P4C198/P4C198L, P4C198A/P4C198AL ULTRA HIGH SPEED 16K x 4 STATIC CMOS RAMS (SCRAMS)

T-46-23-10

2

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 Operation (Commercial/Military)
  - 690 mW Active – 15/17
  - 550/660 mW Active – 20/25/35/45/55
  - 193/220 mW Standby (TTL Input)
  - 83/110 mW Standby (CMOS Input) P4C198/198A
  - 3/9 mW Standby (CMOS Input) P4C198L/198AL
- 5V ± 10% Power Supply
- Data Retention, 10 µA Typical Current from 2.0V.
- Output Enable and Chip Enable Control Functions
  - Single Chip Enable P4C198
  - Dual Chip Enable P4C198A
- Common Inputs and Outputs
- Fully TTL Compatible Inputs and Outputs
- Produced with PACE Technology™
- Standard Pinout (JEDEC Approved)
  - 24-Pin 300 mil DIP, SOJ
  - 28-Pin 350 x 550 mil LCC

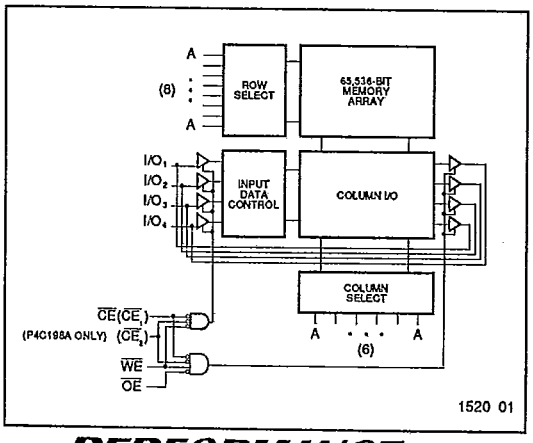
DESCRIPTION

The P4C198/L and P4C198A/L are 65,536-bit ultra high-speed static RAMs organized as 16K x 4. Each device features an active low Output Enable control to eliminate data bus contention. The P4C198/L also have an active low Chip Enable (the P4C198A/L have two Chip Enables, both active low) for easy system expansion. 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. Data integrity is maintained with supply voltages down to 2.0V. Current drain is typically 10 µA from a 2.0V supply.

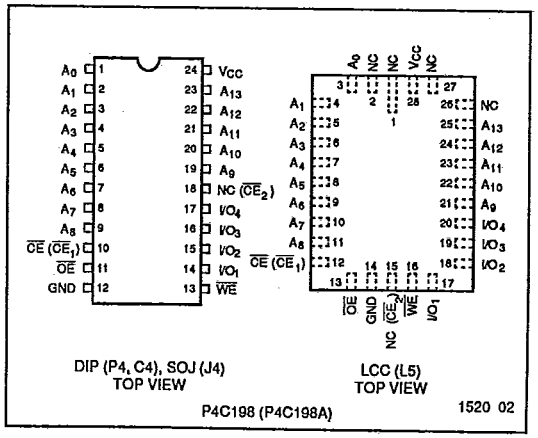
Access times as fast as 15 nanoseconds are available, permitting greatly enhanced system operating speeds. CMOS is utilized to reduce power consumption to a low 690 mW active, 193 mW standby. The P4C198/L and P4C198A/L, are manufactured with PACE Technology™, and are members of a family of PACE RAM™ products offering super fast access times never before available at these complexity levels in TTL-compatible bipolar or CMOS technologies.

The P4C198/L and P4C198A/L are available in 24-pin 300 mil DIP and SOJ, and 28-pin 350 x 550 mil LCC packages providing excellent board level densities.

FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATIONS



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

1520 Tbl 01

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

1520 Tbl 02

RECOMMENDED OPERATING TEMPERATURE AND SUPPLY VOLTAGE

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

1520 Tbl 03

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

1520 Tbl 04

DC ELECTRICAL CHARACTERISTICS

Over recommended operating temperature and supply voltage[2]

Symbol	Parameter	Test Conditions		P4C198 P4C198A		P4C198L P4C198AL		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

1520 Tbl 05

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

1520 Tbl 06

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

1520 Tbl 07

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

T-46-23-10

Over recommended operating temperature and supply voltage[2]

Symbol	Parameter	Test Conditions		P4C198 P4C198A Min	P4C198 P4C198A Max	P4C198L P4C198AL Min	P4C198L P4C198AL 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)	$\overline{CE}_1$, $\overline{CE}_2 \geq V_{IH}$, V_{CC} = Max., f = Max., Outputs Open	Mil.	—	40	—	40	mA
			Com'l.	—	35	—	35	
I_{SB1}	Standby Power Supply Current (CMOS Input Levels)	$\overline{CE}_1$, $\overline{CE}_2 \geq V_{HC}$, V_{CC} = Max., f = 0, Outputs Open, $V_{IN} \leq V_{LC}$ or $V_{IN} \geq V_{HC}$	Mil.	—	20	—	1.5	mA
			Com'l.	—	15	—	0.5	

n/a = Not Applicable

1520 Tbl 08

DATA RETENTION CHARACTERISTICS (P4C198L and P4C198AL 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

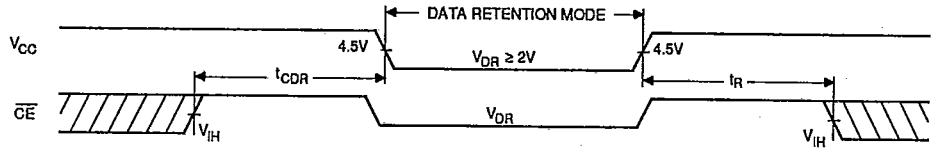
*T_A = +25°C

§t_{RC} = Read Cycle Time

†This parameter is guaranteed but not tested.

1520 Tbl 09

DATA RETENTION WAVEFORM



($\overline{CE}$, or $\overline{CE}_2$ for the P4C198AL)

1520 03

AC CHARACTERISTICS—READ CYCLE

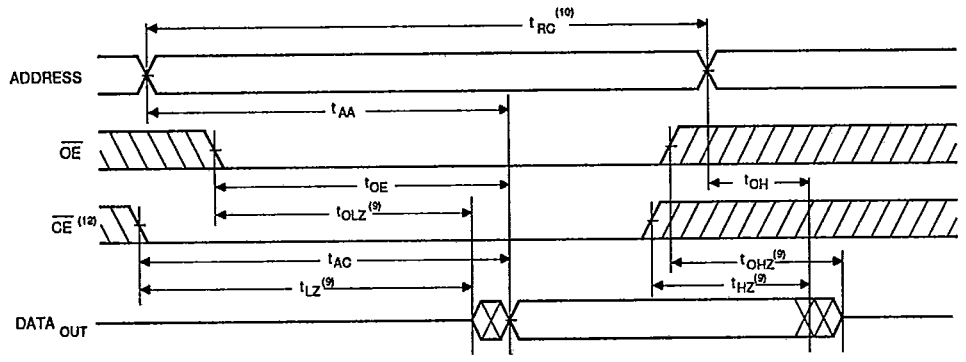
(V_{CC} = 5V ± 10%, All Temperature Ranges)[2]

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		2		2		3		3		3		ns
t_{HZ}	Chip Disable to Output in High Z		7		7		10		10		14		15		20	ns
t_{OE}	Output Enable Low to Data Valid		9		10		12		15		25		30		35	ns
t_{OLZ}	Output Enable to Output in Low Z	2		2		2		2		3		3		3		ns
t_{OHZ}	Output Disable to Output in High Z		6		7		8		10		14		15		20	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

*V_{CC} = 5V ± 5% for -15

1520 Tbl 10

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



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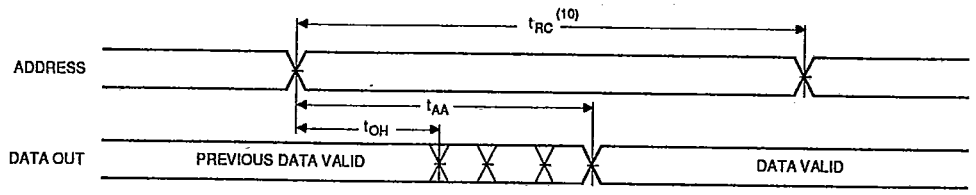
Notes:
5. $\overline{WE}$ is high for READ cycle.

