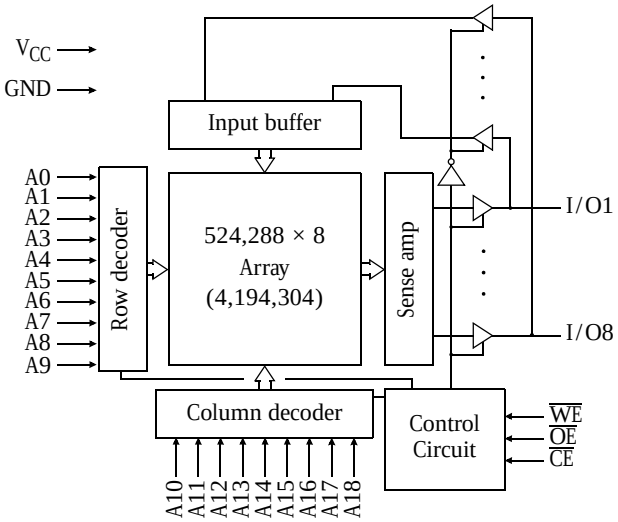
AS7C4096
AS7C34096

5V/3.3V 512K × 8 CMOS SRAM

Features

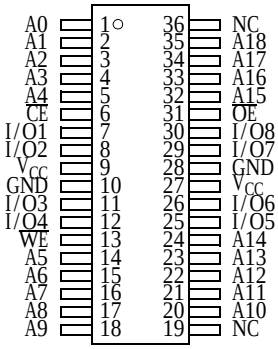
- AS7C4096 (5V version)
- AS7C34096 (3.3V version)
- Industrial and commercial temperature
- Organization: 524,288 words × 8 bits
- Center power and ground pins
- High speed
  - 10/12/15/20 ns address access time
  - 5/6/7/8 ns output enable access time
- Low power consumption: ACTIVE
  - 1375 mW (AS7C4096) / max @ 12 ns
  - 468 mW (AS7C34096) / max @ 12 ns
- Low power consumption: STANDBY
  - 110 mW (AS7C4096) / max CMOS
  - 72 mW (AS7C34096) / 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

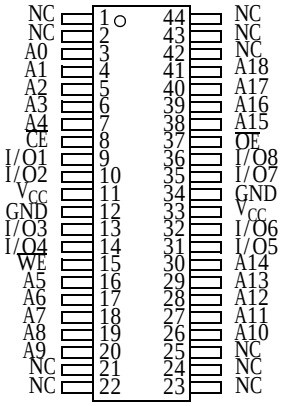


Pin arrangements

36-pin SOJ (400 mil)



44-pin TSOP 2



48-pin BGA Package

	1	2	3	4	5	6
A	A_0	A_1	NC	A_3	A_6	A_8
B	I/O_5	A_2	$\overline{WE}$	A_4	A_7	I/O_1
C	I/O_6	NC	NC	A_5	NC	I/O_2
D	V_{SS}	NC	NC	NC	NC	V_{CC}
E	V_{CC}	NC	NC	NC	NC	V_{SS}
F	I/O_7	NC	A_{18}	A_{17}	NC	I/O_3
G	I/O_8	$\overline{OE}$	$\overline{CE}$	A_{16}	A_{15}	I/O_4
H	A_9	A_{10}	A_{11}	A_{12}	A_{13}	A_{14}

Selection guide

		–10	–12	–15	–20	Unit
Maximum address access time		10	12	15	20	ns
Maximum outputenable access time		5	6	7	9	ns
Maximum operating current	AS7C4096	–	250	220	180	mA
	AS7C34096	160	130	110	100	mA
Maximum CMOS standby current	AS7C4096	–	20	20	20	mA
	AS7C34096	20	20	20	20	mA

Functional description

The AS7C4096 and AS7C34096 are high-performance CMOS 4,194,304-bit Static Random Access Memory (SRAM) devices organized as 524,288 words × 8 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. 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 AS7C4096 is guaranteed not to exceed 110 mW 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 supply voltage. Both devices are available in the industry standard 400-mil 36-pin SOJ and 44-pin TSOP 2 packages.

