P4C164L
LOW POWER 8K x 8
STATIC CMOS RAM

FEATURES

- V_{CC} Current (Commercial/Industrial)
  - — Operating: 55 mA
  - — CMOS Standby: 3 µA
- Access Times
  - —80/100 (Commercial or Industrial)
- Single 5 Volts ±10% Power Supply
- Easy Memory Expansion Using $\overline{CE}_1$, CE_2 and OE Inputs
- Common Data I/O
- Three-State Outputs
- Fully TTL Compatible Inputs and Outputs
- Advanced CMOS Technology
- Automatic Power Down
- Packages
  - —28-Pin 300 and 600 mil DIP
  - —28-Pin 330 mil SOP

DESCRIPTION

The P4C164L is a 64K density low power CMOS static RAM organized as 8Kx8. 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.

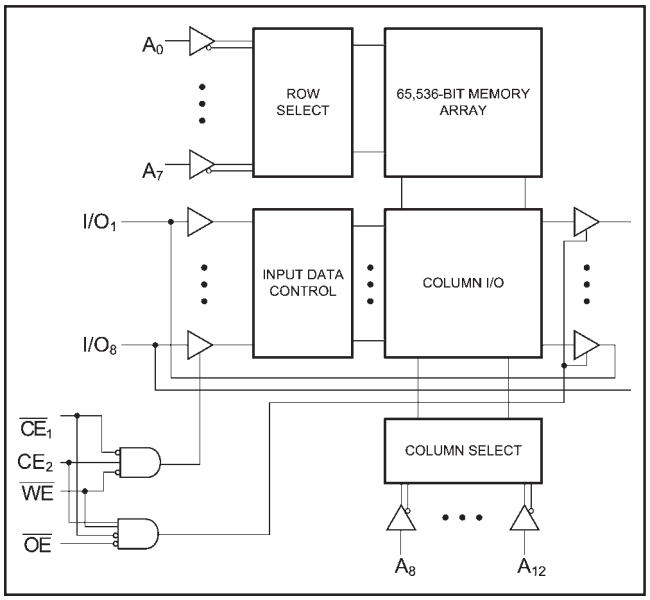
Access times of 80 ns and 100 ns are available. CMOS is utilized to reduce power consumption to a low level.

The P4C164L device provides asynchronous operation with matching access and cycle times.

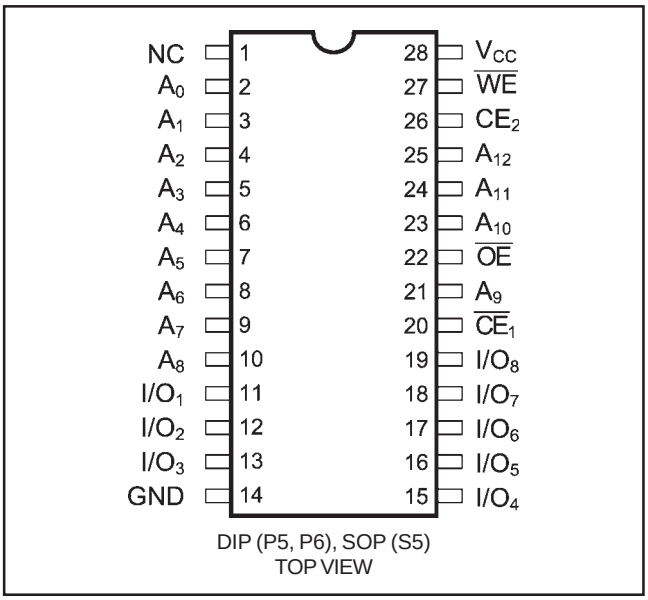
Memory locations are specified on address pins A_0 to A_{12}. Reading is accomplished by device selection (CE_1 low CE_2 high) and output enabling (OE) while write enable (WE) remains HIGH. By presenting the address under these conditions, the data in the addressed memory location is presented on the data input/output pins. The input/output pins stay in the HIGH Z state when either CE_1 or OE is HIGH or WE or CE_2 is LOW.

Package options for the P4C164L include 28-pin 300 and 600 mil DIP and 28-pin 330 mil SOP packages.

