

# P4C1048L

## LOW POWER 512K x 8

### CMOS STATIC RAM

#### FEATURES

- $V_{CC}$  Current
  - Operating: 35mA
  - CMOS Standby: 100 $\mu$ A
- Access Times
  - 45/55/70/100 ns
- Single 5 Volts  $\pm$ 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 $\pm$ 10% tolerance power supply.

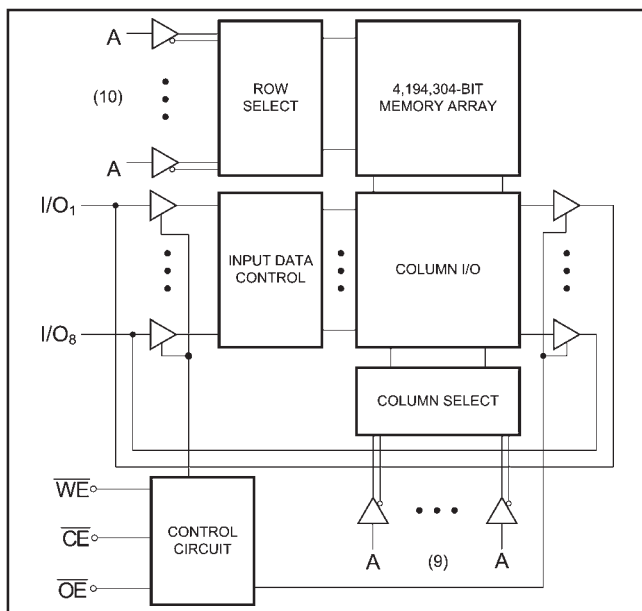
Access times as fast as 45 ns are available. CMOS is utilized to reduce power consumption to a low level.

The P4C1048L device provides asynchronous operation with matching access and cycle times. Memory

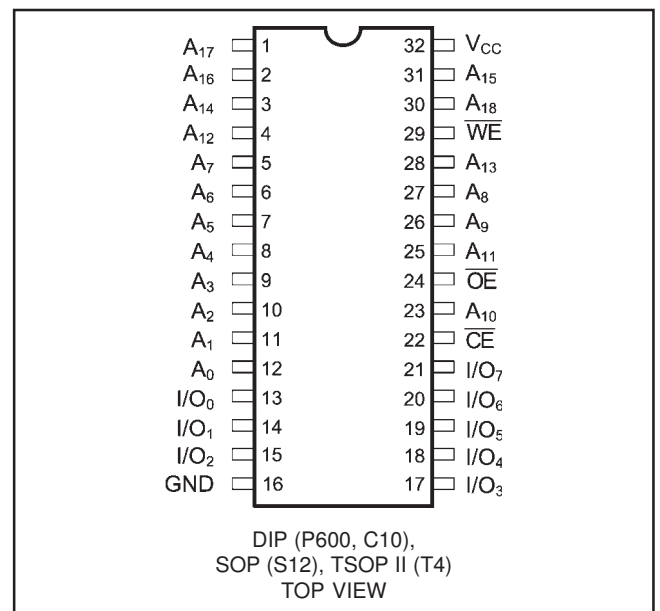
locations are specified on address pins  $A_0$  to  $A_{18}$ . Reading is accomplished by device selection ( $\overline{CE}$  low) and output enabling ( $\overline{OE}$ ) while write enable ( $\overline{WE}$ ) remains HIGH. By presenting the address under these conditions, the data in the addressed memory 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



## RECOMMENDED OPERATING TEMPERATURE & SUPPLY VOLTAGE

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

## MAXIMUM RATINGS<sup>(a)</sup>

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<sup>(d)</sup>

( $V_{CC} = 5.0V$ ,  $T_A = 25^\circ C$ ,  $f = 1.0$  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  $\overline{WE} \leq V_{IL}$  (max),  $\overline{OE}$  is high. Switching inputs are 0V and 3V.

### Notes:

- 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.
- Extended temperature operation guaranteed with 400 linear feet per minute of air flow.
- Transient inputs with  $V_{IL}$  and  $I_{IL}$  not more negative than -3.0V and -100mA, respectively, are permissible for pulse widths up to 20ns.
- This parameter is sampled and not 100% tested.

