

## ATT7C199

# High-Speed CMOS SRAM, 256 Kbit (32K x 8), Common I/O, Output Enable

### Features

- High speed —12 ns maximum access times
- Automatic powerdown during long cycles
- Advanced CMOS technology
- Chip-select powerdown
- Data retention at 2 V for battery backup operation
- Plug-compatible with IDT71256 and CY7C198/199
- Low-power operation
  - Active: 750 mW typical at 25 ns
  - Standby: 10 mW typical
- Package styles available:
  - 28-pin, plastic DIP
  - 28-pin, plastic SOJ (J-lead)

### Description

The ATT7C199 device is a high-performance, low-power, CMOS static RAM organized as 32,768 words by 8 bits per word. The eight data-in and data-out signals share I/O pins.

The ATT7C199 device is available in four speeds with maximum access times from 12 ns to 25 ns. Inputs and output are TTL compatible. Operation is from a single 5 V power supply. Power consumption is 750 mW (typical) at 25 ns. Dissipation drops to 100 mW (typical) when the memory is deselected (enable is high).

Two standby modes are available. Automatic powerdown during long cycles reduces power consumption during read or write accesses that are longer than the minimum access time, or when memory is deselected. In addition, data can be retained in inactive storage with a supply voltage as low as 2 V.

The ATT7C199 consumes only 1.5 mW at 3 V (typical), thereby allowing effective battery backup operation.

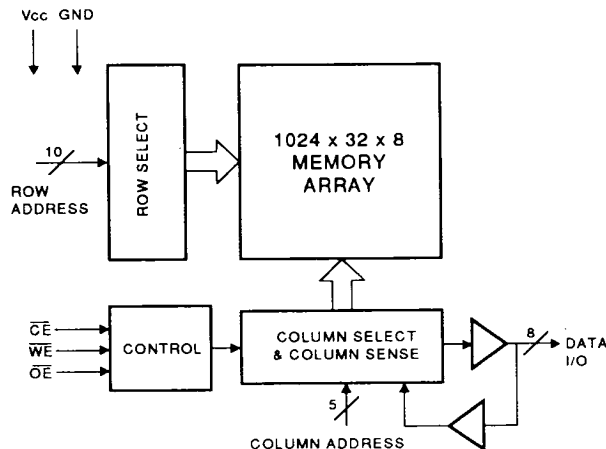


Figure 1. Block Diagram

## Pin Information

Table 1. Pin Descriptions

Pin	Name/Function
A0—A14	Address
I/O0—I/O7	Data Input/Output
$\overline{CE}$	Chip Enable
$\overline{OE}$	Output Enable
$\overline{WE}$	Write Enable
GND	Ground
Vcc	Power

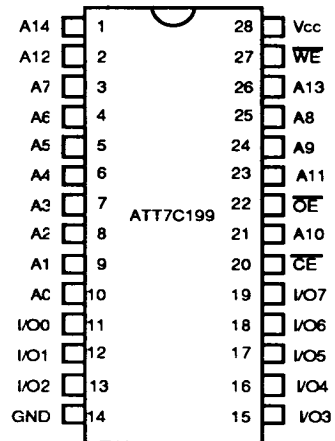


Figure 2. Pin Diagram

## Functional Description

The ATT7C199 device provides asynchronous (unclocked) operation with matching access and cycle times. An active-low chip enable and a 3-state I/O bus with a separate output-enable control simplify the connection of several chips for increased storage capacity.

Memory locations are specified on address pins A0 through A14. Reading from a designated location is accomplished by presenting an address and taking  $\overline{CE}$  low while  $\overline{WE}$  remains high. The data in the addressed memory location then appears on the data-out pin within one access time. The output pin stays in a high-impedance state when either  $\overline{CE}$  or  $\overline{OE}$  is high or  $\overline{WE}$  is low.

Writing to an addressed location is accomplished when  $\overline{CE}$  and  $\overline{WE}$  inputs are both low. Either signal can terminate the write operation. Data-in has the same polarity as data-out.

Latch-up and static discharge protection are provided on-chip. The ATT7C199 can withstand an injection of up to 200 mA on any pin without damage.

## Absolute Maximum Ratings

Stresses in excess of the Absolute Maximum Ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of this data sheet. Exposure to Absolute Maximum Ratings for extended periods can adversely affect device reliability.

Parameter	Symbol	Min	Max	Unit
Storage Temperature	$T_{stg}$	-65	150	°C
Operating Ambient Temperature	$T_A$	-55	125	°C
Supply Voltage with Respect to Ground	$V_{cc}$	-0.5	7.0	V
Input Signal with Respect to Ground	—	-3.0	7.0	V
Signal Applied to High-impedance Output	—	-3.0	7.0	V
Output Current into Low Outputs	—	—	25	mA
Latch-up Current	—	>200	—	mA

## Handling Precautions

The ATT7C199 device includes internal circuitry designed to protect the chip from damaging substrate injection currents and accumulations of static charge. Nevertheless, conventional precautions should be observed during storage, handling, and use to avoid exposure to excessive electrical stress.

