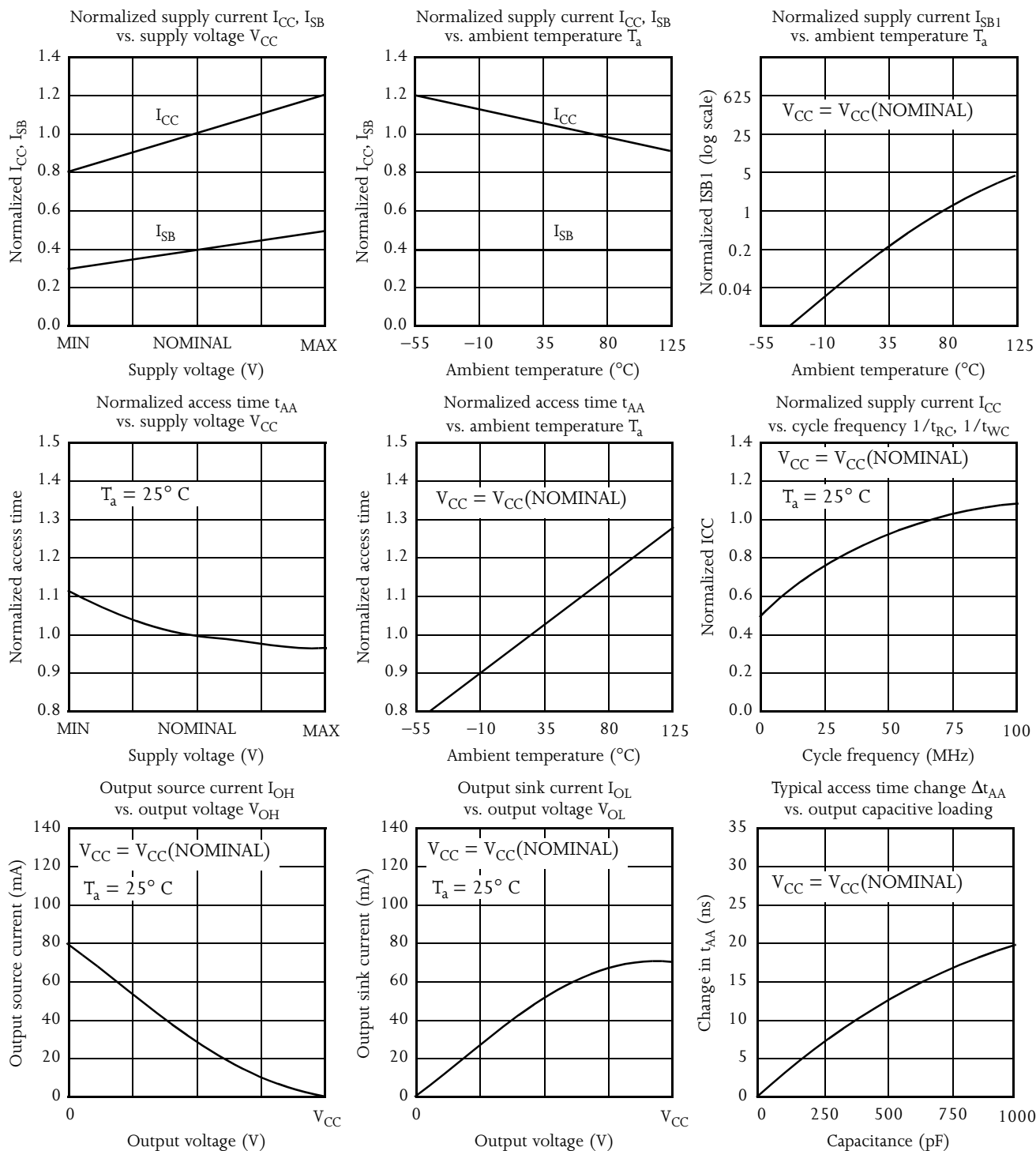
Figure C: 3.3V Output load

### Notes

- During  $V_{CC}$  power-up, a pull-up resistor to  $V_{CC}$  on  $\overline{CE}$  is required to meet  $I_{GB}$  specification.
- This parameter is sampled, but not 100% tested.
- For test conditions, see AC Test Conditions, Figures A, B, and C.
- These parameters are specified with  $C_L = 5pF$ , as in Figures B or C. Transition is measured  $\pm 500$  mV from steady-state voltage.
- This parameter is guaranteed, but not tested.
- $\overline{WE}$  is High for read cycle.
- $\overline{CE}$  and  $\overline{OE}$  are Low for read cycle.
- Address valid prior to or coincident with  $\overline{CE}$  transition Low.
- All read cycle timings are referenced from the last valid address to the first transitioning address.
- $\overline{CE}$  or  $\overline{WE}$  must be High during address transitions. Either  $\overline{CE}$  or  $\overline{WE}$  asserting high terminates a write cycle.
- All write cycle timings are referenced from the last valid address to the first transitioning address.
- Not applicable.
- 2V data retention applies to commercial temperature range operation only.
- $C = 30pF$ , except all high Z and low Z parameters where  $C = 5pF$ .

