P4C1048L
LOW POWER 512K x 8
CMOS STATIC RAM

FEATURES

- **V_{CC} Current**
  - **— Operating: 35mA**
  - **— CMOS Standby: 100µA**
- **Access Times**
  - **—45/55/70/100 ns**
- **Single 5 Volts ±10% Power Supply**
- **Easy Memory Expansion Using $\overline{CE}$ and $\overline{OE}$ Inputs**
- **Common Data I/O**
- **Three-State Outputs**
- **Fully TTL Compatible Inputs and Outputs**
- **Advanced CMOS Technology**
- **Automatic Power Down**
- **Packages**
  - **—32-Pin 600 mil Plastic and Ceramic DIP**
  - **—32-Pin 445 mil SOP**
  - **—32-Pin TSOP II**

DESCRIPTION

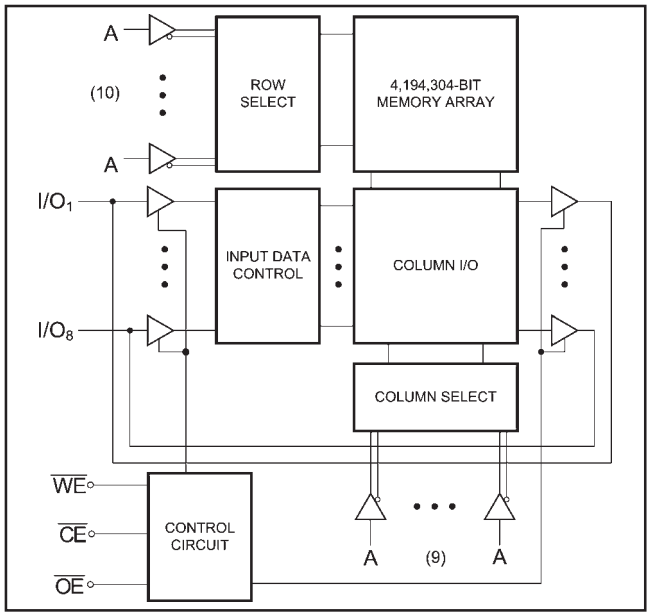
The P4C1048L is a 4 Megabit low power CMOS static RAM organized as 512K x 8. The CMOS memory requires no clocks or refreshing, and has equal access and cycle times. Inputs are fully TTL-compatible. The RAM operates from a single 5V±10% tolerance power supply.

Access times as fast as 45 ns are availale. CMOS is utilized to reduce power consumption to a low level.

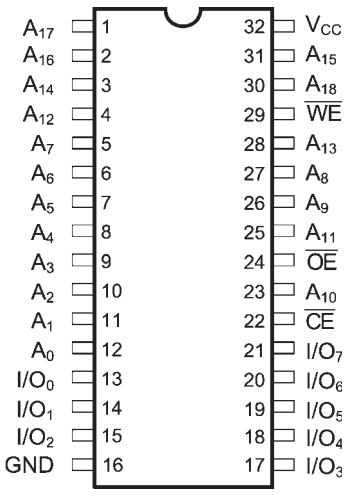
The P4C1048L device provides asynchronous operation with matching access and cycle times. Memory locations are specified on address pins A_0 to A_{18}. Reading is accomplished by device selection ($\overline{CE}$ low) and output enabling ($\overline{OE}$) while write enable ($\overline{WE}$) remains HIGH. By presenting the address under these conditions, the data in the addressed memory location is presented on the data input/output pins. The input/output pins stay in the HIGH Z state when either $\overline{CE}$ is HIGH or $\overline{WE}$ is LOW.

The P4C1048L is packaged in a 32-pin 445 mil plastic SOP, 32-pin TSOP II, or 600 mil plastic or ceramic side-brazed DIP.

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION



DIP (P600, C10),
SOP (S12), TSOP II (T4)
TOP VIEW

RECOMMENDED OPERATING TEMPERATURE & SUPPLY VOLTAGE

Temperature Range (Ambient)	Supply Voltage
Commercial (0°C to 70°C)	$4.5V \le V_{CC} \le 5.5V$
Industrial (-40°C to 85°C)	$4.5V \le V_{CC} \le 5.5V$
Military (-55°C to 125°C)	$4.5V \le V_{CC} \le 5.5V$

MAXIMUM RATINGS[(a)]

Stresses greater than those listed can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this data sheet. Exposure to Maximum Ratings for extended periods can adversely affect device reliability.

Symbol	Parameter	Min	Max	Unit
V_{CC}	Supply Voltage with Respect to GND	-0.5	7.0	V
V_{TERM}	Terminal Voltage with Respect to GND (up to 7.0V)	-0.5	V_{CC} + 0.5	V
T_A	Operating Ambient Temperature	-55	125	°C
S_{TG}	Storage Temperature	-65	150	°C
I_{OUT}	Output Current into Low Outputs		25	mA
I_{LAT}	Latch-up Current	>200		mA

CAPACITANCES[(d)]

(V_{CC} = 5.0V, T_A = 25°C, f = 1.0 MHz)

Symbol	Parameter	Test Conditions	Max	Unit
C_{IN}	Input Capacitance	V_{IN} = 0V	6	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0V	8	pF

POWER DISSIPATION CHARACTERISTICS VS. SPEED

Symbol	Parameter	Temperature Range	*				Unit
			-45	-55	-70	-100	
I_{CC}	Dynamic Operating Current	Commercial	20	20	20	20	mA
		Industrial	25	25	25	25	
		Military	35	35	35	35	

*****Tested with outputs open and all address and data inputs changing at the maximum write-cycle rate. The device is continuously enabled for writing, i.e. $\overline{CE}$ and $\overline{WE} \le V_{IL}$ (max), $\overline{OE}$ is high. Switching inputs are 0V and 3V.

