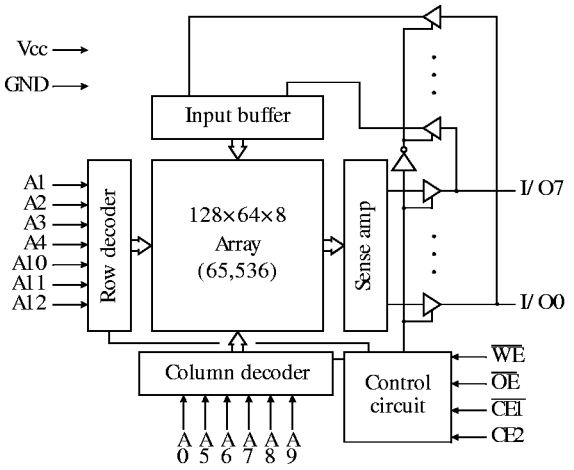
5V 8K×8 CMOS SRAM

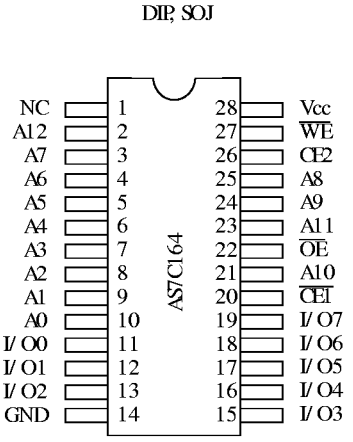
Features

- Organization: 8,192 words × 8 bits
- High speed
  - 8/ 10/ 12/ 15/ 20 ns address access time
  - 3/ 3/ 3/ 4/ 5 ns output enable access time
- Low power consumption
  - Active: 633 mW max (10 ns cycle)
  - Standby: 11 mW max, CMOS I/ O
- Very low DC component in active power
- 2.0V data retention
- Equal access and cycle times
- Very fast 3 ns output enable access time
- Easy memory expansion with $\overline{CE1}$, CE2, $\overline{OE}$ inputs
- TTL-compatible, three-state I/ O
- 28-pin JEDEC standard packages
- 300 mil PDIP and SOJ
- ESD protection ≥ 2000 volts
- Latch-up current ≥ 200 mA

Logic block diagram



Pin arrangement



Selection guide

	7C164-8	7C164-10	7C164-12	7C164-15	7C164-20	Unit
Maximum address access time	8	10	12	15	20	ns
Maximum output enable access time	3	3	3	4	5	ns
Maximum operating current	120	115	110	100	90	mA
Maximum CMOS standby current	2.0	2.0	2.0	2.0	2.0	mA

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Functional description

The AS7C164 is a high performance CMOS 65,536-bit Static Random Access Memory (SRAM) organized as 8,192 words × 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 8/ 10/ 12/ 15/ 20 ns with output enable access times (t_{OE}) of 3/ 3/ 3/ 4/ 5 ns are ideal for high performance applications. Active high and low chip enables ($\overline{CE1}$, CE2) permit easy memory expansion with multiple-bank memory systems.

When $\overline{CE1}$ is High or CE2 is Low the device enters standby mode. The standard AS7C164 is guaranteed not to exceed 11.0 mW power consumption in standby mode, and typically requires only 250 µW; it offers 2.0V data retention with maximum power of 120 µW.

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 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 5V supply. The AS7C164 is packaged in all high volume industry standard packages.

Absolute maximum ratings

Parameter	Symbol	Min	Max	Unit
Voltage on any pin relative to GND	V_t	–0.5	+7.0	V
Power dissipation	P_D	–	1.0	W
Storage temperature (plastic)	T_{stg}	–55	+150	°C
Temperature under bias	T_{bias}	–10	+85	°C
DC output current	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

$\overline{CE1}$	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
L	H	H	L	D_{out}	Read
L	H	L	X	D_{in}	Write

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

Recommended operating conditions

Applicable to all portions of this specification unless otherwise noted.

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage	V_{CC}	4.5	5.0	5.5	V
	GND	0.0	0.0	0.0	V
Input voltage	V_{IH}	2.2	–	V_{CC}+1	V
	V_{IL}	–0.5*	–	0.8	V
Ambient operating temperature	T_a	0	–	70	

* V_{IL} min = –3.0V for pulse width less than t_{RC}/ 2.