T-46-23-10

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



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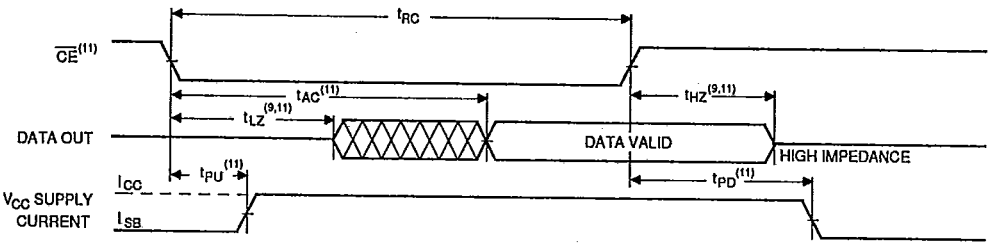
READ CYCLE NO.3 ($\overline{CE}$[12] controlled) [5,7,8]



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Notes:

6. $\overline{CE}$ ($\overline{CE}_1$, $\overline{CE}_2$ for P4C198A/L) and $\overline{OE}$ are low READ cycle.
7. $\overline{OE}$ is low for the cycle.
8. ADDRESS must be valid prior to, or coincident with, $\overline{CE}$ ($\overline{CE}_1$ and $\overline{CE}_2$ for P4C198A/L) transition low.
9. Transition is measured ±200mV from steady state voltage prior to change, with loading as specified in Figure 1.
10. Read Cycle Time is measured from the last valid address to the first transitioning address.
11. Transitions caused by a chip enable control have similar delays irrespective of whether $\overline{CE}_1$ or $\overline{CE}_2$ causes them (P4C198A/L).
12. $\overline{CE}_1$, $\overline{CE}_2$ for P4C198A/L.

AC CHARACTERISTICS—WRITE CYCLE

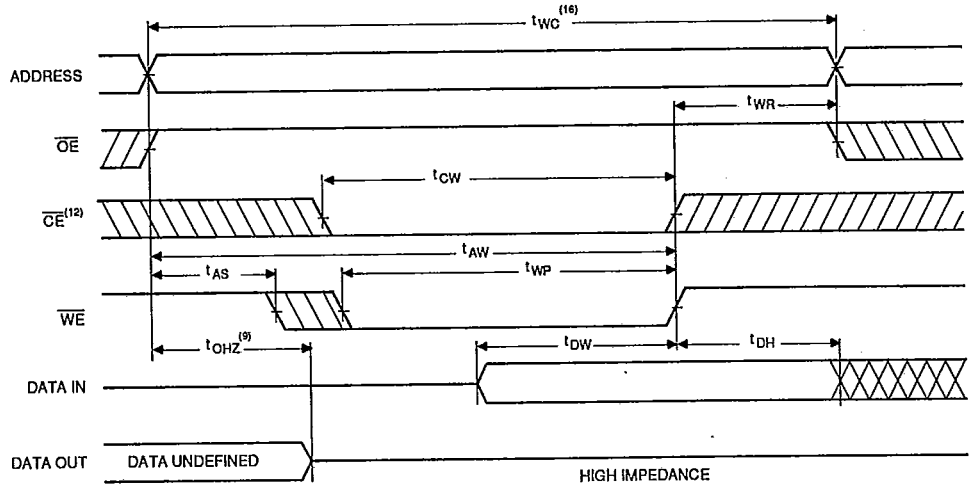
(V_{CC} = 5V ± 10%, All Temperature Ranges)[2]