**DC ELECTRICAL CHARACTERISTICS**(Over Recommended Operating Temperature & Supply Voltage)<sup>(b)</sup>

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

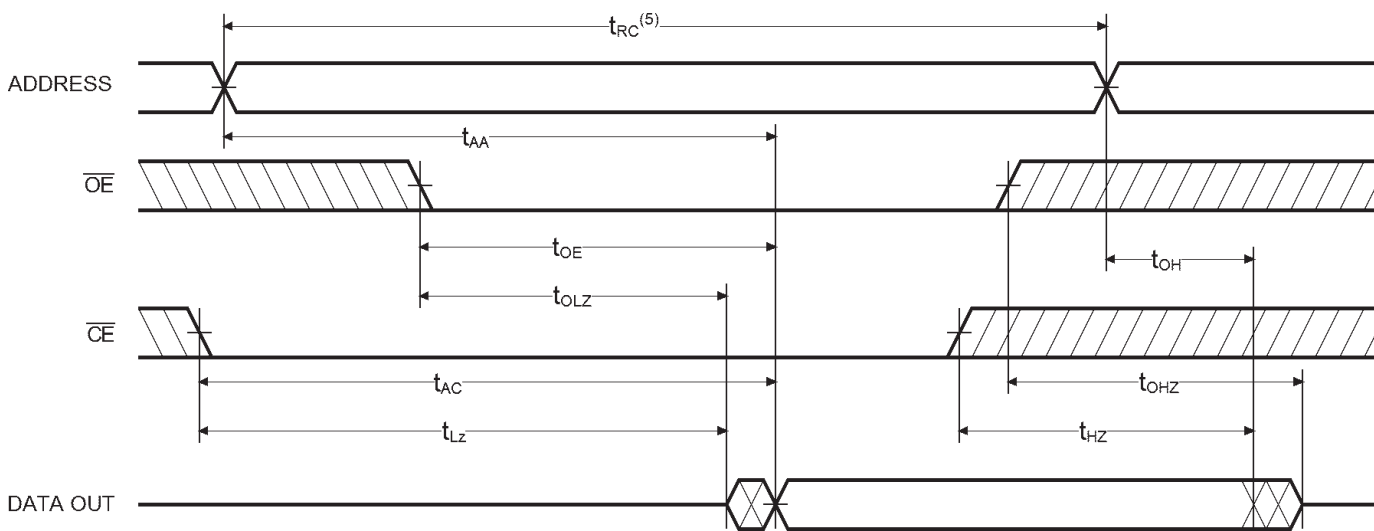
N/A = Not Applicable

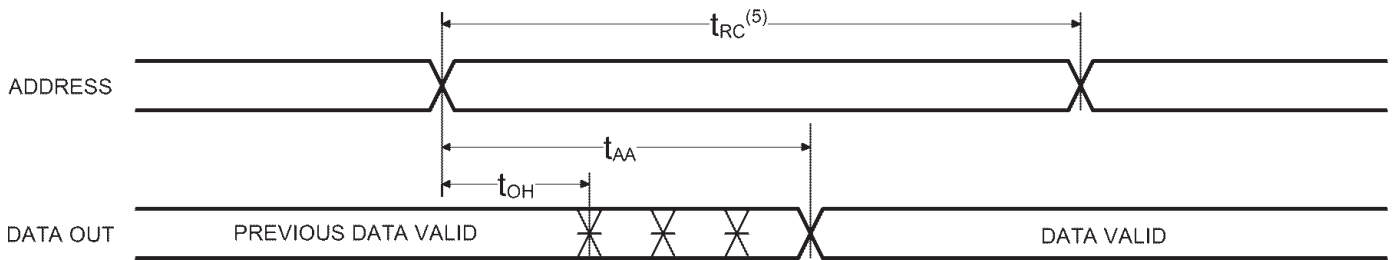
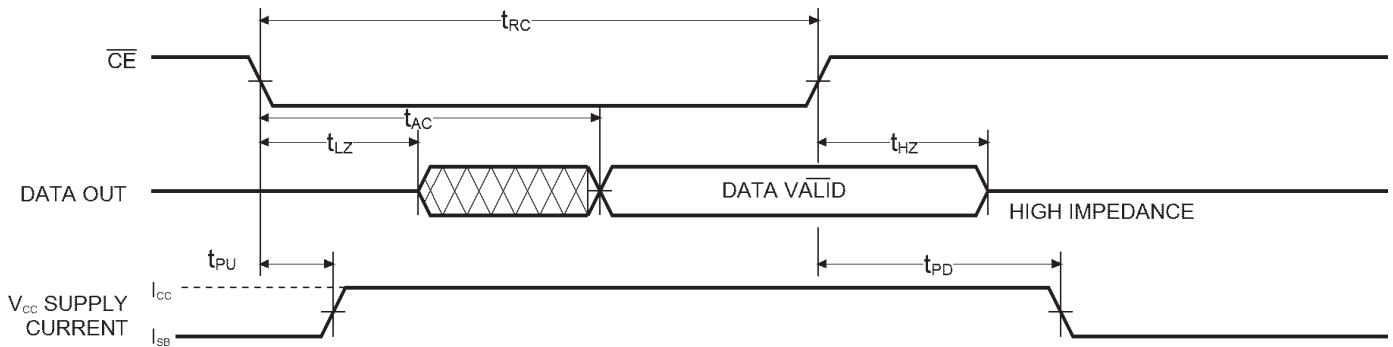
### AC ELECTRICAL CHARACTERISTICS - READ CYCLE