DC operating characteristics

			-8		-10		-12		-15		-20		
Parameter	Symbol	Test Conditions	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Unit
Input leakage current	$\|I_{LI}\|$	V_{CC} = Max, V_{in} = GND to V_{CC}	–	1	–	1	–	1	–	1	–	1	µA
Output leakage current	$\|I_{LO}\|$	$\overline{CE1}$ = V_{IH} *or* CE2 = V_{IL}, V_{CC} = Max, V_{out} = GND to V_{CC}	–	1	–	1	–	1	–	1	–	1	µA
Operating power supply current	I_{CC}	$\overline{CE1}$ = V_{IL}, CE2 = V_{IH}, $f = f_{max}$, I_{out} = 0 mA	–	120	–	115	–	110	–	100	–	90	mA
Standby power supply current	I_{SB}	$\overline{CE1}$ = V_{IH} *or* CE2 = V_{IL}, $f = f_{max}$	–	40	–	35	–	30	–	25	–	25	mA
	I_{SB1}	$\overline{CE1} \geq V_{CC}$–0.2V *or* CE2 ≤ 0.2V, $V_{in} \leq$ 0.2V *or* $V_{in} \geq V_{CC}$–0.2V, f = 0	–	2.0	–	2.0	–	2.0	–	2.0	–	2.0	mA
Output voltage	V_{OL}	I_{OL} = 8 mA, V_{CC} = Min	–	0.4	–	0.4	–	0.4	–	0.4	–	0.4	V
	V_{OH}	I_{OH} = –4 mA, V_{CC} = Min	2.4	–	2.4	–	2.4	–	2.4	–	2.4	–	V

Capacitance

f = 1 MHz, T_a = room temperature

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

Key to switching waveforms

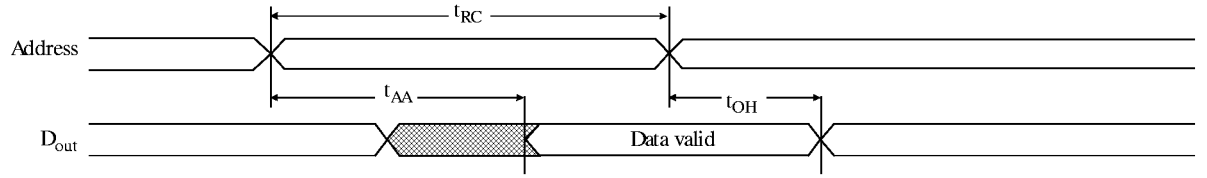
Rising input Falling input Undefined output/ don't care

Read cycle

		-8		-10		-12		-15		-20			
Parameter	Symbol	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Unit	Notes
Read cycle time	t_{RC}	8	–	10	–	12	–	15	–	20	–	ns	
Address access time	t_{AA}	–	8	–	10	–	12	–	15	–	20	ns	3
Chip enable ($\overline{CE1}$) access time	t_{ACE1}	–	8	–	10	–	12	–	15	–	20	ns	3, 12
Chip enable (CE2) access time	t_{ACE2}	–	8	–	10	–	12	–	15	–	20	ns	3, 12
Output enable ($\overline{OE}$) access time	t_{OE}	–	3	–	3	–	3	–	4	–	5	ns	
Output hold from address change	t_{OH}	3	–	3	–	3	–	3	–	3	–	ns	5
$\overline{CE1}$ Low to output in low Z	t_{CLZ1}	3	–	3	–	3	–	3	–	3	–	ns	4, 5, 12
CE2 High to output in low Z	t_{CLZ2}	3	–	3	–	3	–	3	–	3	–	ns	4, 5, 12
$\overline{CE1}$ High to output in high Z	t_{CHZ1}	–	3	–	3	–	3	–	4	–	5	ns	4, 5, 12
CE2 Low to output in high Z	t_{CHZ2}	–	3	–	3	–	3	–	4	–	5	ns	4, 5, 12
$\overline{OE}$ Low to output in low Z	t_{OLZ}	0	–	0	–	0	–	0	–	0	–	ns	4, 5
$\overline{OE}$ High to output in high Z	t_{OHZ}	–	3	–	3	–	3	–	4	–	5	ns	4, 5
Power up time	t_{PU}	0	–	0	–	0	–	0	–	0	–	ns	4, 5, 12
Power down time	t_{PD}	–	8	–	10	–	12	–	15	–	20	ns	4, 5, 12