## Recommended Operating Conditions

Mode	Temperature Range (Ambient)	Supply Voltage
Active Operation	0 °C to 70 °C	4.5 V ≤ $V_{cc}$ ≤ 5.5 V
Data Retention	0 °C to 70 °C	2.0 V ≤ $V_{cc}$ ≤ 5.5 V

## Truth Table

Table 2. Truth Table

$\overline{CE}$	$\overline{WE}$	$\overline{OE}$	Inputs/Outputs	Mode	Power
H	X	X	High Z	Powerdown	Standby
L	H	L	Data Out	Read	Active
L	L	X	Data In	Write	Active
L	H	H	High Z	Output Disable	Active*

\* $t_{cc}$  ≡  $t_{cc1}$  at  $t_0$  followed by powerdown after  $t_{CHICL}$  has elapsed.

## Electrical Characteristics

Over all Recommended Operating Conditions

**Table 3. General Electrical Characteristics**

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Output Voltage:						
High	V <sub>OH</sub>	I <sub>OH</sub> = -4.0 mA, V <sub>CC</sub> = 4.5 V	2.4	—	—	V
Low	V <sub>OL</sub>	I <sub>OL</sub> = 8.0 mA	—	—	0.4	V
Input Voltage:						
High	V <sub>IH</sub>	—	2.2	—	V <sub>CC</sub> + 0.3	V
Low <sup>1</sup>	V <sub>IL</sub>	—	-3.0	—	0.8	V
Input Current	I <sub>IX</sub>	Ground ≤ V <sub>I</sub> ≤ V <sub>CC</sub>	-10	—	10	μA
Output Leakage Current	I <sub>OZ</sub>	Ground ≤ V <sub>O</sub> ≤ V <sub>CC</sub> , $\overline{CE} = V_{CC}$	-10	—	10	μA
Output Short Current <sup>2</sup>	I <sub>OS</sub>	V <sub>O</sub> = Ground, V <sub>CC</sub> = Max	—	—	-350	mA
V <sub>CC</sub> Current:						
Inactive <sup>3</sup>	I <sub>CC2</sub>	—	—	20	40	mA
Standby <sup>4</sup>	I <sub>CC3</sub>	—	—	2	10	mA
DR Mode <sup>5</sup>	I <sub>CC4</sub>	V <sub>CC</sub> = 3.0 V	—	500	5,000	μA
Capacitance:						
Input	C <sub>I</sub>	T <sub>A</sub> = 25 °C, V <sub>CC</sub> = 5.0 V	—	—	5	pF
Output <sup>6</sup>	C <sub>O</sub>	Test frequency = 1 MHz	—	—	7	pF

1. This device provides hard clamping of transient undershoot. Input levels below ground are clamped beginning at -0.6 V. A current in excess of 100 mA is required to reach -2 V. The device can withstand indefinite operation with inputs as low as -3 V, subject only to power dissipation and bond-wire fusing constraints.
2. Duration of the output short-circuit should not exceed 30 s.
3. Tested with outputs open and all address and data inputs changing at the maximum write-cycle rate. The device is continuously disabled, i.e.,  $\overline{CE} \geq V_{IH}$ .
4. Tested with outputs open and all address and data inputs stable. The device is continuously disabled, i.e.,  $\overline{CE} = V_{CC}$ . Input levels are within 0.2 V of V<sub>CC</sub> or ground.
5. Data retention operation requires that V<sub>CC</sub> never drops below 2.0 V.  $\overline{CE}$  must be ≥ V<sub>CC</sub> - 0.2 V. For all other inputs, V<sub>IN</sub> ≥ V<sub>CC</sub> - 0.2 V or V<sub>IN</sub> < 0.2 V is required to ensure full powerdown.
6. This parameter is not 100% tested.

**Table 4. Electrical Characteristics by Speed**

Parameter	Symbol	Test Conditions	Speed				Unit
			25	20	15	12	
Max V <sub>CC</sub> Current, Active	I <sub>CC1</sub>	*	150	185	240	275	mA

- \* Tested with outputs open and all address and data inputs changing at the maximum write-cycle rate. The device is continuously enabled for writing, i.e.,  $\overline{CE}$  and  $\overline{WE} \leq V_{IL}$ . Input pulse levels are 0 V to 3.0 V. Max I<sub>CC</sub> shown applies over the active operating temperature range.

## Timing Characteristics

**Table 5. Read Cycle<sup>1, 2, 3, 4</sup>**

Over all Recommended Operating Conditions; all measurements in ns. Test conditions assume input transition times of <3 ns, reference levels of 1.5 V, input pulse levels of 0 V to 3.0 V (see Figure 9), and output loading for specified  $I_{OL}$  and  $I_{OH} +30$  pF (see Figure 8A).

