



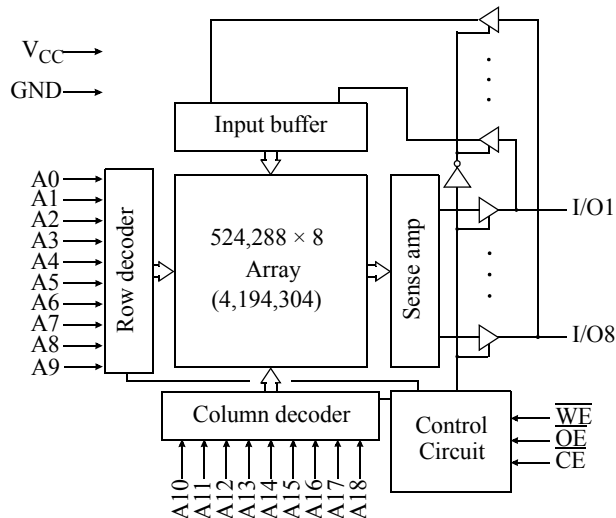
## 5.0V 512K × 8 CMOS SRAM

## Features

- Pin compatible to AS7C4096
- Industrial and commercial temperature
- Organization: 524,288 words × 8 bits
- Center power and ground pins
- High speed
  - 10/12/15/20 ns address access time
  - 5/6 ns output enable access time
- Low power consumption: ACTIVE
  - 880mW/max @ 10 ns
- Low power consumption: STANDBY
  - 55mW/max CMOS

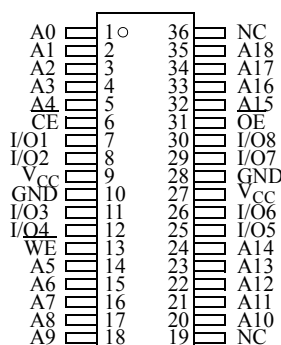
- Equal access and cycle times
- Easy memory expansion with  $\overline{CE}$ ,  $\overline{OE}$  inputs
- TTL-compatible, three-state I/O
- JEDEC standard packages
  - 400 mil 36-pin SOJ
  - 44-pin TSOP 2
- ESD protection ≥ 2000 volts
- Latch-up current ≥ 200 mA

## Logic block diagram

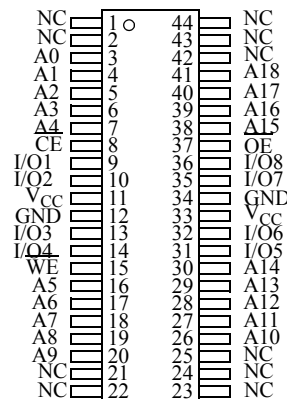


## Pin arrangements

36-pin SOJ (400 mil)



44-pin TSOP 2



## Selection guide

	-10	-12	-15	-20	Unit
Maximum address access time	10	12	15	20	ns
Maximum outputenable access time	5	6	6	6	ns
Maximum operating current	160	140	120	100	mA
Maximum CMOS standby current	10	10	10	10	mA



## Functional description

The AS7C4096A is a high-performance CMOS 4,194,304-bit Static Random Access Memory (SRAM) device organized as 524,288 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 10/12/15/20 ns with output enable access times ( $t_{OE}$ ) of 5/6 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. The device is guaranteed not to exceed 55mW power consumption in CMOS standby mode.

A write cycle is accomplished by asserting write enable ( $\overline{WE}$ ) and chip enable ( $\overline{CE}$ ). Data on the input pins I/O1–I/O8 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 chip drives 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.

All chip inputs and outputs are TTL-compatible, and operation is from a single 5.0V supply voltage. This device is available as per industry standard 400-mil 36-pin SOJ and 44-pin TSOP 2 packages.

## Absolute maximum ratings

Parameter	Symbol	Min	Max	Unit
Voltage on $V_{CC}$ relative to GND	$V_{t1}$	–0.5	+7.0	V
Voltage on any pin relative to GND	$V_{t2}$	–0.5	$V_{CC} + 0.5$	V
Power dissipation	$P_D$	–	1.0	W
Storage temperature (plastic)	$T_{stg}$	–65	+150	°C
Temperature with $V_{CC}$ applied	$T_{bias}$	–55	+125	°C
DC current into output (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

