

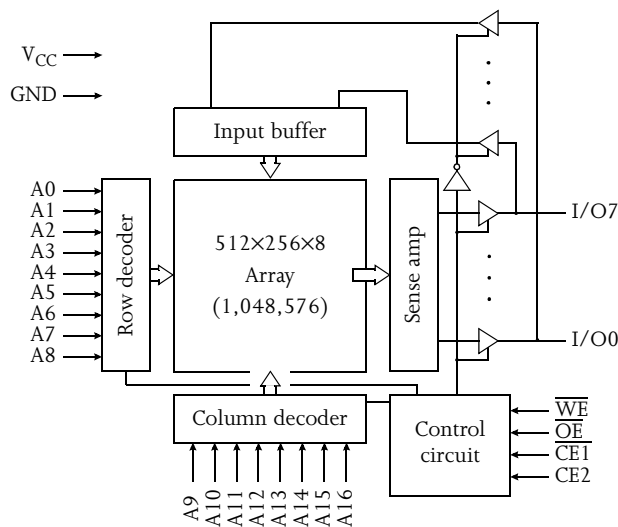


## 5V/3.3V 128K×8 CMOS SRAM (Evolutionary Pinout)

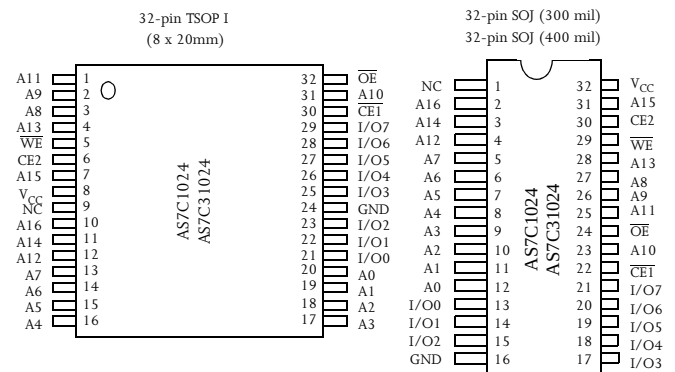
## Features

- AS7C1024 (5V version)
- AS7C31024 (3.3V version)
- Industrial and commercial temperatures
- Organization: 131,072 words × 8 bits
- High speed
  - 12/15/20 ns address access time
  - 6,7,8 ns output enable access time
- Low power consumption: ACTIVE
  - 825 mW (c) / max @ 12 ns
  - 360 mW (AS7C31024) / max @ 12 ns
- Low power consumption: STANDBY
  - 55 mW (AS7C1024) / max CMOS
  - 36 mW (AS7C31024) / max CMOS
- 2.0V data retention
- Easy memory expansion with  $\overline{CE1}$ , CE2,  $\overline{OE}$  inputs
- TTL/LVTTL-compatible, three-state I/O
- 32-pin JEDEC standard packages
  - 300 mil SOJ
  - 400 mil SOJ
  - 8 × 20mm TSOP I
  - 8 × 13.4 mm sTSOP I
- ESD protection ≥ 2000 volts
- Latch-up current ≥ 200 mA

## Logic block diagram



## Pin arrangement



## Selection guide

|                                   |           | AS7C1024-12<br>AS7C31024-12 | AS7C1024-15<br>AS7C31024-15 | AS7C1024-20<br>AS7C31024-20 | Unit |
|-----------------------------------|-----------|-----------------------------|-----------------------------|-----------------------------|------|
| Maximum address access time       |           | 12                          | 15                          | 20                          | ns   |
| Maximum output enable access time |           | 6                           | 8                           | 10                          | ns   |
| Maximum operating current         | AS7C1024  | 140                         | 125                         | 110                         | mA   |
|                                   | AS7C31024 | 90                          | 80                          | 75                          | mA   |
| Maximum CMOS standby current      | AS7C1024  | 10                          | 10                          | 15                          | mA   |
|                                   | AS7C31024 | 10                          | 10                          | 15                          | mA   |

Shaded areas contain advance information.



## Functional description

The AS7C1024 and AS7C31024 are high performance CMOS 1,048,576-bit Static Random Access Memory (SRAM) devices organized as 131,072 words  $\times$  8 bits. It is 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. Active high and low chip enables ( $\overline{CE1}$ , CE2) permit easy memory expansion with multiple-bank systems.

When  $\overline{CE1}$  is high or CE2 is low the devices enter standby mode. If inputs are still toggling, the device will consume  $I_{SB}$  power. If the bus is static, then full standby power is reached ( $I_{SB1}$  or  $I_{SB2}$ ). For example, the AS7C31024 is guaranteed not to exceed 0.33mW under nominal full standby conditions. All devices in this family will retain data when VCC is reduced as low as 2.0V.