Notes:

a. Stresses greater than those listed under 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 above those indicated in the operational sections of this specification is not implied. Exposure to MAXIMUM rating conditions for extended periods may affect reliability.

b. Extended temperature operation guaranteed with 400 linear feet per minute of air flow.

c. Transient inputs with V_{IL} and I_{IL} not more negative than –3.0V and –100mA, respectively, are permissible for pulse widths up to 20 ns.

d. This parameter is sampled and not 100% tested.

DC ELECTRICAL CHARACTERISTICS

(Over Recommended Operating Temperature & Supply Voltage)[b]

Symbol	Parameter	Test Conditions		P4C1048L Min	P4C1048L Max	Unit
V_{IH}	Input High Voltage			2.2	V_{CC} +0.5	V
V_{IL}	Input Low Voltage			–0.5[c]	0.8	V
V_{HC}	CMOS Input High Voltage			V_{CC} –0.2	V_{CC} +0.5	V
V_{LC}	CMOS Input Low Voltage			–0.5[c]	0.2	V
V_{OL}	Output Low Voltage (TTL Load)	I_{OL} = +2.1 mA, V_{CC} = Min.			0.4	V
V_{OH}	Output High Voltage (TTL Load)	I_{OH} = –1 mA, V_{CC} = Min.		2.4		V
I_{LI}	Input Leakage Current	V_{CC} = Max. V_{IN} = GND to V_{CC}	Mil. Ind./Com'l.	–10 –5	+10 +5	µA
I_{LO}	Output Leakage Current	V_{CC} = Max., $\overline{CE}$ = V_{IH}, V_{OUT} = GND to V_{CC}	Mil. Ind./Com'l.	–10 –5	+10 +5	µA
I_{SB}	Standby Power Supply Current (TTL Input Levels)	$\overline{CE} \geq V_{IH}$ V_{CC}= Max, f = Max., Outputs Open	Mil. Ind./Com'l.	—— ——	5 3	mA
I_{SB1}	Standby Power Supply Current (CMOS Input Levels)	$\overline{CE} \geq V_{HC}$ V_{CC}= Max, f = 0, Outputs Open $V_{IN} \leq V_{LC}$ or $V_{IN} \geq V_{HC}$	Mil. Ind./Com'l.	—— ——	100 30	µA