$\overline{CE}$	$\overline{WE}$	$\overline{OE}$	Data	Mode
H	X	X	High Z	Standby ( $I_{SB}$ , $I_{SB1}$ )
L	H	H	High Z	Output disable ( $I_{CC}$ )
L	H	L	$D_{OUT}$	Read ( $I_{CC}$ )
L	L	X	$D_{IN}$	Write ( $I_{CC}$ )



### Recommended operating condition

Parameter		Symbol	Min	Nominal	Max	Unit
Supply voltage		$V_{CC}(10/12/15/20)$	4.5	5.0	5.5	V
Input voltage		$V_{IH}^*$	2.2	–	$V_{CC} + 0.5$	V
		$V_{IL}^{**}$	–0.5	–	0.8	V
Ambient operating temperature	commercial	$T_A$	0	–	70	°C
	industrial	$T_A$	–40	–	85	°C

\*  $V_{IH} \text{ max} = V_{CC} + 1.5V$  for pulse width less than 5 nS.

\*\*  $V_{IL} \text{ min} = -1.0V$  for pulse width less than 5 nS.

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

Parameter	Symbol	Test conditions	–10		–12		–15		–20		Unit	Notes
			Min	Max	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	–	1	μA	
Output leakage current	$ I_{LO} $	$V_{CC} = \text{Max}, \overline{CE} = V_{IH}$ $V_{OUT} = \text{GND to } V_{CC}$	–	1	–	1	–	1	–	1	μA	
Operating power supply current	$I_{CC}$	$V_{CC} = \text{Max}, \overline{CE} < V_{IL}$ $f = f_{\text{Max}}, I_{OUT} = 0\text{mA}$	–	160	–	140	–	120	–	100	mA	
Standby power supply current	$I_{SB}$	$V_{CC} = \text{Max}, \overline{CE} \geq V_{IH}$ $f = f_{\text{Max}}, I_{OUT} = 0\text{mA}$	–	60	–	55	–	50	–	40	mA	
	$I_{SB1}$	$V_{CC} = \text{Max},$ $\overline{CE} \geq V_{CC} - 0.2V,$ $V_{IN} \leq 0.2V \text{ or } V_{IN} \geq V_{CC} - 0.2V,$ $f = 0$	–	10	–	10	–	10	–	10	mA	
Output voltage	$V_{OL}$	$I_{OL} = 6 \text{ mA}, V_{CC} = \text{Min}$	–	0.4	–	0.4	–	0.4	–	0.4	V	4
		$I_{OL} = 8 \text{ mA}, V_{CC} = \text{Min}$	–	0.5	–	0.5	–	0.5	–	0.5		
	$V_{OH}$	$I_{OH} = -4 \text{ mA}, V_{CC} = \text{Min}$	2.4	–	2.4	–	2.4	–	2.4	–	V	4

### Capacitance ( $f = 1\text{MHz}, T_a = 25^\circ \text{C}, V_{CC} = \text{NOMINAL}$ )<sup>4</sup>

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



### Read cycle (over the operating range)<sup>2,8</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	2
Chip enable ( $\overline{CE}$ ) access time	$t_{ACE}$	–	10	–	12	–	15	–	20	ns	2
Output enable ( $\overline{OE}$ ) access time	$t_{OE}$	–	5	–	6	–	6	–	6	ns	
Output hold from address change	$t_{OH}$	3	–	3	–	3	–	3	–	ns	4
$\overline{CE}$ Low to output in low Z	$t_{CLZ}$	3	–	3	–	3	–	3	–	ns	3,4
$\overline{CE}$ High to output in high Z	$t_{CHZ}$	–	5	–	6	–	7	–	9	ns	3,4
$\overline{OE}$ Low to output in low Z	$t_{OLZ}$	0	–	0	–	0	–	0	–	ns	3,4
$\overline{OE}$ High to output in high Z	$t_{OHZ}$	–	5	–	6	–	7	–	9	ns	3,4
Power up time	$t_{PU}$	0	–	0	–	0	–	0	–	ns	3,4
Power down time	$t_{PD}$	–	10	–	12	–	15	–	20	ns	3,4