A write cycle is accomplished by asserting write enable ( $\overline{WE}$ ) and both chip enables ( $\overline{CE1}$ , CE2). Data on the input pins I/O0-I/O7 is written on the rising edge of  $\overline{WE}$  (write cycle 1) or the active-to-inactive edge of  $\overline{CE1}$  or CE2 (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 both chip enables ( $\overline{CE1}$ , CE2), 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 is inactive, output enable is inactive, or write enable is active, output drivers stay in high-impedance mode.

## Absolute maximum ratings

| Parameter                                        |           | Symbol            | Min   | Max                    | Unit |
|--------------------------------------------------|-----------|-------------------|-------|------------------------|------|
| Voltage on V <sub>CC</sub> relative to GND       | AS7C1024  | V <sub>t1</sub>   | -0.50 | +7.0                   | V    |
|                                                  | AS7C31024 | V <sub>t1</sub>   | -0.50 | +5.0                   | V    |
| Voltage on any pin relative to GND               |           | V <sub>t2</sub>   | -0.50 | V <sub>CC</sub> + 0.50 | V    |
| Power dissipation                                |           | P <sub>D</sub>    | —     | 1.0                    | W    |
| Storage temperature (plastic)                    |           | T <sub>stg</sub>  | -65   | +150                   | °C   |
| Ambient temperature with V <sub>CC</sub> applied |           | T <sub>bias</sub> | -55   | +125                   | °C   |
| DC current into outputs (low)                    |           | I <sub>OUT</sub>  | —     | 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

| $\overline{CE1}$ | CE2 | $\overline{WE}$ | $\overline{OE}$ | Data             | Mode                             |
|------------------|-----|-----------------|-----------------|------------------|----------------------------------|
| H                | X   | X               | X               | High Z           | Standby ( $I_{SB}$ , $I_{SB1}$ ) |
| X                | L   | X               | X               | High Z           | Standby ( $I_{SB}$ , $I_{SB1}$ ) |
| L                | H   | H               | H               | High Z           | Output disable ( $I_{CC}$ )      |
| L                | H   | H               | L               | D <sub>OUT</sub> | Read ( $I_{CC}$ )                |
| L                | H   | L               | X               | D <sub>IN</sub>  | Write ( $I_{CC}$ )               |

Key: X = Don't Care, L = Low, H = High



## Recommended operating conditions

| Parameter                     | Device     | Symbol             | Min  | Nominal | Max            | Unit |
|-------------------------------|------------|--------------------|------|---------|----------------|------|
| Supply voltage                | AS7C1024   | $V_{CC}$           | 4.5  | 5.0     | 5.5            | V    |
|                               | AS7C31024  | $V_{CC}$           | 3.0  | 3.3     | 3.6            | V    |
| Input voltage                 | AS7C1024   | $V_{IH}$           | 2.2  | —       | $V_{CC} + 0.5$ | V    |
|                               | AS7C31024  | $V_{IH}$           | 2.0  | —       | $V_{CC} + 0.5$ | V    |
|                               |            | $V_{IL}^{\dagger}$ | -0.5 | —       | 0.8            | V    |
| Ambient operating temperature | commercial | $T_A$              | 0    | —       | 70             | °C   |
|                               | industrial | $T_A$              | -40  | —       | 85             | °C   |

$\dagger V_{ILmin} = -3.0V$  for pulse width less than  $t_{RC/2}$ .

## 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_{LI} $ | $V_{CC} = \text{Max}, V_{IN} = \text{GND to } V_{CC}$                                                                                                      |           | —   | 1   | —   | 1   | —   | 1   | $\mu\text{A}$ |
| Output leakage current         | $ I_{LO} $ | $V_{CC} = \text{Max}, \overline{CE1} = V_{IH} \text{ or } CE2 = V_{IL}, V_{OUT} = \text{GND to } V_{CC}$                                                   |           | —   | 1   | —   | 1   | —   | 1   | $\mu\text{A}$ |
| Operating power supply current | $I_{CC}$   | $V_{CC} = \text{Max}, \overline{CE1} = V_{IL}, CE2 = V_{IH}, f = f_{Max}, I_{OUT} = 0 \text{ mA}$                                                          | AS7C1024  | —   | 140 | —   | 125 | —   | 110 | mA            |
|                                |            |                                                                                                                                                            | AS7C31024 | —   | 90  | —   | 80  | —   | 75  |               |
| Standby power supply current   | $I_{SB}$   | $V_{CC} = \text{Max}, \overline{CE1} \geq V_{IH} \text{ and/or } CE2 \leq V_{IL}, V_{IN} = V_{IH} \text{ or } V_{IL}, f = f_{Max}, I_{OUT} = 0 \text{ mA}$ | AS7C1024  | —   | 75  | —   | 65  | —   | 60  | mA            |
|                                |            |                                                                                                                                                            | AS7C31024 | —   | 50  | —   | 40  | —   | 35  |               |
|                                | $I_{SB1}$  | $V_{CC} = \text{Max}, \overline{CE1} \geq V_{CC} - 0.2V, V_{IN} \leq \text{GND} + 0.2V \text{ or } V_{IN} \geq V_{CC} - 0.2V, f = 0$                       | AS7C1024  | —   | 10  | —   | 10  | —   | 15  | mA            |
|                                |            |                                                                                                                                                            | AS7C31024 | —   | 10  | —   | 10  | —   | 15  |               |
| Output voltage                 | $V_{OL}$   | $I_{OL} = 8 \text{ mA}, V_{CC} = \text{Min}$                                                                                                               |           | —   | 0.4 | —   | 0.4 | —   | 0.4 | V             |
|                                | $V_{OH}$   | $I_{OH} = -4 \text{ mA}, V_{CC} = \text{Min}$                                                                                                              |           | 2.4 | —   | 2.4 | —   | 2.4 | —   | V             |

Shaded areas contain advance information.

