## **May 2002**



#### **Features**

- AS7C1026A (5V version)
- AS7C31026A (3.3V version)
- Industrial and commercial versions
- Organization: 65,536 words  $\times$  16 bits
- Center power and ground pins for low noise
- High speed
  - 10/12/15/20 ns address access time
  - 5, 6, 7, 8 ns output enable access time
- Low power consumption: ACTIVE
- 1.32W (AS7C1026A) / max @ 10 ns
- 666mW (AS7C31026A) / max @ 10 ns

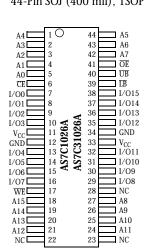
- Low power consumption: STANDBY
  - 55 mW (AS7C1026A) / max CMOS I/O - 36 mW (AS7C31026A) / max CMOS I/O
- Latest 6T 0.25u CMOS technology
- Easy memory expansion with  $\overline{CE}$ ,  $\overline{OE}$  inputs
- TTL-compatible, three-state I/O
- JEDEC standard packaging
  - 44-pin 400 mil SOJ
- 44-pin TSOP 2
- 48-ball  $6 \times 8 \text{ mm BGA}$
- ESD protection  $\geq$  2000 volts
- Latch-up current  $\geq 200 \text{ mA}$

#### Logic block diagram

#### **Pin and ball arrangement**

#### 44-Pin SOJ (400 mil), TSOP 2

| A0 $\longrightarrow$ A1 $\longrightarrow$ A2 $\longrightarrow$ A2 $\longrightarrow$ A4 $\longrightarrow$ A5 $\longrightarrow$ A6 $\longrightarrow$ Bow decoder  | 64K × 16<br>Array  | ← V <sub>CC</sub><br>← GND |
|---|--|----------------------------|
| $A7 \rightarrow 1/00-1/07 \qquad 1/00 \\ 1/08-1/015 \qquad 0 \\ WE \qquad 0 \\ UB \qquad $ | Control circui<br>Column decode<br>$\uparrow \uparrow $ | er                         |



|   | 48 - B0         | GA Ball- | Grid-Ar        | ray Pack       | age            |                 |
|---|-----------------|----------|----------------|----------------|----------------|-----------------|
|   | 1               | 2        | 3              | 4              | 5              | 6               |
| A | LB              | OE       | A <sub>0</sub> | A <sub>1</sub> | A <sub>2</sub> | NC              |
| В | I/08            | UB       | A3             | A4             | CE             | I/O0            |
| С | I/09            | I/010    | A5             | A6             | I/01           | I/O2            |
| D | V <sub>SS</sub> | I/011    | NC             | A7             | I/03           | V <sub>DD</sub> |
| Е | V <sub>DD</sub> | I/012    | NC             | NC             | I/04           | V <sub>SS</sub> |
| F | I/014           | I/013    | A14            | A15            | I/05           | I/06            |
| G | I/015           | NC       | A12            | A13            | WE             | I/07            |
| Η | NC              | A8       | A9             | A10            | A11            | NC              |
|   |                 |          |                |                |                |                 |

#### **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         | AS7C1026A  | 240 | 235 | 230 | 220 | mA   |
|                                   | AS7C31026A | 185 | 180 | 175 | 170 | mA   |
| Maximum CMOS standby current      | AS7C1026A  | 10  | 10  | 10  | 10  | mA   |
| waxinuni CiviO5 standby current   | AS7C31026A | 5   | 5   | 5   | 5   | mA   |

#### **Functional description**

The AS7C1026A and AS7C31026A are high-performance CMOS 1,048,576-bit Static Random Access Memory (SRAM) devices organized as 65,536 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.

When CE is high the devices enter standby mode. The AS7C1026A is guaranteed not to exceed 55 mW power consumption in CMOS standby mode.

