

## HIGH SPEED 128K X 8 SINGLE CHIP ENABLE CMOS STATIC RAM

### FEATURES

- Access Times  
– 20/25/35/45/55/70 ns
- Single 5V±10% Power Supply
- Easy Memory Expansion using  $\overline{CE}$  and  $\overline{OE}$  Inputs
- Battery Backup: 2V Data Retention [P4C1023L only]
- Common Data I/O
- Three-State Outputs
- Fully TTL Compatible Inputs and Outputs
- Advanced CMOS Technology
- Automatic Power Down
- Packages
  - 32-Pin 400 or 600 mil Ceramic DIP
  - 32-Pin Ceramic SOJ
  - 32-Pin Ceramic LCC (400x820 mil) [2-sided]
  - 32-Pin Ceramic LCC (450x550 mil)
  - 32-Pin Solder Seal Ceramic Flatpack



### DESCRIPTION

The P4C1023/L is a 1,048,576-bit high speed CMOS static RAM organized as 128K 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 of 20 ns to 70 ns are available. CMOS is utilized to reduce power consumption to a low level.

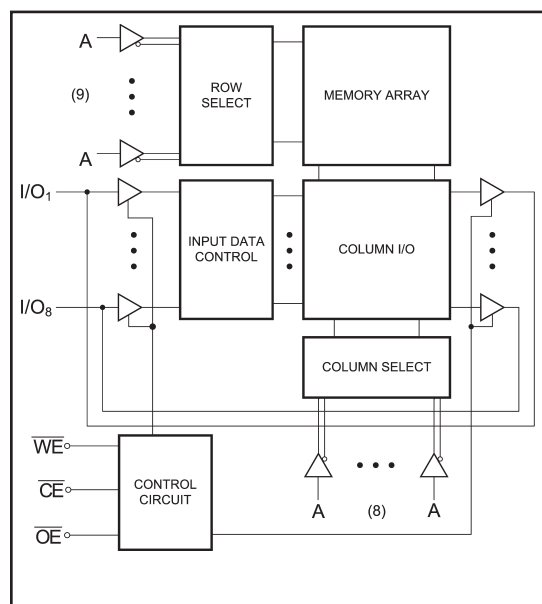
The P4C1023/L device provides asynchronous operation with matching access and cycle times. Memory loca-

tions are specified on address pins  $A_0$  to  $A_{16}$ . 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 low power version offers 2V data retention mode.

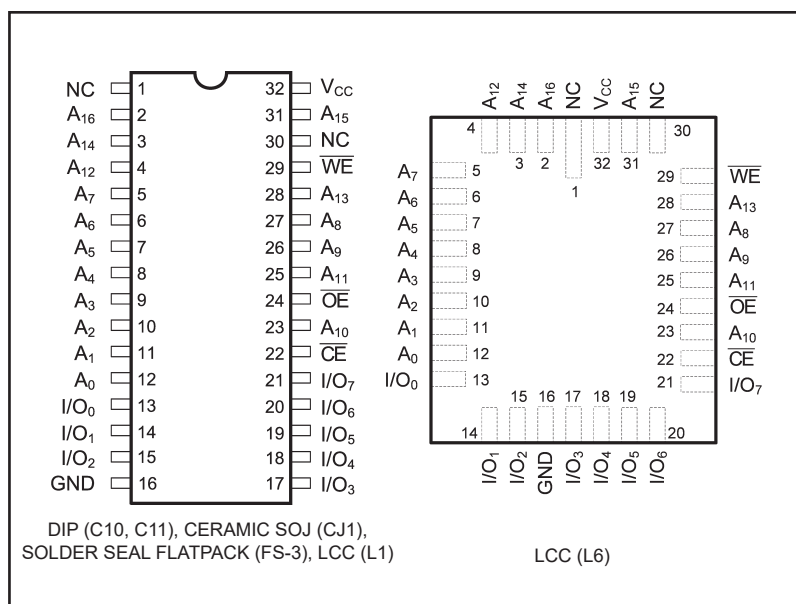
The P4C1023/L is packaged in a 32-pin 400 or 600 mil ceramic DIP and in a 32-pin ceramic SOJ.



### FUNCTIONAL BLOCK DIAGRAM



### PIN CONFIGURATIONS



**MAXIMUM RATINGS<sup>(1)</sup>**

Sym	Parameter	Value	Unit
V <sub>CC</sub>	Power Supply Pin with Respect to GND	-0.5 to +6	V
V <sub>TERM</sub>	Terminal Voltage with Respect to GND (up to 7.0V)	-0.5 to V <sub>CC</sub> + 0.5	V
T <sub>A</sub>	Operating Temperature	-55 to +125	°C
T <sub>BIAS</sub>	Temperature Under Bias	-55 to +125	°C
T <sub>STG</sub>	Storage Temperature	-65 to +150	°C
P <sub>T</sub>	Power Dissipation	1.0	W
I <sub>OUT</sub>	DC Output Current	20	mA

**RECOMMENDED OPERATING CONDITIONS**

Grade <sup>(2)</sup>	Ambient Temp	GND	V <sub>CC</sub>
Commercial	0°C to 70°C	0V	5.0V ± 10%
Industrial	-40°C to +85°C	0V	5.0V ± 10%
Military	-55°C to +125°C	0V	5.0V ± 10%

**CAPACITANCES<sup>(4)</sup>**(V<sub>CC</sub> = 5.0V, T<sub>A</sub> = 25°C, f = 1.0MHz)

Sym	Parameter	Conditions	Typ	Unit
C <sub>IN</sub>	Input Capacitance	V <sub>IN</sub> =0V	8	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>OUT</sub> =0V	10	pF