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

| Parameter         | Symbol    | Signals                                                      | Test conditions         | Max | Unit |
|-------------------|-----------|--------------------------------------------------------------|-------------------------|-----|------|
| Input capacitance | $C_{IN}$  | A, $\overline{CE1}$ , CE2, $\overline{WE}$ , $\overline{OE}$ | $V_{IN} = 0V$           | 5   | pF   |
| I/O capacitance   | $C_{I/O}$ | I/O                                                          | $V_{IN} = V_{OUT} = 0V$ | 7   | pF   |



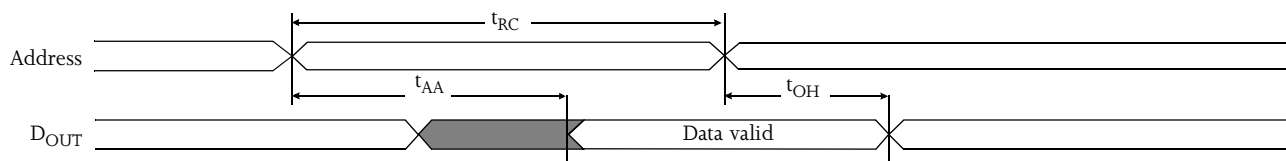
### Read cycle (over the operating range)<sup>3,9,12</sup>

| 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 ( $\overline{CE1}$ ) access time  | $t_{ACE1}$ | —   | 12  | —   | 15  | —   | 20  | ns   | 3, 12    |
| Chip enable (CE2) access time                 | $t_{ACE2}$ | —   | 12  | —   | 15  | —   | 20  | ns   | 3, 12    |
| Output enable ( $\overline{OE}$ ) access time | $t_{OE}$   | —   | 6   | —   | 7   | —   | 8   | ns   |          |
| Output hold from address change               | $t_{OH}$   | 3   | —   | 3   | —   | 3   | —   | ns   | 5        |
| $\overline{CE1}$ Low to output in low Z       | $t_{CLZ1}$ | 3   | —   | 3   | —   | 3   | —   | ns   | 4, 5, 12 |
| CE2 High to output in low Z                   | $t_{CLZ2}$ | 3   | —   | 3   | —   | 3   | —   | ns   | 4, 5, 12 |
| $\overline{CE1}$ Low to output in high Z      | $t_{CHZ1}$ | —   | 3   | —   | 4   | —   | 5   | ns   | 4, 5, 12 |
| CE2 Low to output in high Z                   | $t_{CHZ2}$ | —   | 3   | —   | 4   | —   | 5   | ns   | 4, 5, 12 |
| $\overline{OE}$ Low to output in low Z        | $t_{OLZ}$  | 0   | —   | 0   | —   | 0   | —   | ns   | 4, 5     |
| $\overline{OE}$ High to output in high Z      | $t_{OHZ}$  | —   | 3   | —   | 4   | —   | 5   | ns   | 4, 5     |
| Power up time                                 | $t_{PU}$   | 0   | —   | 0   | —   | 0   | —   | ns   | 4, 5, 12 |
| Power down time                               | $t_{PD}$   | —   | 12  | —   | 15  | —   | 20  | ns   | 4, 5, 12 |