Absolute maximum ratings

Parameter	Device	Symbol	Min	Max	Unit
Voltage on V_{CC} relative to GND	AS7C4096	V_{t1}	–1	+7.0	V
	AS7C34096	V_{t1}	–0.5	+5.0	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 unto 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})

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

Recommended operating condition

Parameter		Device	Symbol	Min	Nominal	Max	Unit
Supply voltage		AS7C4096	V_{CC}(12/15/20)	4.5	5.0	5.5	V
		AS7C34096	V_{CC} (10)	3.15	3.30	3.6	V
		AS7C34096	V_{CC}(12/15/20)	3.0	3.3	3.6	V
Input voltage		AS7C4096	V_{IH}	2.2	–	V_{CC} + 0.5	V
		AS7C34096	V_{IH}	2.0	–	V_{CC} + 0.5	V
			V_{IL}	–0.5[1]	–	0.8	V
Ambient operating temperature	commercial		T_A	0	–	70	°C
	industrial		T_A	–40	–	85	°C

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

DC operating characteristics (over the operating range)[1]

Parameter	Symbol	Test conditions	Device	–10		–12		–15		–20		Unit
				Min	Max	Min	Max	Min	Max	Min	Max	
Input leakage current	$\|I_{LI}\|$	V_{CC} = Max, V_{IN} = GND to V_{CC}		–	1	–	1	–	1	–	1	µA
Output leakage current	$\|I_{LO}\|$	V_{CC} = Max, $\overline{CE}$ = V_{IH} V_{OUT}= GND to V_{CC}		–	1	–	1	–	1	–	1	µA
Operating power supply current	I_{CC}	V_{CC} = Max, $\overline{CE}$ < V_{IL} f = f_{Max}, I_{OUT} = 0mA	AS7C4096	–	–	–	250	–	220	–	180	mA
			AS7C34096	–	160	–	130	–	110	–	100	
Standby power supply current	I_{SB}	V_{CC} = Max, $\overline{CE}$ = V_{IH} f = f_{Max}, I_{OUT} = 0mA	AS7C4096	–	–	–	60	–	60	–	60	mA
			AS7C34096	–	60	–	60	–	60	–	60	
	I_{SB1}	V_{CC} = Max, $\overline{CE}$ ≥ V_{CC} – 0.2V, V_{IN} ≤ 0.2V or V_{IN} ≥ V_{CC} – 0.2V, f = 0	AS7C4096	–	–	–	20	–	20	–	20	mA
			AS7C34096	–	20	–	20	–	20	–	20	
Output voltage	V_{OL}	I_{OL} = 8 mA, V_{CC} = Min		–	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	–	V

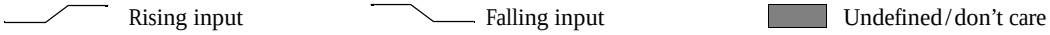
Capacitance (f = 1MHz, T_a = 25° C, V_{CC} = NOMINAL)[2]

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

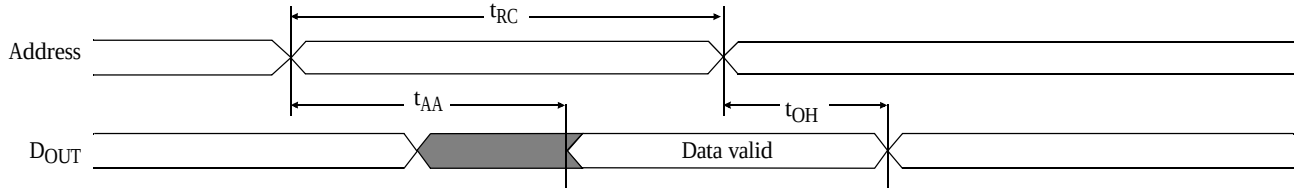
Read cycle (over the operating range)[3,9]