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION



DIP (P5, P6), SOP (S5)
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)	$4.5 \le V_{CC} \le 5.5V$

MAXIMUM RATINGS[1]

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

DC ELECTRICAL CHARACTERISTICS

(Over Recommended Operating Temperature & Supply Voltage)[2]

Symbol	Parameter	Test Conditions	Min	Max	Unit
V_{OH}	Output High Voltage (I/O_0 - I/O_7)	I_{OH} = –1mA, V_{CC} = 4.5V	2.4		V
V_{OL}	Output Low Voltage (I/O_0 - I/O_7)	I_{OL} = 2.1mA		0.4	V
V_{IH}	Input High Voltage		2.2	V_{CC} + 0.3	V
V_{IL}	Input Low Voltage		-0.5[3]	0.8	V
I_{LI}	Input Leakage Current	$GND \le V_{IN} \le V_{CC}$ Ind./Com.	-2	+2	µA
I_{LO}	Output Leakage Current	$GND \le V_{OUT} \le V_{CC}$ Ind./Com. $CE \ge V_{IH}$	-2	+2	µA
I_{SB}	V_{CC} Current TTL Standby Current (TTL Input Levels)	V_{CC} = 5.5V, I_{OUT} = 0 mA $CE_1 = V_{IH}$ or $CE_2 = V_{IL}$		100	µA
I_{SB1}	V_{CC} Current CMOS Standby Current (CMOS Input Levels)	V_{CC} = 5.5V, I_{OUT} = 0 mA $CE_1 \ge V_{CC}$ -0.2V or $CE_2 \le 0.2V$		3	µA

Notes:

1. 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.
2. Extended temperature operation guaranteed with 400 linear feet per minute of air flow.
3. 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.
4. This parameter is sampled and not 100% tested.

CAPACITANCES[4]

(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	7	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0V	9	pF

POWER DISSIPATION CHARACTERISTICS VS. SPEED

Symbol	Parameter	Temperature Range	*		Unit
			-80	-100	
I_{CC}	Dynamic Operating Current	Ind. & Comm.	55	55	mA

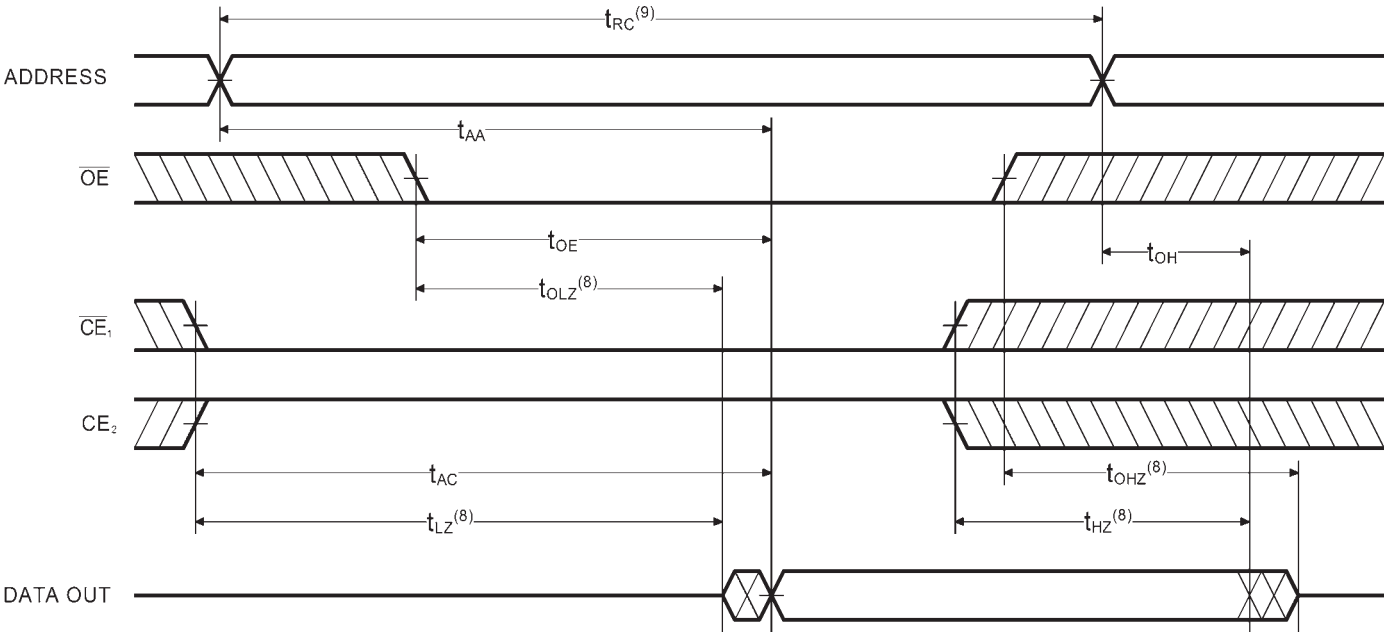
*****Tested with outputs open and all address and data inputs changing at the maximum write-cycle rate. The device is continuously enabled for writing, i.e. CE and WE ≤ V_{IL} (max), OE is high. Switching inputs are 0V and 3V.