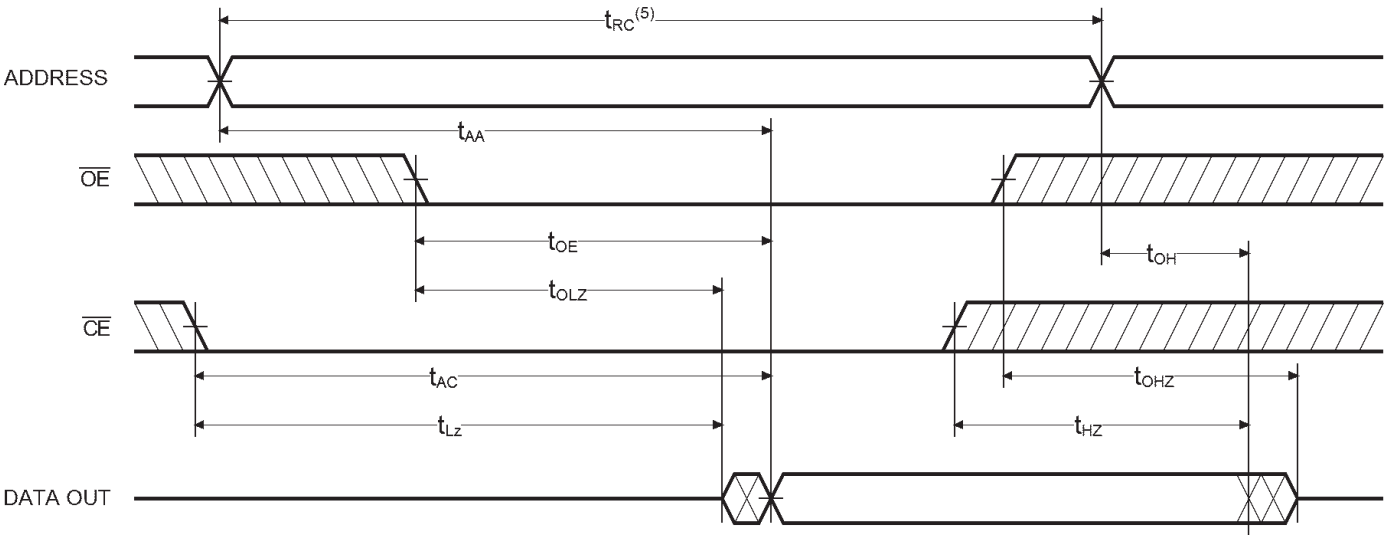
N/A = Not Applicable

AC ELECTRICAL CHARACTERISTICS - READ CYCLE

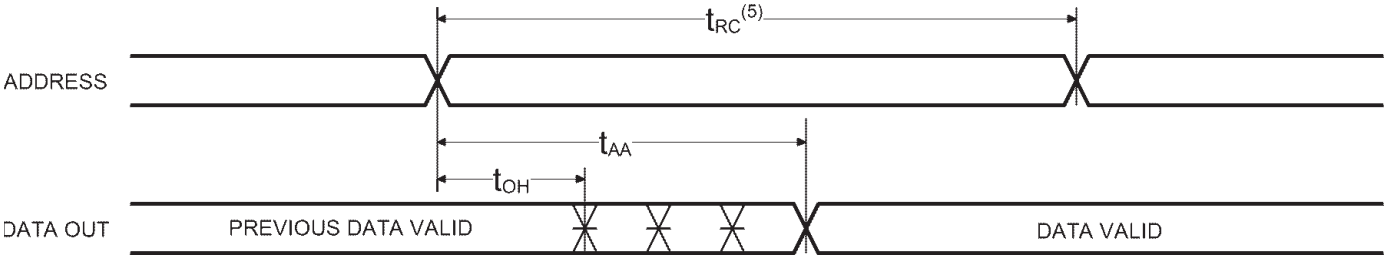
(Over Recommended Operating Temperature & Supply Voltage)

Symbol	Parameter	-45		-55		-70		-100		Unit
		Min	Max	Min	Max	Min	Max	Min	Max	
t_{RC}	Read Cycle Time	45		55		70		100		ns
t_{AA}	Address Access Time		45		55		70		100	ns
t_{AC}	Chip Enable Access Time		45		55		70		100	ns
t_{OH}	Output Hold from Address Change	5		5		5		5		ns
t_{LZ}	Chip Enable to Output in Low Z	10		10		10		10		ns
t_{HZ}	Chip Disable to Output in High Z		18		20		25		35	ns
t_{OE}	Output Enable Low to Data Valid		22		25		35		45	ns
t_{OLZ}	Output Enable Low to Low Z	5		5		5		5		ns
t_{OHZ}	Output Enable High to High Z		18		20		25		35	ns
t_{PU}	Chip Enable to Power Up Time	0		0		0		0		ns
t_{PD}	Chip Disable to Power Down Time		45		55		70		100	ns

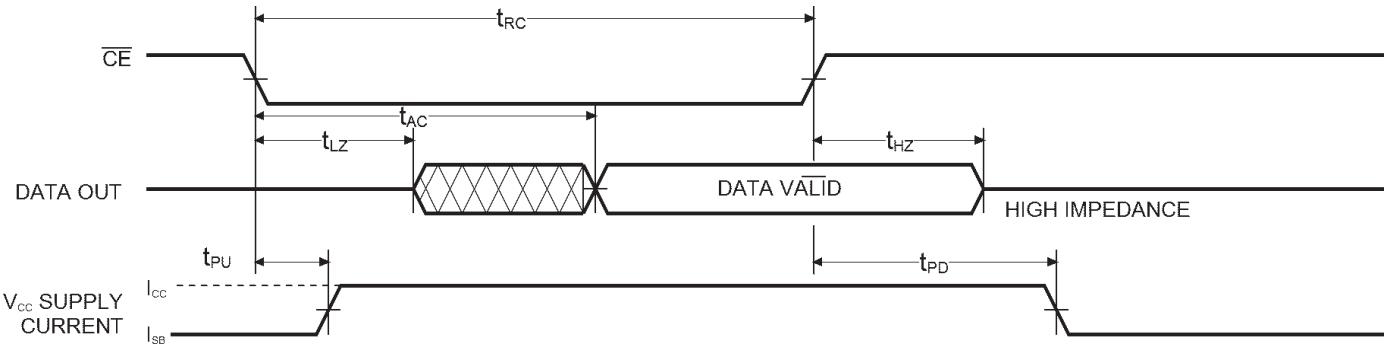
READ CYCLE NO. 1 ($\overline{OE}$ CONTROLLED)[1]



READ CYCLE NO. 2 (ADDRESS CONTROLLED)



READ CYCLE NO. 3 ($\overline{CE}$ CONTROLLED)



Notes:

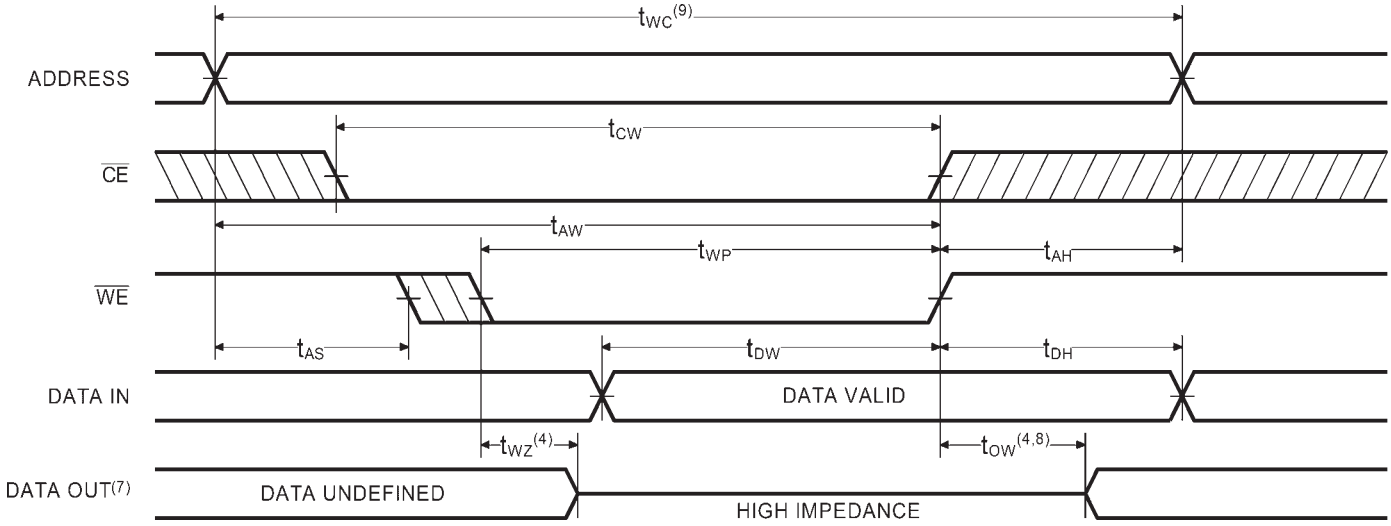
1. $\overline{WE}$ is HIGH for READ cycle.
2. $\overline{CE}$ and $\overline{OE}$ are LOW for READ cycle.
3. ADDRESS must be valid prior to, or coincident with later of $\overline{CE}$ transition LOW.
4. Transition is measured ± 200 mV from steady state voltage prior to change, with loading as specified in Figure 1. This parameter is sampled and not 100% tested.
5. READ Cycle Time is measured from the last valid address to the first transitioning address.

AC CHARACTERISTICS - WRITE CYCLE

(Over Recommended Operating Temperature & Supply Voltage)

Symbol	Parameter	-45		-55		-70		-100		Unit
		Min	Max	Min	Max	Min	Max	Min	Max	
t_{WC}	Write Cycle Time	45		55		70		100		ns
t_{CW}	Chip Enable Time to End of Write	35		40		60		75		ns
t_{AW}	Address Valid to End of Write	35		40		60		75		ns
t_{AS}	Address Set-up Time	0		0		0		0		ns
t_{WP}	Write Pulse Width	35		40		50		60		ns
t_{AH}	Address Hold Time	0		0		0		0		ns
t_{DW}	Data Valid to End of Write	25		30		35		45		ns
t_{DH}	Data Hold Time	0		0		0		0		ns
t_{WZ}	Write Enable to Output in High Z		18		20		25		35	ns
t_{OW}	Output Active from End of Write	5		5		5		5		ns

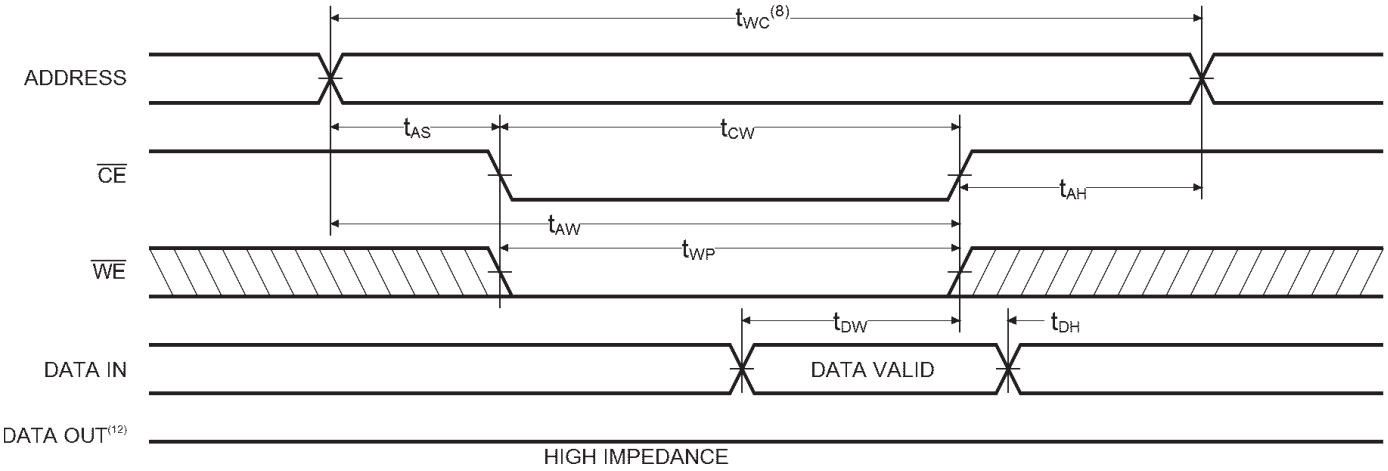
WRITE CYCLE NO. 1 ($\overline{WE}$ CONTROLLED)[6,7]



Notes:

6. $\overline{CE}$ and $\overline{WE}$ are LOW for WRITE cycle.
7. $\overline{OE}$ is LOW for this WRITE cycle to show t_{WZ} and t_{OW}.
8. If $\overline{CE}$ goes HIGH simultaneously with $\overline{WE}$ HIGH, the output remains in a high impedance state.
9. Write Cycle Time is measured from the last valid address to the first transitioning address.

