

P4C168, P4C169, P4C170 ULTRA HIGH SPEED 4K x 4 STATIC CMOS RAMS (SCRAMS)

T-46-23-08

★ FEATURES

- Full CMOS, 6T Cell
- High Speed (Equal Access and Cycle Times)
 - 12/15/20/25ns (Commercial)
- Low Power Operation (Commercial)
 - 715 mW Active
 - 193 mW Standby (TTL Input) P4C168
 - 83 mW Standby (CMOS Input) P4C168
- Single 5V±10% Power Supply
- Fully TTL Compatible, Common I/O Ports

- Three Options
 - P4C168 Low Power Standby Mode
 - P4C169 Fast Chip Select Control
 - P4C170 Fast Chip Select, Output Enable Controls
- Produced with PACE Technology™
- Standard Pinout (JEDEC Approved)
 - 20-Pin and 22-Pin (P4C170) 300 mil DIP
 - 20-Pin 300 mil SOIC (P4C168 only)

★ DESCRIPTION

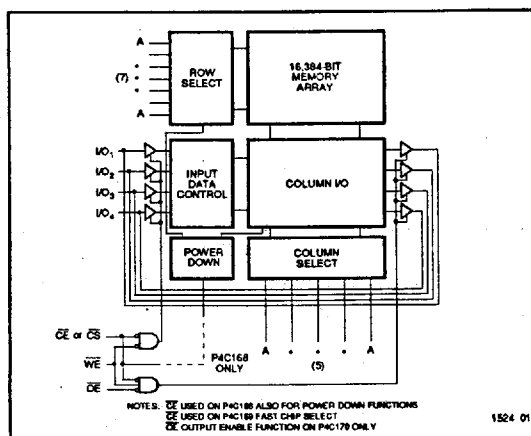
The P4C168, P4C169 and P4C170 are a family of 16,384-bit ultra high-speed static RAMs organized as 4K x 4. All three devices have common input/output ports. The P4C168 enters the standby mode when the chip enable (\overline{CE}) control goes high; with CMOS input levels, power consumption is only 83mW in this mode. Both the P4C169 and the P4C170 offer a fast chip select access time that is only 67% of the address access time. In addition, the P4C170 includes an output enable (\overline{OE}) control to eliminate data bus contention. The RAMs operate from a single 5V ± 10% tolerance power supply.

CMOS is used to reduce power consumption to a low 715 mW active, 193 mW standby. The P4C168, P4C169 and P4C170 are manufactured using 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.

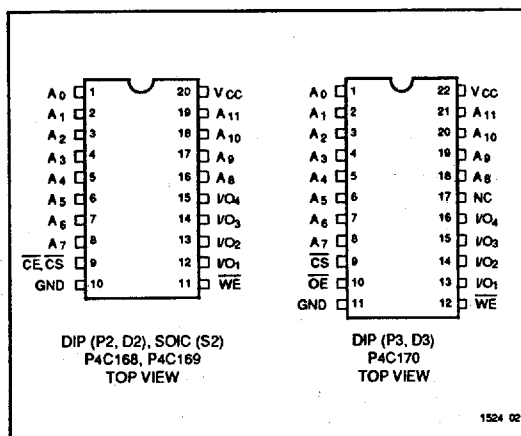
The P4C168 and P4C169 are available in 20-pin (P4C170 in 22-pin) 300 mil DIP packages providing excellent board level densities. The P4C168 is also available in 20-pin 300 mil SOIC packages.

Access times as fast as 12 nanoseconds are available, permitting greatly enhanced system operating speeds.

★ FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATIONS



Means Quality, Service and Speed

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P4C168, P4C169, P4C170

T-46-23-08

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 |

1524 Tbl 01

1524 Tbl 02

RECOMMENDED OPERATING TEMPERATURE AND SUPPLY VOLTAGE

| Grade ⁽²⁾ | Ambient Temperature | GND | V _{CC} |
|----------------------|---------------------|-----|-----------------|
| Commercial | 0°C to +70°C | 0V | 5.0V ± 10% |

1524 Tbl 04

DC ELECTRICAL CHARACTERISTICS

Over recommended operating temperature and supply voltage⁽²⁾.