A write cycle is accomplished by asserting write enable (WE) and chip enable ( $\overline{CE}$ ). Data on the input pins I/O0–I/O15 is written on the rising edge of 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/OO-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 (AS7C1026A) or 3.3V supply (AS7C31026A). 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  $\times$  6 mm.

| Parameter                                  |            | Symbol            | Min   | Max                   | Unit |
|--|------------|-------------------|-------|-----------------------|------|
| Voltage on V <sub>CC</sub> relative to GND | AS7C1026A  | V <sub>t1</sub>   | -0.50 | +7.0                  | V    |
| voltage on vcc relative to GivD            | AS7C31026A | V <sub>t1</sub>   | -0.50 | +5.0                  | V    |
| Voltage on any pin relative to GND         | Both       | V <sub>t2</sub>   | -0.50 | V <sub>CC</sub> +0.50 | V    |
| Power dissipation                          | Both       | PD                | _     | 1.0                   | W    |
| Storage temperature (plastic)              | Both       | T <sub>stg</sub>  | -65   | +150                  | °C   |
| Ambient temperature with VCC applied       | Both       | T <sub>bias</sub> | -55   | +125                  | °C   |
| DC current into outputs (low)              | Both       | I <sub>OUT</sub>  | _     | 20                    | mA   |

#### Absolute maximum ratings

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.

| II util tubi |        |        |        |        |                  |                  |  |
|--------------|--------|--------|--------|--------|------------------|------------------|--|
| CE           | WE     | OE     | LB     | UB     | I/00-I/07        | I/08-I/015       | Mode   |
| Н            | Х      | Х      | Х      | Х      | High Z           | High Z           | Standby (I <sub>SB</sub> ), I <sub>SBI</sub> ) |
| L            | Н      | L      | L      | Н      | D <sub>OUT</sub> | High Z           | Read I/O0–I/O7 (I <sub>CC</sub> )              |
| L            | Н      | L      | Н      | L      | High Z           | D <sub>OUT</sub> | Read I/O8–I/O15 (I <sub>CC)</sub>              |
| L            | Н      | L      | L      | L      | D <sub>OUT</sub> | D <sub>OUT</sub> | Read I/O0-I/O15 (I <sub>CC</sub> )             |
| L            | L      | Х      | L      | L      | D <sub>IN</sub>  | D <sub>IN</sub>  | Write I/O0–I/O15 (I <sub>CC</sub> )            |
| L            | L      | Х      | L      | Н      | D <sub>IN</sub>  | High Z           | Write I/O0–I/O7 (I <sub>CC</sub> )             |
| L            | L      | Х      | Н      | L      | High Z           | D <sub>IN</sub>  | Write I/O8–I/O15 (I <sub>CC</sub> )            |
| L<br>L       | H<br>X | H<br>X | X<br>H | X<br>H | High Z           | High Z           | Output disable (I <sub>CC</sub> )              |

#### Truth table

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

| Parameter                        | Device     | Symbol                       | Min  | Nominal | Max            | Unit |
|----------------------------------|------------|------------------------------|------|---------|----------------|------|
| Supply voltage                   | AS7C1026A  | V <sub>CC</sub>              | 4.5  | 5.0     | 5.5            | V    |
| Supply voltage                   | AS7C31026A | V <sub>CC</sub>              | 3.0  | 3.3     | 3.6            | V    |
|                                  | AS7C1026A  | V <sub>IH</sub>              | 2.2  | -       | $V_{CC} + 0.5$ | V    |
| Input voltage                    | AS7C31026A | V <sub>IH</sub>              | 2.0  | _       | $V_{CC} + 0.5$ | V    |
|                                  | Both       | V <sub>IL</sub> <sup>1</sup> | -0.5 | -       | 0.8            | V    |
| Ambient operating temperature    | commercial | T <sub>A</sub>               | 0    | -       | 70             | оС   |
| initiation operating temperature | industrial | T <sub>A</sub>               | -40  | -       | 85             | оС   |