AC ELECTRICAL CHARACTERISTICS - READ CYCLE

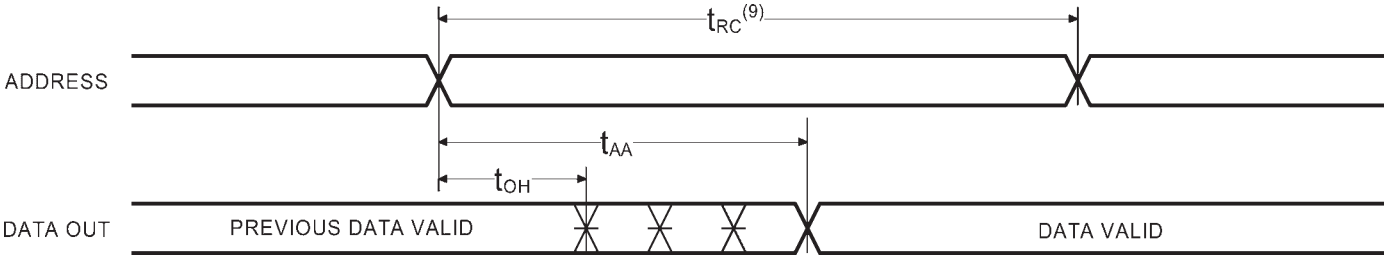
(Over Recommended Operating Temperature & Supply Voltage)

Symbol	Parameter	-80		-100		Unit
		Min	Max	Min	Max	
t_{RC}	Read Cycle Time	80		100		ns
t_{AA}	Address Access Time		80		100	ns
t_{AC}	Chip Enable Access Time		80		100	ns
t_{OH}	Output Hold from Address Change	10		10		ns
t_{LZ}	Chip Enable to Output in Low Z	10		10		ns
t_{HZ}	Chip Disable to Output in High Z		30		30	ns
t_{OE}	Output Enable Low to Data Valid		40		40	ns
t_{OLZ}	Output Enable Low to Low Z	5		5		ns
t_{OHZ}	Output Enable High to High Z		20		20	ns
t_{PU}	Chip Enable to Power Up Time	0		0		ns
t_{PD}	Chip Disable to Power Down Time		80		100	ns

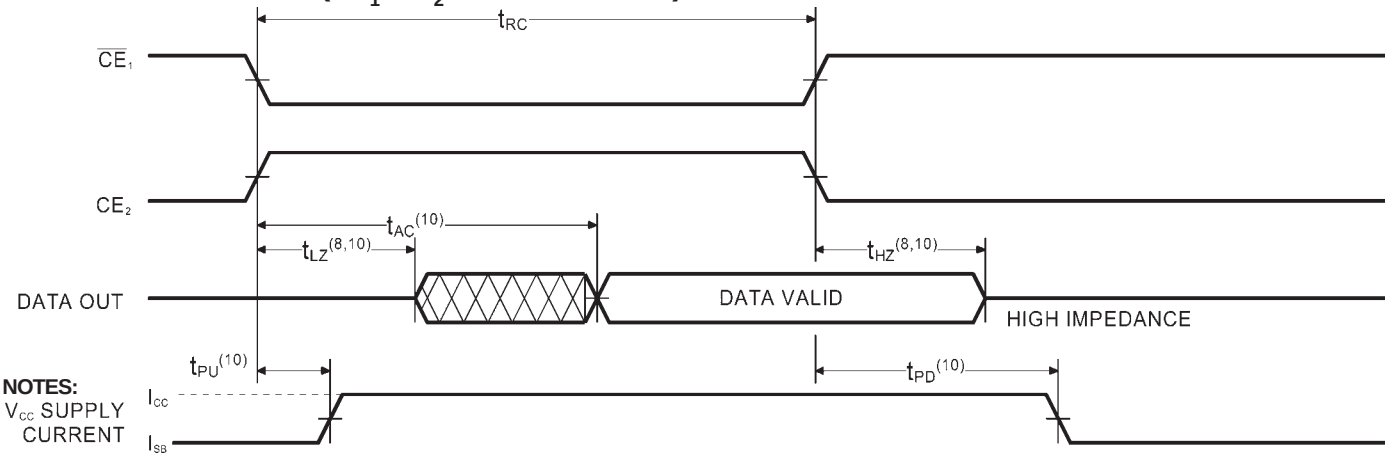
READ CYCLE NO. 1 (OE CONTROLLED)[1]



READ CYCLE NO. 2 (ADDRESS CONTROLLED)



READ CYCLE NO. 3 (CE_1,CE_2 CONTROLLED)



Notes:

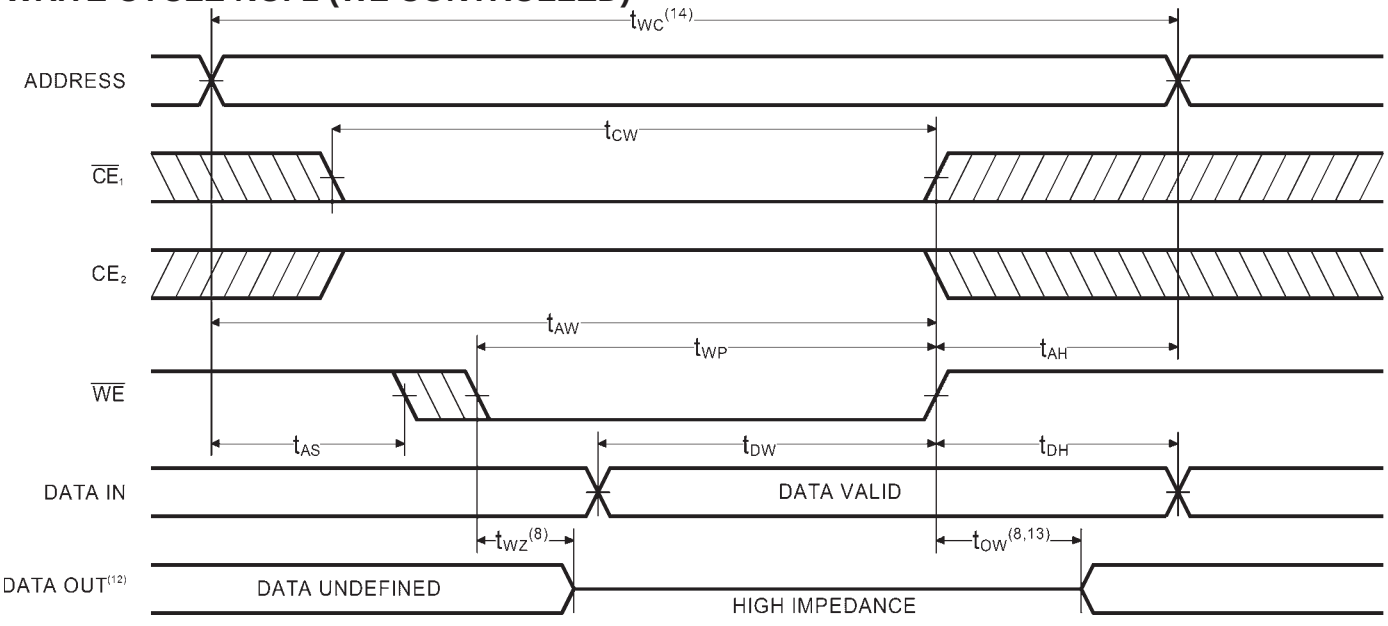
5. WE is HIGH for READ cycle.
6. CE_1 is LOW, CE_2 is HIGH and OE is LOW for READ cycle.
7. ADDRESS must be valid prior to, or coincident with CE_1 transition LOW and CE_2 transition HIGH.
8. Transition is measured ± 200 mV from steady state voltage prior to change, with loading as specified in Figure 1. This parameter is sampled and not 100% tested.
9. READ Cycle Time is measured from the last valid address to the first transitioning address.
10. Transitions caused by a chip enable control have similar delays irrespective of whether CE_1 or CE_2 causes them.

AC CHARACTERISTICS - WRITE CYCLE

(Over Recommended Operating Temperature & Supply Voltage)

Symbol	Parameter	-80		-100		Unit
		Min	Max	Min	Max	
t_{WC}	Write Cycle Time	80		100		ns
t_{CW}	Chip Enable Time to End of Write	70		80		ns
t_{AW}	Address Valid to End of Write	70		80		ns
t_{AS}	Address Set-up Time	0		0		ns
t_{WP}	Write Pulse Width	60		60		ns
t_{AH}	Address Hold Time	0		0		ns
t_{DW}	Data Valid to End of Write	40		40		ns
t_{DH}	Data Hold Time	0		0		ns
t_{WZ}	Write Enable to Output in High Z		30		30	ns
t_{OW}	Output Active from End of Write	10		10		ns