TIMING WAVEFORM OF WRITE CYCLE NO.2 ($\overline{CE}$ CONTROLLED)[6]



AC TEST CONDITIONS

Input Pulse Levels	GND to 3.0V
Input Rise and Fall Times	3ns
Input Timing Reference Level	1.5V
Output Timing Reference Level	1.5V
Output Load	See Fig. 1 and 2

TRUTH TABLE

Mode	$\overline{CE}$	$\overline{OE}$	$\overline{WE}$	I/O	Power
Standby	H	X	X	High Z	Standby
D_{OUT} Disabled	L	H	H	High Z	Active
Read	L	L	H	D_{OUT}	Active
Write	L	X	L	D_{IN}	Active

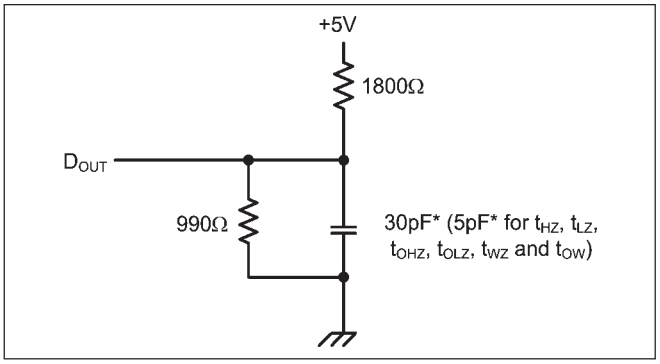


Figure 1. Output Load

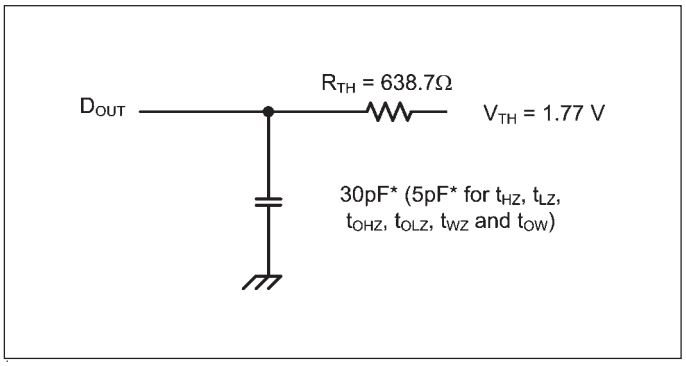


Figure 2. Thevenin Equivalent

* including scope and test fixture.

Note:
Because of the high speed of the P4C1048L, care must be taken when testing this device; an inadequate setup can cause a normal functioning part to be rejected as faulty. Long high-inductance leads that cause supply bounce must be avoided by bringing the V_{CC} and ground planes directly up to the contactor fingers. A 0.01 µF high frequency capacitor is also required between V_{CC} and ground.

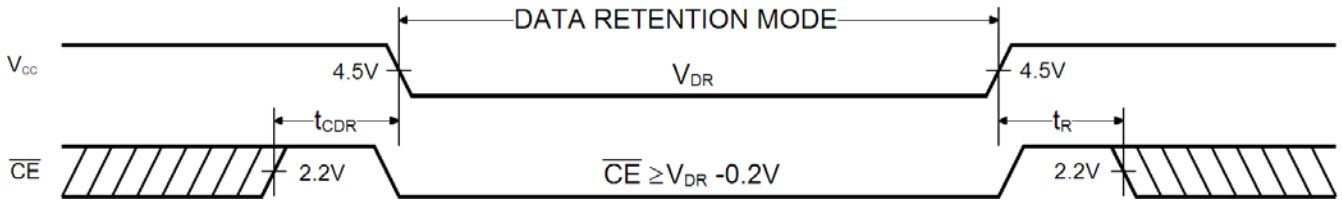
To avoid signal reflections, proper termination must be used; for example, a 50Ω test environment should be terminated into a 50Ω load with 1.77V (Thevenin Voltage) at the comparator input, and a 589Ω resistor must be used in series with D_{OUT} to match 639Ω (Thevenin Resistance).

