P4C188/P4C188L
ULTRA HIGH SPEED 16K x 4
STATIC CMOS RAMS (SCRAMS)

T-46-23-10

FEATURES

- Full CMOS, 6T Cell
- High Speed (Equal Access and Cycle Times)
  - 15/17/20/25/35 ns (Commercial)
  - 20/25/35/45/55 ns (Military)
- Low Power (Commercial/Military)
  - 690 mW Active – 15/17
  - 605/660 mW Active – 20/25/35/45/55
  - 135/220 mW Standby (TTL Input)
  - 55/110 mW Standby (CMOS Input) P4C188
  - 9/12 mW Standby (CMOS Input) P4C188L
- Single 5V±10% Power Supply
- Data Retention with 2.0V Supply
- Three-State Outputs
- TTL/CMOS Compatible Outputs
- Fully TTL Compatible Inputs
- Produced with PACE Technology™
- Standard Pinout (JEDEC Approved)
  - 22-Pin 300 mil DIP
  - 24-Pin 300 mil SOJ
  - 22-Pin 290 x 490 mil LCC

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DESCRIPTION

The P4C188 and P4C188L are 65,536-bit ultra high speed static RAMs organized as 16K x 4. The CMOS memories require no clocks or refreshing and have equal access and cycle times. Inputs and outputs are fully TTL-compatible. The RAMs operate from a single 5V±10% tolerance power supply. With battery backup, data integrity is maintained for supply voltages down to 2.0V. Current drain is typically 10 µA from a 2.0V supply.

Access times as fast as 15 nanoseconds are available, permitting greatly enhanced system speeds. CMOS is utilized to reduce power consumption to a low 690 mW active, 193 mW standby and only 5 mW in the P4C188L version. The P4C188 and P4C188L are members of a family of PACE RAM™ products offering super fast access times never before available at these complexity levels in TTL-compatible bipolar or CMOS technologies.

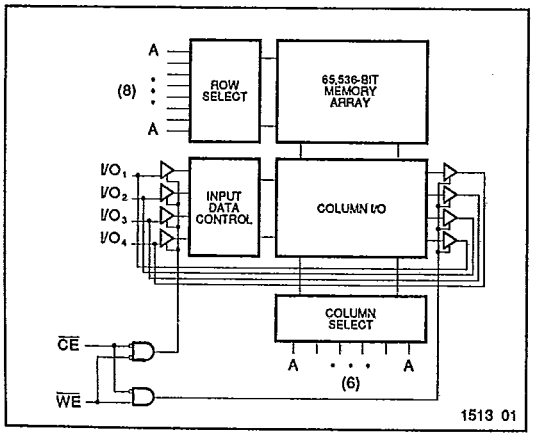
The P4C188 and P4C188L are manufactured with PACE Technology™ which is Performance Advanced CMOS Engineered to use 0.8 micron effective channel lengths giving 500 picoseconds loaded* internal gate delays.

PACE Technology includes two level metal and epitaxial substrates. In addition to very high performance and very high density, the technology features latch-up protection, single event upset protection, and is supported by a Class 1 environment volume production facility.

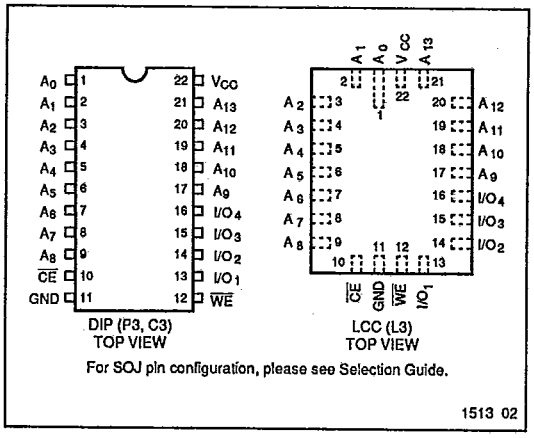
The P4C188 and P4C188L are available in 22-pin 300 mil DIP, 24-pin 300 mil SOJ and 22-pin LCC packages providing excellent board level densities.

*For a fan-in/fan-out of 4, at 85°C junction temperature and 5.0V. For a fan-in/fan-out of 1, the internal gate delay is 200 picoseconds at room temperature and 5.0V.