**DC ELECTRICAL CHARACTERISTICS**

(Over Recommended Operating Temperature &amp; Supply Voltage)

Symbol	Parameter	Test Conditions	Min	Max	Unit	
V <sub>OH</sub>	Output High Voltage (I/O <sub>0</sub> -I/O <sub>7</sub> )	I <sub>OH</sub> = -4mA, V <sub>CC</sub> =4.5V	2.4		V	
V <sub>OL</sub>	Output Low Voltage (I/O <sub>0</sub> -I/O <sub>7</sub> )	I <sub>OL</sub> = 6mA		Com/Ind	0.40	V
				Military	0.55	
V <sub>IH</sub>	Input High Voltage		2.2	V <sub>CC</sub> + 0.5	V	
V <sub>IL</sub>	Input Low Voltage		-0.5	0.8	V	
I <sub>LI</sub>	Input Leakage Current	GND ≤ V <sub>IN</sub> ≤ V <sub>CC</sub>	-10	10	μA	
I <sub>LO</sub>	Output Leakage Current	GND ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub>	-10	10	μA	
I <sub>SB</sub>	V <sub>CC</sub> Current TTL Standby Current (TTL Input Levels)	$\overline{CE} \geq V_{IH}$ ; V <sub>CC</sub> =Max; I <sub>OUT</sub> =0mA, f=0; V <sub>IN</sub> ≤ V <sub>IL</sub> or V <sub>IN</sub> ≥ V <sub>IH</sub>		25	mA	
I <sub>SB1</sub>	V <sub>CC</sub> Current CMOS Standby Current (CMOS Input Levels)	$\overline{CE} \geq V_{CC} - 0.2V$ ; V <sub>CC</sub> =Max; I <sub>OUT</sub> =0mA, f=0 Hz; V <sub>IN</sub> ≤ 0.2V or V <sub>IN</sub> ≥ V <sub>CC</sub> - 0.2V		15	mA	

N/A = Not applicable

## POWER DISSIPATION CHARACTERISTICS VS. SPEED

Symbol	Parameter	Temperature	-20	-25	-35	-45	-55	-70	Unit
$I_{CC}$	Dynamic Operating Current	Commercial	90	85	80	N/A	N/A	N/A	mA
		Industrial	95	90	85	80	N/A	N/A	mA
		Military	100	95	90	85	80	75	mA

## DATA RETENTION CHARACTERISTICS (P4C1023L ONLY)

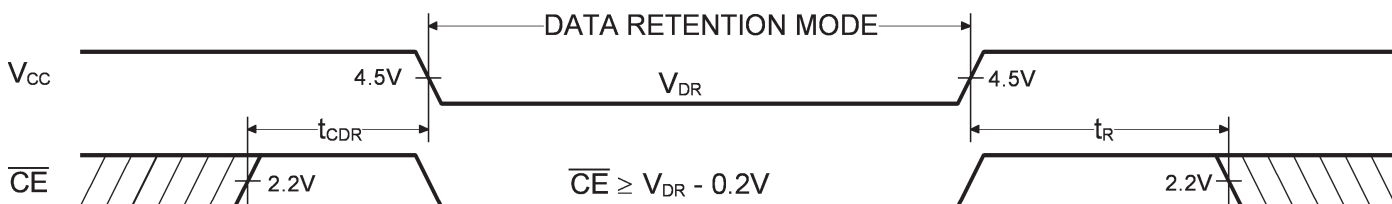
Symbol	Parameter	Test Conditions	Min	Typ* $V_{CC} =$		Max $V_{CC} =$		Unit
				2.0V	3.0V	2.0V	3.0V	
$V_{DR}$	$V_{CC}$ for Data Retention		2.0					V
$I_{CCDR}$	Data Retention Current	$\overline{CE} \geq V_{CC} - 0.2V,$		325	530	5,000	10,000	$\mu A$
$t_{CDR}$	Chip Deselect to Data Retention Time	$V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$	0					ns
$t_R^\dagger$	Operation Recovery Time		$t_{RC}^\S$					ns