| Symbol | Parameter | Test Conditions | P4C168/169/170 | | Unit |
|------------------|---------------------------------|---|----------------------|----------------------|------|
| | | | Min | Max | |
| V _{IH} | Input High Voltage | | 2.2 | V _{CC} +0.5 | V |
| V _{IL} | Input Low Voltage | | -0.5 ⁽³⁾ | 0.8 | V |
| V _{HC} | CMOS Input High Voltage | | V _{CC} -0.2 | V _{CC} +0.5 | V |
| V _{LC} | CMOS Input Low Voltage | | -0.5 ⁽³⁾ | 0.2 | V |
| V _{CD} | Input Clamp Diode Voltage | V _{CC} = Min., I _{IN} = -18 mA | | -1.2 | V |
| V _{OL} | Output Low Voltage (TTL Load) | I _{OL} = +8 mA, V _{CC} = Min. | | 0.4 | V |
| V _{OLC} | Output Low Voltage (CMOS Load) | I _{OLC} = +100 μA, V _{CC} = Min. | | 0.2 | V |
| V _{OH} | Output High Voltage (TTL Load) | I _{OH} = -4 mA, V _{CC} = Min. | 2.4 | | V |
| V _{OHC} | Output High Voltage (CMOS Load) | I _{OHC} = -100 μA, V _{CC} = Min. | V _{CC} -0.2 | | V |
| I _{LI} | Input Leakage Current | V _{CC} = Max. V _{IN} = GND to V _{CC} | -5 | +5 | μA |
| I _{LO} | Output Leakage Current | V _{CC} = Max., $\overline{CE} = V_{IH}$, V _{OUT} = GND to V _{CC} | -5 | +5 | μA |

1524 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 |

1524 Tbl 06

| Symbol | Parameter | Conditions | Typ. | Unit |
|------------------|--------------------|-----------------------|------|------|
| C _{OUT} | Output Capacitance | V _{OUT} = 0V | 7 | pF |

1524 Tbl 07

Notes:

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

POWER DISSIPATION CHARACTERISTICS

T-46-23-08

Over recommended operating temperature and supply voltage⁽²⁾

| Symbol | Parameter | Test Conditions | P4C168 | | P4C169 P4C170 | | Unit |
|-----------|--|--|--------|-----|------------------|-----|------|
| | | | Min | Max | Min | Max | |
| I_{CC} | Dynamic Operating Current | $V_{CC} = \text{Max.}, f = \text{Max.},$ Outputs Open | — | 130 | — | 130 | mA |
| I_{SB} | Standby Power Supply Current (TTL Input Levels) | $\overline{CE}_1 \geq V_{IH}$ $V_{CC} = \text{Max.},$ $f = \text{Max.},$ Outputs Open | — | 35 | — | n/a | mA |
| I_{SB1} | Standby Power Supply Current (CMOS Input Levels) | $\overline{CE}_1 \geq V_{HC}$ $V_{CC} = \text{Max.},$ $f = 0,$ Outputs Open, $V_{IN} \leq V_{LC}$ or $V_{IN} \geq V_{HC}$ | — | 15 | — | n/a | mA |

n/a = Not Applicable

1524 TR 08

4

AC CHARACTERISTICS—READ CYCLE

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

T-46-23-08

| Sym | Parameter | -12 | | -15 | | -20 | | -25 | | Unit |
|-------------------------------|------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|
| | | Min | Max | Min | Max | Min | Max | Min | Max | |
| t _{RC} | Read Cycle Time | 12 | | 15 | | 20 | | 25 | | ns |
| t _{AA} | Address Access Time | | 12 | | 15 | | 20 | | 25 | ns |
| t _{AC} [‡] | Chip Enable Access Time | | 12 | | 15 | | 20 | | 25 | ns |
| t _{AC} [‡] | Chip Select Access Time | | 8 | | 9 | | 12 | | 15 | ns |
| t _{OH} | Output Hold from Address Change | 2 | | 3 | | 3 | | 3 | | ns |
| t _{LZ} [‡] | Chip Enable to Output in Low Z | 2 | | 3 | | 3 | | 3 | | ns |
| t _{HZ} [†] | Chip Disable to Output in High Z | | 6 | | 7 | | 9 | | 10 | ns |
| t _{OE} [†] | Output Enable to Data Valid | | 8 | | 10 | | 12 | | 15 | ns |
| t _{OLZ} [†] | Output Enable to Output in Low Z | 0 | | 0 | | 0 | | 0 | | ns |
| t _{OHZ} [†] | Output Disable to Output in High Z | | 6 | | 7 | | 9 | | 11 | ns |
| t _{RCS} | Read Command Setup Time | 0 | | 0 | | 0 | | 0 | | ns |
| t _{RCH} | Read Command Hold Time | 0 | | 0 | | 0 | | 0 | | ns |
| t _{PU} [‡] | Chip Enable to Power Up Time | 0 | | 0 | | 0 | | 0 | | ns |
| t _{PD} [‡] | Chip Disable to Power Down Time | | 12 | | 15 | | 20 | | 25 | ns |