## **Recommended operating conditions**

1 V\_{IL} min. = –3.0V for pulse width less than  $t_{RC}\!/2.$ 

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

|                           |                  |  |            | -1  | 0   | -1  | 12  | -15 |     | -20 |     |      |
|---------------------------|------------------|--|------------|-----|-----|-----|-----|-----|-----|-----|-----|------|
| Parameter                 | Sym              | <b>Test conditions</b>   | Device     | Min | Max | Min | Max | Min | Max | Min | Max | Unit |
| Input leakage<br>current  | I <sub>LI</sub>  | $V_{CC} = Max$<br>$V_{IN} = GND$ to $V_{CC}$   | Both       | -   | 1   | -   | 1   | -   | 1   | -   | 1   | μΑ   |
| Output leakage<br>current | I <sub>LO</sub>  | $\label{eq:V_CC} \begin{array}{l} V_{CC} = Max \\ \overline{CE} = V_{IH}, \\ V_{OUT} = GND \text{ to } V_{CC} \end{array}$ | Both       | -   | 1   | -   | 1   | -   | 1   | -   | 1   | μΑ   |
| Operating power           | т                | $V_{CC} = Max, \ \overline{CE} \le V_{IL}$   | AS7C1026A  | -   | 240 | -   | 235 | -   | 230 | -   | 220 | mA   |
| supply current            | I <sub>CC</sub>  | outputs open, $f = f_{Max} = 1/t_{RC}$   | AS7C31026A | -   | 185 | -   | 180 | -   | 170 | -   | 170 | mA   |
|                           | -                | $V_{CC} = Max, \ \overline{CE} \le V_{IL},$  | AS7C1026A  | -   | 30  | -   | 25  | -   | 20  | -   | 20  |      |
| Standby<br>power supply   | I <sub>SB</sub>  | outputs open, $f = f_{Max} = 1/t_{RC}$   | AS7C31026A | -   | 30  | -   | 25  | -   | 20  | -   | 20  | mA   |
| current                   |                  | $V_{CC} = Max, \overline{CE} \ge V_{CC} - 0.2V,$   | AS7C1026A  | -   | 10  | -   | 10  | -   | 10  | -   | 10  |      |
|                           | I <sub>SB1</sub> | $\label{eq:VIN} \begin{split} V_{IN} &\leq GND + 0.2V \text{ or} \\ V_{IN} &\geq V_{CC}  0.2V \text{, } f = 0 \end{split}$ | AS7C31026A | -   | 5   | -   | 5   | -   | 5   | -   | 5   | mA   |
| Output                    | VOL              | $I_{OL} = 8 \text{ mA}, V_{CC} = \text{Min}$   | Both       | -   | 0.4 | -   | 0.4 | -   | 0.4 | -   | 0.4 | V    |
| voltage                   | V <sub>OH</sub>  | $I_{OH} = -4 \text{ mA}, V_{CC} = \text{Min}$  | botti      | 2.4 | -   | 2.4 | -   | 2.4 | -   | 2.4 | -   | V    |