(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)<sup>(1)</sup>



**READ CYCLE NO. 2 (ADDRESS CONTROLLED)****READ CYCLE NO. 3 ( $\overline{CE}$  CONTROLLED)****Notes:**

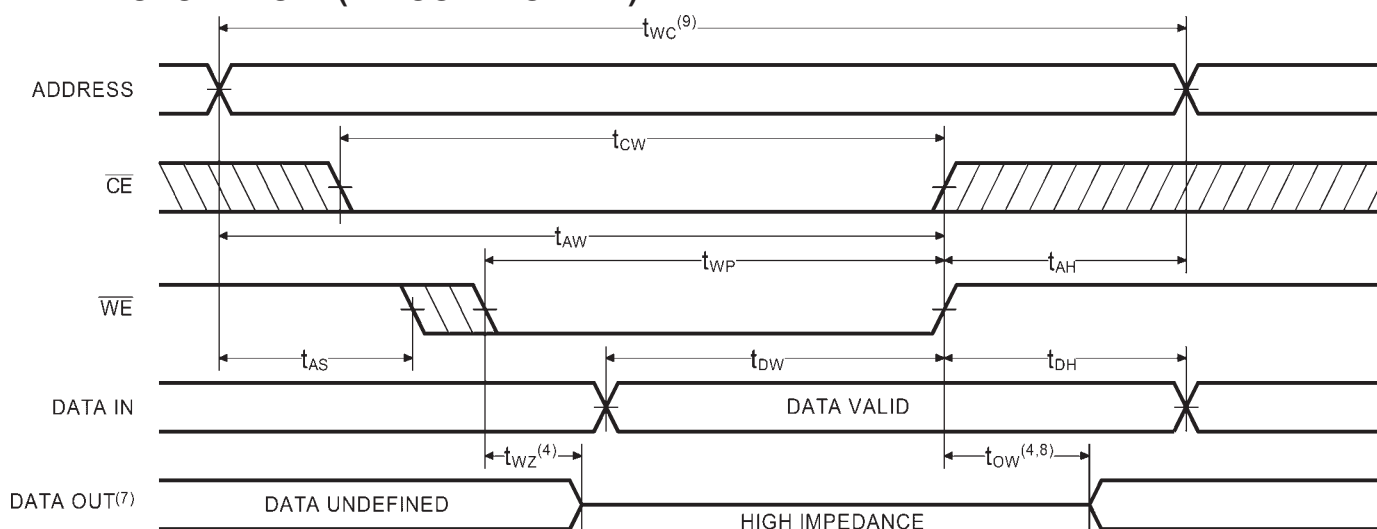
- $\overline{WE}$  is HIGH for READ cycle.
- $\overline{CE}$  and  $\overline{OE}$  are LOW for READ cycle.
- ADDRESS must be valid prior to, or coincident with later of  $\overline{CE}$  transition LOW.
- Transition is measured  $\pm 200$  mV from steady state voltage prior to change, with loading as specified in Figure 1. This parameter is sampled and not 100% tested.
- 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