Symbol	Parameter	Speed (ns)							
		25		20		15		12	
		Min	Max	Min	Max	Min	Max	Min	Max
tADXADX, tCELCEH	Read-cycle Time	25	—	20	—	15	—	12	—
tADXDOV	Address Change to Output Valid <sup>5, 6</sup>	—	25	—	20	—	15	—	12
tADXDOX	Address Change to Output Change	3	—	3	—	3	—	3	—
tCELD0V	Chip Enable Low to Output Valid <sup>5, 7</sup>	—	25	—	20	—	15	—	12
tCELD0Z	Chip Enable Low to Output Low-Z <sup>8, 9</sup>	3	—	3	—	3	—	3	—
tCEHDOZ	Chip Enable High to Output High-Z <sup>8, 9</sup>	—	10	—	8	—	8	—	5
tOELDOV	Output Enable Low to Output Valid	—	12	—	10	—	8	—	6
tOELDOZ	Output Enable Low to Output Low-Z <sup>8, 9</sup>	0	—	0	—	0	—	0	—
tOEHDOZ	Output Enable High to Output High-Z <sup>8, 9</sup>	—	10	—	8	—	5	—	5
tCELICH, tADXICH	Chip Enable Low or Address Change to Powerup <sup>10, 11</sup>	0	—	0	—	0	—	0	—
tICHICL	Powerup to Powerdown <sup>10, 11</sup>	—	25	—	20	—	20	—	15

- Each parameter is shown as a minimum or maximum value. Input requirements are specified from the point of view of the external system driving the chip. For example, tADXWEH (Table 6) is specified as a minimum since the external system must supply at least that much time to meet the worst-case requirements of all parts. Responses from the internal circuitry are specified from the point of view of the device. Access time, for example, is specified as a maximum since worst-case operation of any device always provides data within that time.
- All address timings are referenced from the last valid address line to the first transitioning address line.
- $\overline{CE}$  or  $\overline{WE}$  must be high during address transitions.
- This product is a very high-speed device, and care must be taken during testing in order to realize valid test information. Inadequate attention to setups and procedures can cause a good part to be rejected as faulty. Long high-inductance leads that cause supply bounce must be avoided by bringing the Vcc and ground planes directly up to the contactor fingers. A 0.01  $\mu$ F high-frequency capacitor is also required between Vcc and ground. To avoid signal reflections, proper terminations must be used.
- $\overline{WE}$  is high for the read cycle.
- During this state, the chip is continuously selected ( $\overline{CE}$  low).
- All address lines are valid prior to or coincident with the  $\overline{CE}$  transition to active.
- At any given temperature and voltage condition, output-disable time is less than output-enable time for any given device.
- Transition is measured  $\pm 200$  mV from steady-state voltage with specified loading in Figure 8B. This parameter is sampled and not 100% tested.
- This parameter is not 100% tested.
- Powerup from lcc2 to lcc1 occurs as a result of any of the following conditions: (1) falling edge of  $\overline{CE}$ , (2) falling edge of  $\overline{WE}$  ( $\overline{CE}$  active), (3) transition on any address line ( $\overline{CE}$  active), and (4) transition on any data line ( $\overline{CE}$  and  $\overline{WE}$  active). The device automatically powers down from lcc1 to lcc2 after tICHICL has elapsed from any of the prior conditions. Power dissipation is dependent only on cycle rate, not on chip-select pulse width.

Timing Characteristics (continued)

Table 6. Write Cycle<sup>1, 2, 3, 4</sup>

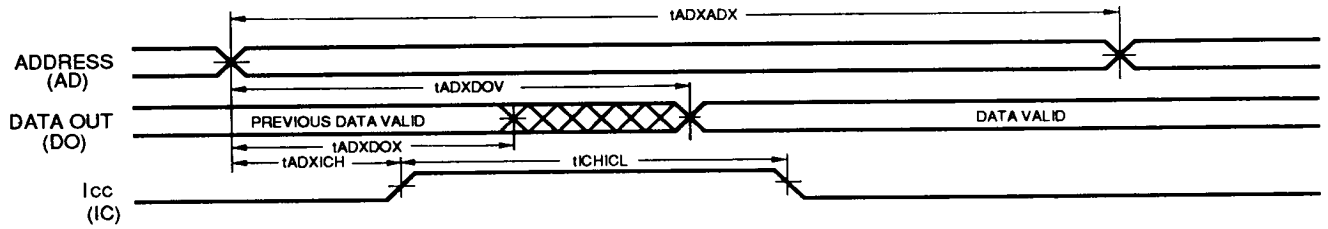
Over all Recommended Operating Conditions; all measurements in ns. Test conditions assume input transition times of <3 ns, reference levels of 1.5 V, input pulse levels of 0 V to 3.0 V (see Figure 9), and output loading for specified IOL and IOH +30 pF (see Figure 8A).

