P4C164/P4C164L
ULTRA HIGH SPEED 8K x 8
STATIC CMOS RAMS

FEATURES

- **Full CMOS, 6T Cell**
- **High Speed (Equal Access and Cycle Times)**
  - **– 8/10/12/15/20/25/35/70/100 ns (Commercial)**
  - **– 10/12/15/20/25/35/70/100 ns(Industrial)**
  - **– 12/15/20/25/35/45 ns (Military)**
- **Low Power Operation**
  - **– 770mW Active –15**
  - **– 660/743 mW Active – 20**
  - **– 495/575 mW Active – 25, 35, 45**
  - **– 193/220 mW Standby (TTL Input)**
  - **– 5.5mW Standby (CMOS Input) P4C164L (Military)**
- **Output Enable and Dual Chip Enable Control Functions**
- **Single 5V±10% Power Supply**
- **Data Retention with 2.0V Supply, 10 µA Typical Current (P4C164L Military)**
- **Common Data I/O**
- **Fully TTL Compatible Inputs and Outputs**
- **Standard Pinout (JEDEC Approved)**
  - **– 28-Pin 300 mil DIP, SOJ**
  - **– 28-Pin 600 mil Plastic DIP (70 & 100ns)**
  - **– 28-Pin 600 mil Ceramic DIP**
  - **– 28-Pin 350 x 550 mil LCC**
  - **– 28-Pin CERPACK**

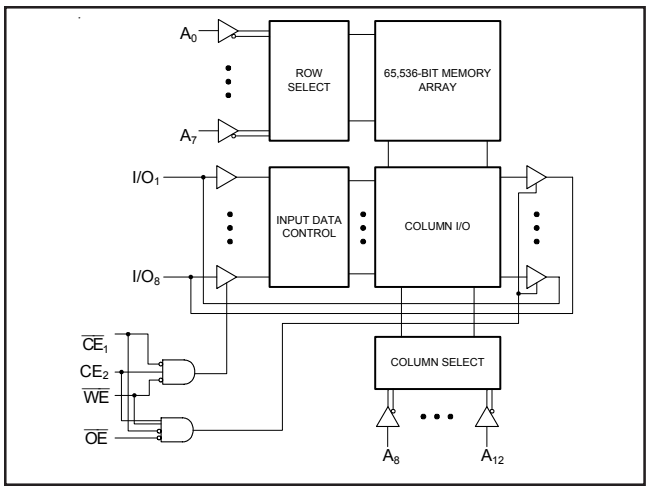
DESCRIPTION

The P4C164 and P4C164L are 65,536-bit ultra high-speed static RAMs organized as 8K x 8. The CMOS memories require no clocks or refreshing and have equal access and cycle times. Inputs are fully TTL-compatible. The RAMs operate from a single 5V±10% tolerance power supply. With battery backup, data integrity is maintained with supply voltages down to 2.0V. Current drain is typically 10 µA from a 2.0V supply.

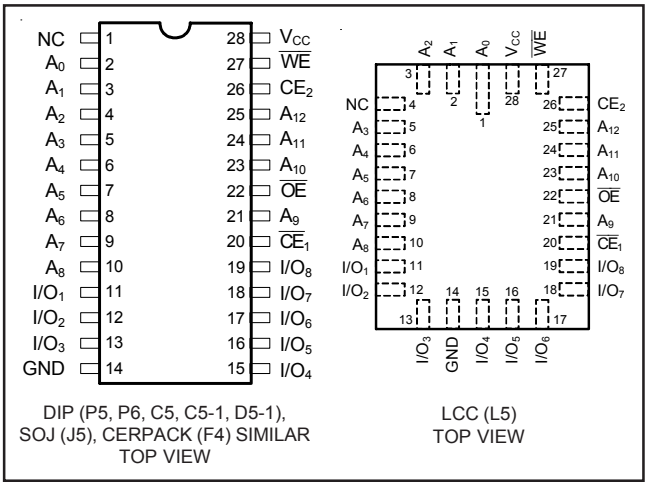
Access times as fast as 8 nanoseconds are available, permitting greatly enhanced system operating speeds. In full standby mode with CMOS inputs, power consumption is only 5.5 mW for the P4C164L.

The P4C164 and P4C164L are available in 28-pin 300 mil DIP and SOJ, 28-pin 600 mil plastic and ceramic DIP, and 28-pin 350 x 550 mil LCC packages providing excellent board level densities. The 70ns and 100ns P4C164 are available in the 600 mil plastic DIP.

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATIONS



DIP (P5, P6, C5, C5-1, D5-1), SOJ (J5), CERPACK (F4) SIMILAR
TOP VIEW

LCC (L5)
TOP VIEW

PYRAMID
SEMICONDUCTOR CORPORATION

MAXIMUM RATINGS[1]

Symbol	Parameter	Value	Unit
V_{CC}	Power Supply Pin with Respect to GND	–0.5 to +7	V
V_{TERM}	Terminal Voltage with Respect to GND (up to 7.0V)	–0.5 to V_{CC} +0.5	V
T_A	Operating Temperature	–55 to +125	°C

Symbol	Parameter	Value	Unit
T_{BIAS}	Temperature Under Bias	–55 to +125	°C
T_{STG}	Storage Temperature	–65 to +150	°C
P_T	Power Dissipation	1.0	W
I_{OUT}	DC Output Current	50	mA

RECOMMENDED OPERATING TEMPERATURE AND SUPPLY VOLTAGE

Grade(2)	Ambient Temperature	GND	V_{cc}
Military	–55°C to +125°C	0V	5.0V ± 10%
Industrial	–40°C to +85°C	0V	5.0V ± 10%
Commercial	0°C to +70°C	0V	5.0V ± 10%

CAPACITANCES[4]

V_{CC} = 5.0V, T_A = 25°C, f = 1.0MHz

Symbol	Parameter	Conditions	Typ.	Unit
C_{IN}	Input Capacitance	V_{IN} = 0V	5	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0V	7	pF

DC ELECTRICAL CHARACTERISTICS

Over recommended operating temperature and supply voltage[2]