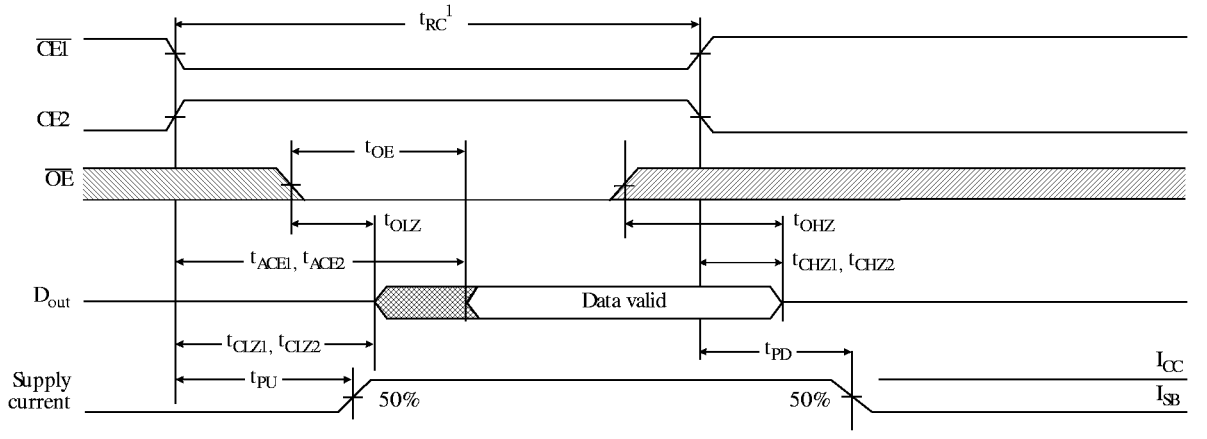
Read waveform 1 *3, 6, 7, 9, 12*

Address controlled



Read waveform 2 *3, 6, 8, 9, 12*

$\overline{CE1}$ and CE2 controlled

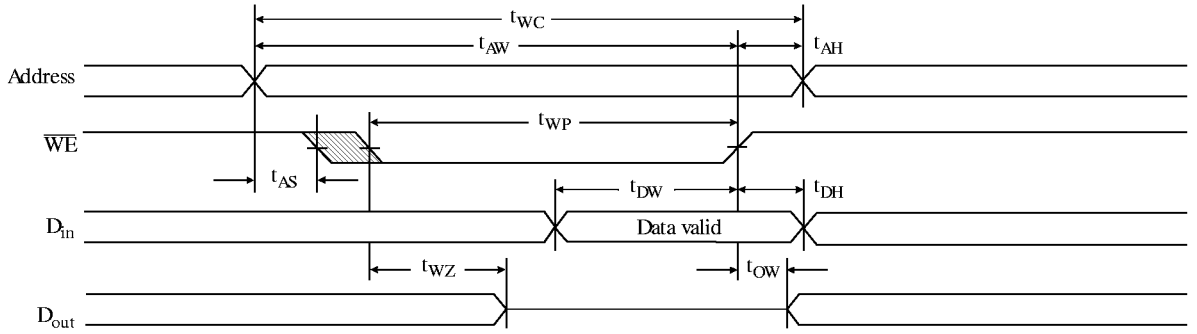


Write cycle

		-8		-10		-12		-15		-20			
Parameter	Symbol	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Unit	Notes
Write cycle time	t_{WC}	8	–	10	–	12	–	15	–	20	–	ns	
Chip enable ($\overline{CE1}$) to write end	t_{CW1}	7	–	8	–	9	–	10	–	12	–	ns	12
Chip enable (CE2) to write end	t_{CW2}	7	–	8	–	9	–	10	–	12	–	ns	12
Address setup to write end	t_{AW}	7	–	8	–	9	–	10	–	12	–	ns	
Address setup time	t_{AS}	0	–	0	–	0	–	0	–	0	–	ns	12
Write pulse width	t_{WP}	7	–	7	–	8	–	9	–	12	–	ns	
Address hold from write end	t_{AH}	0	–	0	–	0	–	0	–	0	–	ns	
Data valid to write end	t_{DW}	5	–	6	–	6	–	7	–	8	–	ns	
Data hold time	t_{DH}	0	–	0	–	0	–	0	–	0	–	ns	4, 5
Write enable to output in high Z	t_{WZ}	–	5	–	5	–	5	–	5	–	5	ns	4, 5