$\S t_{RC}$  = Read Cycle Time

$\dagger$  This Parameter is guaranteed but not tested

\*  $T_A = +25^\circ C$

## DATA RETENTION WAVEFORM

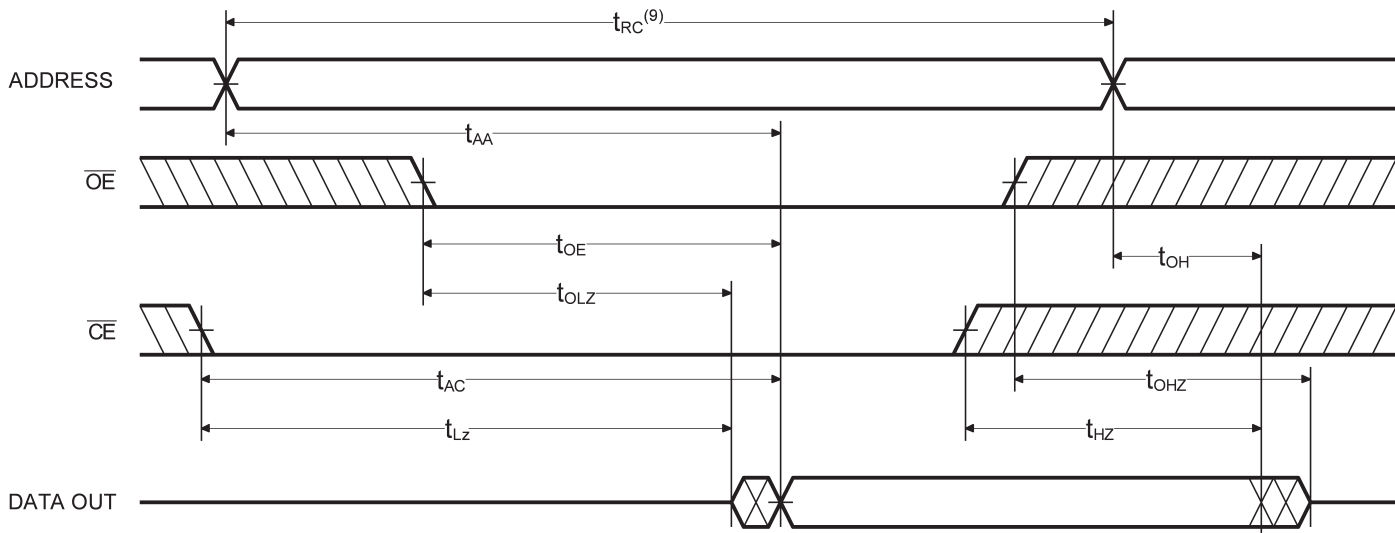


## AC ELECTRICAL CHARACTERISTICS—READ CYCLE

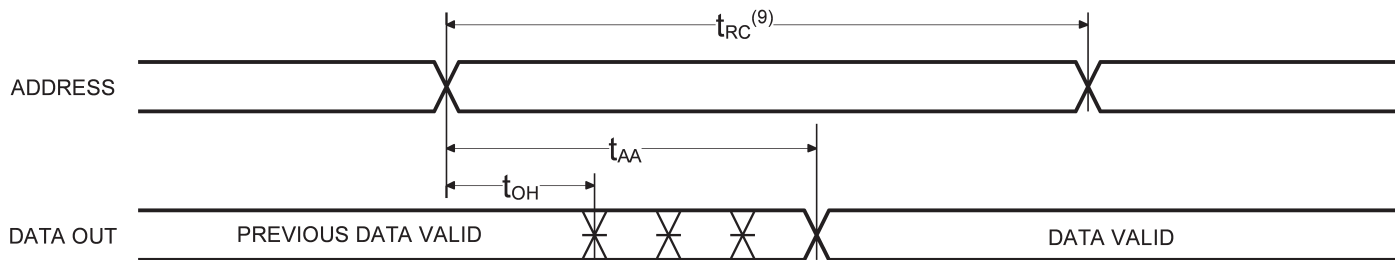
( $V_{CC} = 5V \pm 10\%$ , All Temperature Ranges)<sup>(2)</sup>

Sym	Parameter	-20		-25		-35		-45		-55		-70		Unit
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
$t_{RC}$	Read Cycle Time	20		25		35		45		55		70		ns
$t_{AA}$	Address Access Time		20		25		35		45		55		70	ns
$t_{AC}$	Chip Enable Access Time		20		25		35		45		55		70	ns
$t_{OH}$	Output Hold from Address Change	3		3		3		3		3		3		ns
$t_{LZ}$	Chip Enable to Output in Low Z	3		3		3		3		3		3		ns
$t_{HZ}$	Chip Disable to Output in High Z		10		12		15		20		25		30	ns
$t_{OE}$	Output Enable Low to Data Valid		10		12		15		20		25		30	ns
$t_{OLZ}$	Output Enable Low to Low Z	0		0		0		0		0		0		ns
$t_{OHZ}$	Output Enable High to High Z		10		12		15		20		25		30	ns
$t_{PU}$	Chip Enable to Power Up Time	0		0		0		0		0		0		ns
$t_{PD}$	Chip Disable to Power Down Time		20		25		35		45		55		70	ns

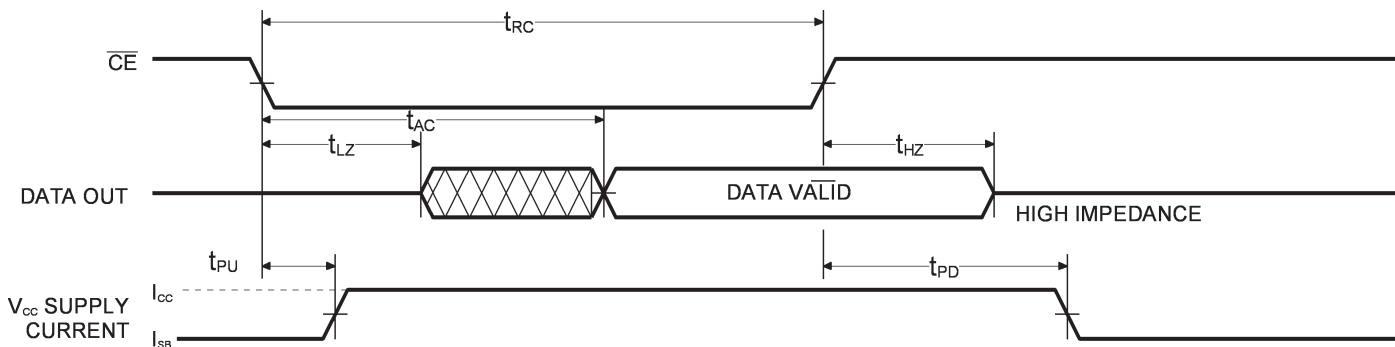
**TIMING WAVEFORM OF READ CYCLE NO. 1 ( $\overline{OE}$  CONTROLLED)<sup>(5)</sup>**



**TIMING WAVEFORM OF READ CYCLE NO. 2 (ADDRESS CONTROLLED)<sup>(5,7,8)</sup>**



**TIMING WAVEFORM OF READ CYCLE NO. 3 ( $\overline{CE}$  CONTROLLED)**



**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  $V_L$  and  $I_L$  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.
5.  $\overline{WE}$  is HIGH for READ cycle.
6.  $\overline{CE}$  is LOW and  $\overline{OE}$  is LOW for READ cycle.
7. ADDRESS must be valid prior to, or coincident with  $\overline{CE}$  transition LOW.
8. 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.
9. Read Cycle Time is measured from the last valid address to the first transitioning address.