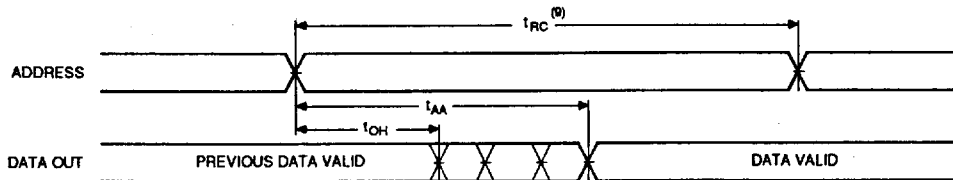
[‡] P4C168 only

[†] P4C170 only

[‡] Chip Select/Deselect for P4C169 and P4C170

1524 TBI 10

TIMING WAVEFORM OF READ CYCLE NO. 1 (ADDRESS CONTROLLED)^(5,6)



1524 04

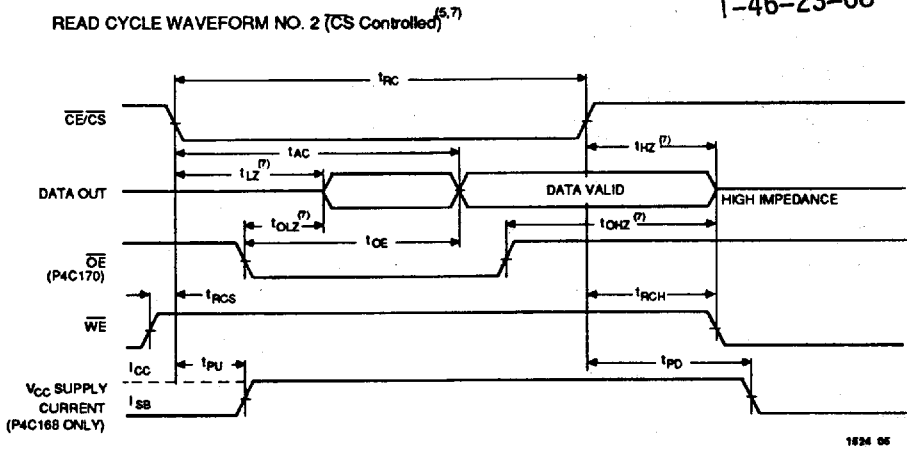
Notes:

5. WE is HIGH for READ cycle.

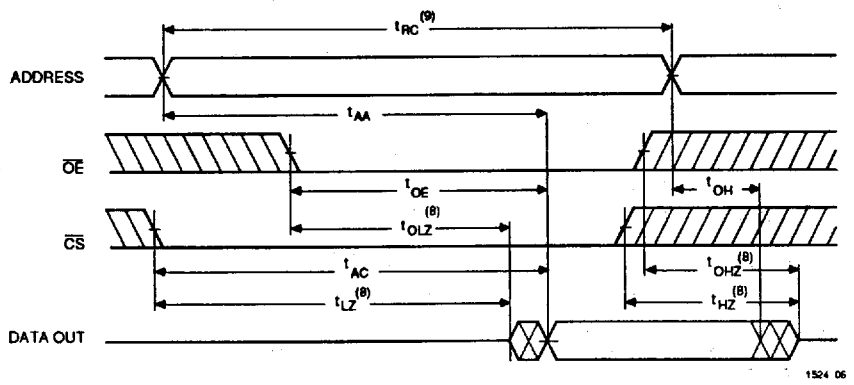
6. CE/CS and OE are LOW for READ cycle.

TIMING WAVEFORM OF READ CYCLE NO. 2 ($\overline{CE}/\overline{CS}$ CONTROLLED) ^(6,7)

T-46-23-08



TIMING WAVEFORM OF READ CYCLE NO. 3—P4C170 ONLY (\overline{OE} CONTROLLED) ⁽⁸⁾



Notes:

- 7. ADDRESS must be valid prior to, or coincident with $\overline{CE}/\overline{CS}$ transition low. For Fast \overline{CS} , t_{AA} must still be met.
- 8. Transition is measured $\pm 200\text{mV}$ from steady state voltage prior to

- change, with loading as specified in Figure 1.
- 9. Read Cycle Time is measured from the last valid address to the first transitioning address.