Symbol	Parameter	Speed (ns)							
		25		20		15		12	
		Min	Max	Min	Max	Min	Max	Min	Max
tADXADX	Write-cycle Time	20	—	20	—	15	—	12	—
tCELWEH	Chip Enable Low to End of Write	15	—	15	—	12	—	10	—
tADXWEX, tADXWEL	Address Change to Beginning of Write	0	—	0	—	0	—	0	—
tADXWEH	Address Change to End of Write	15	—	15	—	12	—	10	—
tWEHADX	End of Write to Address Change	0	—	0	—	0	—	0	—
tWELWEH	Write Enable Low to End of Write	15	—	15	—	12	—	10	—
tDIVWEH, tDIXCEH	Data Valid to End of Write	10	—	10	—	7	—	6	—
tWEHDIX	End of Write to Data Change	0	—	0	—	0	—	0	—
tWEHDOZ	Write Enable High to Output Low-Z <sup>5, 6</sup>	0	—	0	—	0	—	0	—
tWELDOZ	Write Enable Low to Output High-Z <sup>5, 6</sup>	—	7	—	7	—	5	—	4
tCELICH	Chip Enable Low to Powerup <sup>7, 8</sup>	0	—	0	—	0	—	0	—
tWELICH	Write Enable Low to Powerup <sup>7, 8</sup>	0	—	0	—	0	—	0	—
tCEHVCL	Chip Enable High to Data Retention <sup>7</sup>	0	—	0	—	0	—	0	—
tICHICL	Powerup to Powerdown	—	25	—	20	—	20	—	15

- Each parameter is shown as a minimum or maximum value. Input requirements are specified from the point of view of the external system driving the chip. For example, tADXWEH is specified as a minimum since the external system must supply at least that much time to meet the worst-case requirements of all parts. Responses from the internal circuitry are specified from the point of view of the device. Access time, for example, is specified as a maximum since worst-case operation of any device always provides data within that time.
- All address timings are referenced from the last valid address line to the first transitioning address line.
- CE or WE must be high during address transitions.
- This product is a very high-speed device, and care must be taken during testing in order to realize valid test information. Inadequate attention to setups and procedures can cause a good part to be rejected as faulty. Long high-inductance leads that cause supply bounce must be avoided by bringing the Vcc and ground planes directly up to the contactor fingers. A 0.01 μF high-frequency capacitor is also required between Vcc and ground. To avoid signal reflections, proper terminations must be used.
- At any given temperature and voltage condition, output-disable time is less than output-enable time for any given device.
- Transition is measured ±200 mV from steady-state voltage with specified loading in Figure 8B. This parameter is sampled and not 100% tested.
- This parameter is not 100% tested.
- Powerup from Icc2 to Icc1 occurs as a result of any of the following conditions: (1) falling edge of  $\overline{CE}$ , (2) falling edge of  $\overline{WE}$  ( $\overline{CE}$  active), (3) transition on any address line ( $\overline{CE}$  active), and (4) transition on any data line ( $\overline{CE}$  and  $\overline{WE}$  active). The device automatically powers down from Icc1 to Icc2 after tICHICL has elapsed from any of the prior conditions. Power dissipation is dependent only on cycle rate, not on chip-select pulse width.

## Timing Characteristics (continued)

### Timing Diagrams

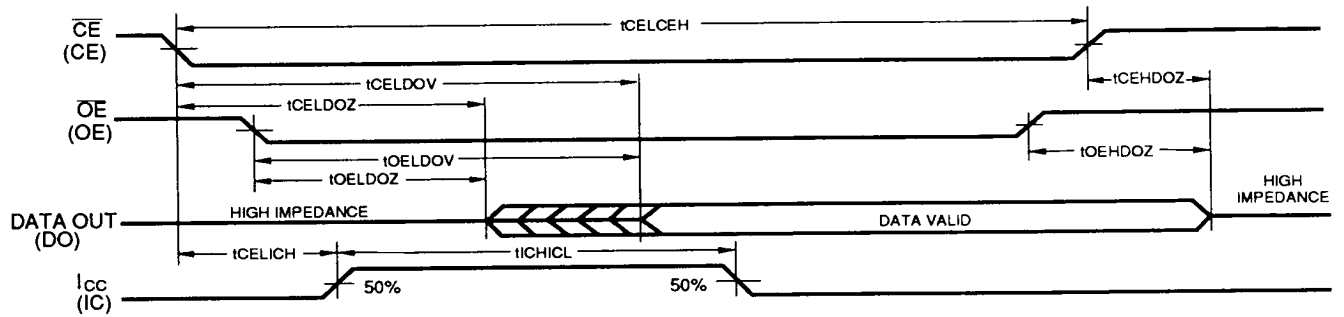


**Notes:**

$\overline{WE}$  is high for the read cycle.

The chip is continuously selected ( $\overline{CE}$  low).