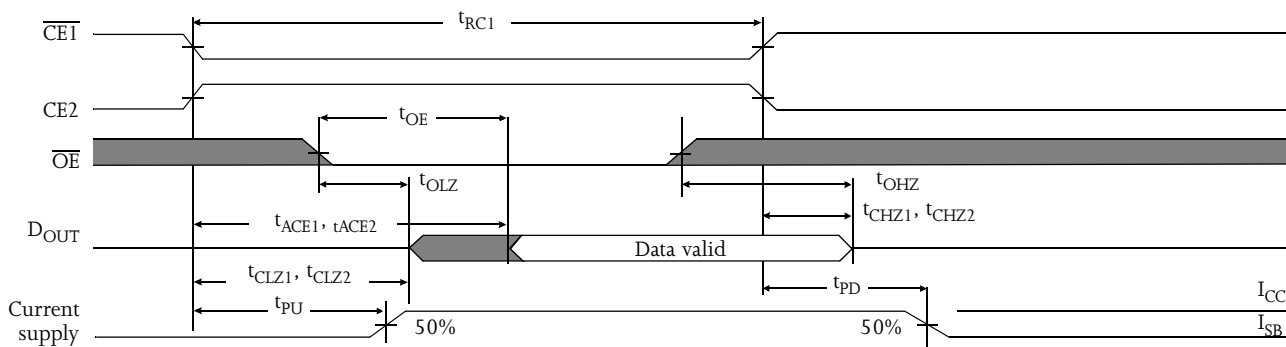
### Key to switching waveforms

Rising input     
 Falling input     
 Undefined / don't care

### Read waveform 1 (address controlled)<sup>3,6,7,9,12</sup>



### Read waveform 2 ( $\overline{CE1}$ , CE2, and $\overline{OE}$ controlled)<sup>3,6,8,9,12</sup>



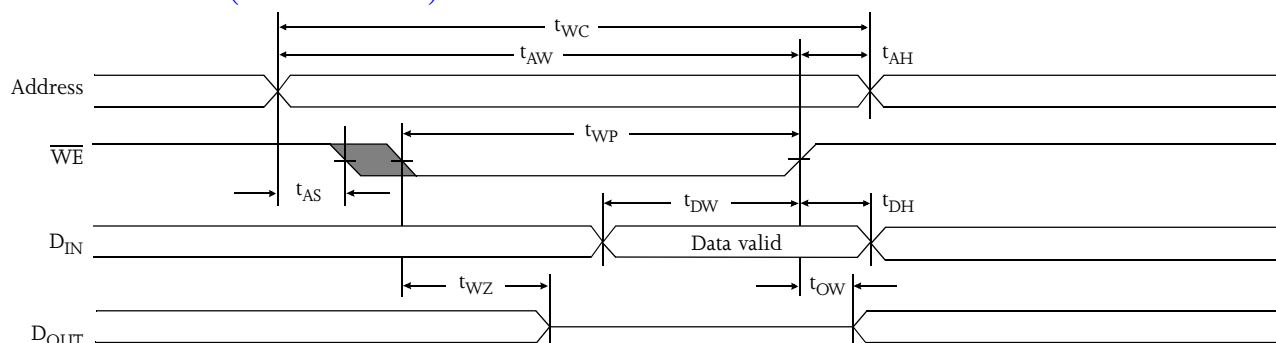


## Write cycle (over the operating range)<sup>11, 12</sup>

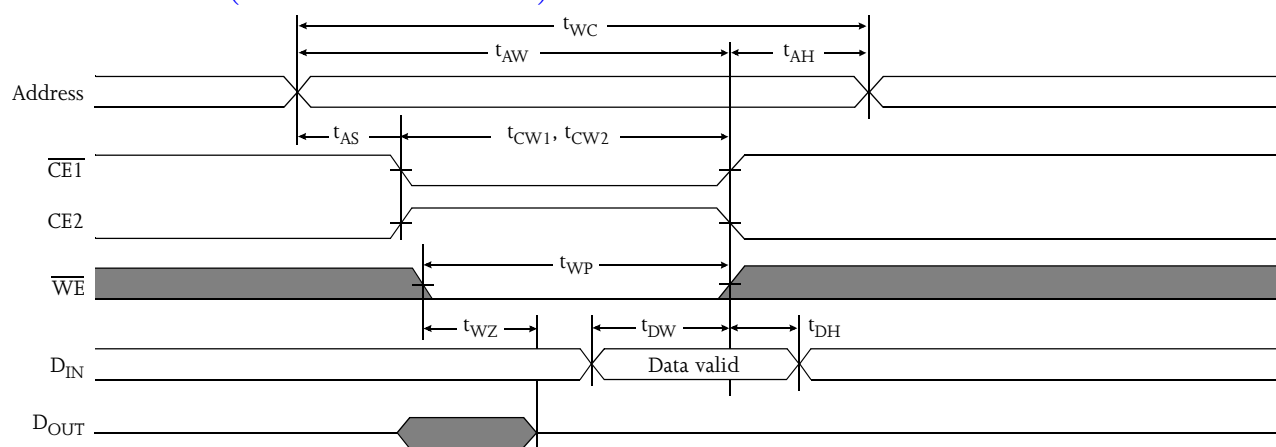
| Parameter                                     | Symbol    | -12 |     | -15 |     | -20 |     | Unit | Notes |
|-----------------------------------------------|-----------|-----|-----|-----|-----|-----|-----|------|-------|
|                                               |           | Min | Max | Min | Max | Min | Max |      |       |
| Write cycle time                              | $t_{WC}$  | 12  | —   | 15  | —   | 20  | —   | ns   |       |
| Chip enable ( $\overline{CE1}$ ) to write end | $t_{CW1}$ | 10  | —   | 12  | —   | 12  | —   | ns   | 12    |
| Chip enable (CE2) to write end                | $t_{CW2}$ | 10  | —   | 12  | —   | 12  | —   | ns   | 12    |
| Address setup to write end                    | $t_{AW}$  | 10  | —   | 12  | —   | 12  | —   | ns   |       |
| Address setup time                            | $t_{AS}$  | 0   | —   | 0   | —   | 0   | —   | ns   | 12    |
| Write pulse width                             | $t_{WP}$  | 8   | —   | 9   | —   | 12  | —   | ns   |       |
| Address hold from end of write                | $t_{AH}$  | 0   | —   | 0   | —   | 0   | —   | ns   |       |
| Data valid to write end                       | $t_{DW}$  | 6   | —   | 9   | —   | 10  | —   | ns   |       |
| Data hold time                                | $t_{DH}$  | 0   | —   | 0   | —   | 0   | —   | ns   | 4, 5  |
| Write enable to output in high Z              | $t_{WZ}$  | —   | 5   | —   | 5   | —   | 5   | ns   | 4, 5  |
| Output active from write end                  | $t_{OW}$  | 3   | —   | 3   | —   | 3   | —   | ns   | 4, 5  |