AC ELECTRICAL CHARACTERISTICS—WRITE CYCLE

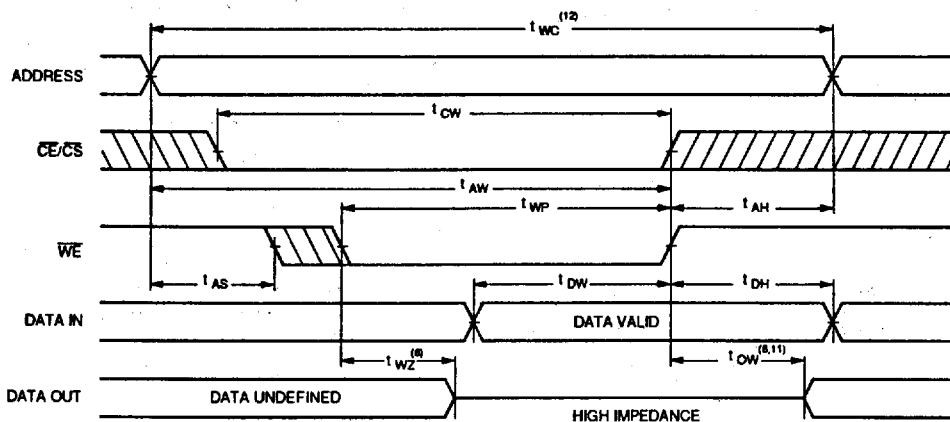
($V_{CC} = 5V \pm 10\%$, All Temperature Ranges)⁽²⁾

T-46-23-08

| Sym | Parameter | -12 | | -15 | | -20 | | -25 | | Unit |
|----------|----------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|
| | | Min | Max | Min | Max | Min | Max | Min | Max | |
| t_{WC} | Write Cycle Time | 12 | | 15 | | 18 | | 20 | | ns |
| t_{CW} | Chip Enable Time to End of Write | 12 | | 15 | | 18 | | 20 | | ns |
| t_{AW} | Address Valid to End of Write | 12 | | 15 | | 18 | | 20 | | ns |
| t_{AS} | Address Set-up Time | 0 | | 0 | | 0 | | 0 | | ns |
| t_{WP} | Write Pulse Width | 12 | | 15 | | 18 | | 20 | | ns |
| t_{AH} | Address Hold Time | 0 | | 0 | | 0 | | 0 | | ns |
| t_{DW} | Data Valid to End of Write | 7 | | 8 | | 10 | | 10 | | ns |
| t_{DH} | Data Hold Time | 0 | | 0 | | 0 | | 0 | | ns |
| t_{WZ} | Write Enable to Output in High Z | | 4 | | 5 | | 7 | | 7 | ns |
| t_{OW} | Output Active from End of Write | 0 | | 0 | | 0 | | 0 | | ns |

1524 TU 11

TIMING WAVEFORM OF WRITE CYCLE NO. 1 (WE CONTROLLED)⁽¹⁰⁾



1524 07

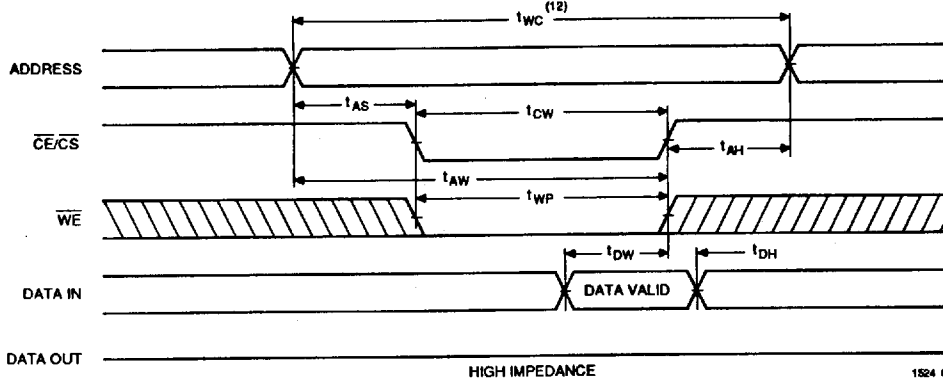
Notes:

- 10. CE/CS and WE must be LOW for WRITE cycle.
- 11. If CE/CS goes HIGH simultaneously with WE HIGH, the output remains in a high impedance state.

- 12. Write Cycle Time is measured from the last valid address to the first transitioning address.