Symbol	Parameter	Test Conditions	P4C164		P4C164L		Unit
			Min	Max	Min	Max	
V_{IH}	Input High Voltage		2.2	V_{CC} +0.5	2.2	V_{CC} +0.5	V
V_{IL}	Input Low Voltage		–0.5[3]	0.8	–0.5[3]	0.8	V
V_{HC}	CMOS Input High Voltage		V_{CC} –0.2	V_{CC} +0.5	V_{CC} –0.2	V_{CC} +0.5	V
V_{LC}	CMOS Input Low Voltage		–0.5[3]	0.2	–0.5(3)	0.2	V
V_{CD}	Input Clamp Diode Voltage	V_{CC} = Min., I_{IN} = 18 mA		–1.2		–1.2	V
V_{OL}	Output Low Voltage (TTL Load)	I_{OL} = +8 mA, V_{CC} = Min.		0.4		0.4	V
V_{OH}	Output High Voltage (TTL Load)	I_{OH} = –4 mA, V_{CC} = Min.	2.4		2.4		V
I_{LI}	Input Leakage Current	V_{CC} = Max. Mil. V_{IN} = GND to V_{CC} Com'l.	–10 –5	+10 +5	–5 n/a	+5 n/a	µA
I_{LO}	Output Leakage Current	V_{CC} = Max., $\overline{CE}$ = V_{IH}, Mil. V_{OUT} = GND to V_{CC} Com'l.	–10 –5	+10 +5	–5 n/a	+5 n/a	µA
I_{SB}	Standby Power Supply Current (TTL Input Levels)	$\overline{CE} \geq V_{IH}$ or Mil. $CE_2 \leq V_{IL}$, V_{CC}= Max Ind./Com'l. f = Max., Outputs Open	—— ——	40 30	—— ——	40 n/a	mA
I_{SB1}	Standby Power Supply Current (CMOS Input Levels)	$\overline{CE} \geq V_{HC}$ or Mil. $CE_2 \leq V_{LC}$, V_{CC}= Max Ind./Com'l. f = 0, Outputs Open $V_{IN} \leq V_{LC}$ or $V_{IN} \geq V_{HC}$	—— ——	25 15	—— ——	1 n/a	mA

n/a = Not Applicable

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.

POWER DISSIPATION CHARACTERISTICS VS. SPEED

Symbol	Parameter	Temperature Range	-8	-10	-12	-15	-20	-25	-35	-45	-70	-100	Unit
I_{CC}	Dynamic Operating Current*	Commercial	200	180	170	160	155	150	145	N/A	130	125	mA
		Industrial	N/A	190	180	170	160	155	150	N/A	145	140	mA
		Military	N/A	N/A	180	170	160	155	150	145	N/A	N/A	mA

*V_{CC} = 5.5V. Tested with outputs open. f = Max. Switching inputs are 0V and 3V. $\overline{CE_1}$ = V_{IL}, CE_2 = V_{IH}, $\overline{OE}$ = V_{IH}

DATA RETENTION CHARACTERISTICS (P4C164L, Military Temperature Only)

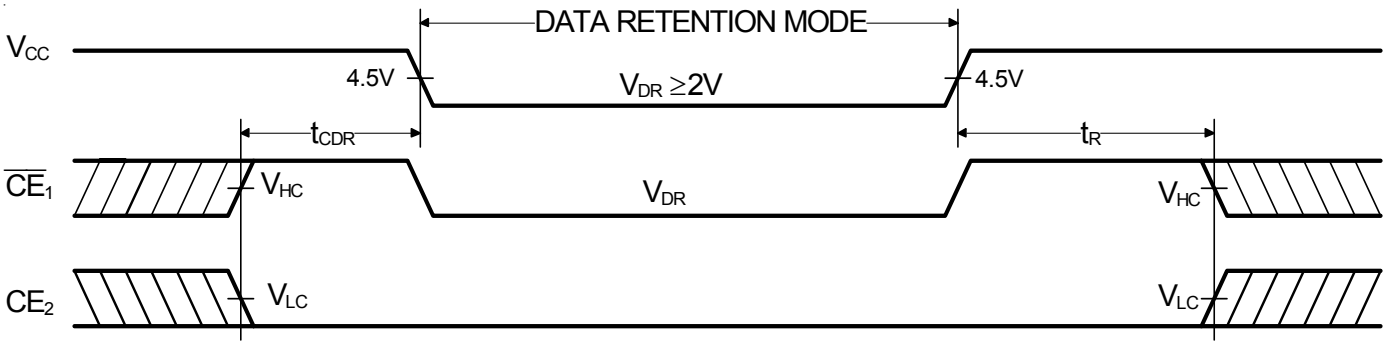
Symbol	Parameter	Test Condition	Min	Typ.* V_{cc}= 2.0V	Typ.* V_{cc}= 3.0V	Max V_{cc}= 2.0V	Max V_{cc}= 3.0V	Unit
V_{DR}	V_{CC} for Data Retention		2.0					V
I_{CCDR}	Data Retention Current	$\overline{CE_1} \geq V_{CC} - 0.2V$ or $CE_2 \leq 0.2V$, $V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$		10	15	200	300	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

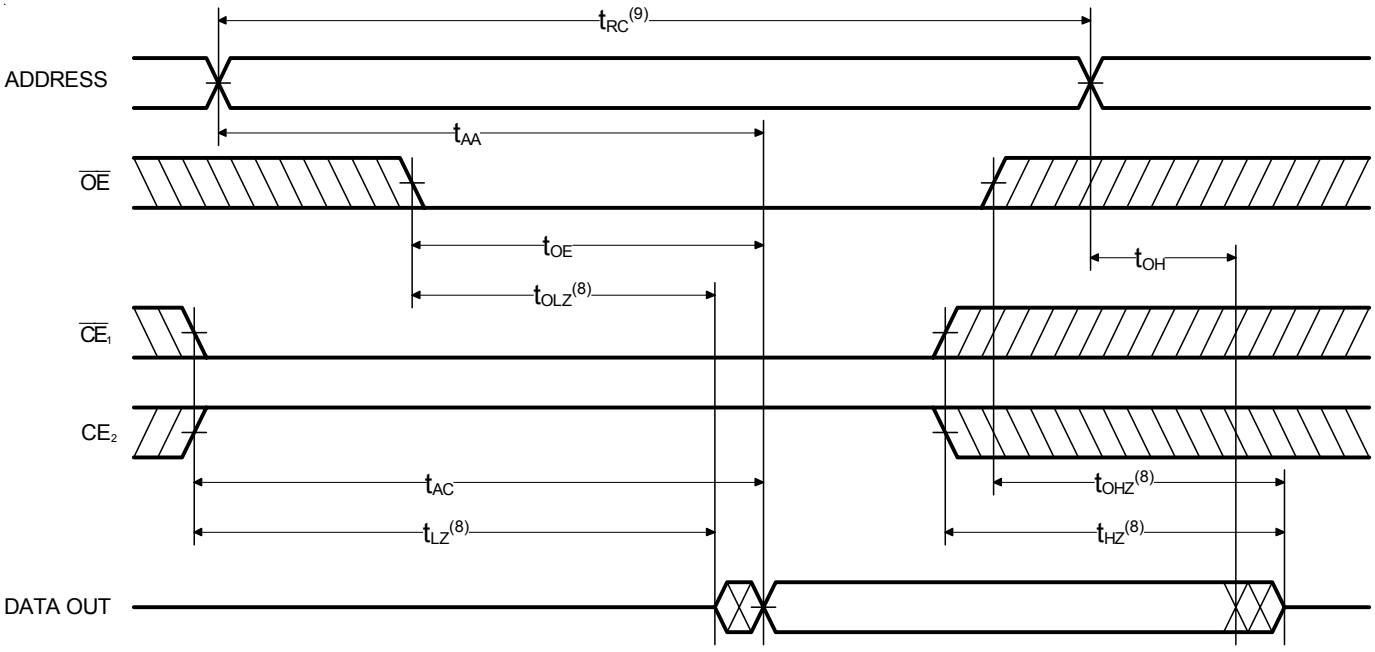


AC ELECTRICAL CHARACTERISTICS—READ CYCLE

(V_{CC} = 5V ± 10%, All Temperature Ranges)[2]