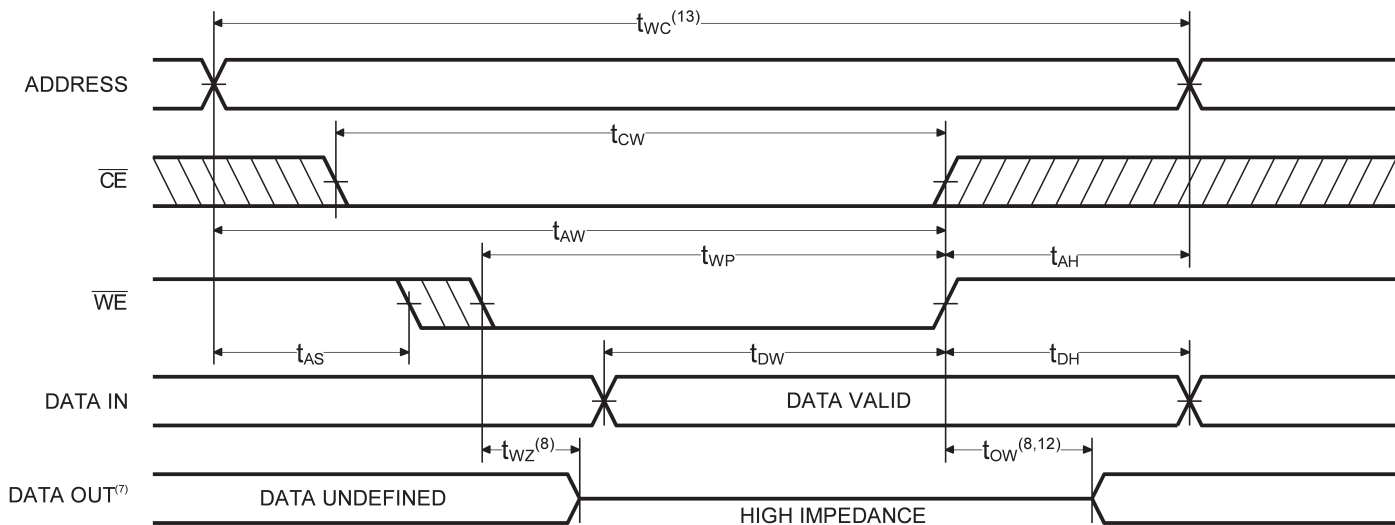


### AC CHARACTERISTICS—WRITE CYCLE

( $V_{CC} = 5V \pm 10\%$ , All Temperature Ranges)<sup>(2)</sup>

Sym	Parameter	-20		-25		-35		-45		-55		-70		Unit
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
$t_{WC}$	Write Cycle Time	20		25		35		45		55		70		ns
$t_{CW}$	Chip Enable Time to End of Write	15		20		25		35		40		45		ns
$t_{AW}$	Address Valid to End of Write	15		20		25		35		40		45		ns
$t_{AS}$	Address Setup Time	0		0		0		0		0		0		ns
$t_{WP}$	Write Pulse Width	15		20		25		35		40		45		ns
$t_{AH}$	Address Hold Time	0		0		0		0		0		0		ns
$t_{DW}$	Data Valid to End of Write	10		15		20		30		35		40		ns
$t_{DH}$	Data Hold Time	0		0		0		0		0		0		ns
$t_{WZ}$	Write Enable to Output in High Z	9		10		15		20		25		30		ns
$t_{OW}$	Output Active from End of Write	3		3		3		3		3		3		ns

### TIMING WAVEFORM OF WRITE CYCLE NO. 1 ( $\overline{WE}$ CONTROLLED)<sup>(10)</sup>



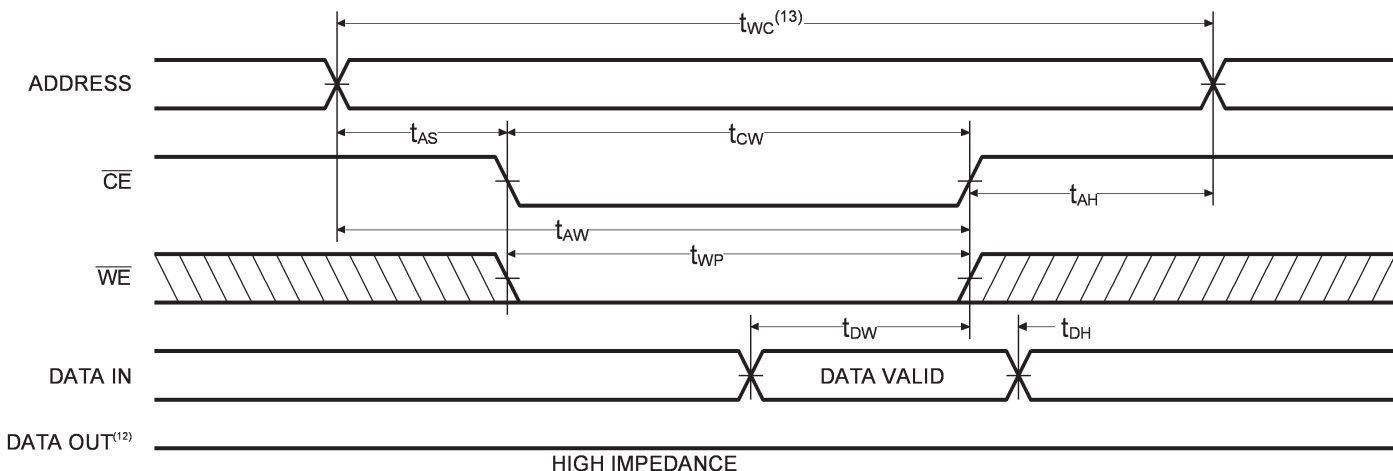
Notes:

- 10.  $\overline{CE}$  and  $\overline{WE}$  must be LOW for WRITE cycle.
- 11.  $\overline{OE}$  is LOW for this WRITE cycle to show  $t_{WZ}$  and  $t_{OW}$ .
- 12. If  $\overline{CE}$  goes HIGH simultaneously with  $\overline{WE}$  HIGH, the output remains in a high impedance state.

- 13. 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>(10)</sup>



### AC TEST CONDITIONS

Input Pulse Levels	GND to 3.0V
Input Rise and Fall Times	5ns
Input Timing Reference Level	1.5V
Output Timing Reference Level	1.5V
Output Load	See Figures 1 and 2

### TRUTH TABLE

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

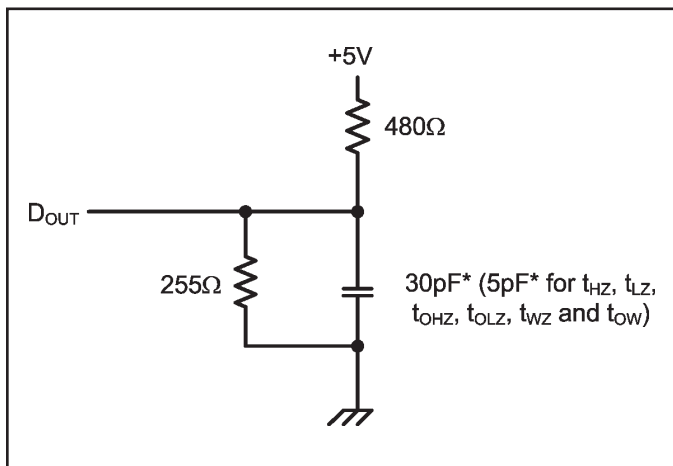


Figure 1. Output Load

\* including scope and test fixture.