DATA RETENTION

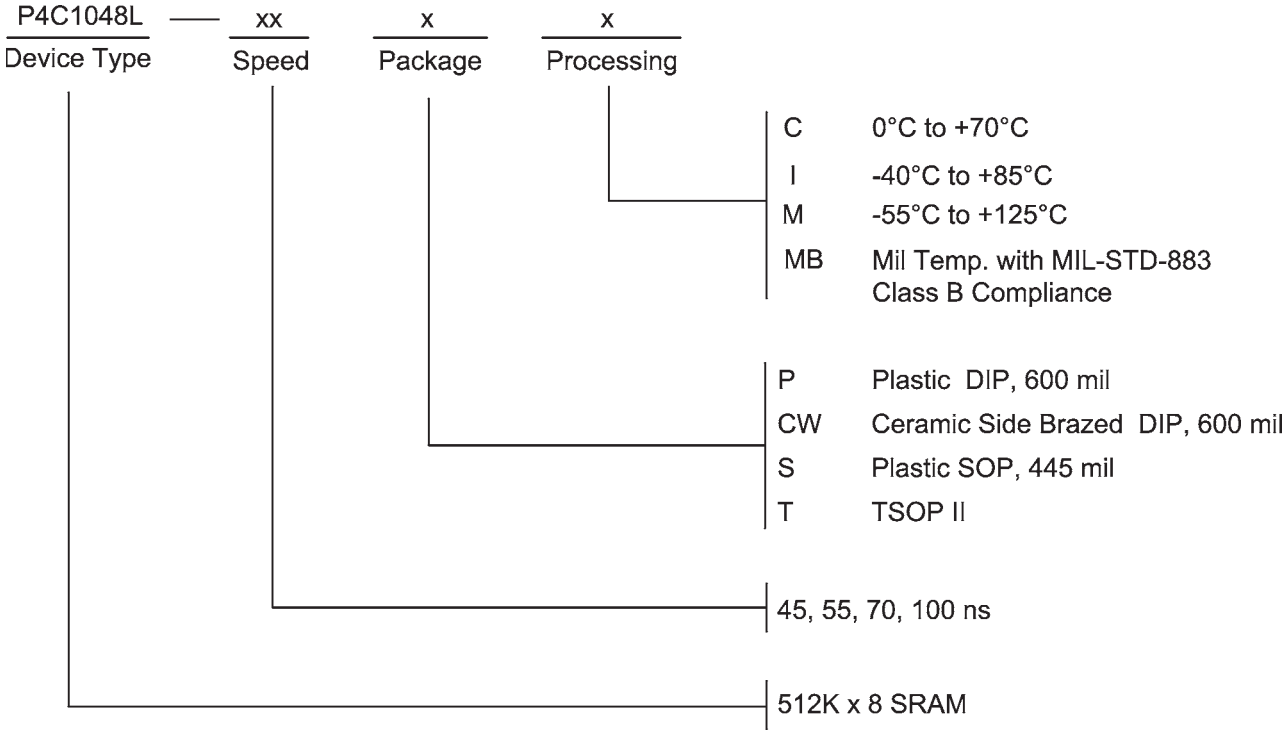
Symbol	Parameter	Test Conditions		Min	Max	Unit
V_{DR}	V_{CC} for Data Retention	$\overline{CE} \geq V_{CC}$ -0.2V, $V_{IN} \geq V_{CC}$ -0.2V or $V_{IN} \leq 0.2V$		2.0	5.5	V
I_{CCDR}	Data Retention Current	V_{DR} = 2.0V	Comm/Ind		20	µA
			Military		200	
		V_{DR} = 3.0V	Comm/Ind		30	µA
			Military		300	
t_{CDR}	Chip Deselect to Data Retention Time	See Retention Waveform		0		ns
t_R	Operating Recovery Time			t_{RC}		ns

1. $\overline{CE}_1 \geq V_{DR}$ -0.2V, $CE_2 \geq V_{DR}$ -0.2V or $CE_2 \leq 0.2V$; or $\overline{CE}_1 \leq 0.2V$, CE_2 - 0.2V; $V_{IN} \geq V_{DR}$ -0.2V or $V_{IN} \leq 0.2V$

LOW V_{CC} DATA RETENTION WAVEFORM



ORDERING INFORMATION



SELECTION GUIDE

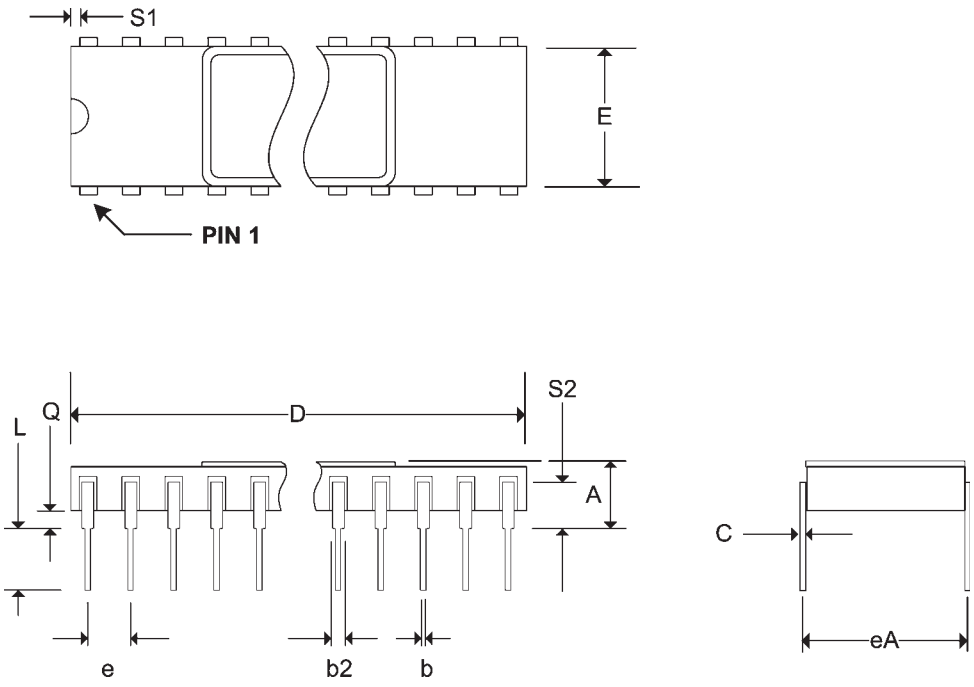
The P4C1048L is available in the following temperature, speed and package options.