Symbol	Parameter	-8		-10		-12		-15		-20		-25		-35		-45		-70		-100		Unit
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
t_{RC}	Read Cycle Time	8		10		12		15		20		25		35		45		70		100		ns
t_{AA}	Address Access Time		8		10		12		15		20		25		35		45		70		100	ns
t_{AC}	Chip Enable Access Time		8		10		12		15		20		25		35		45		70		100	ns
t_{OH}	Output Hold from Address Change	3		3		3		3		3		3		3		3		3		3		ns
t_{LZ}	Chip Enable to Output in Low Z	2		2		2		2		2		2		2		2		2		2		ns
t_{HZ}	Chip Disable to Output in High Z		5		6		7		8		8		10		15		20		35		45	ns
t_{OE}	Output Enable Low to Data Valid		5		6		7		9		10		13		18		20		35		45	ns
t_{OLZ}	Output Enable Low to Low Z	2		2		2		2		2		2		2		2		2		2		ns
t_{OHZ}	Output Enable High to High Z		5		6		7		9		9		12		15		20		35		45	ns
t_{PU}	Chip Enable to Power Up Time	0		0		0		0		0		0		0		0		0		0		ns
t_{PD}	Chip Disable to Power Down Time		8		10		12		15		20		20		20		25		35		45	ns

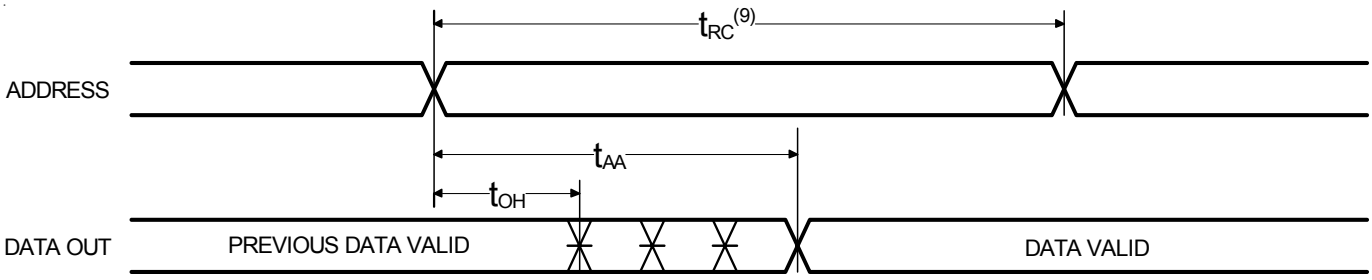
READ CYCLE NO. 1 ($\overline{OE}$ CONTROLLED)[5]



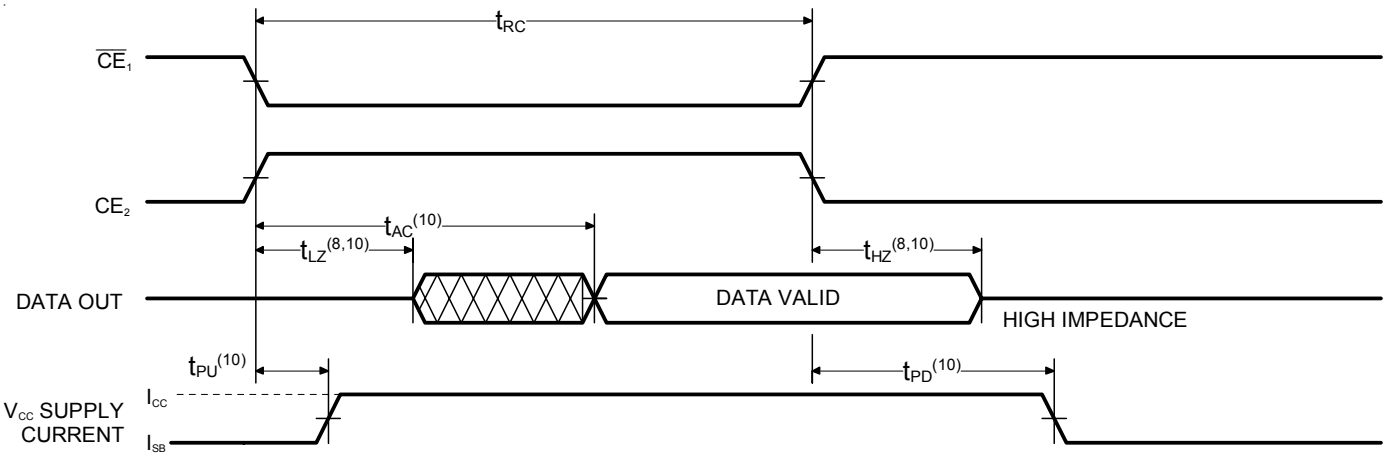
Notes:

5. $\overline{WE}$ is HIGH for READ cycle.
6. $\overline{CE_1}$ is LOW, CE_2 is HIGH and $\overline{OE}$ is LOW for READ cycle.
7. ADDRESS must be valid prior to, or coincident with $\overline{CE_1}$ 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.

READ CYCLE NO. 2 (ADDRESS CONTROLLED)[5,6]



READ CYCLE NO. 3 ($\overline{CE}_1$, CE_2 CONTROLLED)[5,7,10]



Notes:

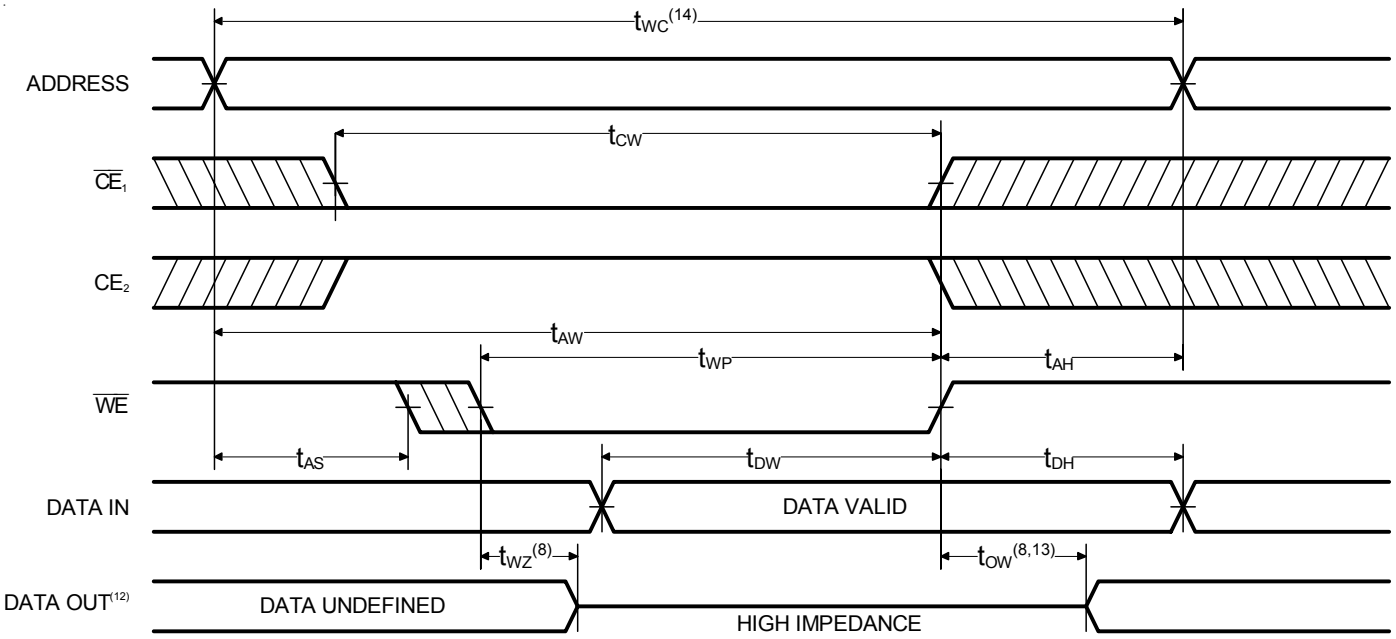
9. READ Cycle Time is measured from the last valid address to the first transitioning address.
10. Transitions caused by a chip enable control have similar delays irrespective of whether $\overline{CE}_1$ or CE_2 causes them.