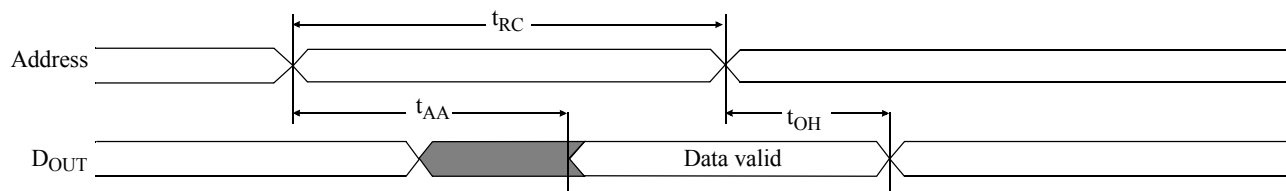
### Key to switching waveforms

Rising input

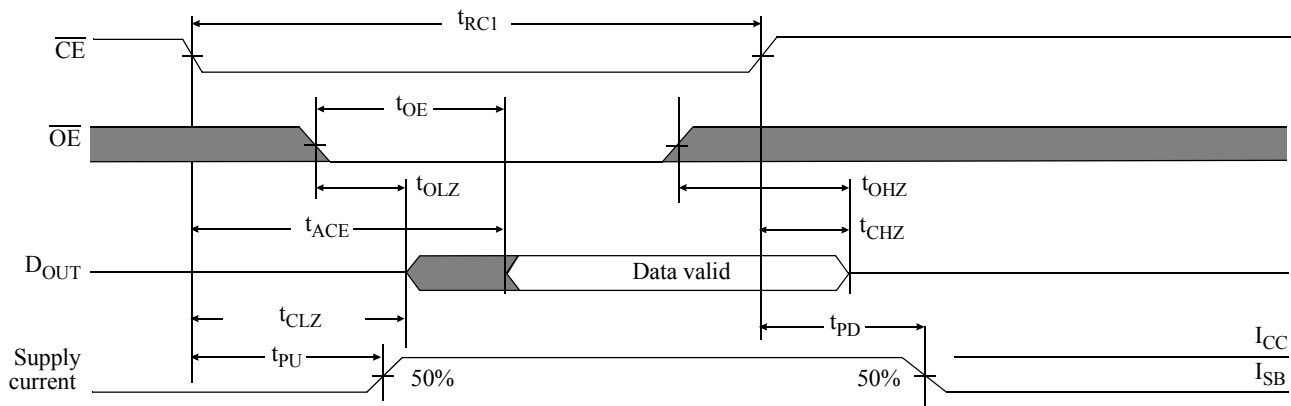
Falling input

Undefined/don't care

### Read waveform 1 (address controlled)<sup>2,5,6,8</sup>



### Read waveform 2 ( $\overline{CE}$ , $\overline{OE}$ controlled)<sup>2,5,7,8</sup>

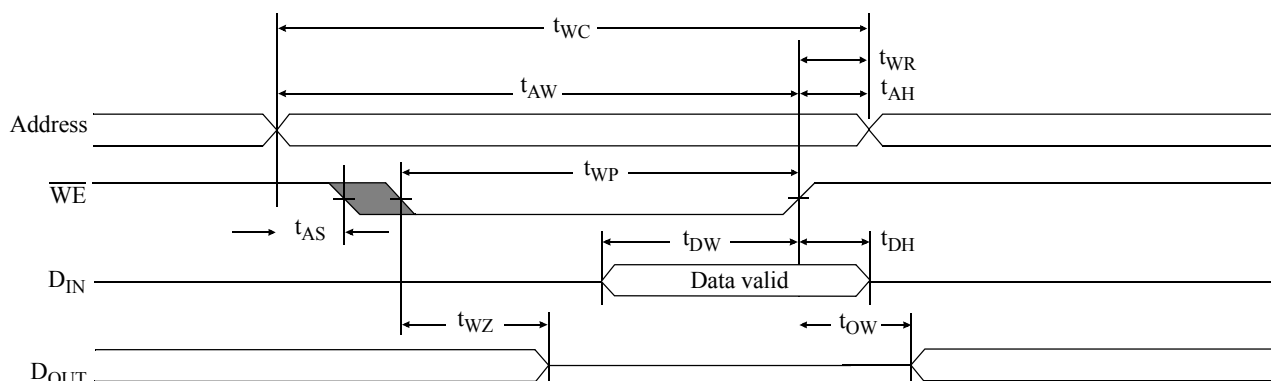




### Write cycle (over the operating range)<sup>9</sup>

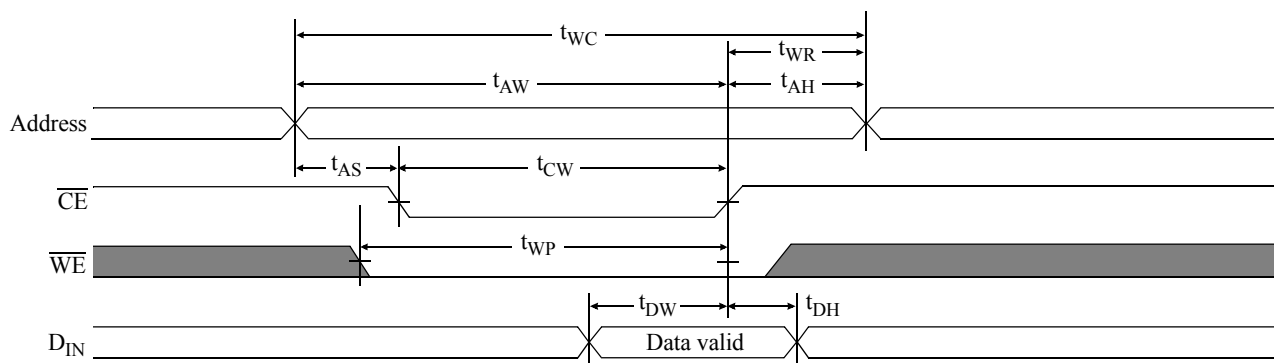
Parameter	Symbol	-10		-12		-15		-20		Unit	Notes
		Min	Max	Min	Max	Min	Max	Min	Max		
Write cycle time	$t_{WC}$	10	—	12	—	15	—	20	—	ns	
Chip enable ( $\overline{CE}$ ) to write end	$t_{CW}$	7	—	8	—	10	—	12	—	ns	
Address setup to write end	$t_{AW}$	7	—	8	—	10	—	12	—	ns	
Address setup time	$t_{AS}$	0	—	0	—	0	—	0	—	ns	
Write pulse width ( $\overline{OE} = \text{high}$ )	$t_{WP1}$	7	—	8	—	10	—	12	—	ns	
Write pulse width ( $\overline{OE} = \text{low}$ )	$t_{WP2}$	10	—	12	—	15	—	20	—	ns	