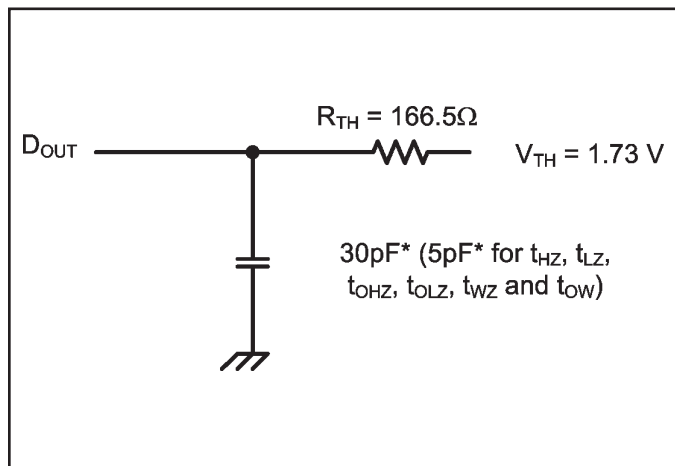


Figure 2. Thevenin Equivalent

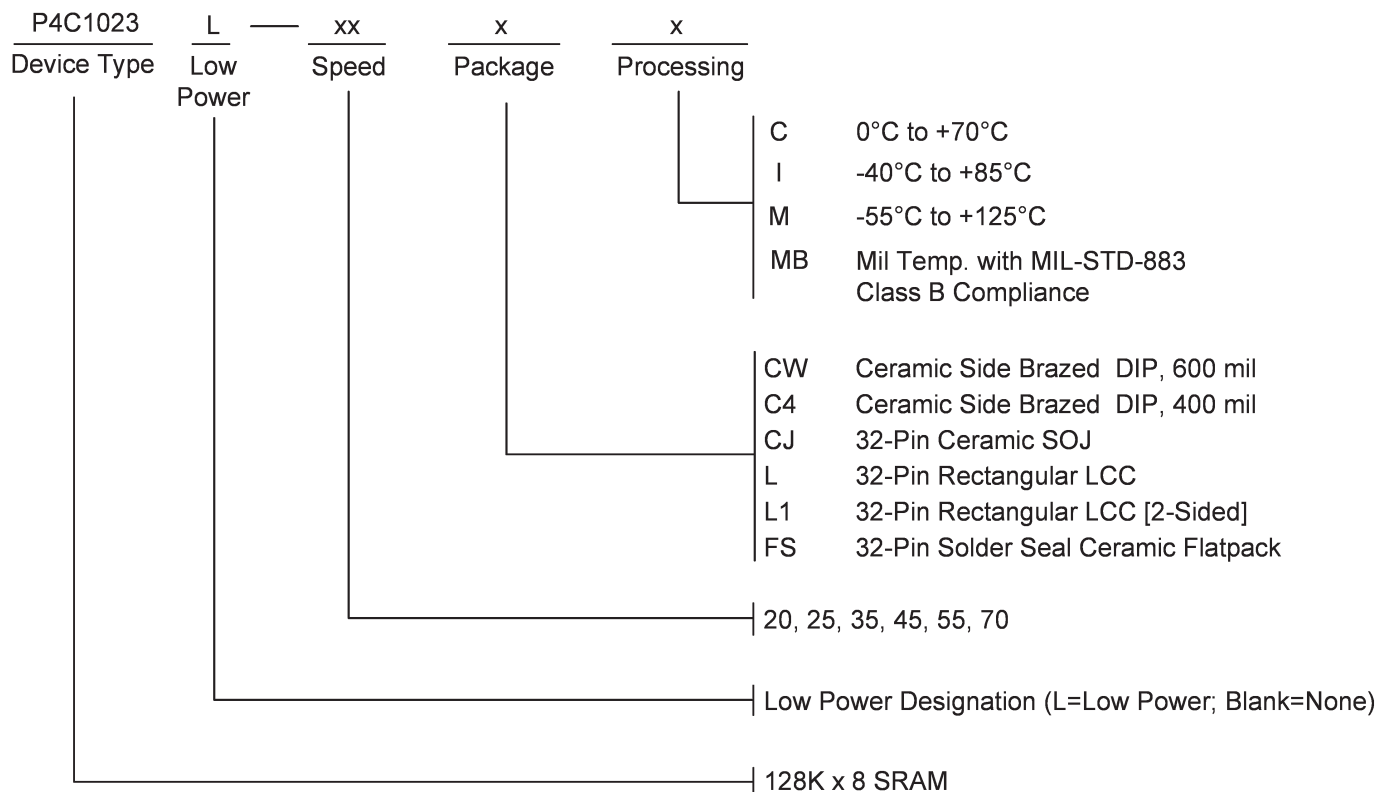
**Note:**

Because of the high speed of the P4C1023/L, 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<sub>CC</sub> and ground planes directly up to the contactor fingers. A 0.01 μF high frequency capacitor is also required between V<sub>CC</sub> 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 1.73V (Thevenin Voltage) at the comparator input, and a 116Ω resistor must be used in series with D<sub>OUT</sub> to match 166Ω (Thevenin Resistance).