Shaded areas contain advance information.

## Write waveform 1 ( $\overline{WE}$ controlled)<sup>10,11,12</sup>



## Write waveform 2 ( $\overline{CE1}$ and CE2 controlled)<sup>10,11,12</sup>

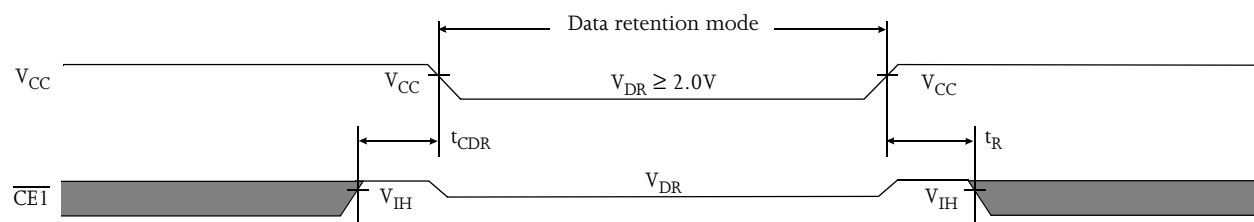




### Data retention characteristics (over the operating range)<sup>13</sup>

| Parameter                            | Symbol | Test conditions                                                                                                                      | Device    | Min             | Max | Unit |
|--------------------------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------------|-----|------|
| $V_{CC}$ for data retention          | VDR    | $V_{CC} = 2.0V$<br>$\overline{CE1} \geq V_{CC} - 0.2V$ or<br>$CE2 \leq 0.2V$<br>$V_{IN} \geq V_{CC} - 0.2V$ or<br>$V_{IN} \leq 0.2V$ |           | 2.0             | —   | V    |
| Data retention current               | ICCDR  |                                                                                                                                      | AS7C1024  | —               | 5   | mA   |
|                                      |        |                                                                                                                                      | AS7C31024 | —               | 1   | mA   |
| Chip deselect to data retention time | tCDR   |                                                                                                                                      |           | 0               | —   | ns   |
| Operation recovery time              | tR     |                                                                                                                                      |           | t <sub>RC</sub> | —   | ns   |
| Input leakage current                | ILI    |                                                                                                                                      |           | —               | 1   | μA   |

### Data retention waveform



### AC test conditions

- 5V 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.