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATIONS



For SOJ pin configuration, please see Selection Guide.

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

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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

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RECOMMENDED OPERATING TEMPERATURE AND SUPPLY VOLTAGE

Grade[2]	Ambient Temperature	GND	V_{CC}
Military	–55 to +125°C	0V	5.0V ± 10%

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Grade[2]	Ambient Temperature	GND	V_{CC}
Commercial	0°C to +70°C	0V	5.0V ± 10%

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DC ELECTRICAL CHARACTERISTICS

Over recommended operating temperature and supply voltage[2]

Symbol	Parameter	Test Conditions		P4C188		P4C188L		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} = +10 mA, V_{CC} = Min. I_{OL} = +8 mA, V_{CC} = Min.			0.5 0.4		0.5 0.4	V
V_{OLC}	Output Low Voltage (CMOS Load)	I_{OLC} = +100 µA, V_{CC} = Min.			0.2		0.2	V
V_{OH}	Output High Voltage (TTL Load)	I_{OH} = –4 mA, V_{CC} = Min.		2.4		2.4		V
V_{OHC}	Output High Voltage (CMOS Load)	I_{OHC} = –100 µA, V_{CC} = Min.		V_{CC}–0.2		V_{CC}–0.2		V
I_{LI}	Input Leakage Current	V_{CC} = Max. V_{IN} = GND to V_{CC}	Mil. Com'l.	–10 –5	+10 +5	–5 –2	+5 +2	µA
I_{LO}	Output Leakage Current	V_{CC} = Max., $\overline{CE}$ = V_{IH}, V_{OUT} = GND to V_{CC}	Mil. Com'l.	–10 –5	+10 +5	–5 –2	+5 +2	µA

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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

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

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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

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Over recommended operating temperature and supply voltage[2]

Symbol	Parameter	Test Conditions		P4C188 Min	P4C188 Max	P4C188L Min	P4C188L Max	Unit
I_{CC}	Dynamic Operating Current – 15, 17	V_{CC} = Max., f = Max., Outputs Open	Mil.	—	n/a	—	n/a	mA
			Com'l.	—	125	—	n/a	
I_{CC}	Dynamic Operating Current – 20, 25, 35, 45, 55	V_{CC} = Max., f = Max., Outputs Open	Mil.	—	120	—	120	mA
			Com'l.	—	100	—	100	
I_{SB}	Standby Power Supply Current (TTL Input Levels)	$\overline{CE} \geq V_{IH}$, V_{CC} = Max., f = Max., Outputs Open	Mil.	—	40	—	40	mA
			Com'l.	—	35	—	35	
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.	—	20	—	2.7	mA
			Com'l.	—	15	—	0.9	

n/a = Not Applicable

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DATA RETENTION CHARACTERISTICS (P4C188L 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	Mil.		10	15	600	900	µA
		Com'l.		10	15	150	225	µA
t_{CDR}	Chip Deselect to Data Retention Time	$\overline{CE} \geq V_{CC} - 0.2V$, $V_{IN} \geq V_{CC} - 0.2V$ or $V_{IN} \leq 0.2V$	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.

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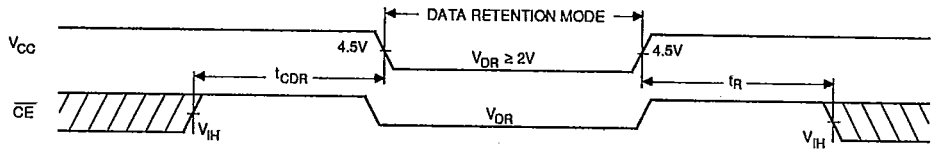
DATA RETENTION WAVEFORM



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AC CHARACTERISTICS—READ CYCLE