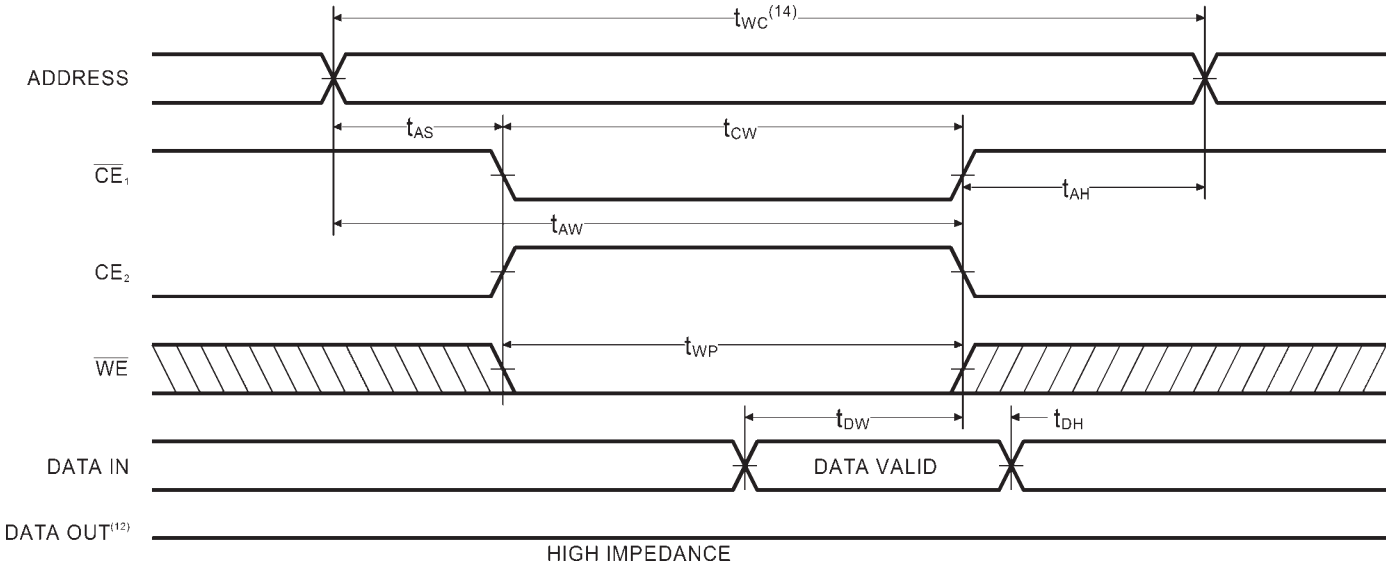
WRITE CYCLE NO. 1 (WE CONTROLLED)[6]



Notes:

11. CE_1 and WE must be LOW, and CE_2 HIGH for WRITE cycle.
12. OE is LOW for this WRITE cycle to show t_{WZ} and t_{OW}.
13. If CE_1 goes HIGH, or CE_2 goes LOW, simultaneously with WE HIGH, the output remains in a high impedance state.
14. Write Cycle Time is measured from the last valid address to the first transitioning address.

TIMING WAVEFORM OF WRITE CYCLE NO.2 (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 Figures 1 and 2

TRUTH TABLE

Mode	CE_1	CE_2	OE	WE	I/O	Power
Standby	H	X	X	X	High Z	Standby
Standby	X	L	X	X	High Z	Standby
D_{OUT} Disabled	L	H	H	H	High Z	Active
Read	L	H	L	H	D_{OUT}	Active
Write	L	H	X	L	High Z	Active

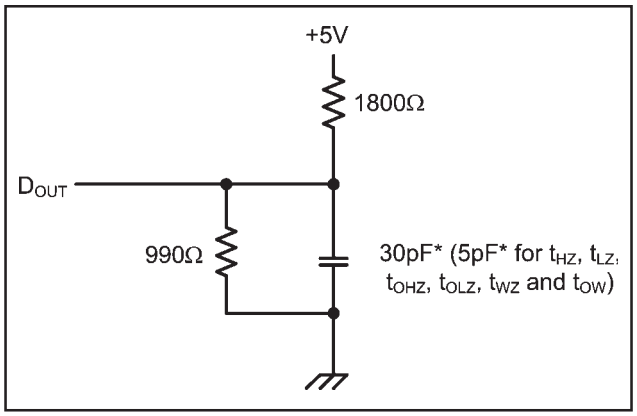


Figure 1. Output Load

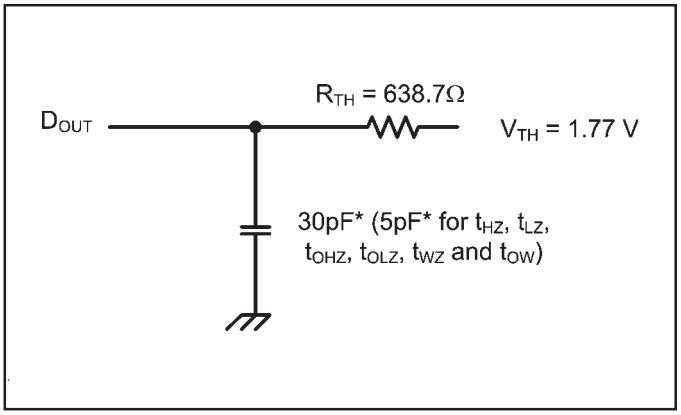


Figure 2. Thevenin Equivalent

* including scope and test fixture.