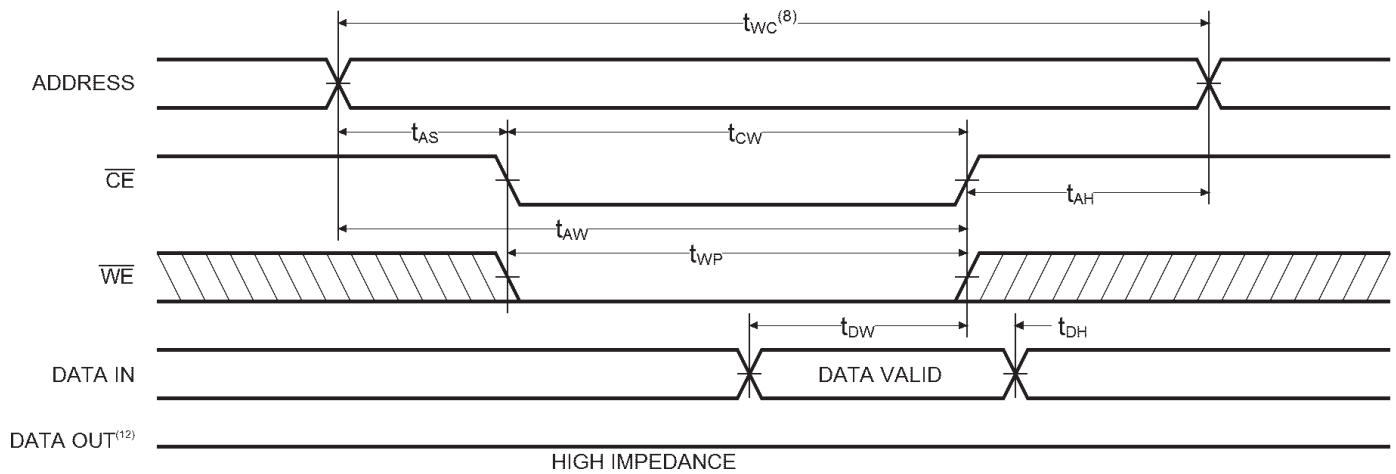
### WRITE CYCLE NO. 1 ( $\overline{WE}$ CONTROLLED)<sup>(6,7)</sup>



#### 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)<sup>(6)</sup>



### 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

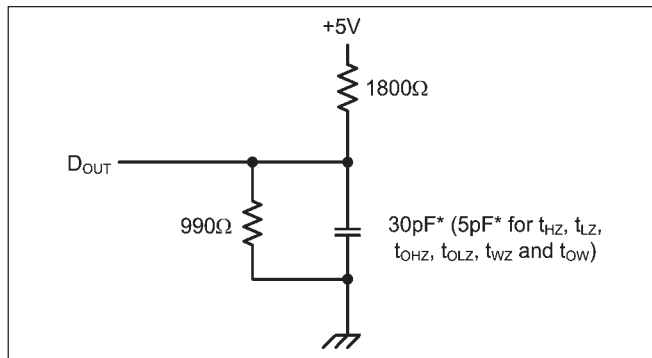


Figure 1. Output Load

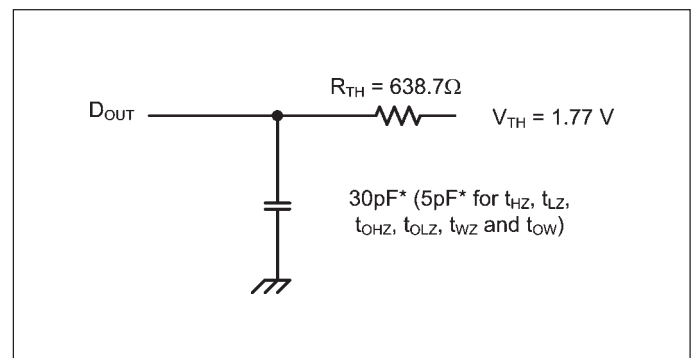


Figure 2. Thevenin Equivalent

\* 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  $\mu$ F high frequency capacitor is also required between  $V_{CC}$  and ground.