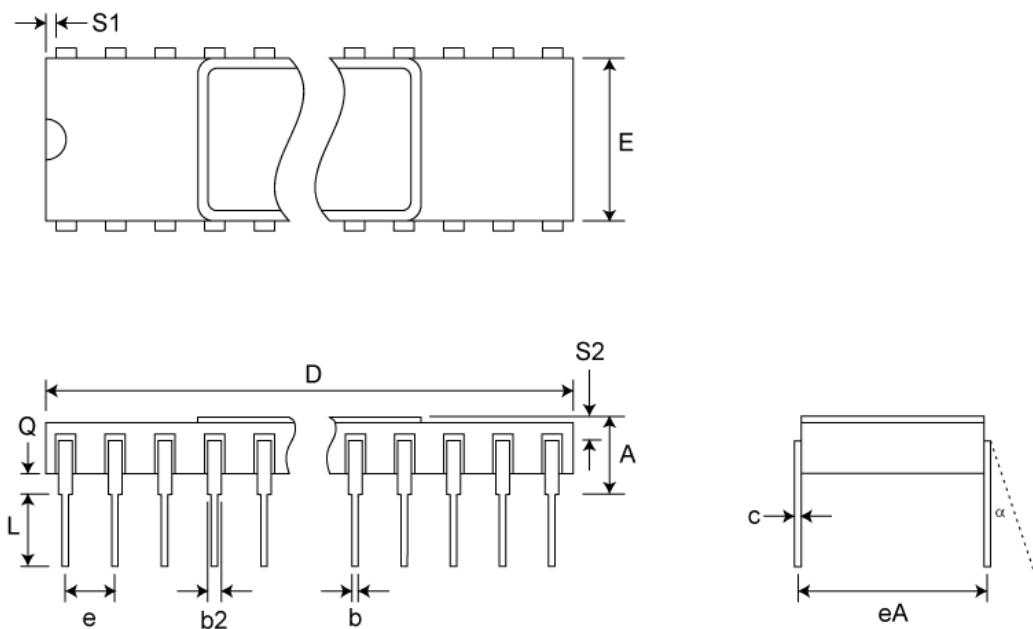
### ORDERING INFORMATION





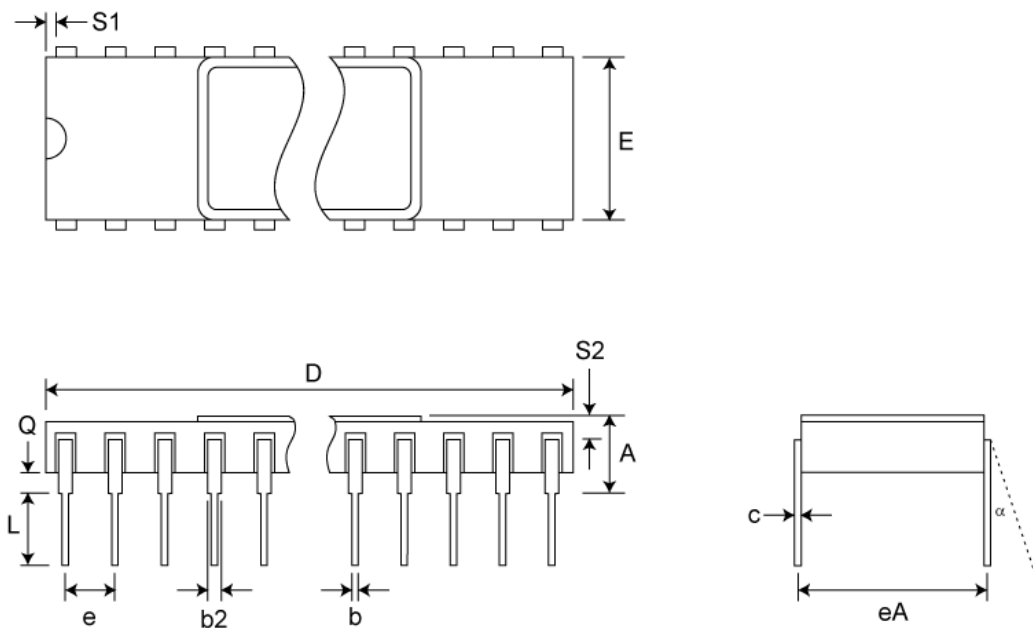
Pkg #	C10	
# Pins	32 (600 mil)	
Symbol	Min	Max
A	-	0.225
b	0.014	0.026
b2	0.045	0.065
C	0.008	0.018
D	-	1.680
E	0.510	0.620
eA	0.600 BSC	
e	0.100 BSC	
L	0.125	0.200
Q	0.015	0.070
S1	0.005	-
S2	0.005	-

**SIDEBRAZED DUAL IN-LINE PACKAGE**



Pkg #	C11	
# Pins	32 (400 mil)	
Symbol	Min	Max
A	-	0.232
b	0.014	0.023
b2	0.038	0.065
C	0.008	0.018
D	-	1.700
E	0.350	0.410
eA	0.400 BSC	
e	0.100 BSC	
L	0.125	0.200
Q	0.015	0.060
S1	0.005	-
S2	0.005	-

**SIDEBRAZED DUAL IN-LINE PACKAGE**

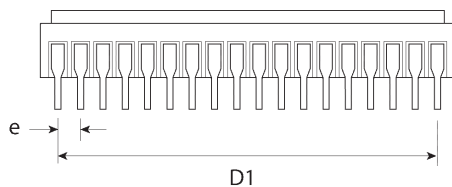
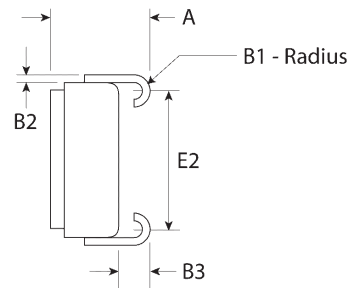
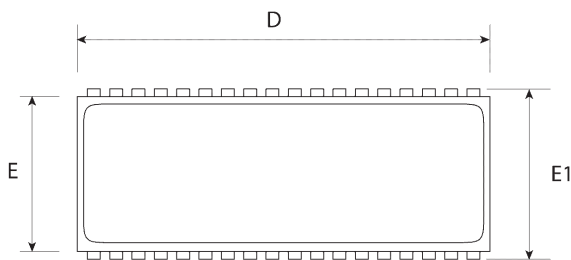






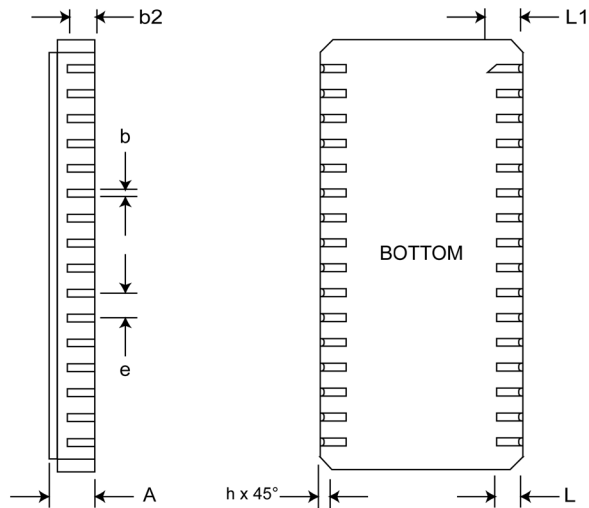
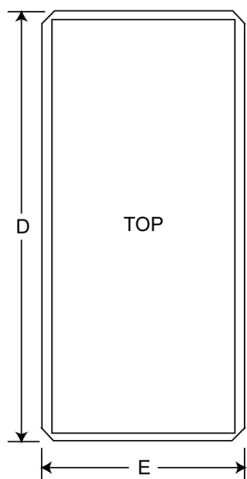
### CERAMIC SOJ SMALL OUTLINE IC PACKAGE

Pkg #	<b>CJ1</b>	
# Pins	32	
Symbol	Min	Max
A	0.120	0.165
A1	0.088	0.120
A2	0.070	REF
B	0.010	REF
B1	0.030R	TYP
B2	0.020	REF
B3	0.040	0.060
D	0.820	0.840
D1	0.750	REF
E	0.425	0.435
E1	0.430	0.445
E2	0.366	0.386
e	0.050 BSC	
e1	0.038	TYP
e2	0.005	
j	0.005	TYP
S	0.030	0.040
S1	0.020	TYP



Pkg #	<b>L1</b>	
# Pins	32	
Symbol	Min	Max
A	0.080	0.100
b	0.022	0.028
b1	0.006	0.022
b2	0.040	-
D	0.820	0.840
E	0.392	0.400
e	0.050 BSC	
h	0.012 REF	
L	0.070	0.080
L1	0.090	0.110
L2	0.003	0.015
N	32	