Note:
Because of the high speed of the P4C164L, 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 CHARACTERISTICS

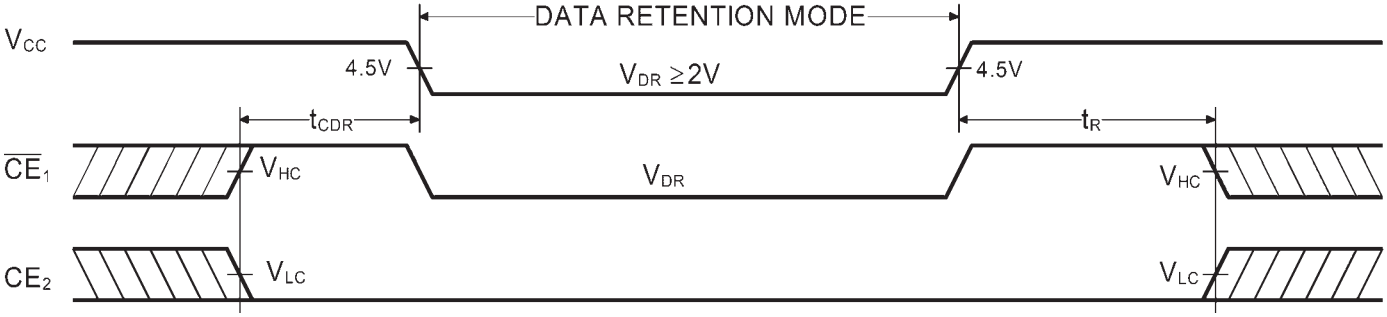
Symbol	Parameter	Test Condition	Min	Typ.* V_{CC}= 2.0V	Typ.* V_{CC}= 3.0V	Max V_{CC}= 2.0V	Max V_{CC}= 3.0V	Unit
V_{DR}	V_{CC} for Data Retention		2.0					V
I_{CCDR}	Data Retention Current	$CE_1 \geq V_{CC} - 0.2V$ or $CE_2 \leq 0.2V$, $V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$		1	1	3	3	µA
t_{CDR}	Chip Deselect to Data Retention Time		0					ns
t_R †	Operation Recovery Time		t_{RC} §					ns

*T_A = +25°C

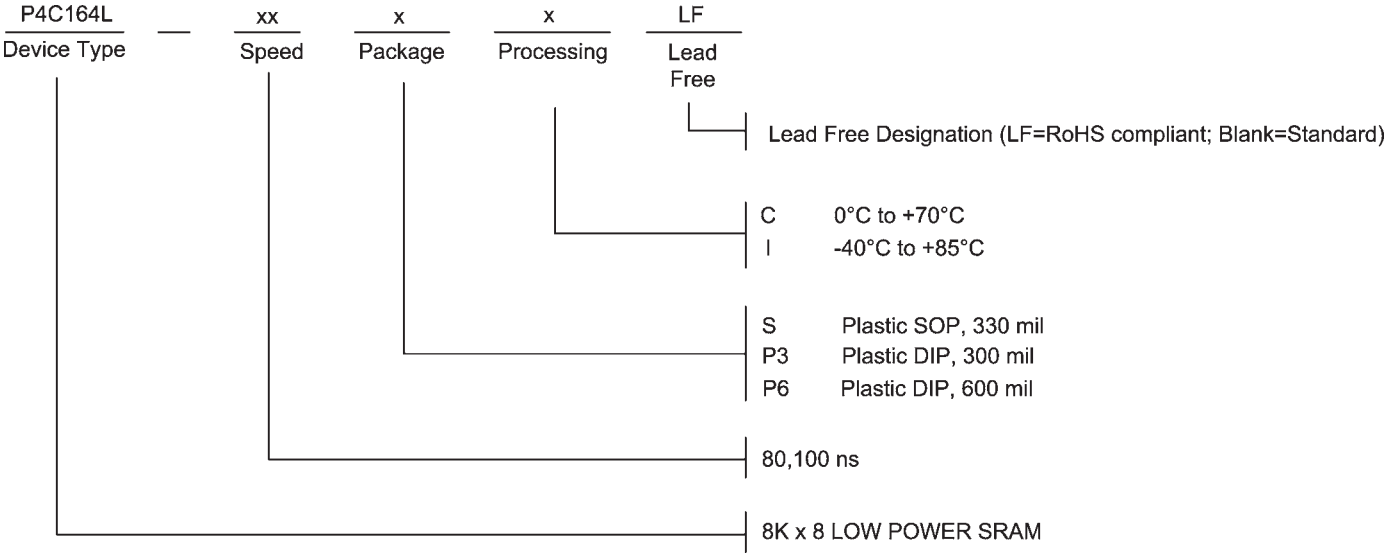
§t_{RC} = Read Cycle Time

†This parameter is guaranteed but not tested.