Temperature Range	Package	Speed (ns)			
		45	55	70	100
Commercial	Plastic DIP (600 mil)	-45PC	-55PC	-70PC	-100PC
	Side Brazed DIP (600 mil)	-45CWC	-55CWC	-70CWC	-100CWC
	Plastic SOP (445 mil)	-45SC	-55SC	-70SC	-100SC
	TSOP II	-45TC	-55TC	-70TC	-100TC
Industrial	Plastic DIP (600 mil)	-45PI	-55PI	-70PI	-100PI
	Side Brazed DIP (600 mil)	-45CWI	-55CWI	-70CWI	-100CWI
	Plastic SOP (445 mil)	-45SI	-55SI	-70SI	-100SI
	TSOP II	-45TI	-55TI	-70TI	-100TI
Military	Side Brazed DIP (600 mil)	N/A	N/A	-70CWM	-100CWM
Military Processed*	Side Brazed DIP (600 mil)	N/A	N/A	-70CWMB	-100CWMB

*** Military temperature range with MIL-STD-883 Class B processing.**

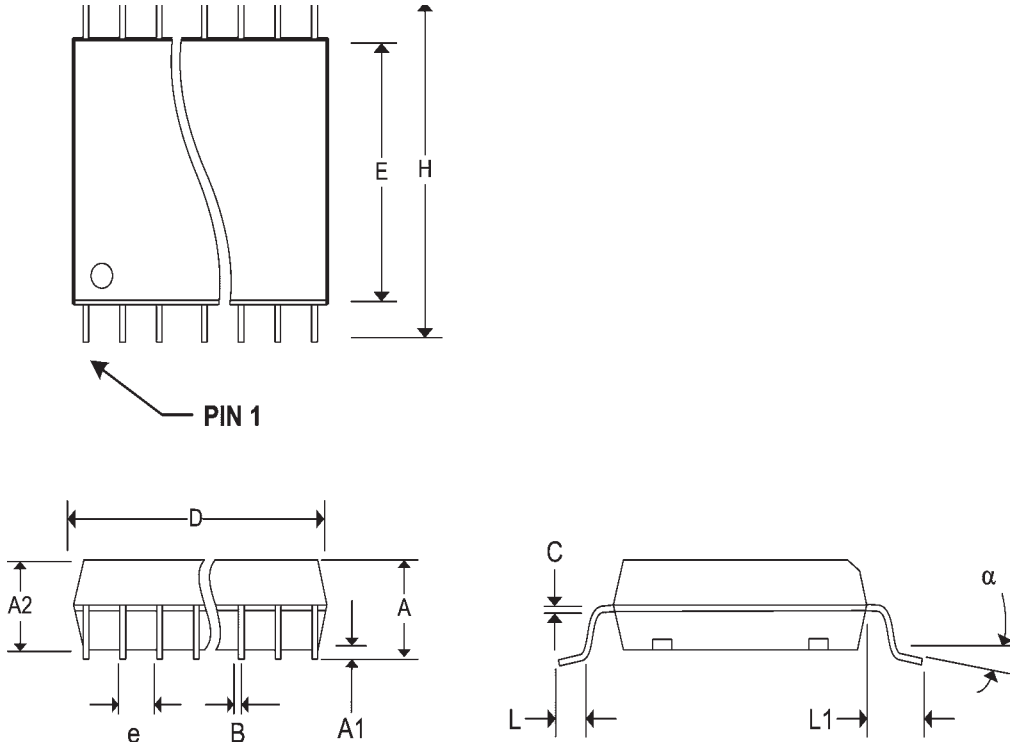
Pkg #	C10	
# Pins	32 (600 mil)	
Symbol	**Min**	**Max**
A	-	0.225
b	0.014	0.026
b2	0.045	0.065
C	0.008	0.018
D	-	1.680
E	0.510	0.620
eA	0.600 BSC	
e	0.100 BSC	
L	0.125	0.200
Q	0.015	0.070
S1	0.005	-
S2	0.005	-