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

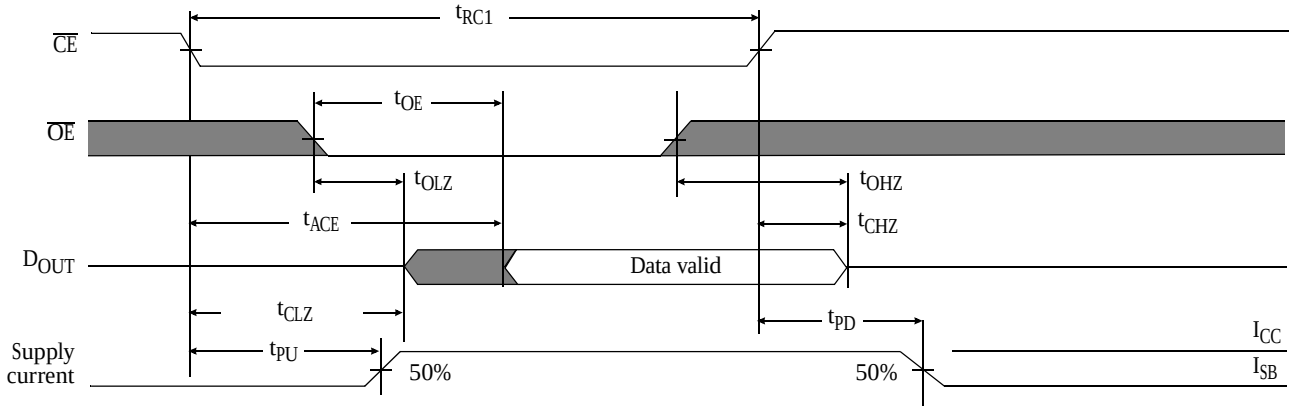
Key to switching waveforms



Read waveform 1 (address controlled)[3,6,7,9]



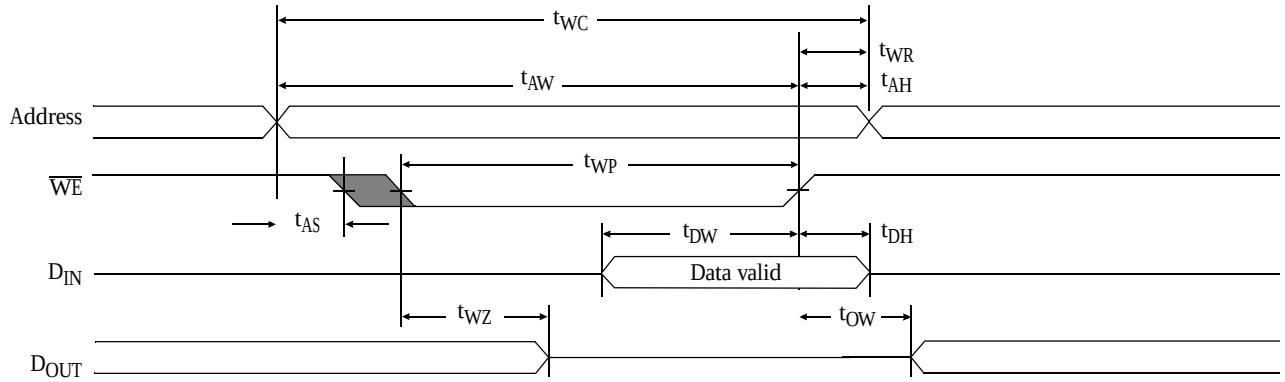
Read waveform 2 ($\overline{CE}$, $\overline{OE}$ controlled)[3,6,8,9]