Output active from write end	t_{OW}	2	–	2	–	3	–	3	–	3	–	ns	4, 5

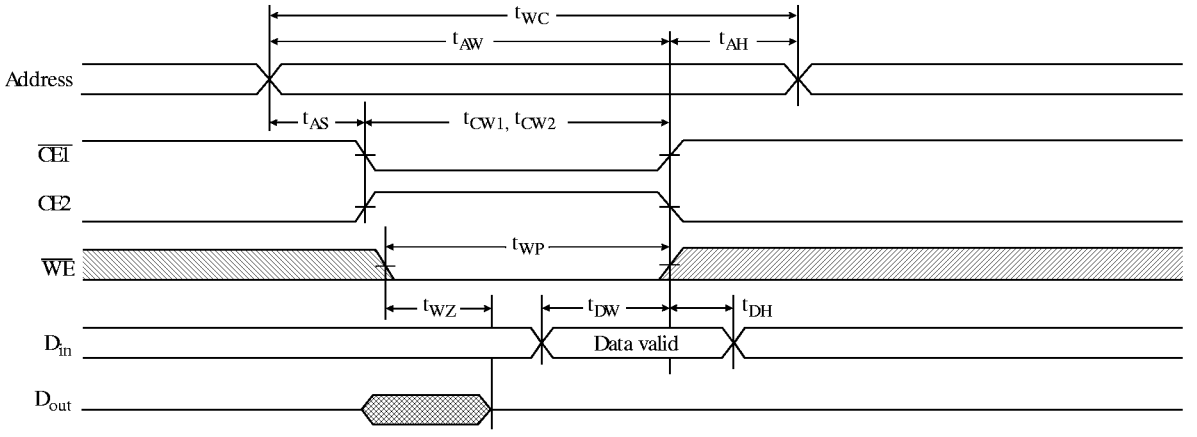
Write waveform 1 *10, 11, 12*

$\overline{WE}$ controlled



Write waveform 2 *10, 11, 12*

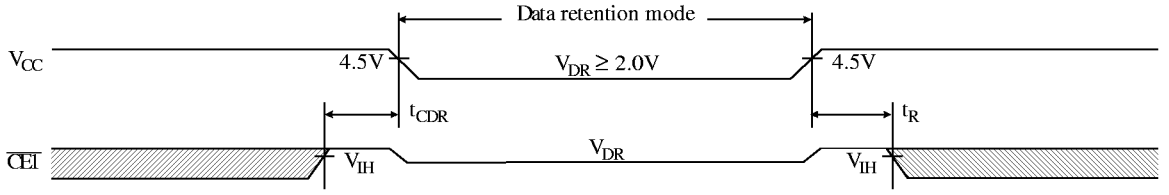
$\overline{CE1}$ and CE2 controlled



Data retention characteristics

Parameter	Symbol	Test conditions	Min	Max	Unit
V_{CC} for data retention	V_{DR}	V_{CC} = 2.0V $\overline{CE1} \geq V_{CC}-0.2V$ *or* CE2 ≤ 0.2V	2.0	–	V
Data retention current	I_{CCDR}		–	60	µA
Chip enable to data retention time	t_{CDR}		0	–	ns
Operation recovery time	t_R		t_{RC}	–	ns

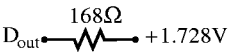
Data retention waveform



AC test conditions

- Output load: see Figure B, except for t_{CLZ} and t_{CHZ} see Figure C.
- Input pulse level: GND to 3.0V. See Figure A.
- Input rise and fall times: 5 ns. See Figure A.
- Input and output timing reference levels: 1.5V.