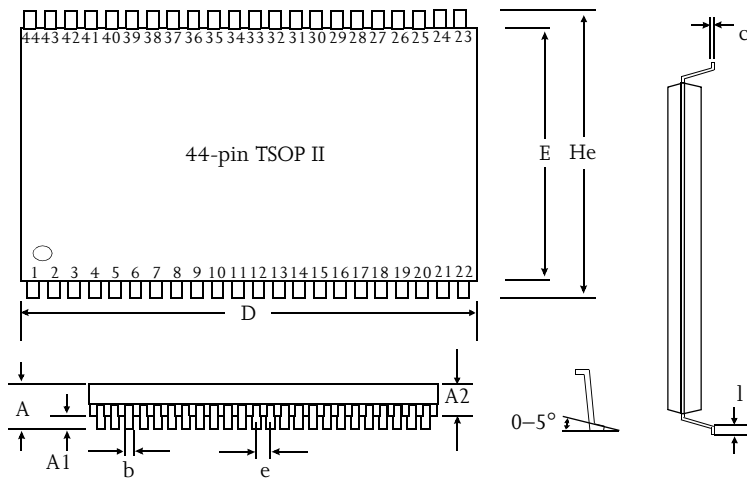


## Typical DC and AC characteristics

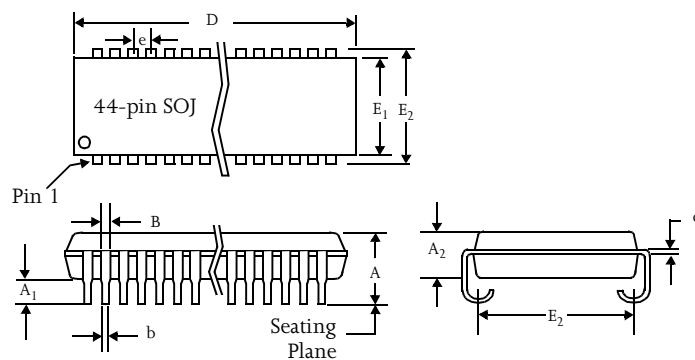




## Package dimensions



|    | 44-pin TSOP II  |          |
|----|-----------------|----------|
|    | Min (mm)        | Max (mm) |
| A  |                 | 1.2      |
| A1 | 0.05            |          |
| A2 | 0.95            | 1.05     |
| b  | 0.30            | 0.45     |
| c  | 0.127 (typical) |          |
| D  | 18.28           | 18.54    |
| E  | 10.03           | 10.29    |
| He | 11.56           | 11.96    |
| e  | 0.80 (typical)  |          |
| l  | 0.40            | 0.60     |