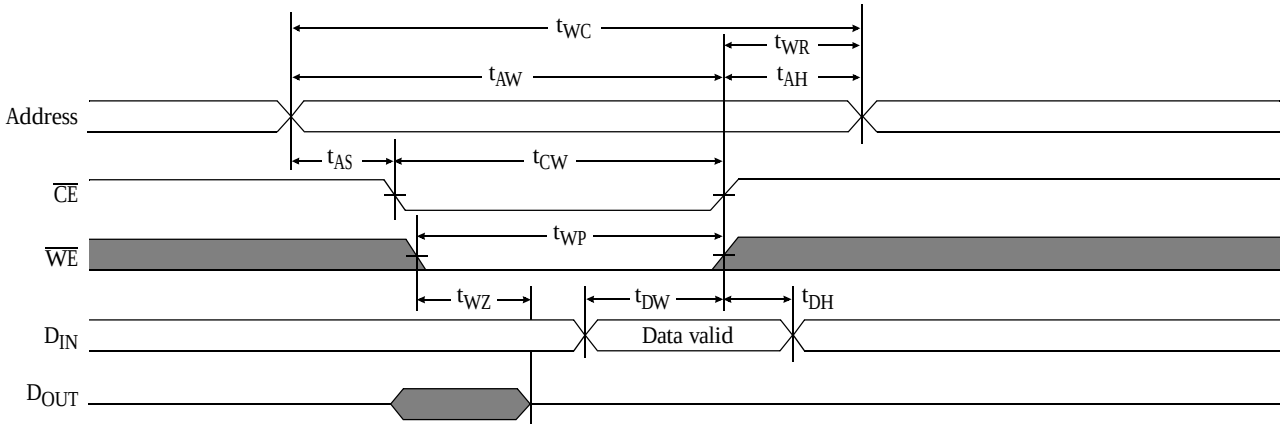
Write cycle (over the operating range)[11]

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 ($\overline{OE}$ = high)	t_{WP1}	7	–	8	–	10	–	12	–	ns	
Write pulse width ($\overline{OE}$ = 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	4, 5
Write enable to output in high Z	t_{WZ}	0	5	0	6	0	7	0	9	ns	4, 5
Output active from write end	t_{OW}	3	–	3	–	3	–	3	–	ns	4, 5

Write waveform 1 ($\overline{WE}$ controlled)[10,11]



Write waveform 2 ($\overline{CE}$ controlled)[10,11]



AC test conditions

- Output load: see Figure B or Figure C.
- Input pulse level: GND to 3.0V. See Figures A, B, and C.
- Input rise and fall times: 2 ns. See Figure A.
- Input and output timing reference levels: 1.5V.

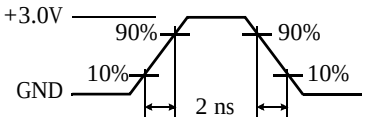


Figure A: Input pulse

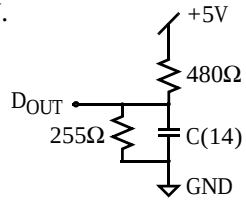
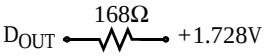


Figure B: 5V Output load

Thevenin equivalent:



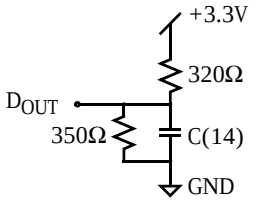


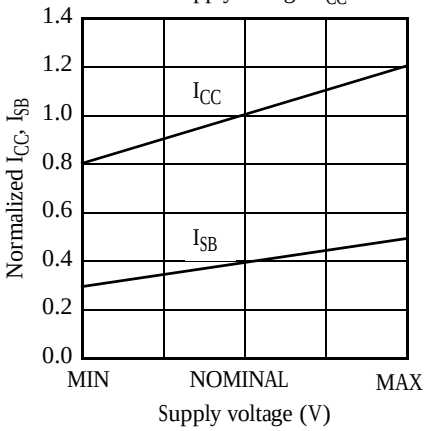
Figure C: 3.3V Output load

Notes

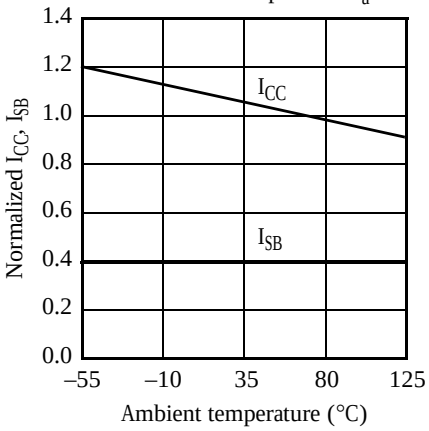
1 During V_{CC} power-up, a pull-up resistor to V_{CC} on $\overline{CE}$ is required to meet I_{SB} specification.
2 This parameter is sampled, but not 100% tested.
3 For test conditions, see *AC Test Conditions.*
4 t_{CLZ} and t_{CHZ} are specified with C_L = 5pF as in Figure C. Transition is measured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

Typical DC and AC characteristics [12]

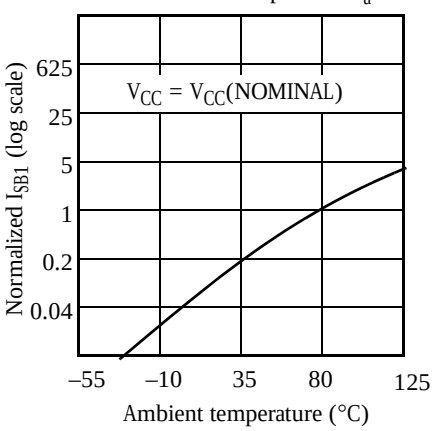
Normalized supply current I_{CC}, I_{SB} vs. supply voltage V_{CC}



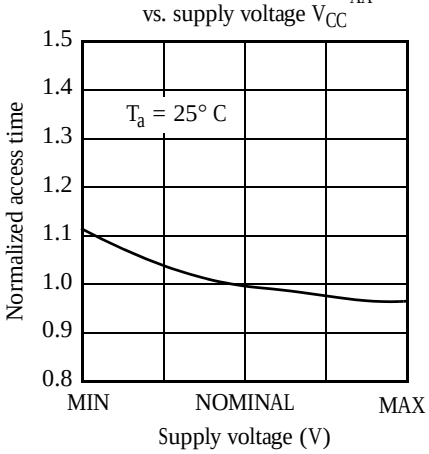
Normalized supply current I_{CC}, I_{SB} vs. ambient temperature T_a



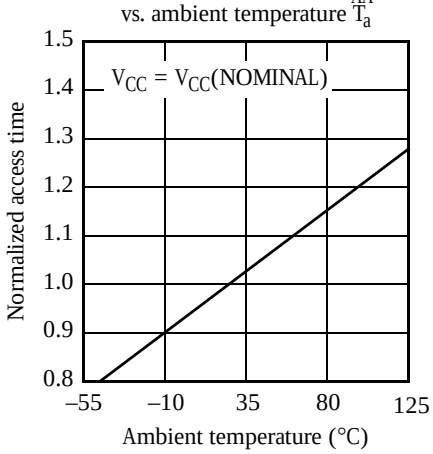
Normalized supply current I_{SB1} vs. ambient temperature T_a



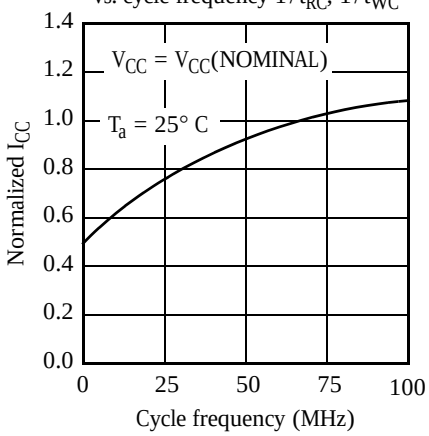
Normalized access time t_{AA} vs. supply voltage V_{CC}