AC CHARACTERISTICS—WRITE CYCLE

(V_{CC} = 5V ± 10%, All Temperature Ranges)[2]

Symbol	Parameter	-8		-10		-12		-15		-20		-25		-35		-45		-70		-100		Unit
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
t_{WC}	Write Cycle Time	8		10		12		15		20		25		35		45		70		100		ns
t_{CW}	Chip Enable Time to End of Write	6		7		8		12		15		18		25		33		50		70		ns
t_{AW}	Address Valid to End of Write	7		8		10		12		15		18		25		33		50		70		ns
t_{AS}	Address Set-up Time	0		0		0		0		0		0		0		0		0		0		ns
t_{WP}	Write Pulse Width	7		8		9		12		15		18		20		25		40		50		ns
t_{AH}	Address Hold Time	0		0		0		0		0		0		0		0		0		0		ns
t_{DW}	Data Valid to End of Write	6		7		8		9		11		13		15		20		30		40		ns
t_{DH}	Date Hold Time	0		0		0		0		0		0		0		0		0		0		ns
t_{WZ}	Write Enable to Output in High Z		6		7		7		7		8		10		14		18		30		40	ns
t_{OW}	Output Active from End of Write	3		3		3		3		3		3		3		3		3		3		ns

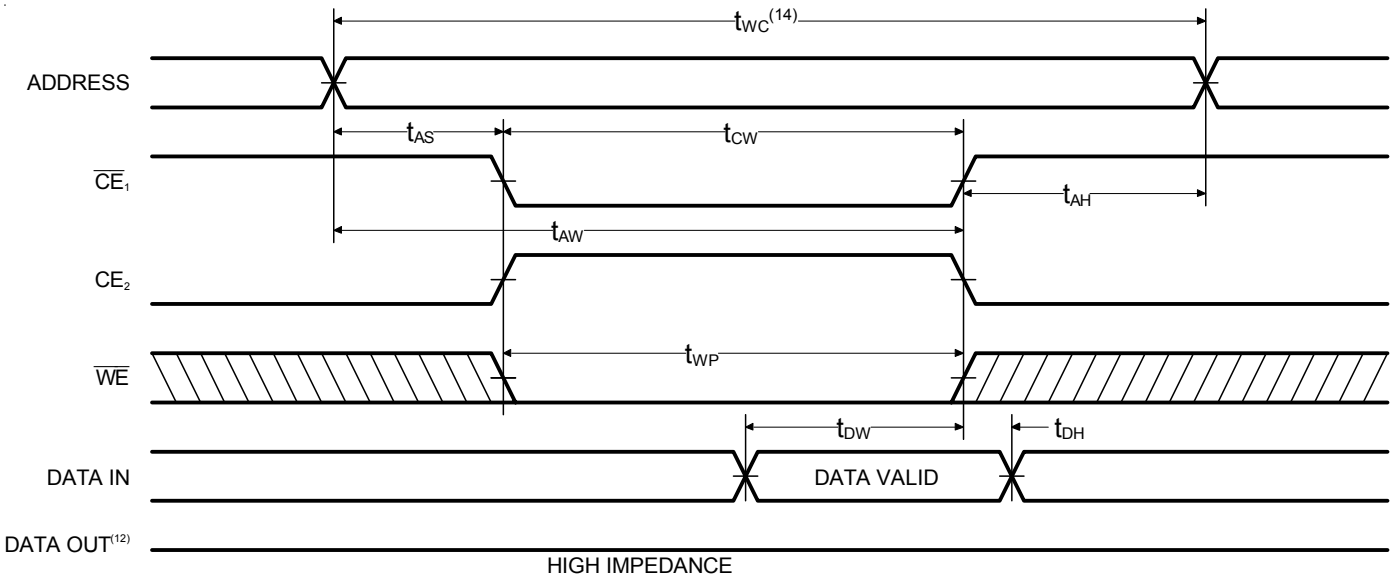
WRITE CYCLE NO. 1 ($\overline{WE}$ CONTROLLED)[11]



Notes:

11. $\overline{CE_1}$ and $\overline{WE}$ must be LOW, and CE_2 HIGH for WRITE cycle.
12. $\overline{OE}$ is LOW for this WRITE cycle to show t_{WZ} and t_{OW}.
13. If $\overline{CE_1}$ goes HIGH, or CE_2 goes LOW, simultaneously with $\overline{WE}$ 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 ($\overline{CE}$ CONTROLLED)[11]



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	$\overline{CE}_1$	CE_2	$\overline{OE}$	$\overline{WE}$	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