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

Sym.	Parameter	-15		-17		-20		-25		-35		-45		-55		Unit
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
t_{RC}	Read Cycle Time	15		17		20		25		35		45		55		ns
t_{AA}	Address Access Time		15		17		20		25		35		45		55	ns
t_{AC}	Chip Enable Access Time		15		17		20		25		35		45		55	ns
t_{OH}	Output Hold from Address Change	2		3		3		3		3		3		3		ns
t_{LZ}	Chip Enable to Output in Low Z	2		2		3		3		3		3		3		ns
t_{HZ}	Chip Disable to Output in High Z		6		7		8		10		20		25		25	ns
t_{PU}	Chip Enable to Power Up Time	0		0		0		0		0		0		0		ns
t_{PD}	Chip Disable to Power Down Time		15		17		20		25		35		45		55	ns

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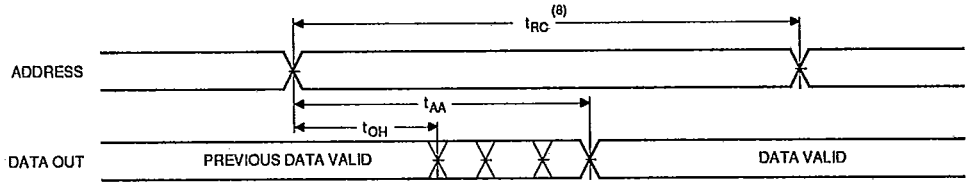
TIMING WAVEFORM OF READ CYCLE NO. 1 [5]



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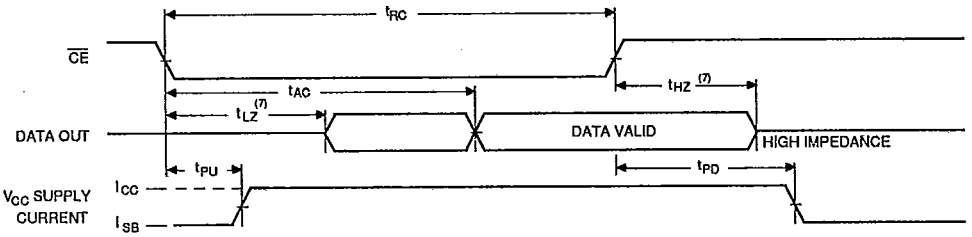
TIMING WAVEFORM OF READ CYCLE NO. 2 [6]



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Notes:

5. $\overline{CE}$ is low and $\overline{WE}$ is high for READ cycle.
6. $\overline{WE}$ is high, and address must be valid prior to or coincident with $\overline{CE}$ transition low.
7. Transition is measured ±200mV from steady state voltage prior to change with specified loading in Figure 1. This parameter is sampled and not 100% tested.
8. Read Cycle Time is measured from the last valid address to the first transitioning address.

AC CHARACTERISTICS—WRITE CYCLE

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

Sym.	Parameter	-15		-17		-20		-25		-35		-45		-55		Unit
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
t_{WC}	Write Cycle Time	15		17		20		25		35		45		55		ns
t_{CW}	Chip Enable Time to End of Write	12		12		13		15		25		35		45		ns
t_{AW}	Address Valid to End of Write	12		12		15		20		25		35		40		ns
t_{AS}	Address Set-up Time	0		0		0		0		0		0		0		ns
t_{WP}	Write Pulse Width	10		12		13		15		25		35		45		ns
t_{AH}	Address Hold Time from End of Write	0		0		0		0		0		0		0		ns
t_{WR}	Write Recovery Time	0		0		0		0		0		0		0		ns
t_{DW}	Data Valid to End of Write	7		8		8		10		15		20		25		ns
t_{DH}	Data Hold Time	0		0		0		0		0		5		5		ns
t_{WZ}	Write Enable to Output in High Z		6		7		8		10		15		20		25	ns
t_{OW}	Output Active from End of Write	2		2		2		2		3		3		3		ns