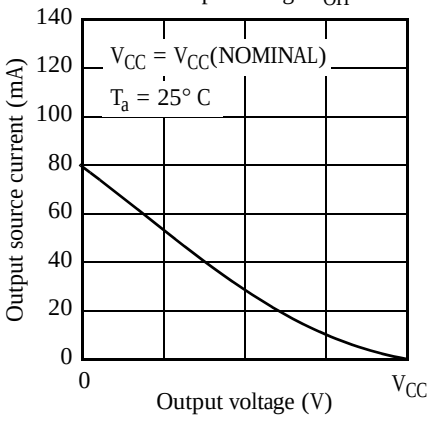
Normalized access time t_{AA} vs. ambient temperature T_a



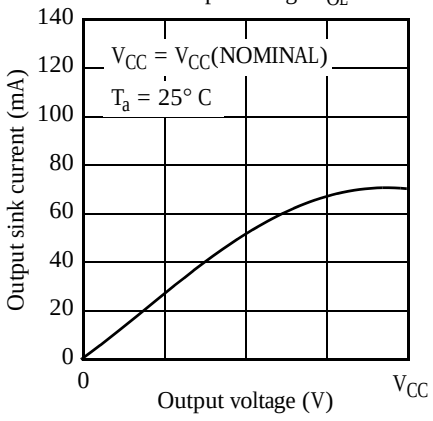
Normalized supply current I_{CC} vs. cycle frequency $1/t_{RC}$, $1/t_{WC}$



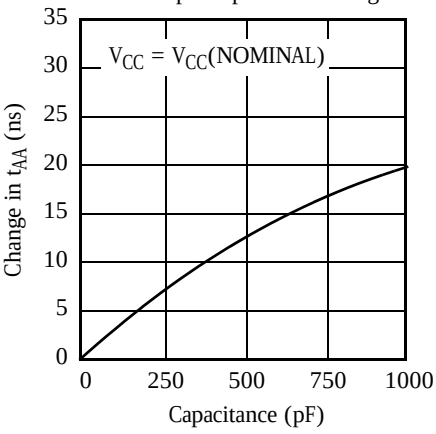
Output source current I_{OH} vs. output voltage V_{OH}



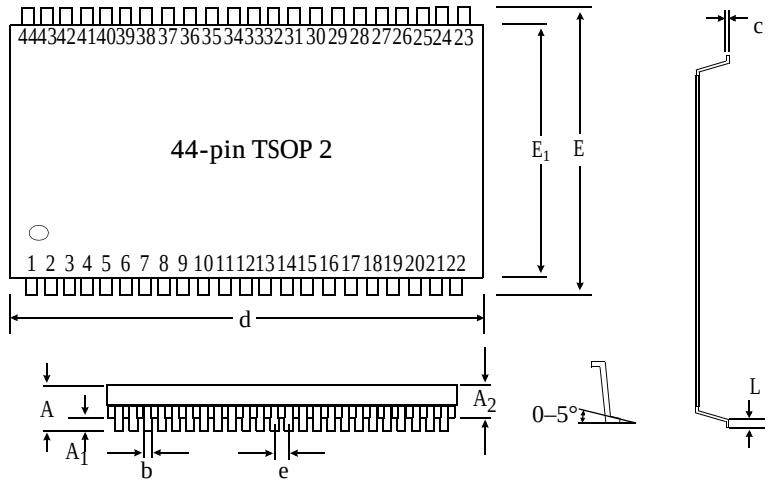
Output sink current I_{OL} vs. output voltage V_{OL}