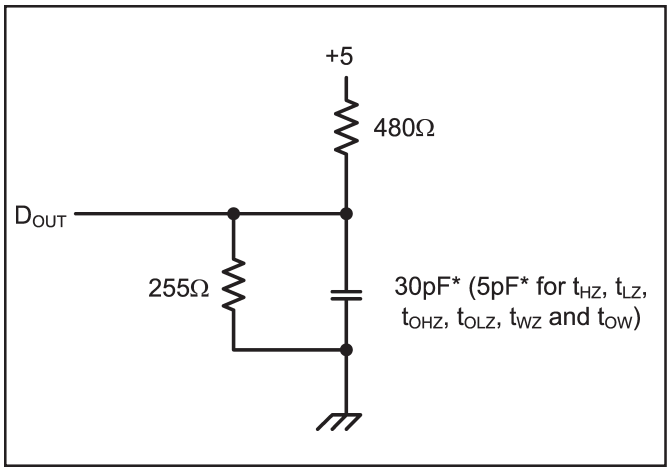


Figure 1. Output Load

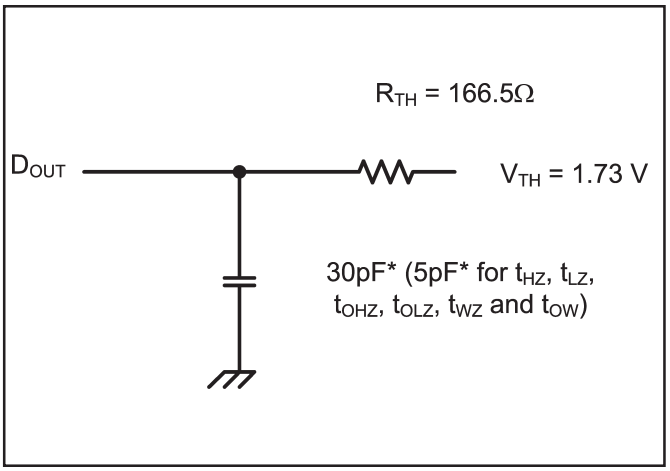
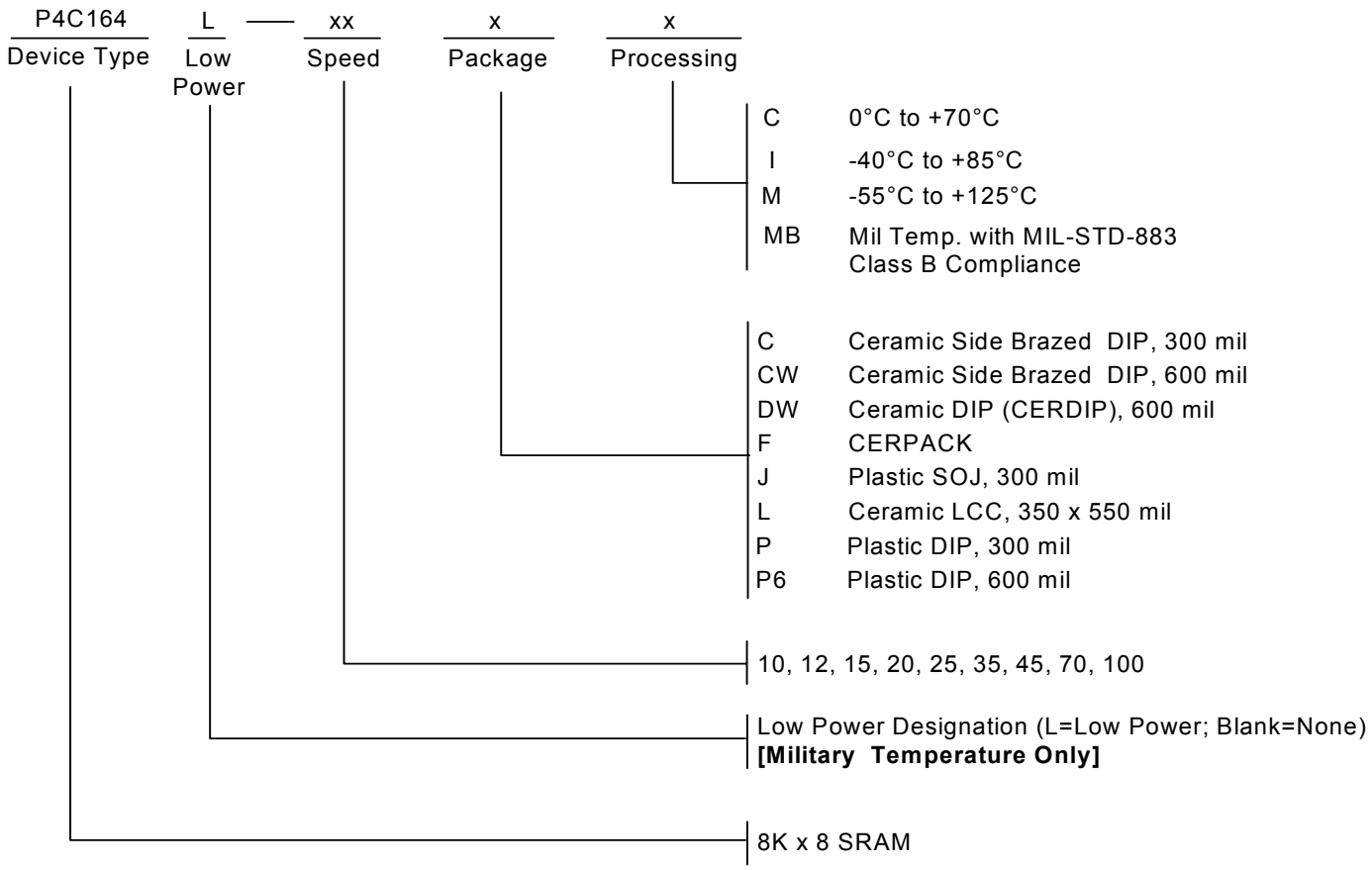


Figure 2. Thevenin Equivalent

* including scope and test fixture.

Note:
Because of the high speed of the P4C164/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_{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 1.73V (Thevenin Voltage) at the comparator input, and a 116Ω resistor must be used in series with D_{OUT} to match 166Ω (Thevenin Resistance).

ORDERING INFORMATION



SELECTION GUIDE

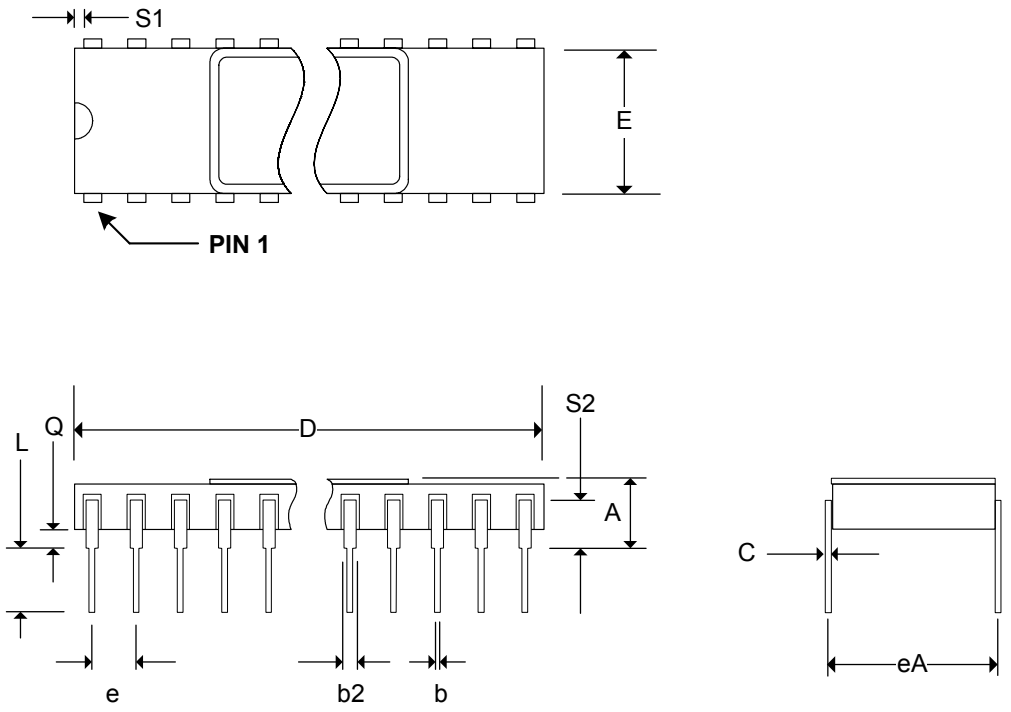
The P4C164 is available in the following temperature, speed and package options. The P4C164L is available only over the military temperature range.