Thevenin equivalent:



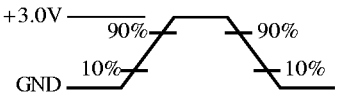


Figure A: Input waveform

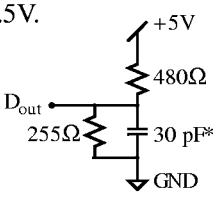
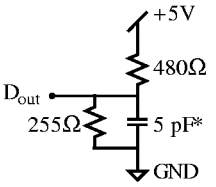


Figure B: Output load



*including scope and jig capacitance

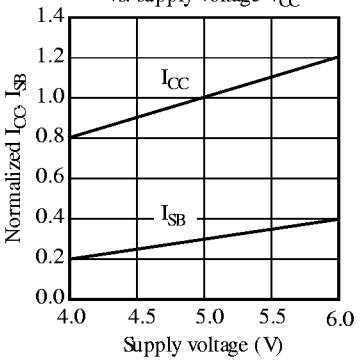
Figure C: Output load for t_{CLZ}, t_{CHZ}

Notes

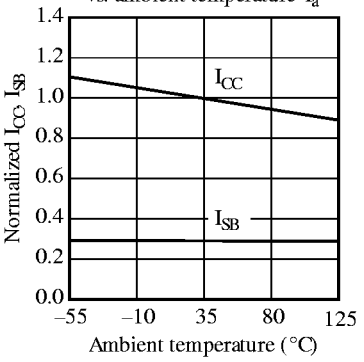
1 During V_{CC} power-up, a pull-up resistor to V_{CC} on $\overline{CE1}$ is required to meet I_{SB} specification.
2 This parameter is sampled and not 100% tested.
3 For test conditions, see *AC Test Conditions*, Figures A, B, C.
4 t_{CLZ} and t_{CHZ} are specified with CL = 5pF as in Figure C. Transition is measured ±500mV from steady-state voltage.
5 This parameter is guaranteed but not tested.
6 $\overline{WE}$ is High for read cycle.
7 $\overline{CE1}$ and $\overline{OE}$ are Low and CE2 is High for read cycle.
8 Address valid prior to or coincident with $\overline{CE1}$ transition Low and CE2 transition High.
9 All read cycle timings are referenced from the last valid address to the first transitioning address.
10 $\overline{CE1}$ or $\overline{WE}$ must be High or CE2 Low during address transitions.
11 All write cycle timings are referenced from the last valid address to the first transitioning address.
12 $\overline{CE1}$ and CE2 have identical timing.

Typical DC and AC characteristics

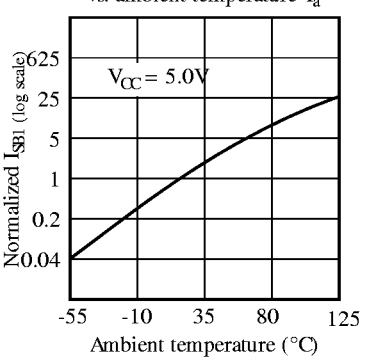
Normalized supply current I_{CC}, I_{SB} vs. supply voltage V_{CC}



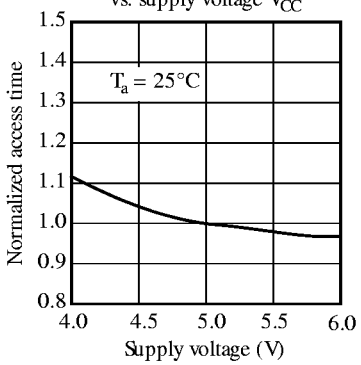
Normalized supply current I_{CC}, I_{SB} vs. ambient temperature T_a



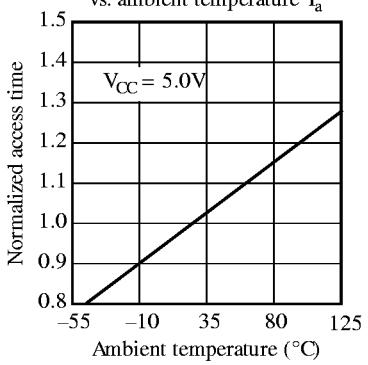
Normalized supply current I_{SB1} vs. ambient temperature T_a