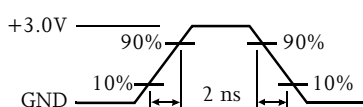


Figure A: Input pulse

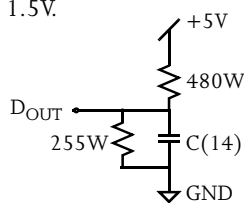


Figure B: 5V Output load

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

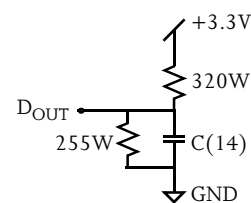


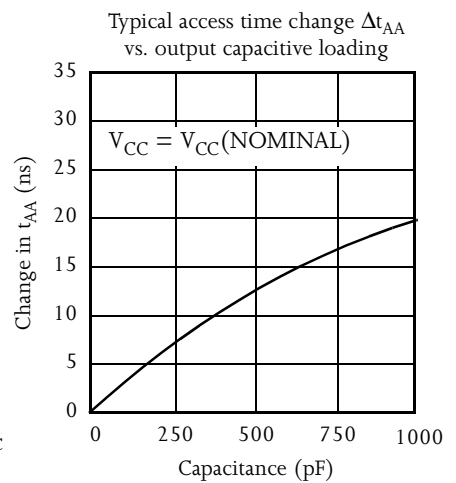
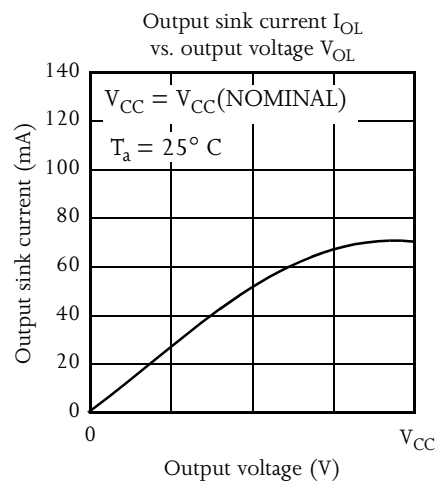
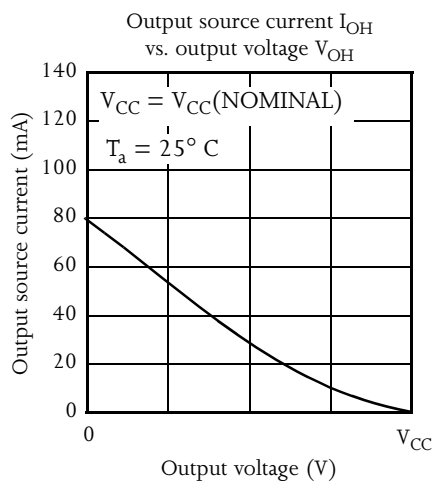
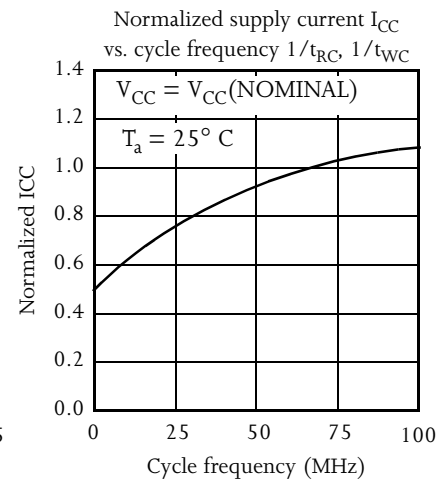
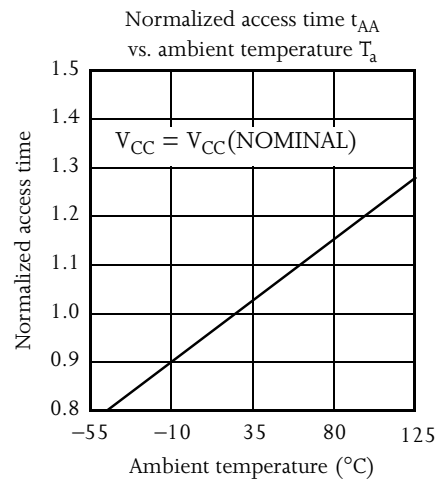
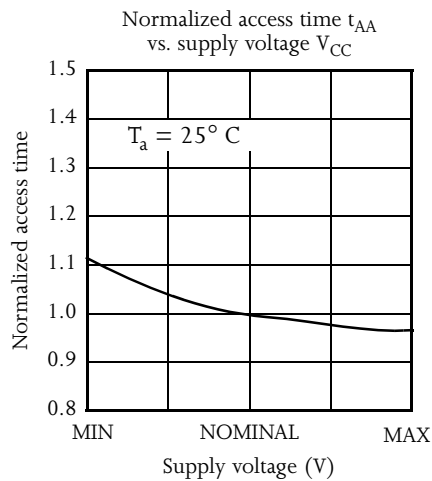
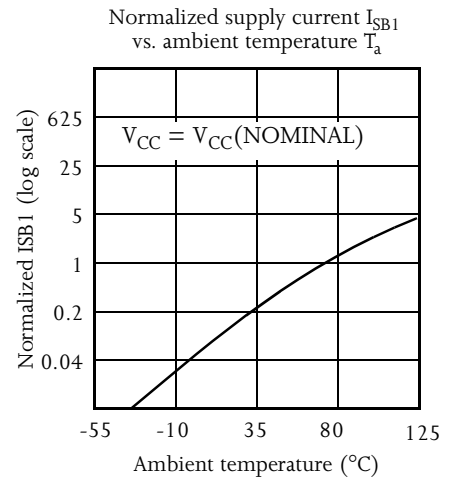
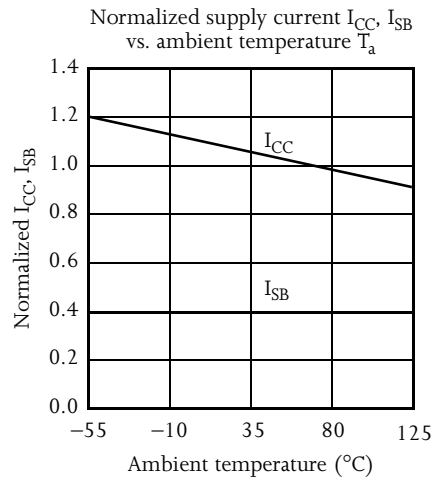
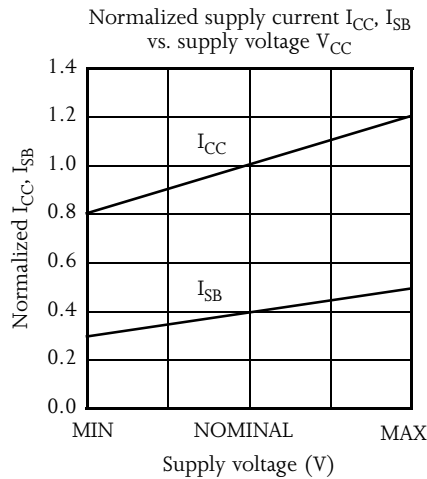
Figure C: 3.3V Output load