**Figure 3. Read Cycle — Address-Controlled**



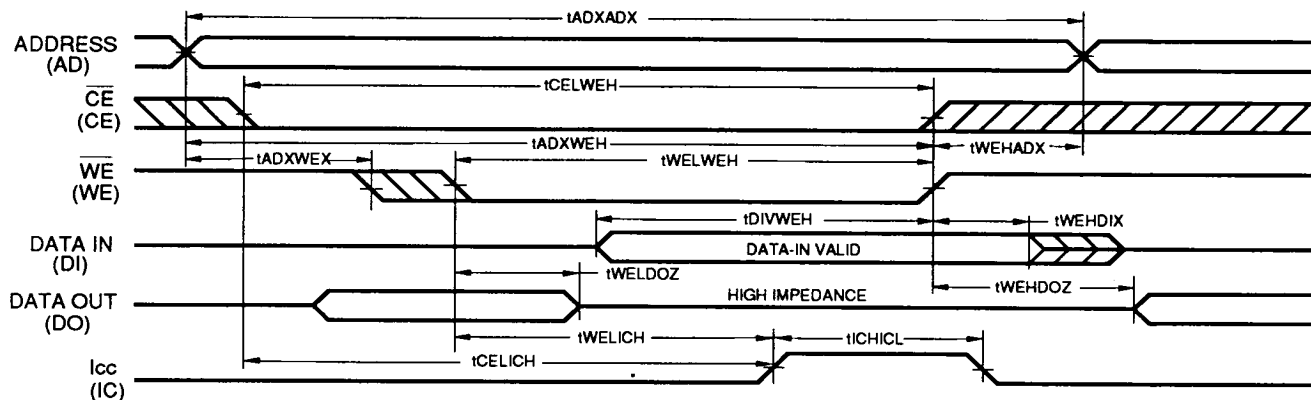
**Notes:**

$\overline{WE}$  is high for the read cycle.

All address lines are valid prior to or coincident with the  $\overline{CE}$  transition to low.

**Figure 4. Read Cycle —  $\overline{CE}$  /  $\overline{OE}$  -Controlled**

Timing Characteristics (continued)



Notes:

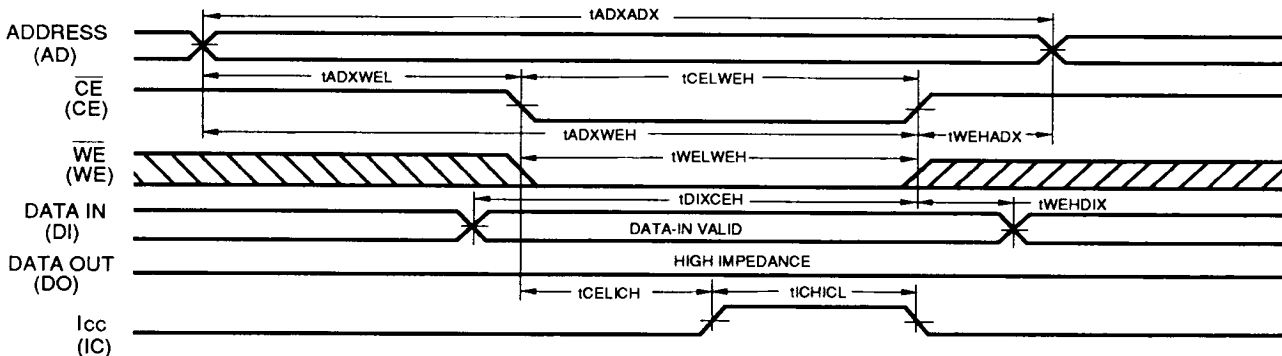
The internal write cycle of the memory is defined by the overlap of  $\overline{CE}$  low and  $\overline{WE}$  low. Both signals must be low to initiate a write. Either signal can terminate a write by going high. The address, data, and control input setup and hold times should be referred to the signal that falls last or rises first.

If  $\overline{WE}$  goes low before or concurrent with  $\overline{CE}$  going low, the output remains in a high-impedance state.

If  $\overline{CE}$  goes high before or concurrent with  $\overline{WE}$  going high, the output remains in a high-impedance state.

Powerup from  $I_{CC2}$  to  $I_{CC1}$  occurs as a result of any of the following conditions: (1) falling edge of  $\overline{CE}$ , (2) falling edge of  $\overline{WE}$  ( $\overline{CE}$  active), (3) transition on any address line ( $\overline{CE}$  active), and (4) transition on any data line ( $\overline{CE}$  and  $\overline{WE}$  active). The device automatically powers down from  $I_{CC1}$  to  $I_{CC2}$  after  $t_{ICHICL}$  has elapsed from any of the prior conditions. Power dissipation is dependent only on cycle rate, not on chip-select pulse width.

Figure 5. Write Cycle —  $\overline{WE}$ -Controlled



Notes:

The internal write cycle of the memory is defined by the overlap of  $\overline{CE}$  low and  $\overline{WE}$  low. Both signals must be low to initiate a write. Either signal can terminate a write by going high. The address, data, and control input setup and hold times should be referred to the signal that falls last or rises first.