DATA RETENTION WAVEFORM



ORDERING INFORMATION



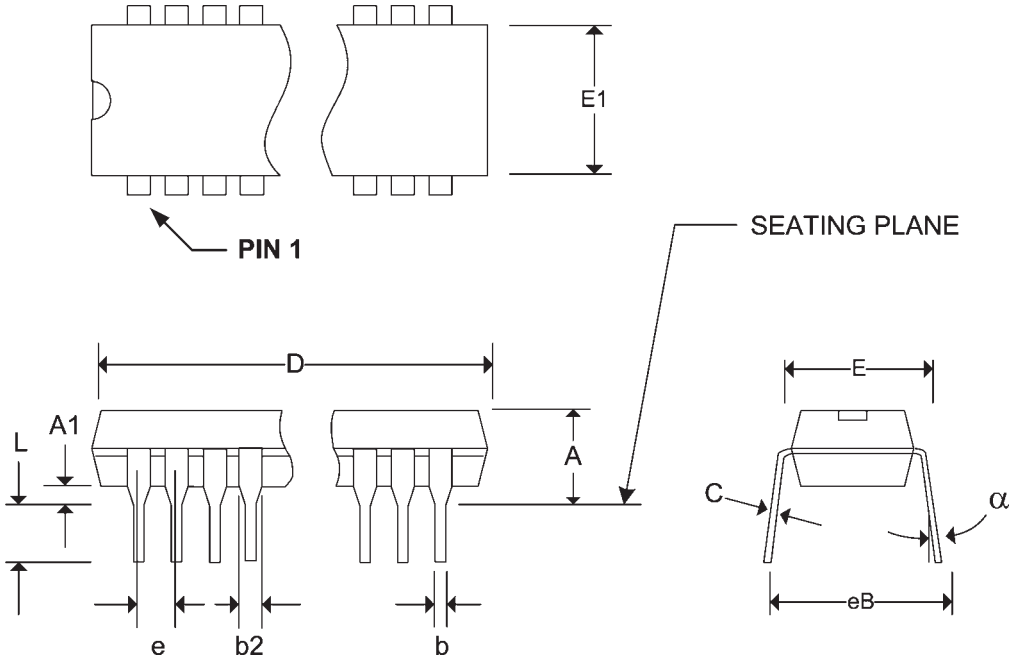
SELECTION GUIDE

The P4C164L is available in the following temperature, speed and package options.

Temperature Range	Package	Speed (ns)	
		80	100
Commercial	Plastic DIP (300 mil)	-80P3C	-100P3C
	Plastic DIP (600 mil)	-80P6C	-100P6C
	Plastic SOP (450 mil)	-80SC	-100SC
Industrial	Plastic DIP (300 mil)	-80P3I	-100P3I
	Plastic DIP (600 mil)	-80P6I	-100P6I
	Plastic SOP (450 mil)	-80SI	-100SI