Temperature Range	Package		Speed (ns)								
		8	10	12	15	20	25	35	45	70	100
Commercial	Plastic DIP (300 mil)	-8PC	-10PC	-12PC	-15PC	-20PC	-25PC	-35PC	N/A	N/A	N/A
	Plastic DIP (600 mil)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-70P6C	-100P6C
	Plastic SOJ	-8JC	-10JC	-12JC	-15JC	-20JC	-25JC	-35JC	N/A	N/A	N/A
Industrial	Plastic DIP (300 mil)	N/A	N/A	-12PI	-15PI	-20PI	-25PI	-35PI	N/A	N/A	N/A
	Plastic DIP (600 mil)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-70P6I	-100P6I
	Plastic SOJ	N/A	N/A	-12JI	-15JI	-20JI	-25JI	-35JI	N/A	N/A	N/A
Military Temperature	Side Brazed DIP	N/A	N/A	N/A	-15CM	-20CM	-25CM	-35CM	-45CM	N/A	N/A
	CERDIP (600 mil)	N/A	N/A	N/A	-15DWM	-20DWM	-25DWM	-35DWM	-45DWM	N/A	N/A
	CERPACK	N/A	N/A	N/A	-15FM	-20FM	-25FM	-35FM	-45FM	N/A	N/A
	LCC	N/A	N/A	N/A	-15LM	-20LM	-25LM	-35LM	-45LM	N/A	N/A
Military Processed*	Side Brazed DIP	N/A	N/A	N/A	-15CMB	-20CMB	-25CMB	-35CMB	-45CMB	N/A	N/A
	CERDIP (600 mil)	N/A	N/A	N/A	-15DWMB	-20DWMB	-25DWMB	-35DWMB	-45DWMB	N/A	N/A
	CERPACK	N/A	N/A	N/A	-15FMB	-20FMB	-25FMB	-35FMB	-45FMB	N/A	N/A
	LCC	N/A	N/A	N/A	-15LMB	-20LMB	-25LMB	-35LMB	-45LMB	N/A	N/A

* Military temperature range with MIL-STD-883, Class B processing.
N/A = Not available

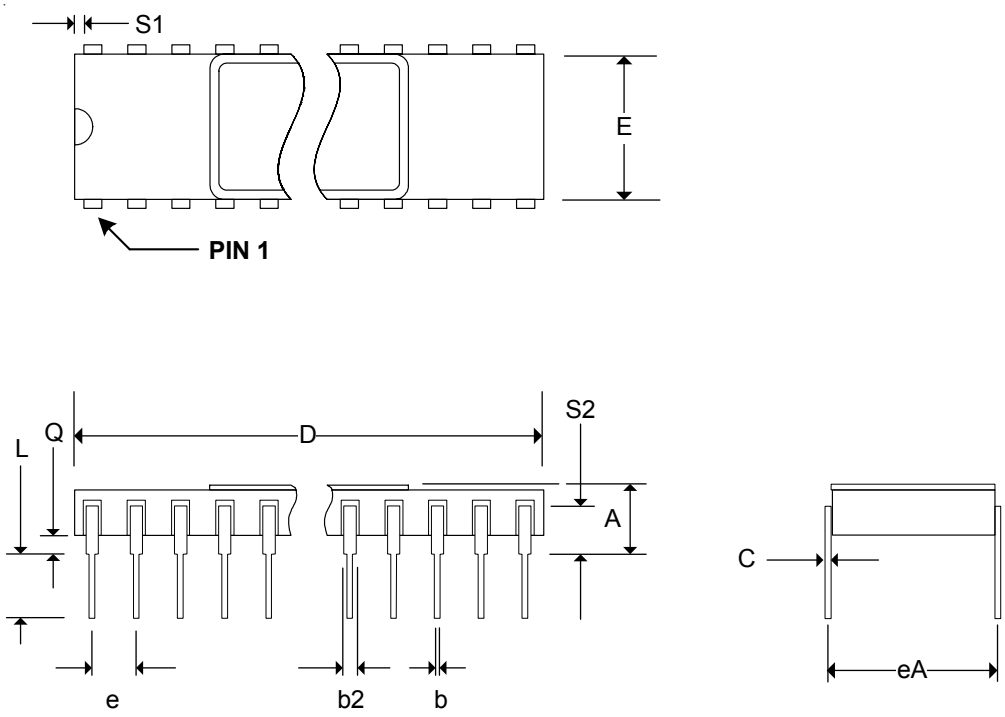
Pkg #	C5	
# Pins	28 (300 mil)	
Symbol	**Min**	**Max**
A	-	0.225
b	0.014	0.026
b2	0.045	0.065
C	0.008	0.018
D	-	1.485
E	0.240	0.310
eA	0.300 BSC	
e	0.100 BSC	
L	0.125	0.200
Q	0.015	0.070
S1	0.005	-
S2	0.005	-