## Capacitance (f = 1MHz, $T_a = 25$ °C, $V_{CC} = \text{NOMINAL})^2$

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

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

|                                 |                  | -1  | 0   | -1  | .2  | -1  | 5   | -2  | 20  |      |       |
|---------------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|-------|
| Parameter                       | Symbol           | Min | Max | Min | Max | Min | Max | Min | Max | Unit | Notes |
| Read cycle time                 | t <sub>RC</sub>  | 10  | -   | 12  | -   | 15  | -   | 20  | -   | ns   |       |
| Address access time             | t <sub>AA</sub>  | -   | 10  | -   | 12  | -   | 15  | _   | 20  | ns   | 3     |
| Chip enable (CE) access time    | t <sub>ACE</sub> | _   | 10  | -   | 12  | _   | 15  | _   | 20  | ns   | 3     |
| Output enable (OE) access time  | t <sub>OE</sub>  | _   | 5   | -   | 6   | _   | 7   | _   | 8   | ns   |       |
| Output hold from address change | t <sub>OH</sub>  | 2   | -   | 3   | -   | 3   | -   | 3   | -   | ns   | 5     |
| CE Low to output in low Z       | t <sub>CLZ</sub> | 0   | -   | 0   | -   | 0   | -   | 0   | -   | ns   | 4, 5  |
| CE High to output in high Z     | t <sub>CHZ</sub> | _   | 3   | -   | 3   | _   | 4   | _   | 5   | ns   | 4, 5  |
| OE Low to output in low Z       | t <sub>OLZ</sub> | 0   | -   | 0   | -   | 0   | -   | 0   | -   | ns   | 4, 5  |
| Byte select access time         | t <sub>BA</sub>  | -   | 5   | -   | 6   | -   | 7   | -   | 8   | ns   |       |
| Byte select Low to low Z        | t <sub>BLZ</sub> | 0   | _   | 0   | -   | 0   | _   | 0   | -   | ns   | 4, 5  |
| Byte select High to high Z      | t <sub>BHZ</sub> | _   | 5   | -   | 6   | _   | 6   | _   | 8   | ns   | 4, 5  |
| OE High to output in high Z     | t <sub>OHZ</sub> | -   | 3   | -   | 3   | -   | 4   | -   | 5   | ns   | 4, 5  |
| Power up time                   | t <sub>PU</sub>  | 0   | -   | 0   | -   | 0   | -   | 0   | -   | ns   | 4, 5  |
| Power down time                 | t <sub>PD</sub>  | -   | 10  | -   | 12  | -   | 15  | -   | 20  | ns   | 4, 5  |

### Key to switching waveforms

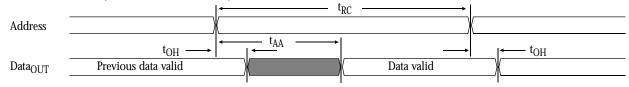
\_\_\_\_\_ Rising i

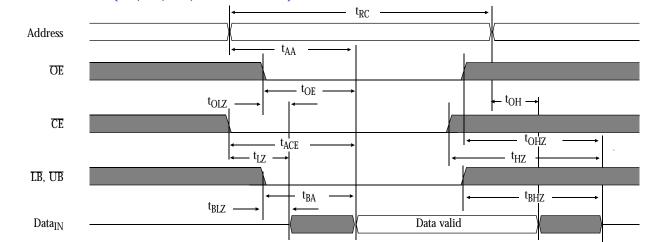
Rising input

\_\_\_\_\_ Falling input

Undefined output/don't care

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





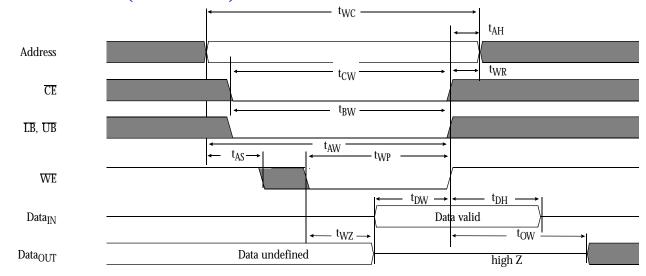
## Read waveform 2 (OE, CE, UB, LB controlled)<sup>3,6,8,9</sup>

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

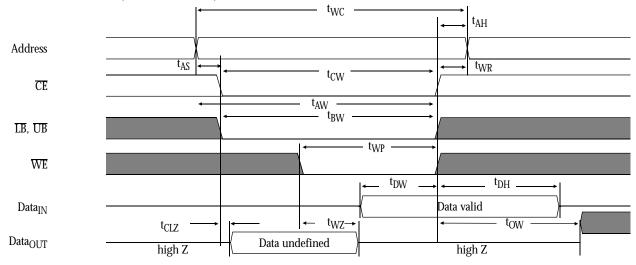
|                                  |                 | -1  | L <b>O</b> | -12 |     | -15 |     | -20 |     |      |       |
|----------------------------------|-----------------|-----|------------|-----|-----|-----|-----|-----|-----|------|-------|
| Parameter                        | Symbol       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



Write waveform 1 (WE controlled)<sup>10,11</sup>



## Write waveform 2 (CE controlled)<sup>10,11</sup>

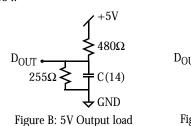


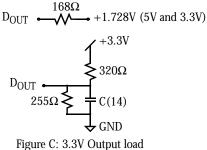
#### **AC test conditions**

+3.0V

GND

- Output load: see Figure B or Figure C.
- 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.