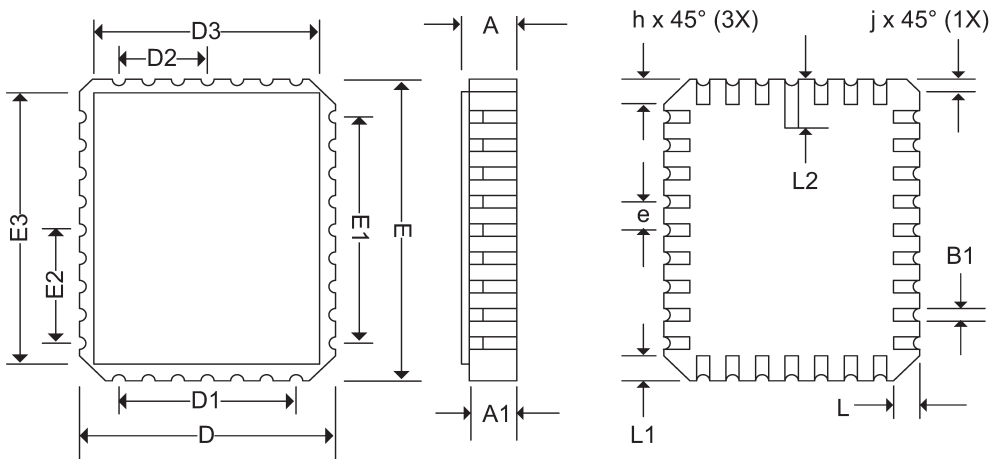
### 2-SIDED LEADLESS CHIP CARRIER





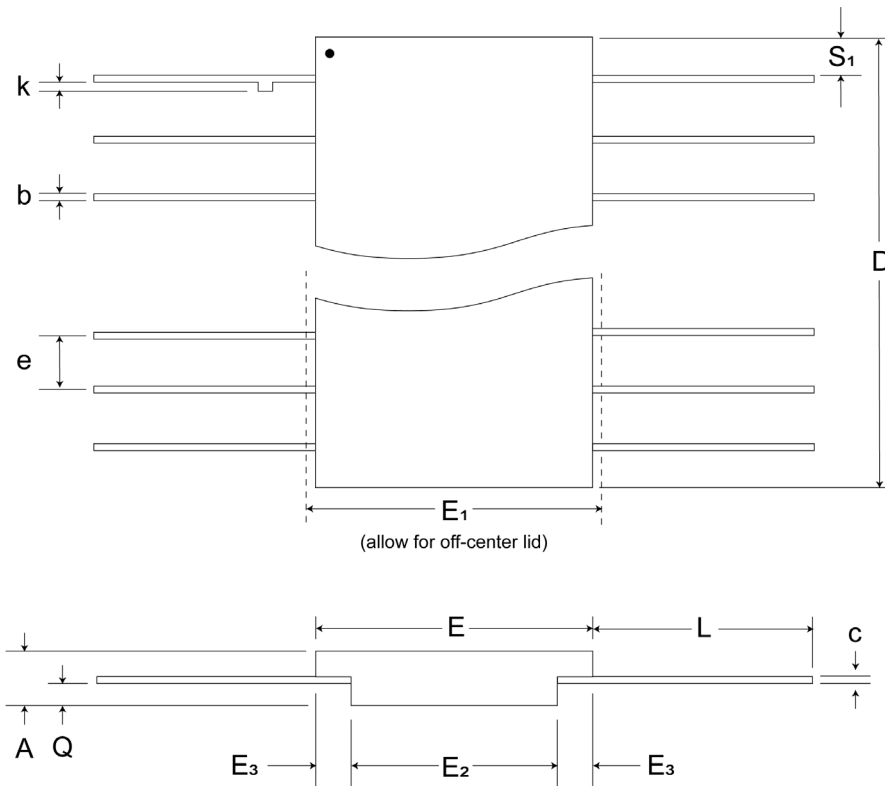
### RECTANGULAR LEADLESS CHIP CARRIER

Pkg #	L6	
# Pins	32	
Symbol	Min	Max
A	0.060	0.075
A1	0.050	0.065
B1	0.022	0.028
D	0.442	0.458
D1	0.300 BSC	
D2	0.150 BSC	
D3	-	0.458
E	0.540	0.560
E1	0.400 BSC	
E2	0.200 BSC	
E3	-	0.558
e	0.050 BSC	
h	0.040 REF	
j	0.020 REF	
L	0.045	0.055
L1	0.045	0.055
L2	0.075	0.095
ND	7	
NE	9	



### SOLDER SEAL FLAT PACKAGE

Pkg #	FS-3	
# Pins	32	
Symbol	Min	Max
A	0.097	0.125
b	0.015	0.019
c	0.003	0.009
D	-	0.830
E	0.400	0.420
E1	-	0.450
E2	0.180	-
E3	0.030	-
e	0.050 BSC	
L	0.250	0.370
Q	0.020	0.045
S	-	0.045
S1	0.000	-
M	-	0.002
N	32	



**REVISIONS**

<b>DOCUMENT NUMBER</b>	SRAM141
<b>DOCUMENT TITLE</b>	P4C1023 - HIGH SPEED 128K X 8 SINGLE CHIP ENABLE CMOS STATIC RAM

<b>REV</b>	<b>ISSUE DATE</b>	<b>ORIGINATOR</b>	<b>DESCRIPTION OF CHANGE</b>
OR	Dec-2010	JDB	New Data Sheet
01	Dec-2019	JDB	Added L1, L6, and FS-3 packages
02	Dec-2020	JDB	Updated $V_{OL}$ to show commercial and military temps