SIDEBRAZED DUAL IN-LINE PACKAGE



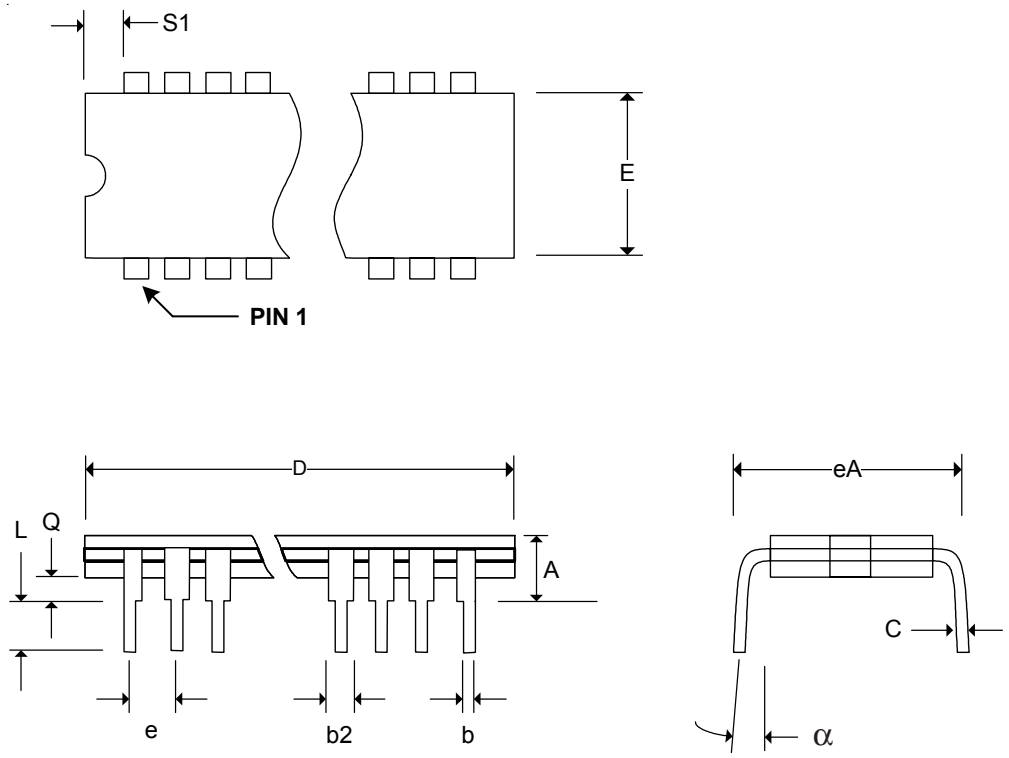
Pkg #	C5-1	
# Pins	28 (600 mil)	
Symbol	**Min**	**Max**
A	-	0.232
b	0.014	0.026
b2	0.045	0.065
C	0.008	0.018
D	-	1.490
E	0.500	0.610
eA	0.600 BSC	
e	0.100 BSC	
L	0.125	0.200
Q	0.015	0.060
S1	0.005	-
S2	0.005	-

SIDEBRAZED DUAL IN-LINE PACKAGE



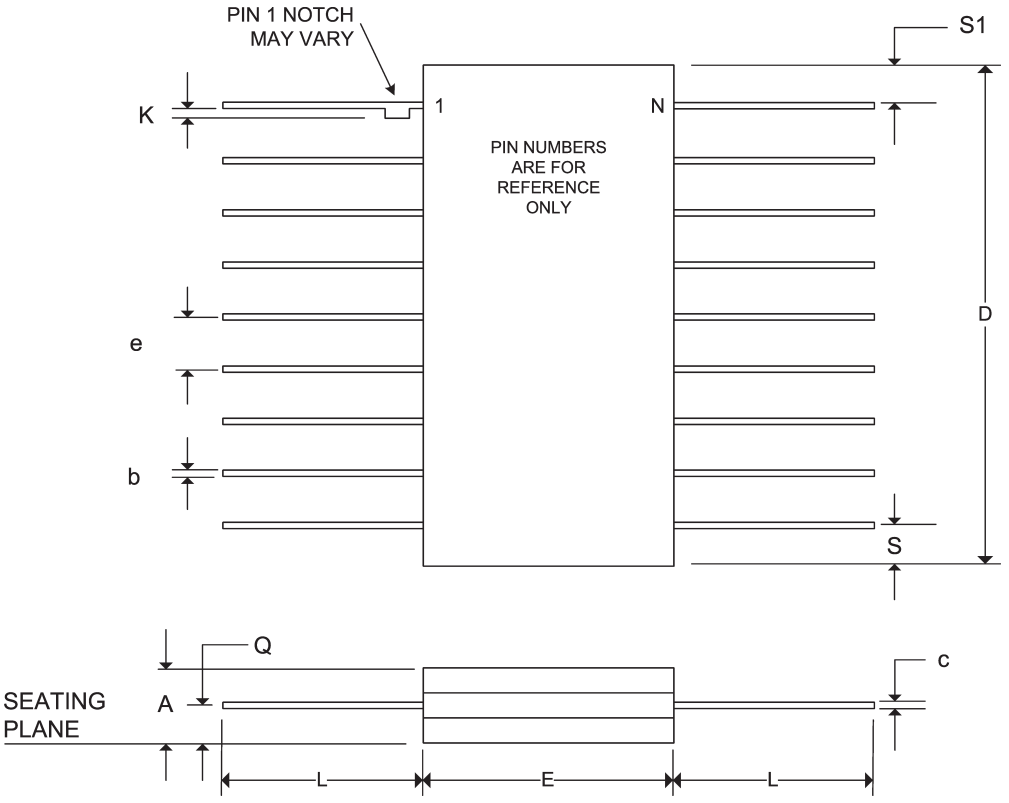
Pkg #	D5-1	
# Pins	28 (600 mil)	
Symbol	**Min**	**Max**
A	-	0.232
b	0.014	0.026
b2	0.045	0.065
C	0.008	0.018
D	-	1.490
E	0.500	0.610
eA	0.600 BSC	
e	0.100 BSC	
L	0.125	0.200
Q	0.015	0.060
S1	0.005	-
α	0°	15°

CERDIP DUAL IN-LINE PACKAGE



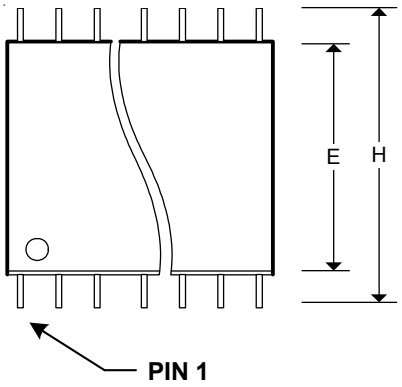
Pkg #	F4	
# Pins	28	
Symbol	**Min**	**Max**
A	0.060	0.090
b	0.015	0.022
c	0.004	0.009
D	-	0.730
E	0.330	0.380
e	0.050 BSC	
k	0.005	0.018
L	0.250	0.370
Q	0.026	0.045
S	-	0.085
S1	0.005	-

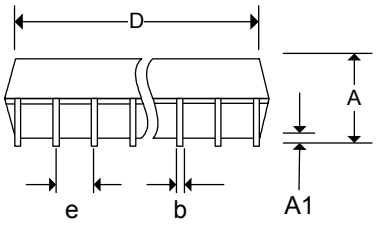
CERPACK CERAMIC FLAT PACKAGE

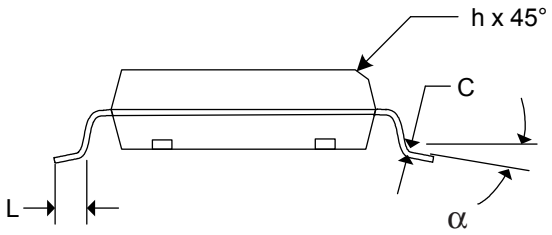


Pkg #	J5	
# Pins	28 (300 mil)	
Symbol	**Min**	**Max**
A	0.128	0.148
A1	0.082	-
b	0.016	0.020
C	0.007	0.010
D	0.720	0.730
e	0.050 BSC	
E	0.335 BSC	
E1	0.292	0.300
E2	0.267 BSC	
Q	0.025	-