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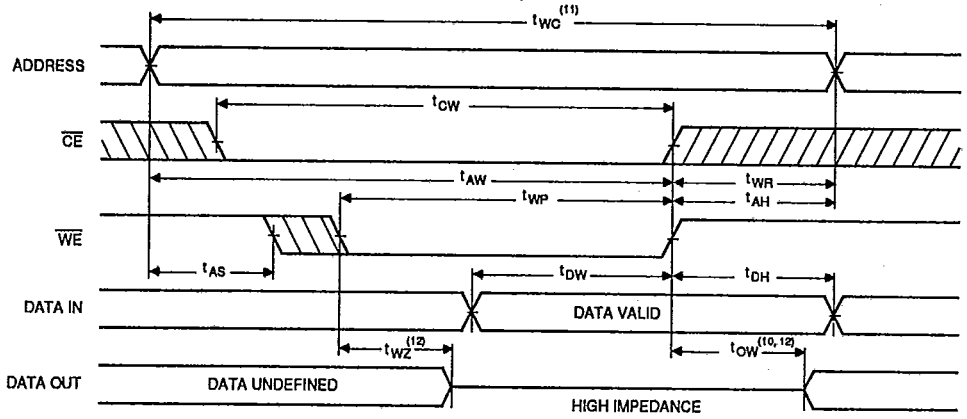
TIMING WAVEFORM OF WRITE CYCLE NO. 1 ($\overline{WE}$ CONTROLLED) [9]



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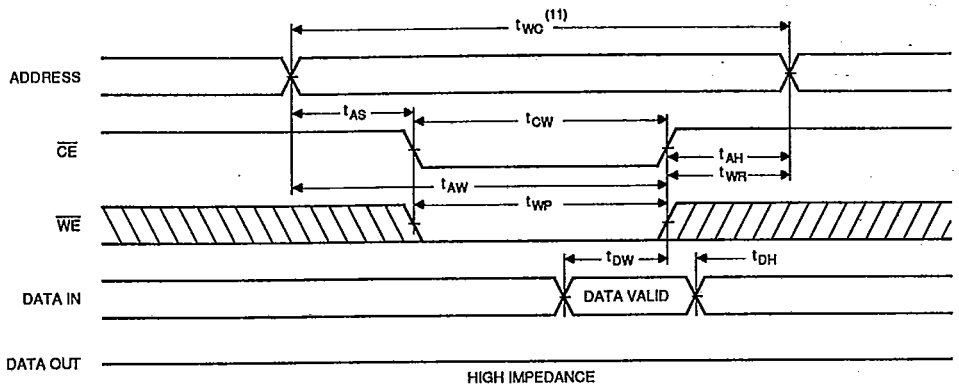
Notes:

9. $\overline{CE}$ and $\overline{WE}$ must be low for WRITE cycle.
10. If $\overline{CE}$ goes high simultaneously with $\overline{WE}$ high, the output remains in a high impedance state.
11. Write Cycle Time is measured from the last valid address to the first transition address.
12. Transition is measured ±200mV from steady state voltage prior to change with specified loading in Figure 1. This parameter is sampled and not 100% tested.

TIMING WAVEFORM OF WRITE CYCLE NO. 2 ($\overline{CE}$ CONTROLLED) [9]



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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

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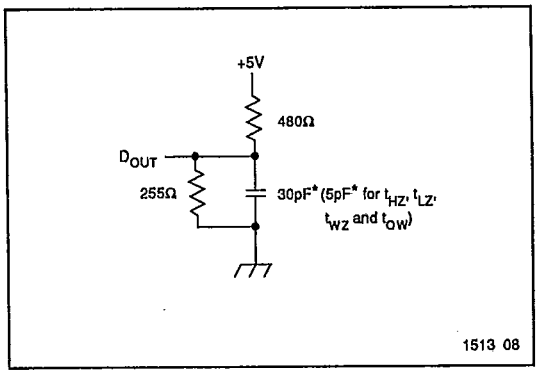

Figure 1. Output Load

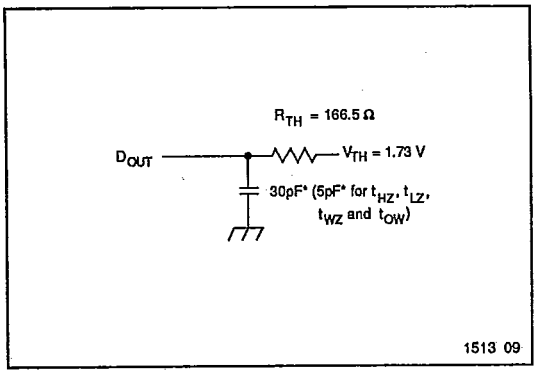

Figure 2. Thevenin Equivalent

TRUTH TABLE

Mode	$\overline{CE}$	$\overline{WE}$	Output	Power
Standby	H	X	High Z	Standby
Read	L	H	D_{OUT}	Active
Write	L	L	D_{IN}	Active

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* including scope and test fixture.