Address hold from end of write	$t_{AH}$	0	—	0	—	0	—	0	—	ns	
Write recovery time	$t_{WR}$	0	—	0	—	0	—	0	—	ns	
Data valid to write end	$t_{DW}$	5	—	6	—	7	—	9	—	ns	
Data hold time	$t_{DH}$	0	—	0	—	0	—	0	—	ns	3,4
Write enable to output in high Z	$t_{WZ}$	2	5	2	6	2	7	2	9	ns	3,4
Output active from write end	$t_{OW}$	3	—	3	—	3	—	3	—	ns	3,4

### Write waveform 1 ( $\overline{WE}$ controlled)<sup>9</sup>





## Write waveform 2 ( $\overline{\text{CE}}$ controlled)<sup>9</sup>



## AC test conditions

- Output load: see Figure B.
- Input pulse level: GND to  $V_{CC} - 0.5V$ . See Figures A and B.
- Input rise and fall times: 2 ns. See Figure A.
- Input and output timing reference levels: 1.5V.

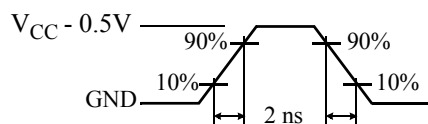


Figure A: Input pulse

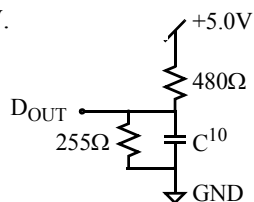
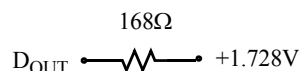


Figure B: 5.0V Output load

Thevenin equivalent:

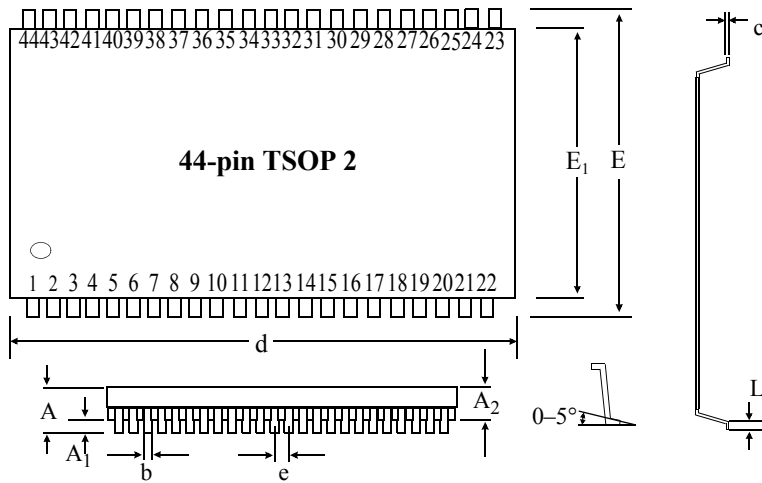


## Notes

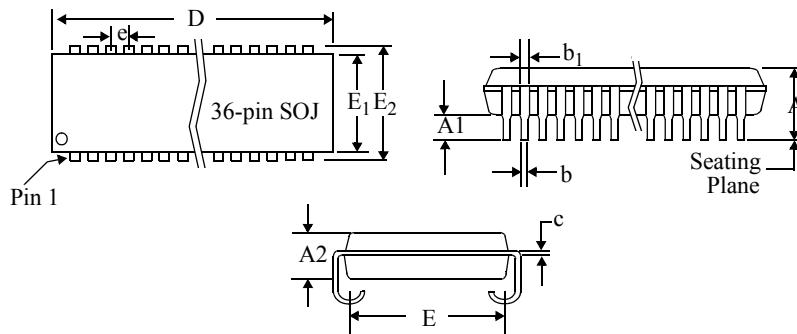
- 1 During  $V_{CC}$  power-up, a pull-up resistor to  $V_{CC}$  on  $\overline{\text{CE}}$  is required to meet  $I_{SB}$  specification.
- 2 For test conditions, see *AC Test Conditions*.
- 3  $t_{CLZ}$  and  $t_{CHZ}$  are specified with  $C_L = 5\text{pF}$  as in Figure B. Transition is measured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



## Package dimensions



	44-pin TSOP 2	
	Min(mm)	Max(mm)
<b>A</b>		1.2
<b>A<sub>1</sub></b>	0.05	0.15
<b>A<sub>2</sub></b>	0.95	1.05
<b>b</b>	0.30	0.45
<b>c</b>	0.12	0.21
<b>d</b>	18.31	18.52
<b>E<sub>1</sub></b>	10.06	10.26
<b>E</b>	11.68	11.94
<b>e</b>	0.80 (typical)	
<b>L</b>	0.40	0.60



	36-pin SOJ 400	
	Min(mils)	Max(mils)
<b>A</b>	0.128	0.148
<b>A<sub>1</sub></b>	0.025	—
<b>A<sub>2</sub></b>	0.105	0.115
<b>b</b>	0.015	0.020
<b>b<sub>1</sub></b>	0.026	0.032
<b>c</b>	0.007	0.013
<b>D</b>	.920	.930
<b>e</b>	0.045	0.055
<b>E</b>	0.370 BSC	
<b>E<sub>1</sub></b>	0.395	0.405
<b>E<sub>2</sub></b>	0.435	0.445



### Ordering codes

Package	Version	10 ns	12 ns	15 ns	20 ns
SOJ	Commercial	AS7C4096A-10JC	AS7C4096A-12JC	AS7C4096A-15JC	AS7C4096A-20JC
	Industrial	AS7C4096A-10JI	AS7C4096A-12JI	AS7C4096A-15JI	AS7C4096A-20JI
TSOP 2	Commercial	AS7C4096A-10TC	AS7C4096A-12TC	AS7C4096A-15TC	AS7C4096A-20TC
	Industrial	AS7C4096A-10TI	AS7C4096A-12TI	AS7C4096A-15TI	AS7C4096A-20TI

**Note:** Add suffix 'N' to the above part number for Lead Free Parts. (Ex: AS7C4096A - 10 TIN)

### Part numbering system

AS7C	4096A	-XX	J or T	X	X
SRAM prefix	Device number	Access time	Packages: J: SOJ 400 mil T: TSOP 2	Temperature ranges: C: Commercial, 0°C to 70°C I: Industrial, -40°C to 85°C	N=Lead Free Parts



**Revision History**

Rev. No.	History	Revised Date
v1.0	Initial release	11/08/04
v1.1	Included $I_{CC}$ , $I_{SB}$ & $I_{SB1}$ parameters	05/27/05
	Corrected the following: $T_{OE}$ , $V_{IH}$ , $V_{OL}$ & $t_{WZ}$	
v1.2	Removed the title "PRELIMINARY INFORMATION"	02/21/06



AS7C4096A



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