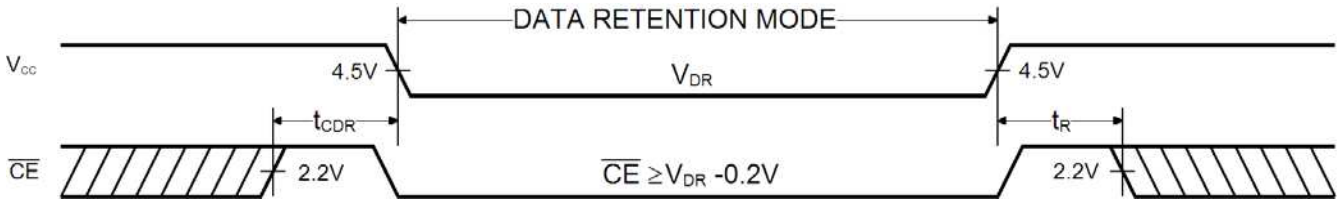
To avoid signal reflections, proper termination must be used; for example, a 50 $\Omega$  test environment should be terminated into a 50 $\Omega$  load with 1.77V (Thevenin Voltage) at the comparator input, and a 589 $\Omega$  resistor must be used in series with  $D_{OUT}$  to match 639 $\Omega$  (Thevenin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

## DATA RETENTION

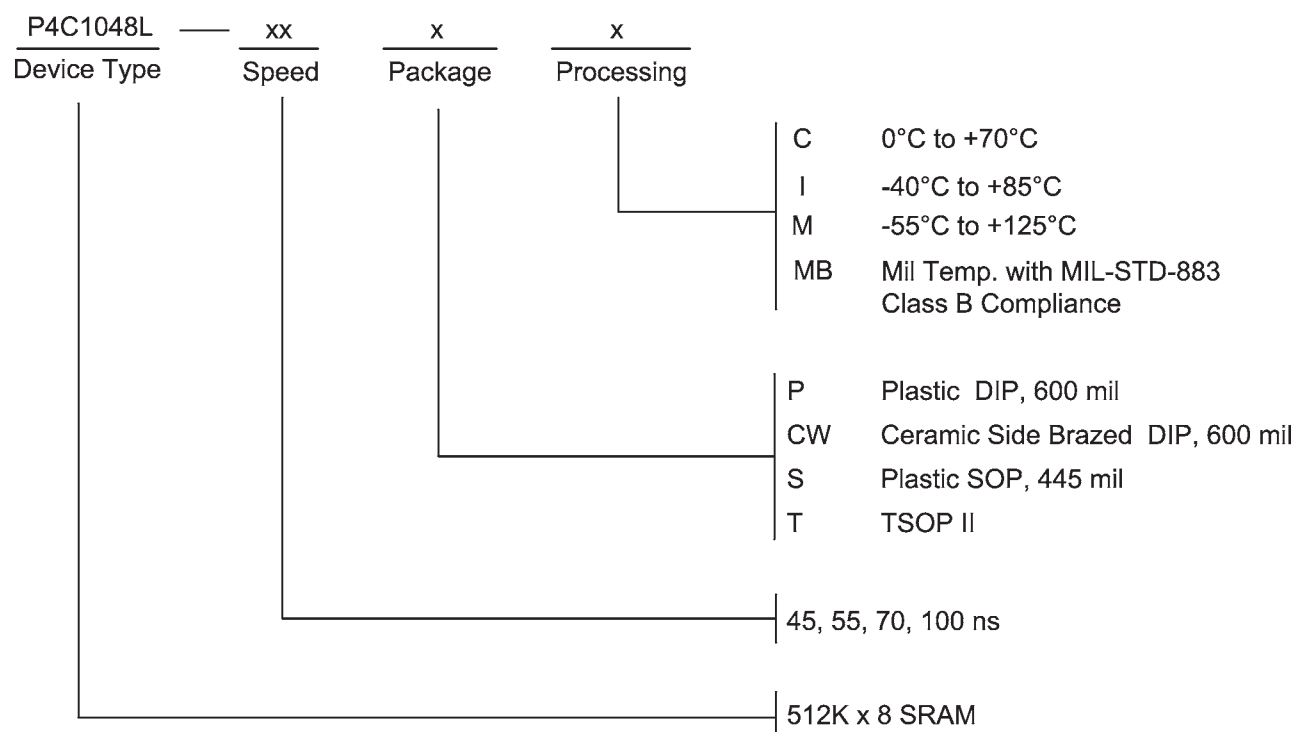
Symbol	Parameter	Test Conditions	Min	Max	Unit
$V_{DR}$	$V_{CC}$ for Data Retention	$\overline{CE} \geq V_{CC} - 0.2V$ , $V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$	2.0	5.5	V
$I_{CCDR}$	Data Retention Current	$V_{DR} = 2.0V$	Comm/Ind	20	$\mu A$
			Military	200	
		$V_{DR} = 3.0V$	Comm/Ind	30	$\mu A$
			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