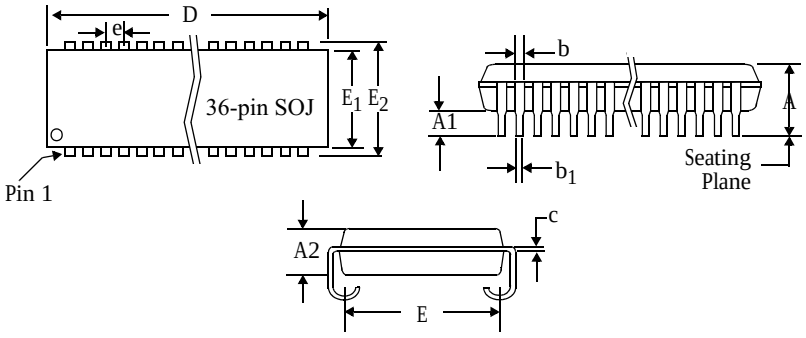
Typical access time change Δt_{AA} vs. output capacitive loading



Package dimensions

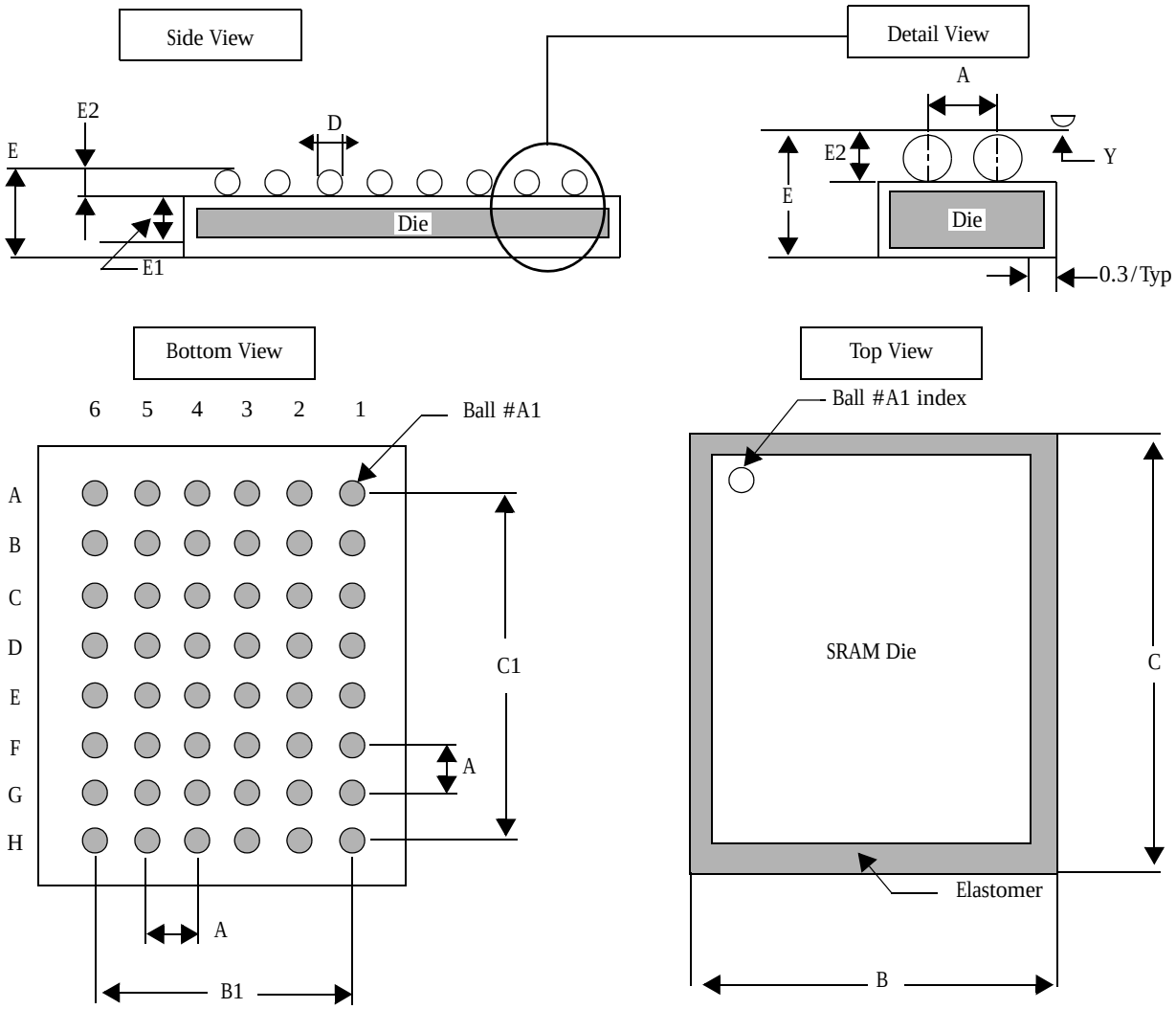


	44-pin TSOP 2	
	Min(mm)	Max(mm)
A		1.2
A_1	0.05	0.15
A_2	0.95	1.05
b	0.30	0.45
c	0.15 (typical)	
d	18.28	18.54
E_1	10.03	10.16
E	11.56	11.96
e	0.80 (typical)	
L	0.40	0.60



	36-pin SOJ 400	
	Min(mils)	Max(mils)
A	.128	0.148
A_1	0.027	–
A_2	0.102 NOM	
b	0.015	0.020
b_1	0.026	0.032
c	0.007	0.013
D	.920	.930
e	0.045	0.055
E	0.400 NOM	
E	0.435	0.445

48-ball FBGA



Notes

1. Bump counts: 48 (8 row × 6 column).
2. Pitch: (x,y) = 0.75 mm × 0.75 mm (typ).
3. Units: millimeters.
4. All tolerance are ±0.050 unless otherwise specified.
5. Typ: typical.
6. Y is coplanarity: 0.08 (max).

48-ball FBGA			
	Minimum	Typical	Maximum
A	–	0.75	–
B	6.90	7.00	7.10
B1	–	3.75	–
C	10.90	11.00	11.10
C1	–	5.25	–
D	0.30	0.35	0.40
E	–	–	1.20
E1	–	0.68	–
E2	0.22	0.25	0.27
Y	–	–	0.08

Ordering codes

Package	Version	10 ns	12 ns	15 ns	20 ns