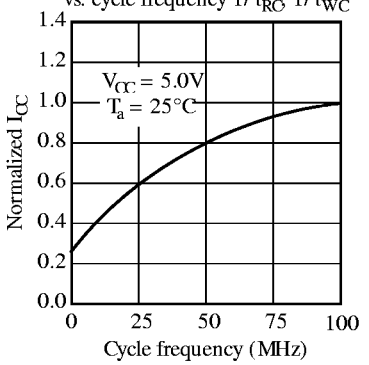
Normalized access time t_{AA} vs. supply voltage V_{CC}



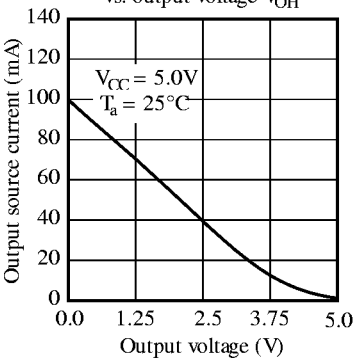
Normalized access time t_{AA} vs. ambient temperature T_a



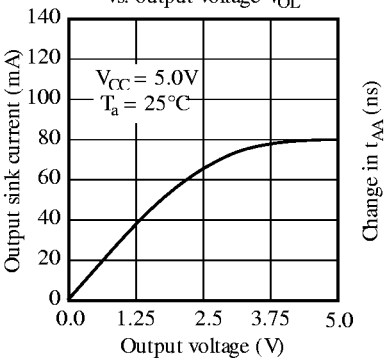
Normalized supply current I_{CC} vs. cycle frequency $1/t_{RC}$, $1/t_{WC}$



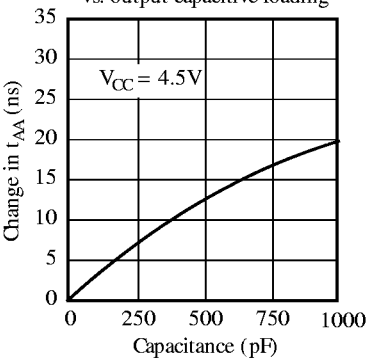
Output source current I_{OH} vs. output voltage V_{OH}



Output sink current I_{OL} vs. output voltage V_{OL}



Typical access time change Δt_{AA} vs. output capacitive loading



AS7C164 ordering codes

Package \ Access time	8 ns	10 ns	12 ns	15 ns	20 ns
Plastic DIP, 300 mil	-	AS7C164-10PC	AS7C164-12PC	AS7C164-15PC	AS7C164-20PC
Plastic SOJ, 300 mil	AS7C164-8JC	AS7C164-10JC	AS7C164-12JC	AS7C164-15JC	AS7C164-20JC

AS7C164 part numbering system

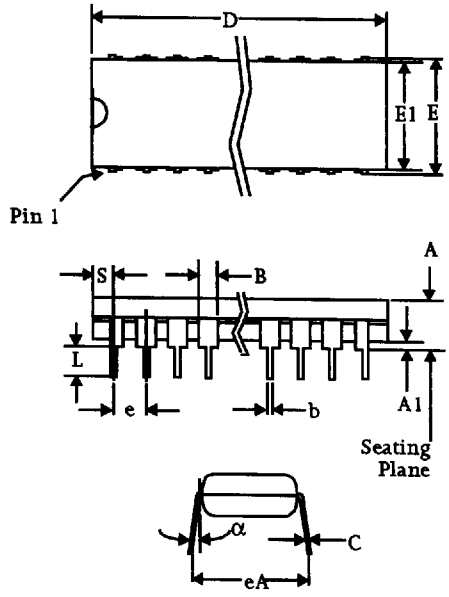
AS7C	164	X	–XX	X	C
SRAM prefix	Device number	Blank = Standard power	Access time	Package code: P = PDIP 300 mil J = SOJ 300 mil	Commercial temperature range, 0°C to 70 °C

Package diagrams

Plastic dual in-line package (PDIP)