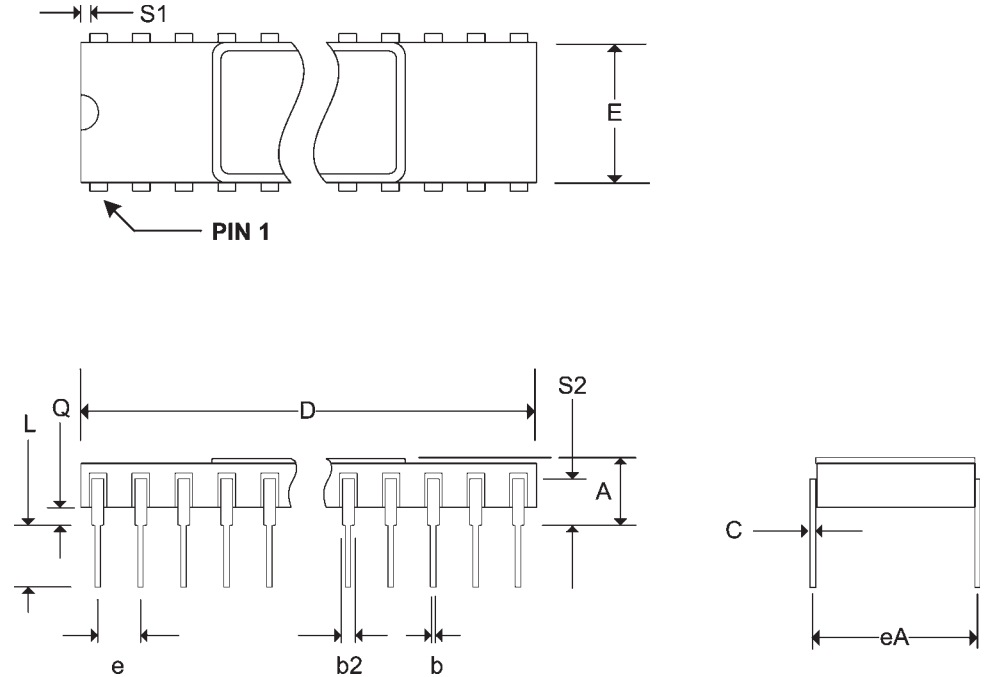
The P4C1048L is available in the following temperature, speed and package options.

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.

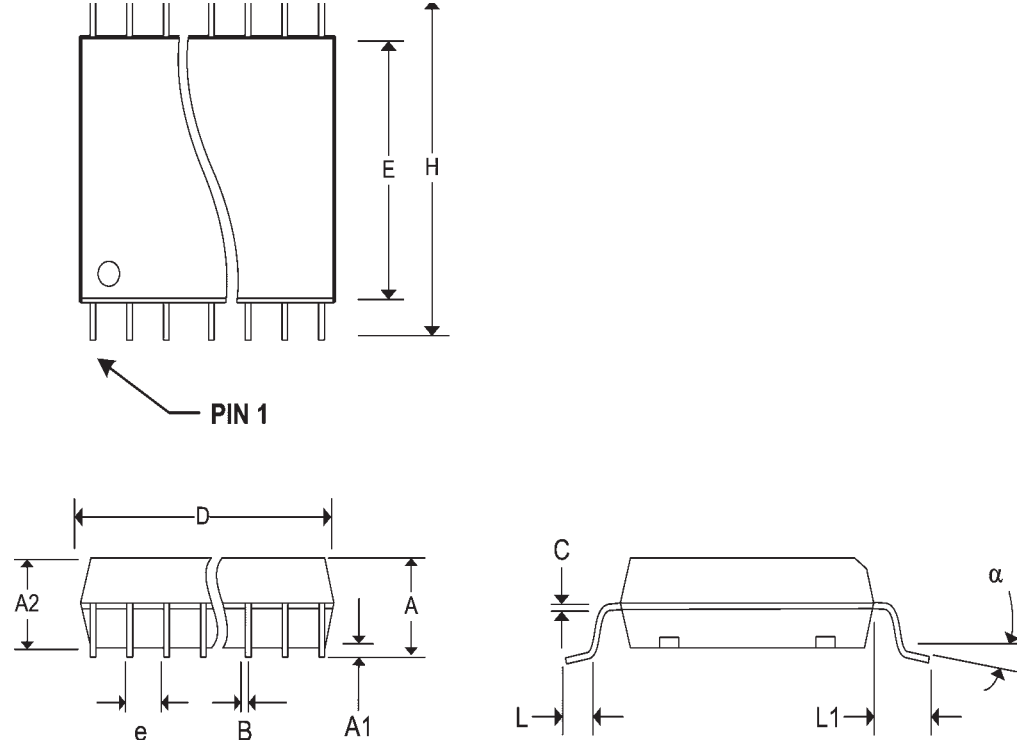
Pkg #	<b>C10</b>	
# Pins	32 (600 mil)	
Symbol	<b>Min</b>	<b>Max</b>
A	-	0.225
b	0.014	0.026
b2	0.045	0.065
C	0.008	0.018
D	-	1.680
E	0.510	0.620
eA	0.600 BSC	
e	0.100 BSC	
L	0.125	0.200
Q	0.015	0.070
S1	0.005	-
S2	0.005	-