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_{WC}	Write Cycle Time	13		14		15		20		30		40		50		ns
t_{CW}	Chip Enable Time to End of Write	10		12		15		20		30		35		40		ns
t_{AW}	Address Valid to End of Write	10		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		15		20		25		35		40		ns
t_{WR}	Write Recovery Time	0		0		0		0		0		0		0		ns
t_{AH}	Address Hold Time from End of Write	0		0		0		0		0		0		0		ns
t_{DW}	Data Valid to End of Write	7		8		10		13		15		20		25		ns
t_{DH}	Data Hold Time	0		0		0		0		0		0		0		ns
t_{WZ}	Write Enable to Output in High Z		7		7		8		10		10		15		20	ns
t_{OW}	Output Active from End of Write	2		2		2		3		3		3		3		ns

*V_{CC} = 5V ± 5% for -15

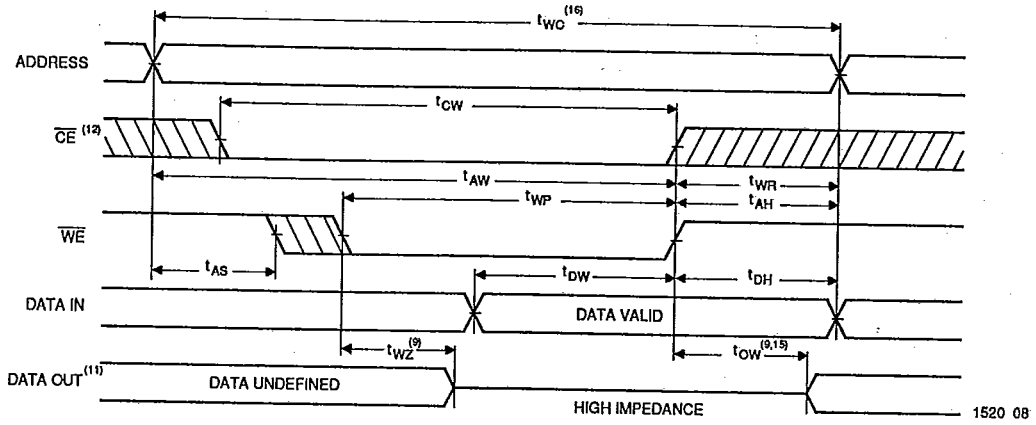
1520 Tbl 11

WRITE CYCLE NO. 1 (With $\overline{OE}$ high)

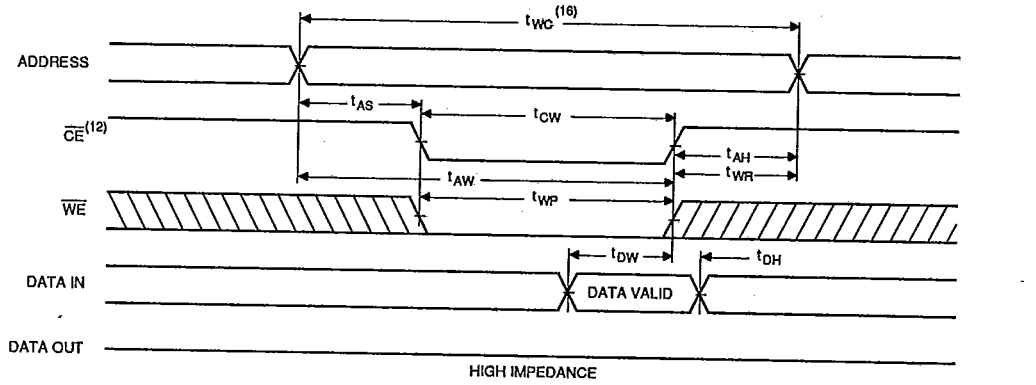


1520 07

WRITE CYCLE NO. 2 ($\overline{WE}$ CONTROLLED) [13,14]



WRITE CYCLE NO. 3 ($\overline{CE}$ (12) CONTROLLED) [13,14]



Notes:

13. $\overline{CE}$ ($\overline{CE_1}$, $\overline{CE_2}$ for P4C198A/L) and $\overline{WE}$ must be low for WRITE cycle.
14. $\overline{OE}$ is low for this WRITE cycle.
15. If $\overline{CE}$ ($\overline{CE_1}$ or $\overline{CE_2}$ for P4C198A/L) goes high simultaneously with $\overline{WE}$ high, the output remains in a low impedance state.
16. Write Cycle Time is measured from the last valid address to the first transitioning address.