SOJ SMALL OUTLINE IC PACKAGE

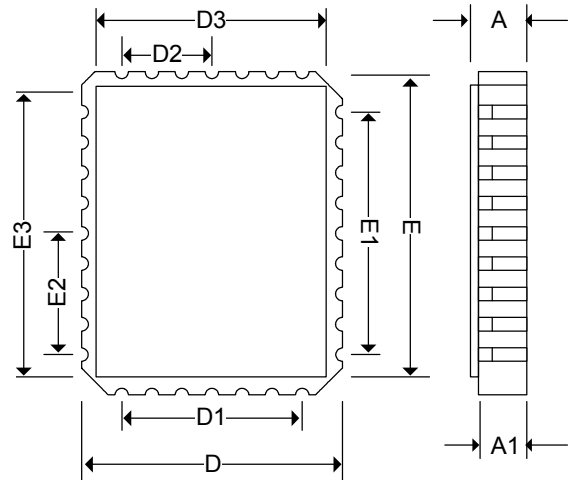


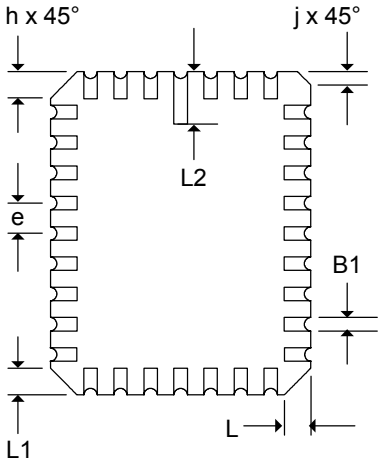




Pkg #	L5	
# Pins	28	
Symbol	**Min**	**Max**
A	0.060	0.075
A1	0.050	0.065
B1	0.022	0.028
D	0.342	0.358
D1	0.200 BSC	
D2	0.100 BSC	
D3	-	0.358
E	0.540	0.560
E1	0.400 BSC	
E2	0.200 BSC	
E3	-	0.558
e	0.050 BSC	
h	0.040 REF	
j	0.020 REF	
L	0.045	0.055
L1	0.045	0.055
L1	0.075	0.095
ND	5	
NE	9	

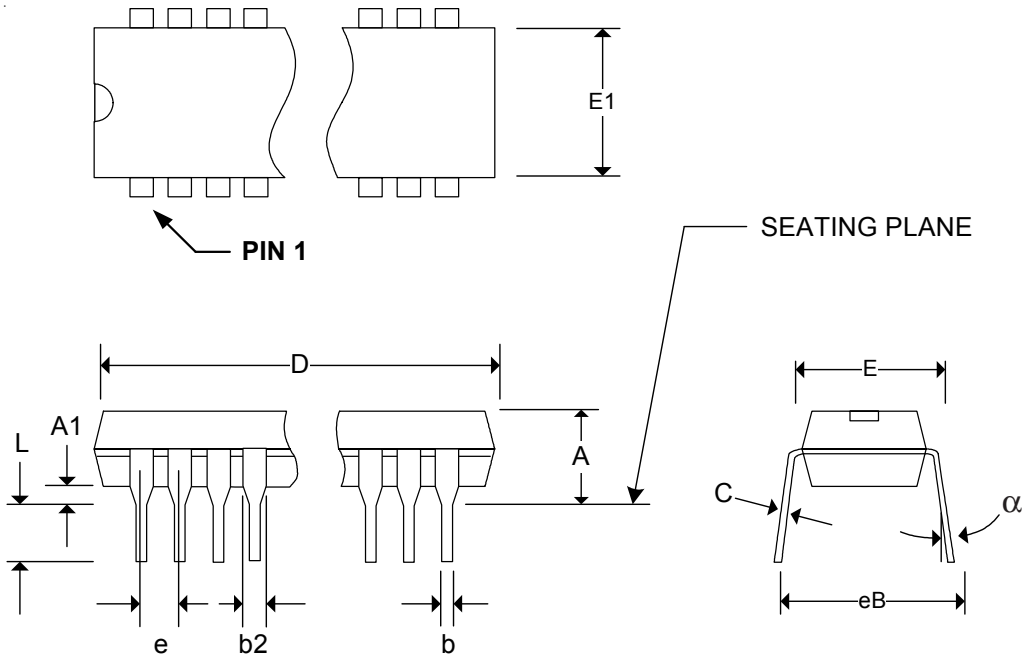
RECTANGULAR LEADLESS CHIP CARRIER

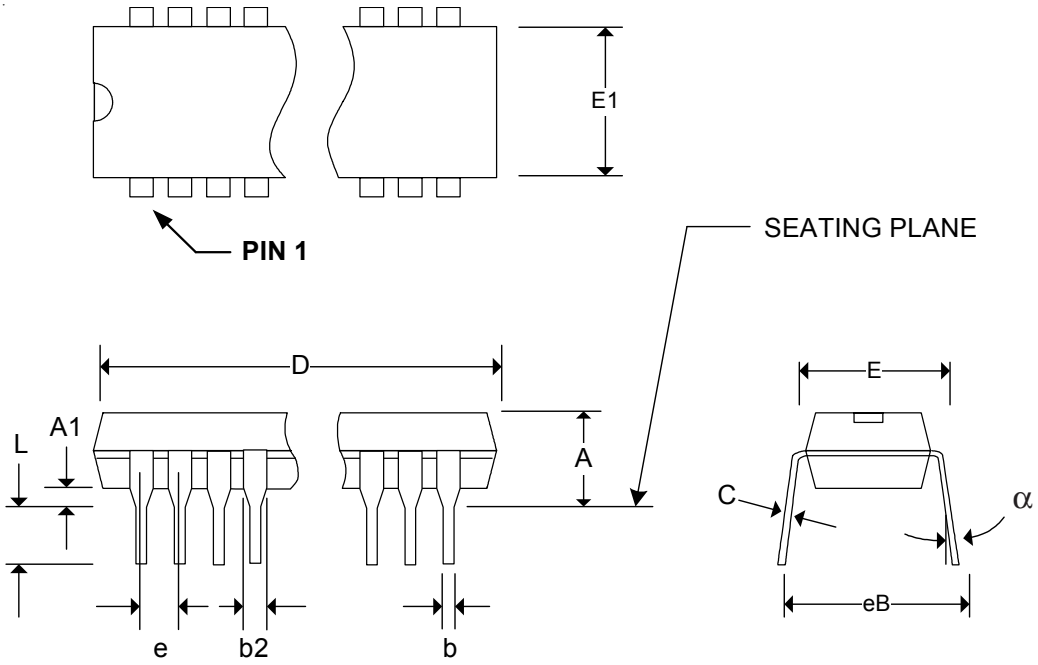




Pkg #	P5	
# Pins	28 (300 mil)	
Symbol	**Min**	**Max**
A	-	0.210
A1		-
b	0.014	0.023
b2	0.045	0.070
C	0.008	0.014
D	1.345	1.400
E1	0.270	0.300
E	0.300	0.380
e	0.100 BSC	
eB	-	0.430
L	0.115	0.150
α	0°	15°

PLASTIC DUAL IN-LINE PACKAGE



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