TIMING WAVEFORM OF WRITE CYCLE NO. 2 ($\overline{CE}/\overline{CS}$ CONTROLLED) ⁽¹⁰⁾

T-46-23-08



TRUTH TABLES

P4C168 (P4C169)

| Mode | \overline{CE} (\overline{CS}) | \overline{WE} | Output |
|--------------------|-------------------------------------|-----------------|-----------|
| Standby (Deselect) | H | X | High Z |
| Read | L | H | D_{OUT} |
| Write | L | L | High Z |

1524 Tbl 12

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 |

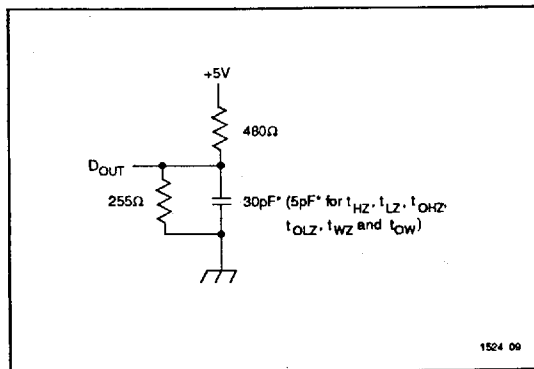
1524 Tbl 14

P4C170

| Mode | \overline{CE} | \overline{WE} | \overline{OE} | Output |
|----------------|-----------------|-----------------|-----------------|-----------|
| Deselect | H | X | X | High Z |
| Read | L | H | L | D_{OUT} |
| Output Inhibit | L | H | H | High Z |
| Write | L | L | X | High Z |

1524 Tbl 13

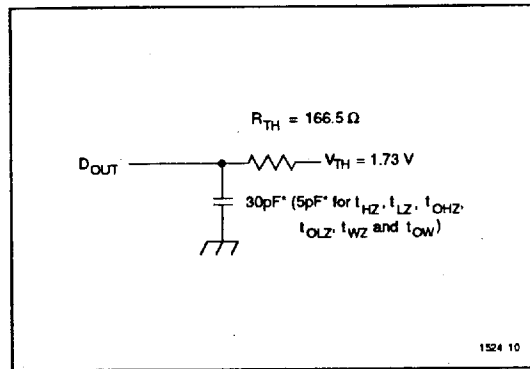
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1524 09

Figure 1. Output Load

* including scope and test fixture.



1524 10

Figure 2. Thevenin Equivalent

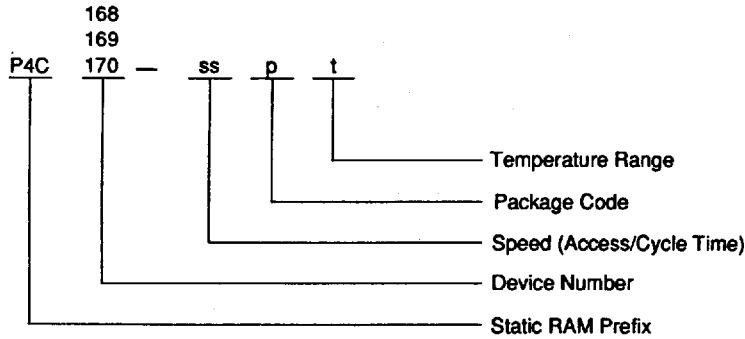
Note:

Because of the ultra-high speed of the P4C168, P4C169 AND P4C170 care must be taken when testing these devices; 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 μ F high frequency capacitor is also

required between V_{CC} and ground. To avoid signal reflections, proper termination must be used; for example, a 50 Ω test environment should be terminated into a 50 Ω load with 1.73V (Thevenin Voltage) at the comparator input, and a 116 Ω resistor must be used in series with D_{OUT} to match 166 Ω (Thevenin Resistance).

ORDERING INFORMATION

T-46-23-08



ss = Speed (access/cycle time in ns), e.g., 15, 20

p = Package code, i.e., P, S, D.

t = Temperature range, i.e., C, M, MB.

1524 11

PACKAGE SUFFIX

| Package Suffix | Description |
|----------------|-------------------------------------|
| P | Plastic DIP, 300 mil wide standard |
| S | Plastic SOIC, 300 mil wide standard |
| D | CERDIP, 300 mil wide standard |

1524 Tbl 15

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-883D Class B compliance |

1524 Tbl 16

SELECTION GUIDE

The P4C168, P4C169 and P4C170 are available in the following temperature, speed and package options.

| Temperature Range | Speed (ns) | | | | |
|---------------------|---------------|-------|-------|-------|-------|
| | Package | 12 | 15 | 20 | 25 |
| Commercial | Plastic DIP | -12PC | -15PC | -20PC | -25PC |
| | Plastic SOIC† | -12SC | -15SC | -20SC | -25SC |
| | CERDIP | -12DC | -15DC | -20DC | -25DC |
| Military Temp. | CERDIP | N/A | N/A | N/A | N/A |
| Military Processed* | CERDIP | N/A | N/A | N/A | N/A |

† P4C168 only

* Military temperature range with MIL-STD-883 Revision D, Class B processing.

N/A = Not available

1524 Tbl 17