SIDEBRAZED DUAL IN-LINE PACKAGE



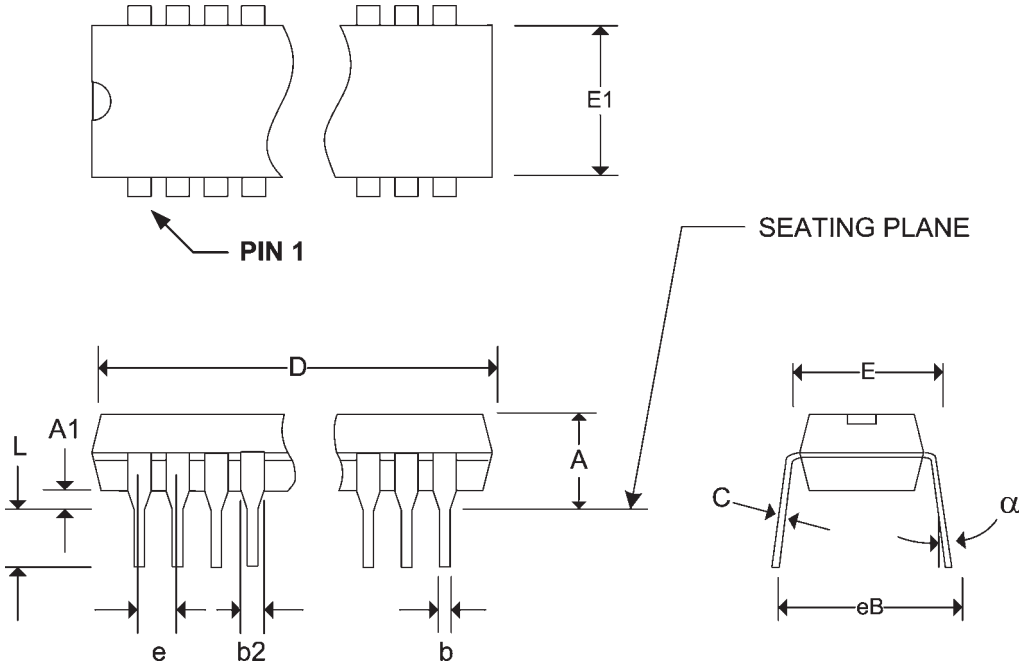
Pkg #	S12	
# Pins	32 (445 Mil)	
Symbol	**Min**	**Max**
A	-	0.118
A1	0.004	-
A2	0.101	0.111
B	0.014	0.020
C	0.006	0.012
D	0.793	0.817
e	0.050 BSC	
E	0.440	0.450
H	0.546	0.566
L	0.023	0.039
L1	0.047	0.063
α	0°	4°

SOIC/SOP SMALL OUTLINE IC PACKAGES



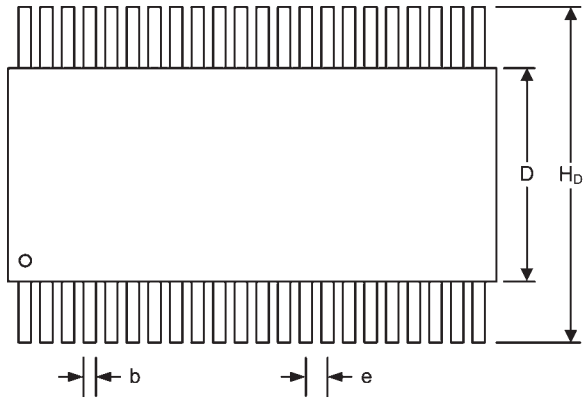
Pkg #	P600	
# Pins	32 (600 mil)	
Symbol	**Min**	**Max**
A	0.160	0.200
A1	0.015	-
b	0.014	0.023
b2	0.045	0.070
C	0.006	0.014
D	1.600	1.700
E1	0.526	0.548
E	0.590	0.610
e	0.100 BSC	
eB	0.600 BSC	
L	0.120	0.150
α	0°	15°

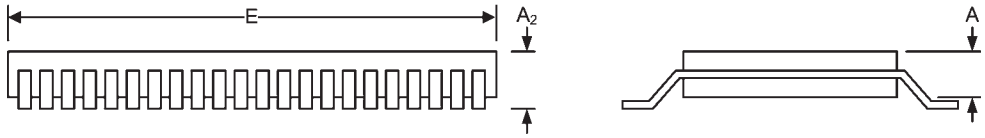
PLASTIC DUAL IN-LINE PACKAGE



Pkg #	T4	
# Pins	32	
Symbol	**Min**	**Max**
A	0.037	0.041
A_2	-	0.047
b	0.012	0.020
D	0.395	0.405
E	0.820	0.831
e	0.050 BSC	
H_D	0.455	0.471

TSOP II PACKAGE





REVISIONS

DOCUMENT NUMBER: SRAM129
DOCUMENT TITLE: P4C1048L LOW POWER 512K x 8 CMOS STATIC RAM

REV.	ISSUE DATE	ORIG. OF CHANGE	DESCRIPTION OF CHANGE
OR	Oct-05	JDB	New Data Sheet
A	Nov-06	JDB	Minor corrections to DC Electrical Characteristics and Data Retention tables
B	Dec-06	JDB	Update SOIC/SOP package drawing.
C	May-07	JDB	Added 45/55 ns and PDIP
D	Jul-07	JDB	Corrected error in selection guide; added TSOP II package