If  $\overline{WE}$  goes low before or concurrent with  $\overline{CE}$  going low, the output remains in a high-impedance state.

If  $\overline{CE}$  goes high before or concurrent with  $\overline{WE}$  going high, the output remains in a high-impedance state.

Powerup from  $I_{CC2}$  to  $I_{CC1}$  occurs as a result of any of the following conditions: (1) falling edge of  $\overline{CE}$ , (2) falling edge of  $\overline{WE}$  ( $\overline{CE}$  active), (3) transition on any address line ( $\overline{CE}$  active), and (4) transition on any data line ( $\overline{CE}$  and  $\overline{WE}$  active). The device automatically powers down from  $I_{CC1}$  to  $I_{CC2}$  after  $t_{ICHICL}$  has elapsed from any of the prior conditions. Power dissipation is dependent only on cycle rate, not on chip-select pulse width.

Figure 6. Write Cycle —  $\overline{CE}$ -Controlled



Timing Characteristics (continued)

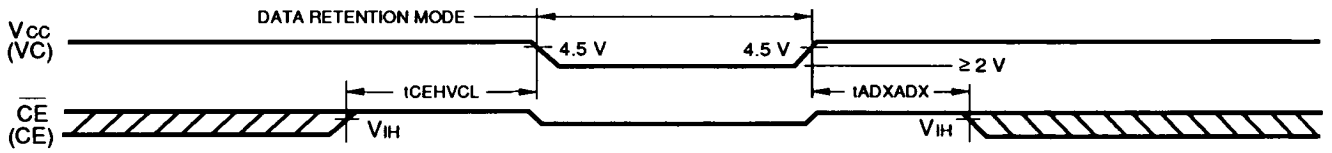


Figure 7. Data Retention

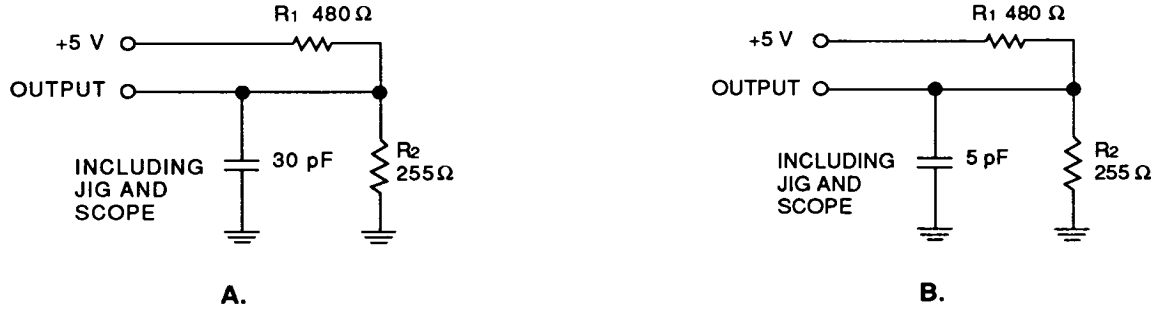


Figure 8. Test Loads

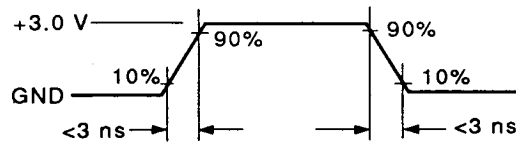
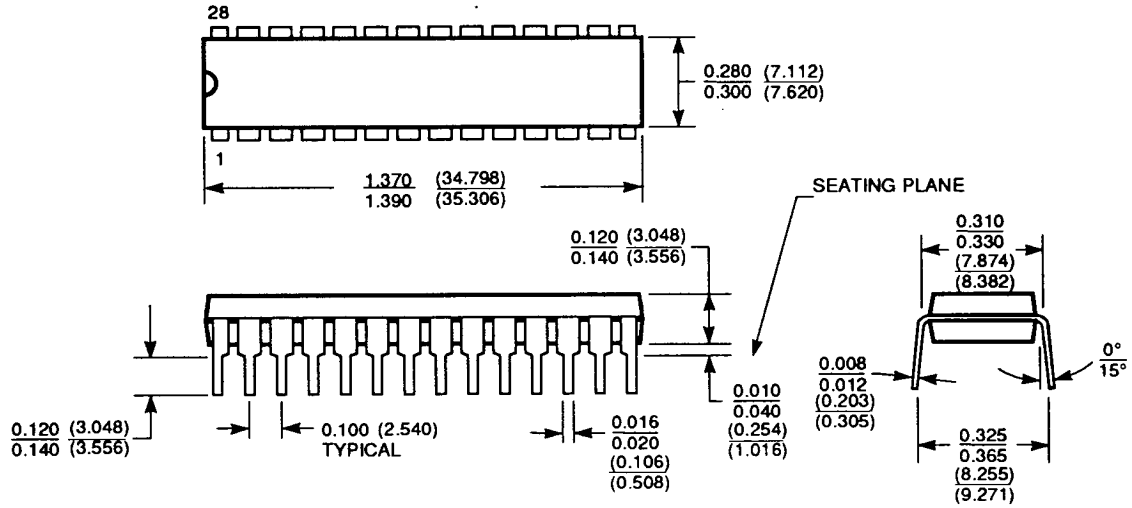