	20-pin 300 mil		28-pin 300 mil		32-pin 300 mil		32-pin 400 mil	
	Min	Max	Min	Max	Min	Max	Min	Max
A	-	0.175	-	0.175	-	0.180	-	0.200
A1	0.010	-	0.010	-	0.015	-	0.015	-
B	0.046	0.054	0.058	0.064	0.045	0.055	0.045	0.065
b	0.018	0.024	0.016	0.022	0.015	0.021	0.014	0.022
C	0.008	0.014	0.008	0.014	0.008	0.012	0.009	0.015
D	-	0.980	-	1.400	-	1.571	-	1.620
E	0.290	0.310	0.295	0.320	0.300	0.325	0.390	0.425
E1	0.263	0.293	0.278	0.298	0.280	0.295	0.340	0.390
e	0.100 BSC		0.100 BSC		0.100 BSC		0.100 BSC	
eA	0.310	0.350	0.330	0.370	0.330	0.370	0.430	0.470
L	0.110	0.130	0.120	0.140	0.110	0.142	0.118	0.162
α	0°	15°	0°	15°	0°	15°	0°	15°
S	-	0.040	-	0.055	-	0.043	-	0.065

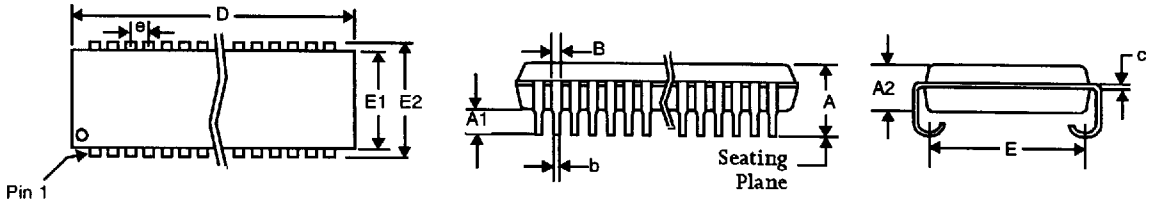
Dimensions in inches



Plastic small outline J-bend (SOJ)

	20/26-pin 300 mil		28-pin 300 mil		32-pin 300 mil		28-pin 400 mil		32-pin 400 mil		36-pin 400 mil		40-pin 400 mil		42-pin 400 mil		44-pin 400 mil	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
A	-	0.140	-	0.140	-	0.145	0.132	0.146	-	0.145	-	-	-	0.145	0.128	0.148	0.128	0.148
A1	0.020	-	0.025	-	0.025	-	0.062	-	0.025	-	-	-	0.025	-	0.025	-	0.025	-
A2	0.095	0.105	0.095	0.105	0.086	0.105	0.105	115	0.086	0.115	0.102 NOM		0.086	0.115	1.105	1.115	1.105	1.115
B	0.025	0.032	0.028 TYP		0.026	0.032	0.024	0.032	0.026	0.032	-	0.032	0.026	0.032	0.026	0.032	0.026	0.032
b	0.016	0.022	0.018 TYP		0.014	0.020	0.013	0.021	0.015	0.020	0.013	0.021	0.015	0.022	0.015	0.020	0.015	0.020
c	0.008	0.014	0.010 TYP		0.006	0.013	0.005	0.012	0.007	0.013	-	-	0.007	0.014	0.007	0.013	0.007	0.013
D	-	0.686	-	0.730	0.820	0.830	0.720	0.729	0.820	0.830	0.920	0.930	1.015	1.035	1.070	1.080	1.120	1.130
E	0.327	0.347	0.327	0.347	0.330	0.340	0.430	0.440	0.435	0.445	0.350	0.390	0.435	0.445	0.370 NOM		0.370 NOM	
E1	0.295	0.305	0.295	0.305	0.292	0.305	0.395	0.405	0.395	0.405	0.400 NOM		0.395	0.405	0.395	0.405	0.395	0.405
E2	0.245	0.285	0.245	0.285	0.250	0.275	0.354	0.378	0.360	0.380	0.435	0.445	0.348	0.390	0.435	0.445	0.435	0.445
e	0.050 BSC		0.050 BSC		0.050 BSC		0.050 BSC		0.050 BSC		0.045	0.055	0.050 BSC		0.050 NOM		0.050 NOM	

Dimensions in inches



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