SOJ	5V commercial	NA	AS7C4096-12JC	AS7C4096-15JC	AS7C4096-20JC
	5V industrial	NA	AS7C4096-12JI	AS7C4096-15JI	AS7C4096-20JI
	3.3V commercial	AS7C34096-10JC	AS7C34096-12JC	AS7C34096-15JC	AS7C34096-20JC
	3.3V industrial	NA	AS7C34096-12JI	AS7C34096-15JI	AS7C34096-20JI
TSOP 2	5V commercial	NA	AS7C4096-12TC	AS7C4096-15TC	AS7C4096-20TC
	5V industrial	NA	AS7C4096-12TI	AS7C4096-15TI	AS7C4096-20TI
	3.3V commercial	AS7C34096-10TC	AS7C34096-12TC	AS7C34096-15TC	AS7C34096-20TC
	3.3V industrial	NA	AS7C34096-12TI	AS7C34096-15TI	AS7C34096-20TI
BGA	5V commercial	NA	AS7C4096-12BC	AS7C4096-15BC	AS7C4096-20BC
	5V industrial	NA	AS7C4096-12BI	AS7C4096-15BI	AS7C4096-20BI
	3.3V commercial	AS7C34096-10BC	AS7C34096-12BC	AS7C34096-15BC	AS7C34096-20BC
	3.3V industrial	NA	AS7C34096-12BI	AS7C34096-15BI	AS7C34096-20BI

Part numbering system

AS7C	X	4096	–XX	J, T, or B	X
SRAM prefix	Voltage: Blank: 5V CMOS 3: 3.3V CMOS	Device number	Access time	Packages: J: SOJ 400 mil T: TSOP 2 B: 48-ball FBGA 7x11 mm	Temperature ranges: C: Commercial, 0°C to 70°C I: Industrial, –40°C to 85°C