Figure 9. Transition Times

## Outline Diagrams

### 28-Pin, Plastic DIP

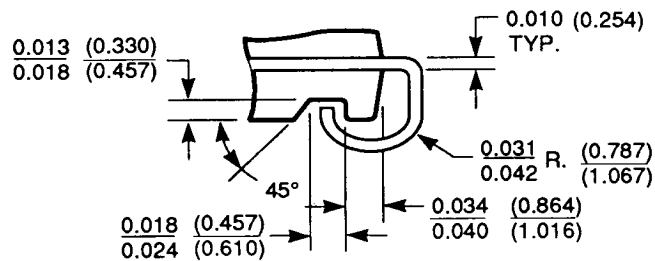
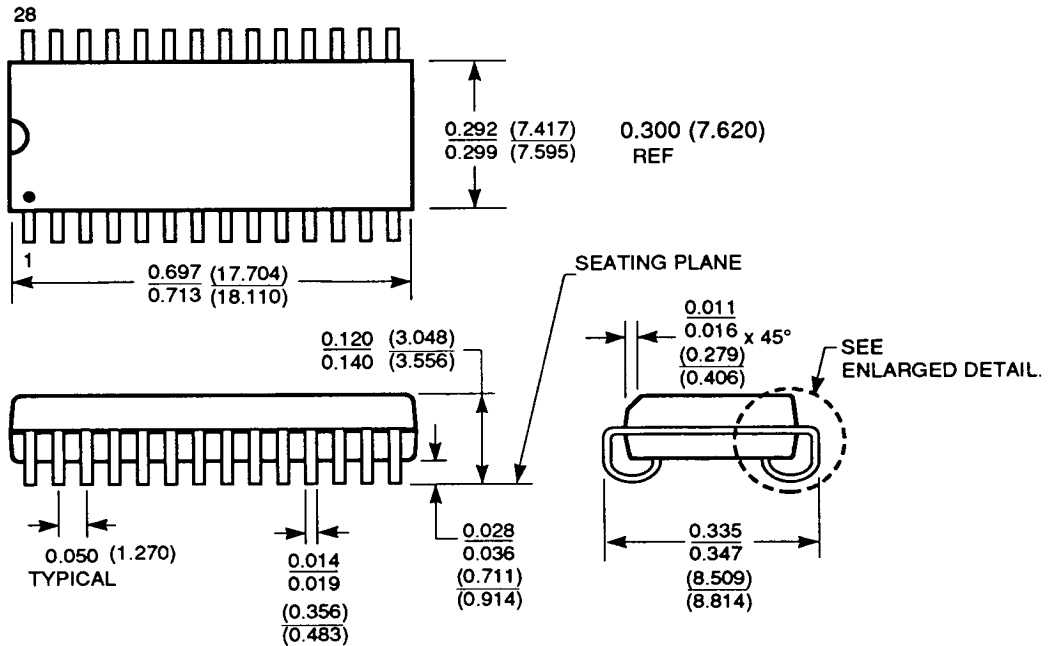
Dimensions are in inches and (millimeters).



Outline Diagrams (continued)

28-Pin, Plastic SOJ

Dimensions are in inches and (millimeters).