**SIDEBRAZED DUAL IN-LINE PACKAGE**



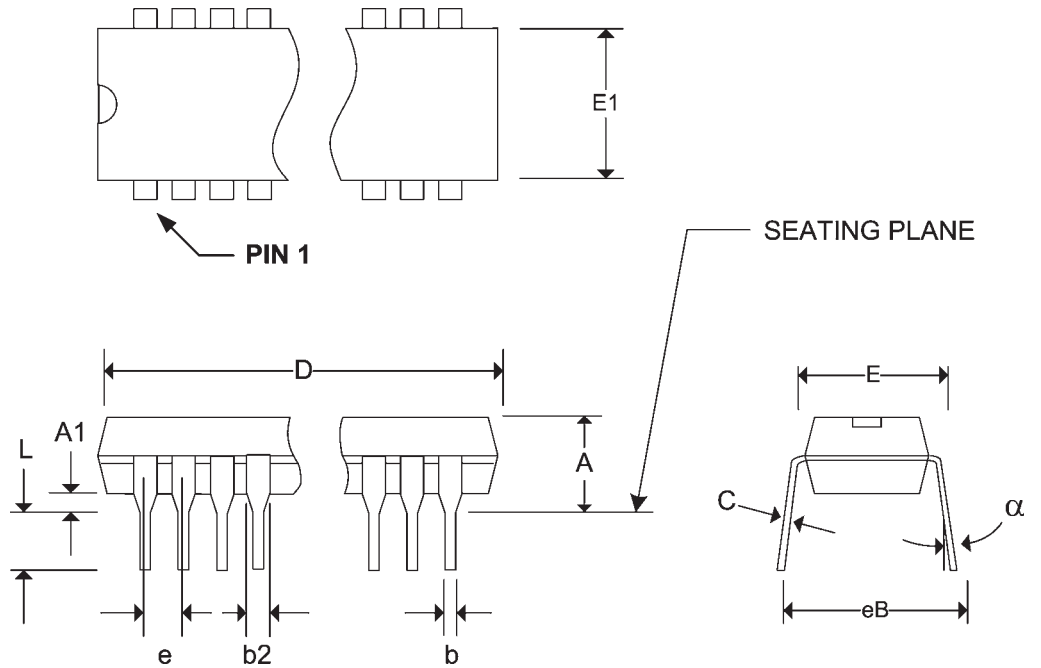
Pkg #	<b>S12</b>	
# Pins	32 (445 Mil)	
Symbol	<b>Min</b>	<b>Max</b>
A	-	0.118
A1	0.004	-
A2	0.101	0.111
B	0.014	0.020
C	0.006	0.012
D	0.793	0.817
e	0.050 BSC	
E	0.440	0.450
H	0.546	0.566
L	0.023	0.039
L1	0.047	0.063
$\alpha$	0°	4°

**SOIC/SOP SMALL OUTLINE IC PACKAGES**



Pkg #	<b>P600</b>	
# Pins	32 (600 mil)	
Symbol	<b>Min</b>	<b>Max</b>
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
$\alpha$	0°	15°

**PLASTIC DUAL IN-LINE PACKAGE**



Pkg #	<b>T4</b>	
# Pins	32	
Symbol	<b>Min</b>	<b>Max</b>
A	0.037	0.041
A <sub>2</sub>	-	0.047
b	0.012	0.020
D	0.395	0.405
E	0.820	0.831
e	0.050 BSC	
H <sub>D</sub>	0.455	0.471

**TSOP II PACKAGE**