Thevenin Equivalent:

Figure A: Input pulse

# Notes

1 During  $V_{CC}$  power-up, a pull-up resistor to  $V_{CC}$  on  $\overline{CE}$  is required to meet  $I_{SB}$  specification.

90%

10%

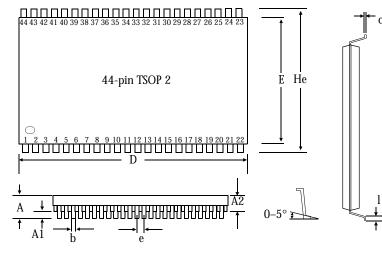
2 This parameter is sampled, but not 100% tested.

90%

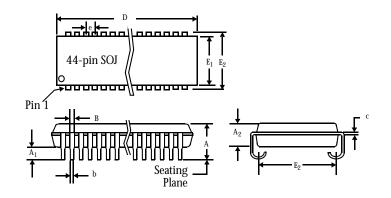
- 3 For test conditions, see AC Test Conditions, Figures A, B, and C.
- 4 These parameters are specified with  $C_L = 5pF$ , as in Figures B or C. Transition is measured  $\pm 500$  mV from steady-state voltage.
- 5 This parameter is guaranteed, but not tested.
- 6 WE is High for read cycle.
- 7  $\overline{\text{CE}}$  and  $\overline{\text{OE}}$  are Low for read cycle.
- 8 Address valid prior to or coincident with CE transition Low.
- 9 All read cycle timings are referenced from the last valid address to the first transitioning address.
- 10 CE or WE must be High during address transitions. Either CE or WE asserting high terminates a write cycle.
- 11 All write cycle timings are referenced from the last valid address to the first transitioning address.
- 12 Not applicable.
- 13 C=30pF, except all high Z and low Z parameters where C=5pF.



## Package dimensions

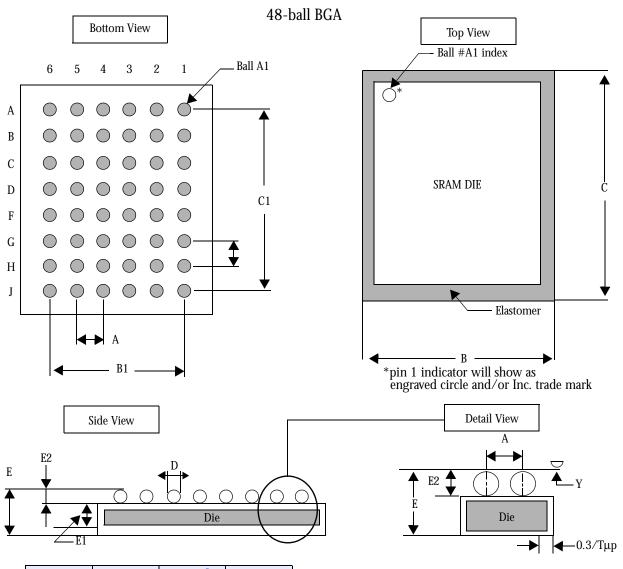


|    | 44-pin '       | TSOP 2   |  |  |  |  |
|----|----------------|----------|--|--|--|--|
|    | Min            | Max      |  |  |  |  |
|    | (mm)           | (mm)     |  |  |  |  |
| A  |                | 1.2      |  |  |  |  |
| A1 | 0.05           |          |  |  |  |  |
| A2 | 0.95           | 1.05     |  |  |  |  |
| b  | 0.30           | 0.45     |  |  |  |  |
| С  | 0.127 (        | typical) |  |  |  |  |
| D  | 18.28          | 18.54    |  |  |  |  |
| E  | 10.03          | 10.29    |  |  |  |  |
| He | 11.56          | 11.96    |  |  |  |  |
| е  | 0.80 (typical) |          |  |  |  |  |
| l  | 0.40           | 0.60     |  |  |  |  |