### Notes

- During  $V_{CC}$  power-up, a pull-up resistor to  $V_{CC}$  on  $\overline{CE1}$  is required to meet  $I_{SB}$  specification.
- This parameter is sampled and not 100% tested.
- For test conditions, see AC Test Conditions, Figures A, B, and C.
- $t_{CLZ}$  and  $t_{CHZ}$  are specified with  $CL = 5pF$ , as in Figure C. Transition is measured  $\pm 500mV$  from steady-state voltage.
- This parameter is guaranteed, but not 100% tested.
- $\overline{WE}$  is High for read cycle.
- $\overline{CE1}$  and  $\overline{OE}$  are Low and  $CE2$  is High for read cycle.
- Address valid prior to or coincident with  $\overline{CE1}$  transition Low.
- All read cycle timings are referenced from the last valid address to the first transitioning address.
- $\overline{CE1}$  or  $\overline{WE}$  must be High or  $CE2$  Low during address transitions. Either  $\overline{CE1}$  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.
- $\overline{CE1}$  and  $CE2$  have identical timing.
- 2V data retention applies to commercial temperature operating range only.
- $C=30pF$ , except all high Z and low Z parameters,  $C=5pF$ .

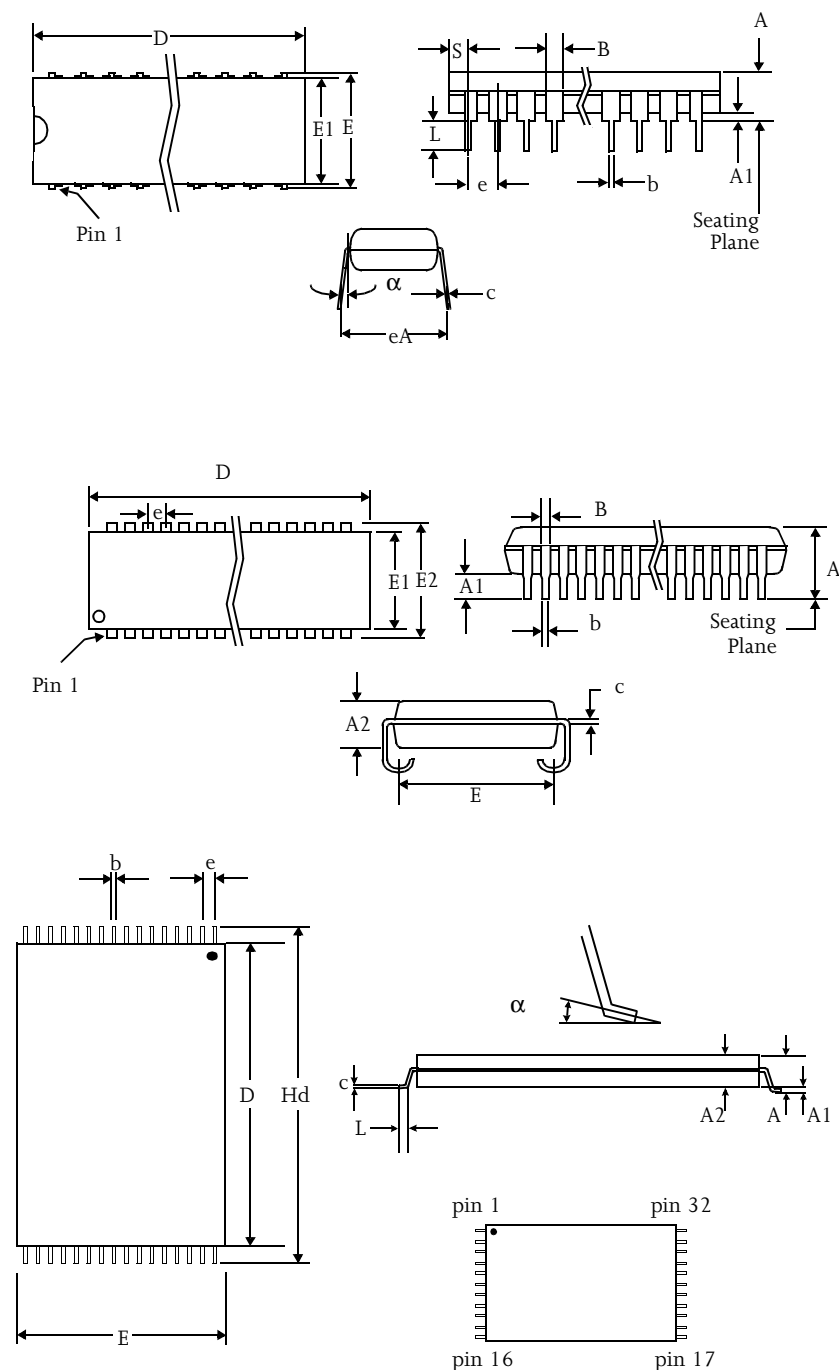


## Typical DC and AC characteristics





## Package dimensions



|    | 32-pin PDIP |       |
|----|-------------|-------|
|    | Min         | Max   |
| A  | -           | 0.180 |
| A1 | 0.015       | -     |
| B  | 0.045       | 0.055 |
| b  | 0.015       | 0.021 |
| c  | 0.008       | 0.012 |
| D  | -           | 1.571 |
| E  | 0.300       | 0.325 |
| E1 | 0.280       | 0.295 |
| e  | 0.100 BSC   |       |
| eA | 0.330       | 0.370 |
| L  | 0.110       | 0.142 |
| a  | 0°          | 15°   |
| S  | -           | 0.043 |

|    | 32-pin SOJ 300 mil |       | 32-pin SOJ 400 mil |       |
|----|--------------------|-------|--------------------|-------|
|    | Min                | Max   | Min                | Max   |
| A  | -                  | 0.145 | -                  | 0.145 |
| A1 | 0.025              | -     | 0.025              | -     |
| A2 | 0.086              | 0.105 | 0.086              | 0.115 |
| B  | 0.026              | 0.032 | 0.026              | 0.032 |
| b  | 0.014              | 0.020 | 0.015              | 0.020 |
| c  | 0.006              | 0.013 | 0.007              | 0.013 |
| D  | 0.820              | 0.830 | 0.820              | 0.830 |
| E  | 0.250              | 0.275 | 0.360              | 0.380 |
| E1 | 0.292              | 0.305 | 0.395              | 0.405 |
| E2 | 0.330              | 0.340 | 0.435              | 0.445 |
| e  | 0.050 BSC          |       | 0.050 BSC          |       |