Note:
Due to the ultra-high speed of the P4C188/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).

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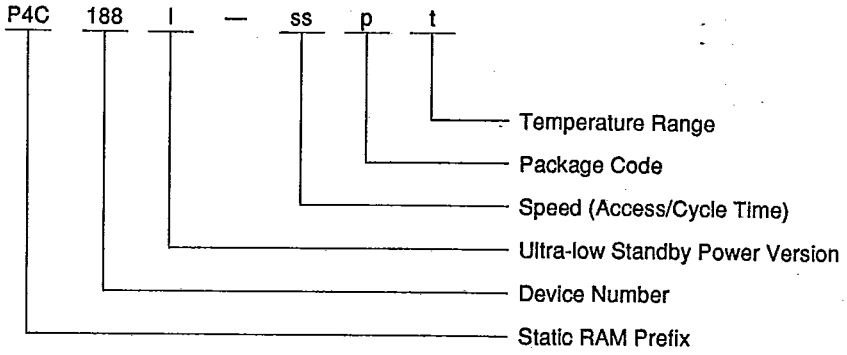
ORDERING INFORMATION

The following part numbering scheme is used for



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I = Ultra-low standby power designator L, if needed.
ss = Speed (access/cycle time in ns), e.g., 25, 35
p = Package code, i.e., P, J, C, L.
t = Temperature range, i.e., C, M, MB.

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PACKAGE SUFFIX

Package Suffix	Description
P	Plastic DIP, 300 mil wide standard
J	Plastic SOJ, 300 mil wide standard
C	Sidebrazed DIP, 300 mil wide standard
L	Leadless Chip Carrier (ceramic)

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TEMPERATURE RANGE SUFFIX

Temperature Range Suffix	Description
C	Commercial Temperature Range, 0°C – +70°C.
M	Military Temperature Range, –55°C – +125°C.
MB	Mil. Temp. with MIL-STD-883C Class B compliance

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SELECTION GUIDE

The P4C188/L is available in the following temperature, speed and package options.

Temperature Range	Speed (ns) / Package	15	17	20	25	35	45	55
Commercial	Plastic DIP	-15PC	-17PC	-20PC	-25PC	-35PC	N/A	N/A
	Plastic SOJ	-15JC	-17JC	-20JC	-25JC	-35JC	N/A	N/A
	Sidebrazed DIP	-15CC	-17CC	-20CC	-25CC	-35CC	N/A	N/A
	LCC	-15LC	-17LC	-20LC	-25LC	-35LC	N/A	N/A
Military Temp.	Sidebrazed DIP	N/A	N/A	-20CM	-25CM	-35CM	-45CM	-55CM
	LCC	N/A	N/A	-20LM	-25LM	-35LM	-45LM	-55LM
Military Processed*	Sidebrazed DIP	N/A	N/A	-20CMB	-25CMB	-35CMB	-45CMB	-55CMB
	LCC	N/A	N/A	-20LMB	-25LMB	-35LMB	-45LMB	-55LMB

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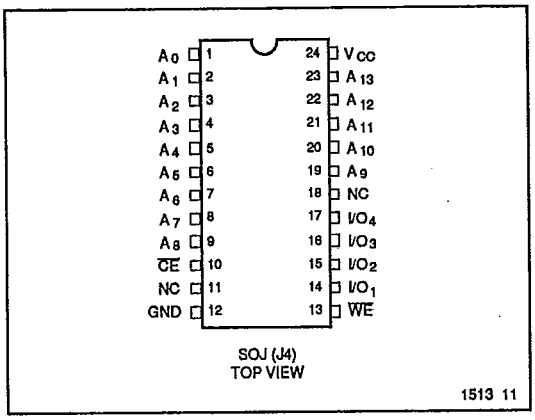
* Military temperature range with MIL-STD-883 Revision C, Class B processing.
N/A = Not available

SOJ PIN CONFIGURATION



SOJ (J4)
TOP VIEW

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TECHDOC 1513