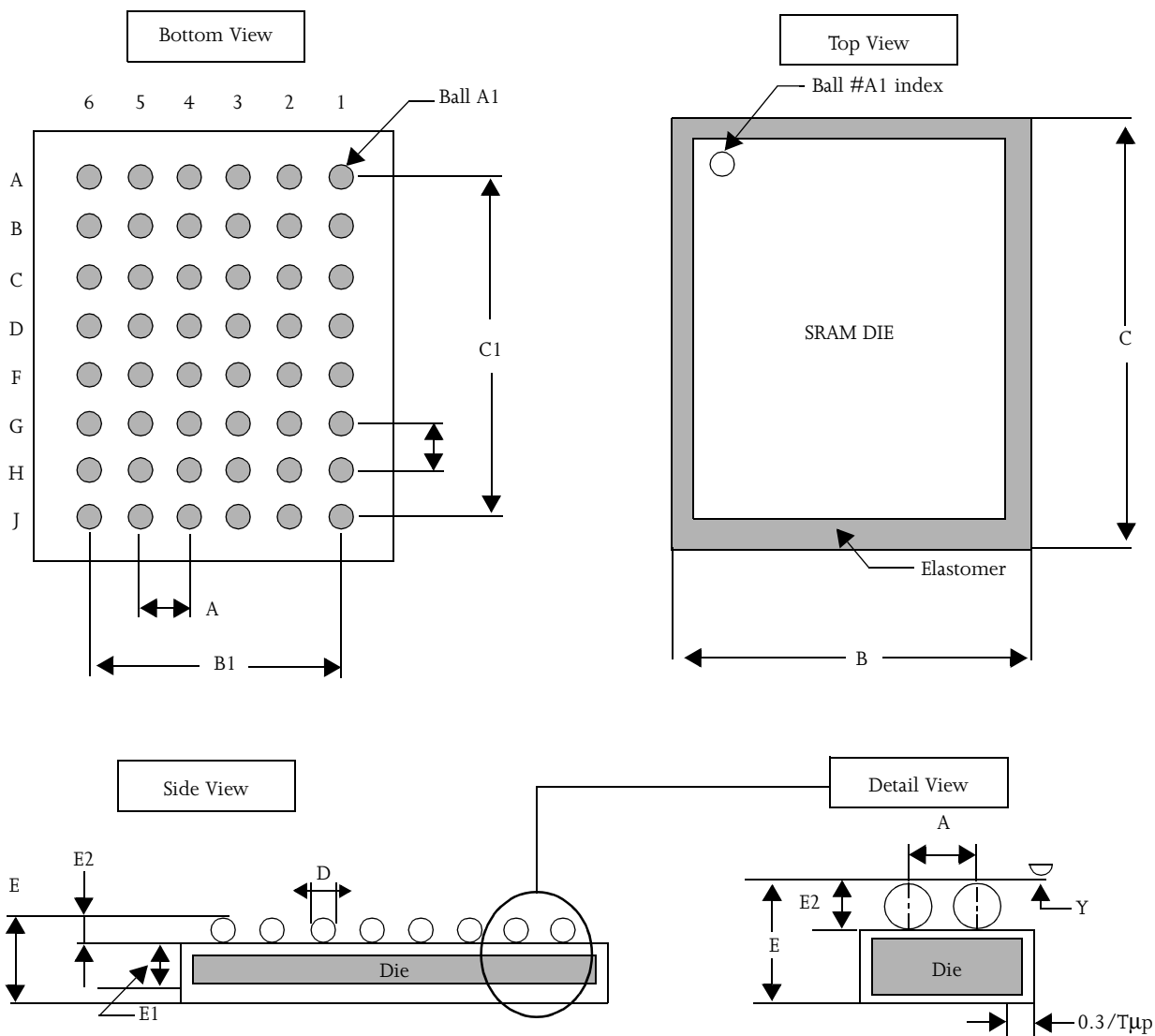


|    | 44-pin SOJ<br>400 mL |       |
|----|----------------------|-------|
|    | Min                  | Max   |
| A  | 0.128                | 0.148 |
| A1 | 0.025                | —     |
| A2 | 1.105                | 1.115 |
| B  | 0.026                | 0.032 |
| b  | 0.015                | 0.020 |
| c  | 0.007                | 0.013 |
| D  | 1.120                | 1.130 |
| E  | 0.370 NOM            |       |
| E1 | 0.395                | 0.405 |
| E2 | 0.435                | 0.445 |
| e  | 0.050 NOM            |       |





48-ball FBGA



|    | Minimum | Typical | Maximum |
|----|---------|---------|---------|
| A  | —       | 0.75    | —       |
| B  | 5.90    | 8.00    | 8.10    |
| B1 | —       | 3.75    | —       |
| C  | 7.90    | 8.00    | 8.10    |
| C1 | —       | 5.25    | —       |
| D  | —       | 0.35    | —       |
| E  | —       | —       | 1.20    |
| E1 | —       | 0.68    | —       |
| E2 | 0.22    | 0.25    | 0.27    |
| Y  | —       | —       | 0.08    |

Notes

- Bump counts: 48 (8 row x 6 column).
- Pitch: (x,y) = 0.75 mm x 0.75 mm (typ).
- Units: millimeters.
- All tolerance are +/- 0.050 unless otherwise specified.
- Typ: typical.
- Y is coplanarity: 0.08 (max).



## Ordering codes

| Package \ Access time | Volt/Temp       | 12 ns          | 15 ns          | 20 ns          |
|-----------------------|-----------------|----------------|----------------|----------------|
| Plastic SOJ, 400 mil  | 5V commercial   | AS7C1026-12JC  | AS7C1026-15JC  | AS7C1026-20JC  |
|                       | 5V industrial   | AS7C1026-12JI  | AS7C1026-15JI  | AS7C1026-20JI  |
|                       | 3.3V commercial | AS7C31026-12JC | AS7C31026-15JC | AS7C31026-20JC |
| TSOP II, 18.4×10.2 mm | 5V commercial   | AS7C1026-12TC  | AS7C1026-15TC  | AS7C1026-20TC  |
|                       | 3.3V commercial | AS7C31026-12TC | AS7C31026-15TC | AS7C31026-20TC |
|                       | 3.3V industrial | AS7C31026-12TI | AS7C31026-15TI | AS7C31026-20TI |
| CSP BGA, 8×6 mm       | 5V commercial   | AS7C1026-12BC  | AS7C1026-15BC  | AS7C1026-20BC  |
|                       | 3.3V commercial | AS7C31026-12BC | AS7C31026-15BC | AS7C31026-20BC |
|                       | 3.3V industrial | AS7C31026-12BI | AS7C31026-15BI | AS7C31026-20BI |

NA: not available.

Shaded areas indicate preliminary information.

## Part numbering system

| AS7C        | X                            | 1026          | -XX         | X                                                                              | C                                                                                  |
|-------------|------------------------------|---------------|-------------|--------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| SRAM prefix | Blank=5V CMOS<br>3=3.3V CMOS | Device number | Access time | Package: J=SOJ 400 mil<br>T=TSOP type 2, 18.4 × 10.2 mm<br>B=CSP BGA, 8 × 6 mm | Temperature range,<br>C=Commercial: 0° C to 70° C<br>I=Industrial: -40° C to 85° C |