|          | 32-pin TSOP 8×20 |       |
|----------|------------------|-------|
|          | Min              | Max   |
| A        | -                | 1.20  |
| A1       | 0.05             | 0.15  |
| A2       | 0.95             | 1.05  |
| b        | 0.17             | 0.27  |
| c        | 0.10             | 0.21  |
| D        | 18.20            | 18.60 |
| e        | 0.50 nominal     |       |
| E        | 7.80             | 8.20  |
| Hd       | 19.80            | 20.20 |
| L        | 0.50             | 0.70  |
| $\alpha$ | 0°               | 5°    |





## Ordering codes

| Package \ Access time | Volt/Temp       | 12 ns           | 15 ns           | 20 ns           |
|-----------------------|-----------------|-----------------|-----------------|-----------------|
| Plastic SOJ, 300 mL   | 5V commercial   | AS7C1024-12TJC  | AS7C1024-15TJC  | AS7C1024-20TJC  |
|                       | 5V industrial   | AS7C1024-12TJI  | AS7C1024-15TJI  | AS7C1024-20TJI  |
|                       | 3.3V commercial | AS7C31024-12TJC | AS7C31024-15TJC | AS7C31024-20TJC |
|                       | 3.3V industrial | AS7C31024-12TJI | AS7C31024-15TJI | AS7C31024-20TJI |
| Plastic SOJ, 400 mL   | 5V commercial   | AS7C1024-12JC   | AS7C1024-15JC   | AS7C1024-20JC   |
|                       | 5V industrial   | AS7C1024-12JI   | AS7C1024-15JI   | AS7C1024-20JI   |
|                       | 3.3V commercial | AS7C31024-12JC  | AS7C31024-15JC  | AS7C31024-20JC  |
|                       | 3.3V industrial | AS7C31024-12JI  | AS7C31024-15JI  | AS7C31024-20JI  |
| TSOP 8×20             | 5V commercial   | AS7C1024-12TC   | AS7C1024-15TC   | AS7C1024-20TC   |
|                       | 5V industrial   | AS7C1024-12TI   | AS7C1024-15TI   | AS7C1024-20TI   |
|                       | 3.3V commercial | AS7C31024-12TC  | AS7C31024-15TC  | AS7C31024-20TC  |
|                       | 3.3V industrial | AS7C31024-12TI  | AS7C31024-15TI  | AS7C31024-20TI  |

NA: not available

Shaded areas contain advance information.

## Part numbering system

| AS7C        | X                            | 1024          | -XX         | X                                                                          | X                                                                                 |
|-------------|------------------------------|---------------|-------------|----------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
| SRAM prefix | Blank=5V CMOS<br>3=3.3V CMOS | Device number | Access time | Package: TP=PDIP 300 mil<br>T=TSOP 8×20<br>J=SOJ 400 mil<br>TJ=SOJ 300 mil | Temperature range<br>C = Commercial, 0°C to 70°C<br>I = Industrial, -40°C to 85°C |