ENLARGED DETAIL

Application Drawings

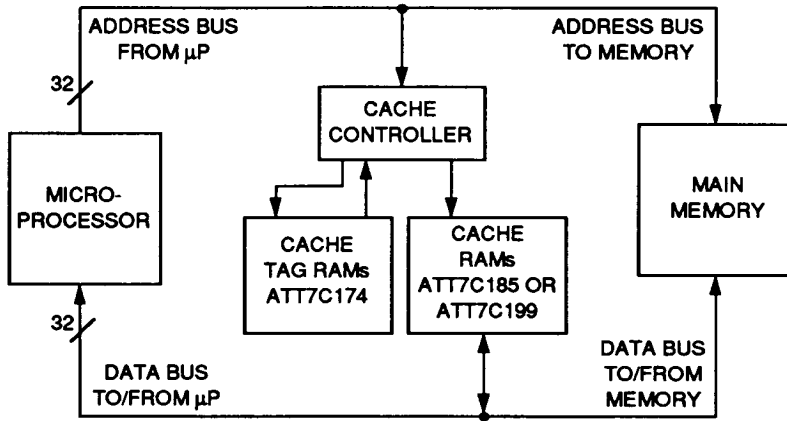


Figure 10. PC Cache Memory Block Diagram

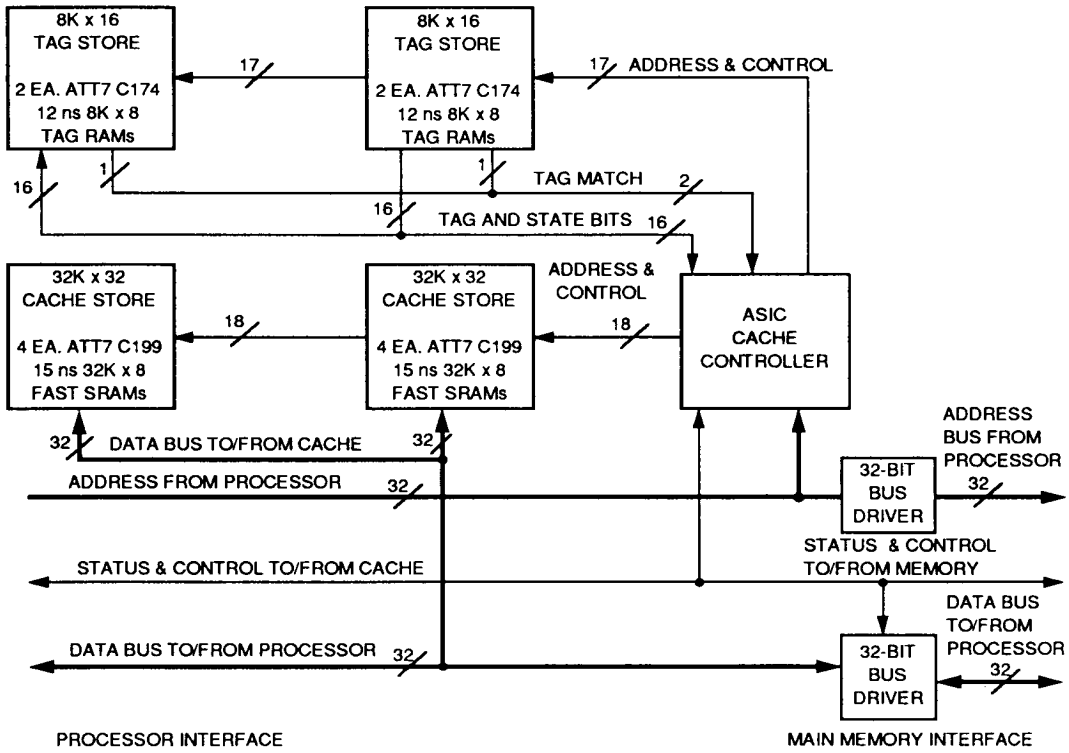
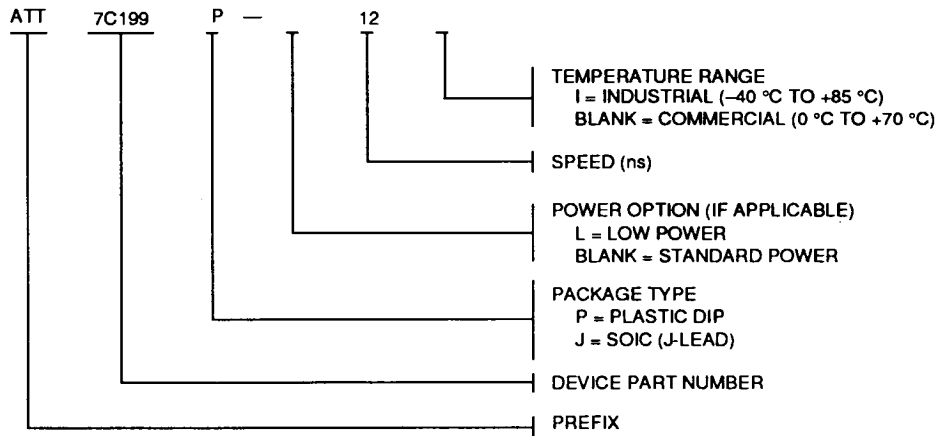


Figure 11. Typical ATT7C199 SRAM Application  
(A 256 Kbit Two-Way Set Associative Cache)

## Ordering Information



Operating Range 0 °C to 70 °C

Package Style	Performance Speed			
	25 ns	20 ns	15 ns	12 ns
28-Pin, Plastic DIP	ATT7C199P-25	ATT7C199P-20	ATT7C199P-15	ATT7C199P-12
28-Pin, Plastic SOJ	ATT7C199J-25	ATT7C199J-20	ATT7C199J-15	ATT7C199J-12

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Tel. (03) 5371-2700, FAX (03) 5371-3556

SPAIN: AT&T Microelectronica de España, Poligono Industrial de Tres Cantos (Zona Oeste), 28770 Colmenar Viejo, Madrid, Spain

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February 1992  
DS91-138MMOS (Replaces DS90-122MMOS)



028932 ✓