TRUTH TABLES

P4C198/L

$\overline{CE}$	$\overline{WE}$	$\overline{OE}$	Mode	Output
H	X	X	Standby	High Z
L	H	H	Output Inhibit	High Z
L	H	L	READ	D_{OUT}
L	L	X	WRITE	D_{IN}

1520 Tbl 13

P4C198A/L

$\overline{CE_1}$	$\overline{CE_2}$	$\overline{WE}$	$\overline{OE}$	Mode	Output
H	X	X	X	Standby	High Z
X	H	X	X	Standby	High Z
L	L	H	H	Output Inhibit	High Z
L	L	H	L	READ	D_{OUT}
L	L	L	X	WRITE	D_{IN}

1520 Tbl 14

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

1520 Tbl 12

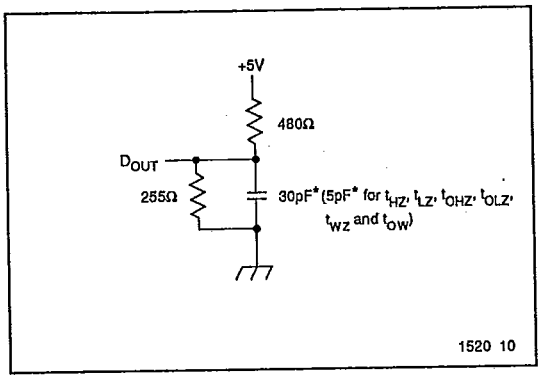


Figure 1. Output Load

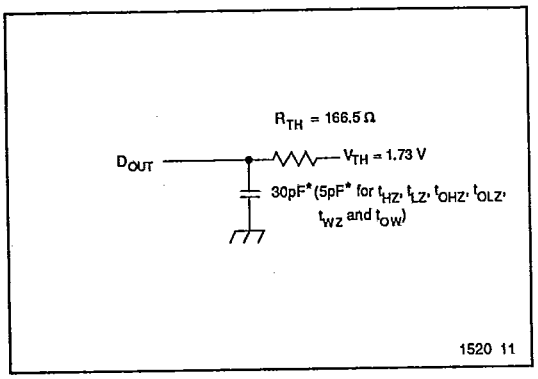


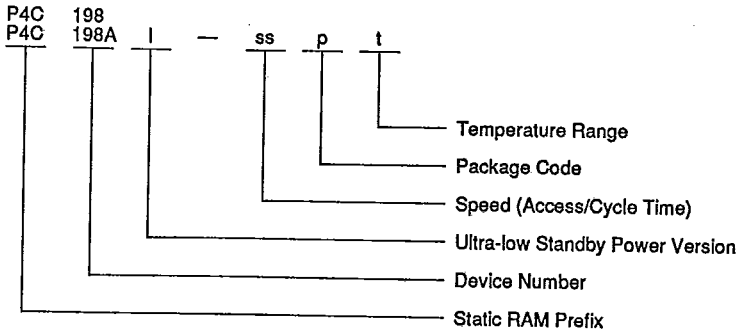
Figure 2. Thevenin Equivalent

* including scope and test fixture.

Note:
Due to the ultra-high speed of the P4C198/L and P4C198A/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

T-46-23-10



l = 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.

1520 12

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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)

1520 Tbl 14

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

1520 Tbl 15

SELECTION GUIDE

The P4C198 and P4C198A are available in the following temperature, speed and package options. The P4C198L and P4C198AL are only available with access times of 20 ns and slower for commercial temperatures, 25 ns and slower for military temperatures.

Temperature Range	Package \ Speed (ns)	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

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

1520 Tbl 16