|                | 44-pin SOJ<br>400 mil |          |  |  |  |  |  |  |
|----------------|-----------------------|----------|--|--|--|--|--|--|
|                | Min (in)              | Max (in) |  |  |  |  |  |  |
| Α              | 0.128                 | 0.148    |  |  |  |  |  |  |
| A <sub>1</sub> | 0.025                 | -        |  |  |  |  |  |  |
| A <sub>2</sub> | 0.105                 | 1.115    |  |  |  |  |  |  |
| B              | 0.026                 | 0.032    |  |  |  |  |  |  |
| b              | 0.015                 | 0.020    |  |  |  |  |  |  |
| С              | 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      |  |  |  |  |  |  |





|           | Minimum | Typical | Maximum |
|-----------|---------|---------|---------|
| A         | -       | 0.75    | -       |
| B         | 5.90    | 6.00    | 6.10    |
| <b>B1</b> | -       | 3.75    | -       |
| С         | 7.90    | 8.00    | 8.10    |
| <b>C1</b> | -       | 5.25    | -       |
| D         | 0.25    | 0.30    | 0.40    |
| E         | -       | -       | 1.20    |
| E1        | -       | 0.68    | -       |
| <b>E2</b> | 0.17    | 0.22    | 0.27    |
| Y         | -       | -       | 0.10    |

#### Notes

- 1 Bump counts: 48 (8 row x 6 column).
- 2 Pitch:  $(x,y) = 0.75 \text{ mm } x \ 0.75 \text{ mm}$  (typ).
- 3 Units: millimeters.
- 4 All tolerance are +/-0.050 unless otherwise specified.
- 5 Typ: typical.
- 6 Y is coplanarity: 0.10 (max).



#### **Ordering codes**

| Package \ Access time  | Volt/Temp       | 10 ns           | 12 ns           | 15 ns           | 20 ns           |
|------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Plastic SOJ, 400 mil   | 5V commercial   | AS7C1026A-10JC  | AS7C1026A-12JC  | AS7C1026A-15JC  | AS7C1026A-20JC  |
|                        | 5V industrial   | AS7C1026A-10JI  | AS7C1026A-12JI  | AS7C1026A-15JI  | AS7C1026A-20JI  |
|                        | 3.3V commercial | AS7C31026A-10JC | AS7C31026A-12JC | AS7C31026A-15JC | AS7C31026A-20JC |
| TSOP 2, 10.2 x 18.4 mm | 5V commercial   | AS7C1026A-10TC  | AS7C1026A-12TC  | AS7C1026A-15TC  | AS7C1026A-20TC  |
|                        | 3.3V commercial | AS7C31026A-10TC | AS7C31026A-12TC | AS7C31026A-15TC | AS7C31026A-20TC |
|                        | 3.3V industrial | AS7C31026A-10TI | AS7C31026A-12TI | AS7C31026A-15TI | AS7C31026A-20TI |
| BGA, 6 x 8 mm          | 5V commercial   | AS7C1026A-10BC  | AS7C1026A-12BC  | AS7C1026A-15BC  | AS7C1026A-20BC  |
|                        | 3.3V commercial | AS7C31026A-10BC | AS7C31026A-12BC | AS7C31026A-15BC | AS7C31026A-20BC |
|                        | 3.3V industrial | AS7C31026A-10BI | AS7C31026A-12BI | AS7C31026A-15BI | AS7C31026A-20BI |

#### Part numbering system

| AS7C | X  | 1026             | <b>-XX</b> | X                       | С  |
|------|--|------------------|------------|-------------------------|--|
| SKAM | Voltage:<br>Blank=5V CMOS<br>3=3.3V CMOS | Device<br>number | time       | 11 = 100P2 102 x 184 mm | Temperature range:<br>C= Commercial: 0° C to 70° C<br>I= Industrial: -40° C to 85° C |

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