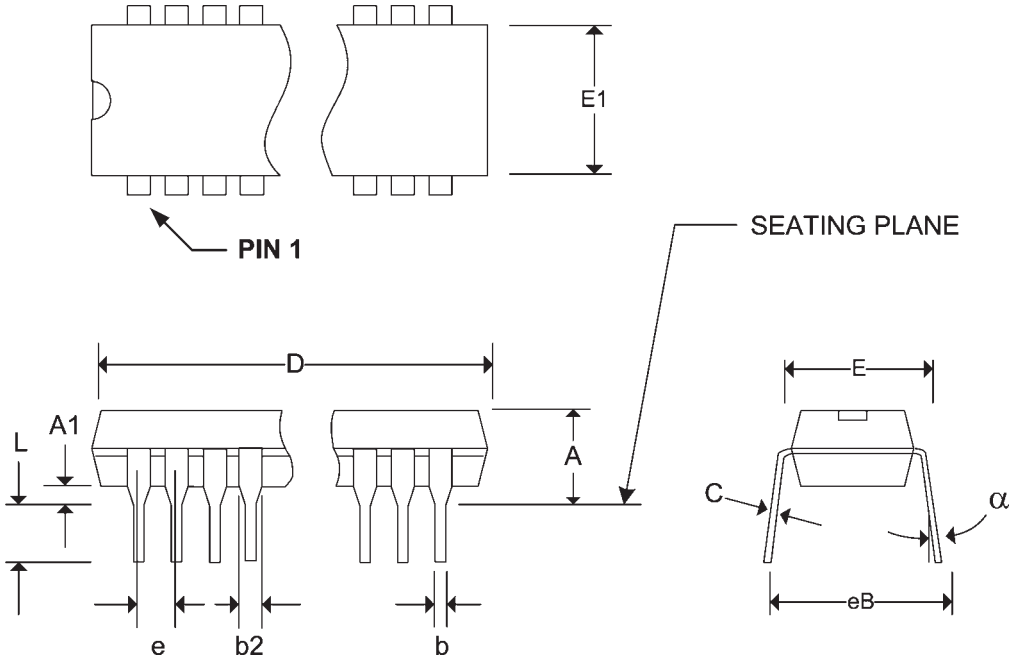
Pkg #	P5	
# Pins	28 (300 mil)	
Symbol	**Min**	**Max**
A	-	0.210
A1		-
b	0.014	0.023
b2	0.045	0.070
C	0.008	0.014
D	1.345	1.400
E1	0.270	0.300
E	0.300	0.380
e	0.100 BSC	
eB	-	0.430
L	0.115	0.150
α	0°	15°

PLASTIC DUAL IN-LINE PACKAGE (300 mil)



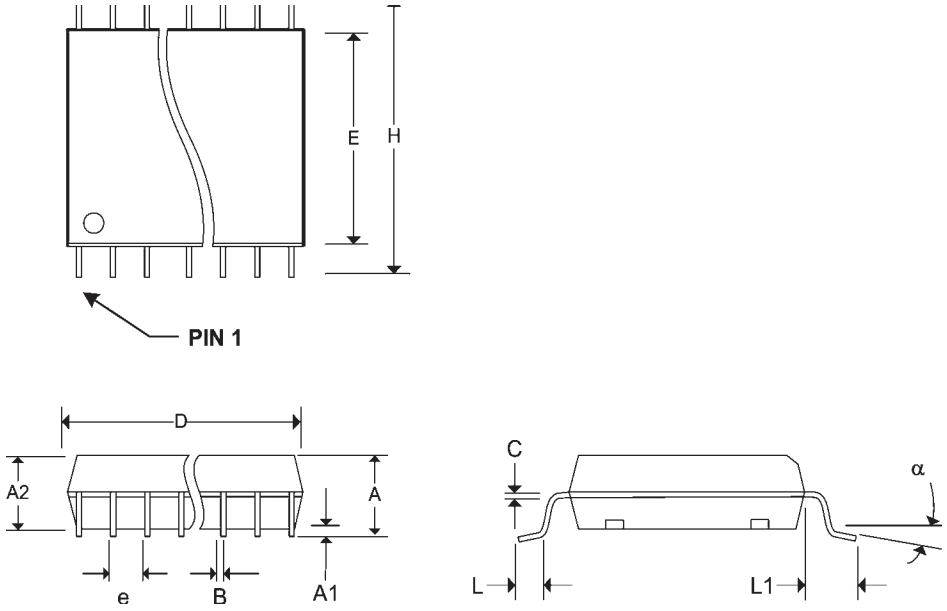
Pkg #	P6	
# Pins	28 (600 mil)	
Symbol	**Min**	**Max**
A	0.090	0.200
A1	0.000	0.070
b	0.014	0.020
b2	0.015	0.065
C	0.008	0.012
D	1.380	1.480
E1	0.485	0.550
E	0.600	0.625
e	0.100 BSC	
eB	0.600 TYP	
L	0.100	0.200
α	0°	15°

PLASTIC DUAL IN-LINE PACKAGE (600 mil)



Pkg #	S5	
# Pins	28 (330 mil)	
Symbol	**Min**	**Max**
A	0.079	0.102
A1	0.000	0.008
B	0.012	0.020
C	0.004	0.008
D	0.701	0.717
e	0.050 BSC	
E	0.331	0.346
H	0.457	0.488
L	0.016	0.050
α	0°	8°

SOIC/SOP SMALL OUTLINE IC PACKAGE (S)



REVISIONS

DOCUMENT NUMBER: SRAM116
DOCUMENT TITLE: P4C164L LOW POWER 8K x 8 STATIC CMOS RAM

REV.	ISSUE DATE	ORIG. OF CHANGE	DESCRIPTION OF CHANGE
OR	Oct-05	JDB	New Data Sheet
A	Aug-06	JDB	Added Lead Free Designation
B	Jun-07	JDB	Corrected SOP package details