

## Features

- Single-voltage Operation
  - 5V Read
  - 5V Reprogramming
- Fast Read Access Time - 55 ns
- Internal Program Control and Timer
- Sector Architecture
  - One 16K Byte Boot Block with Programming Lockout
  - Two 8K Byte Parameter Blocks
  - Two Main Memory Blocks (96K, 128K Bytes)
- Fast Erase Cycle Time - 10 seconds
- Byte-by-byte Programming - 10  $\mu$ s/Byte Typical
- Hardware Data Protection
- $\overline{\text{DATA}}$  Polling for End of Program Detection
- Low Power Dissipation
  - 50 mA Active Current
  - 100  $\mu$ A CMOS Standby Current
- Typical 10,000 Write Cycles

## Description

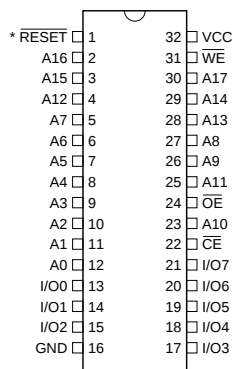
The AT49F002(N)(T) is a 5-volt only in-system reprogrammable Flash memory. Its 2 megabits of memory is organized as 262,144 words by 8 bits. Manufactured with Atmel's advanced nonvolatile CMOS technology, the device offers access times to 55 ns with power dissipation of just 275 mW over the commercial temperature range.

(continued)

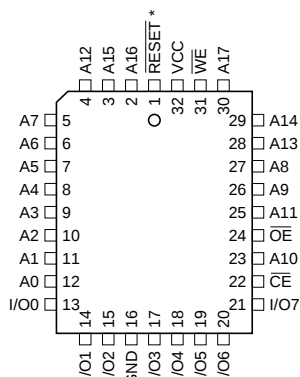
## Pin Configurations

| Pin Name                  | Function            |
|---------------------------|---------------------|
| A0 - A17                  | Addresses           |
| $\overline{\text{CE}}$    | Chip Enable         |
| $\overline{\text{OE}}$    | Output Enable       |
| $\overline{\text{WE}}$    | Write Enable        |
| $\overline{\text{RESET}}$ | RESET               |
| I/O0 - I/O7               | Data Inputs/Outputs |
| DC                        | Don't Connect       |

DIP Top View

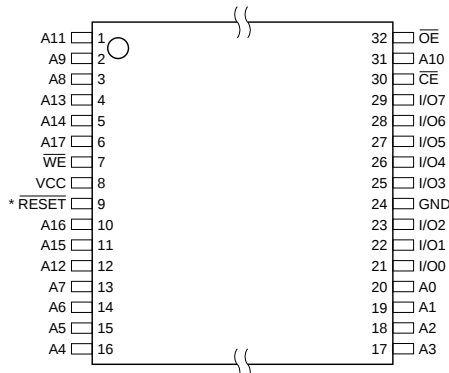


PLCC Top View



VSOP Top View (8 x 14 mm) or  
TSOP Top View (8 x 20 mm)

Type 1



\*Note: This pin is a DC on the AT49F002(N)(T).



**2-megabit  
(256K x 8)  
5-volt Only  
Flash Memory**

**AT49F002  
AT49F002N  
AT49F002T  
AT49F002NT**



When the device is deselected, the CMOS standby current is less than 100  $\mu$ A. For the AT49F002N(T) pin 1 for the DIP and PLCC packages and pin 9 for the TSOP package are don't connect pins.

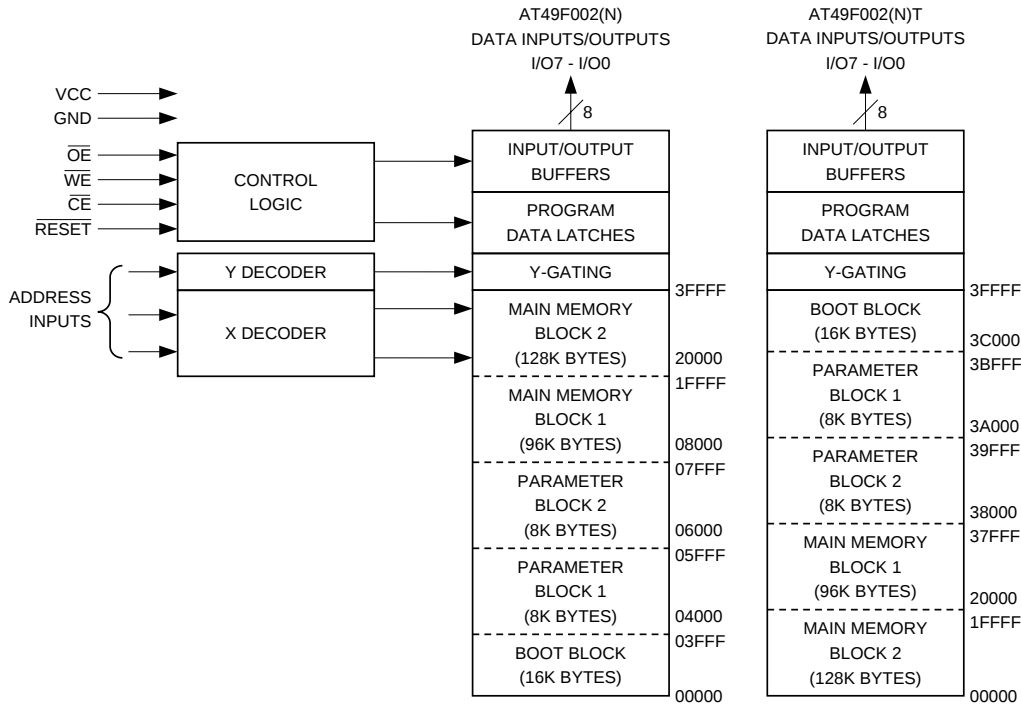
To allow for simple in-system reprogrammability, the AT49F002(N)(T) does not require high input voltages for programming. Five-volt-only commands determine the read and programming operation of the device. Reading data out of the device is similar to reading from an EPROM; it has standard  $\overline{CE}$ ,  $\overline{OE}$ , and  $\overline{WE}$  inputs to avoid bus contention. Reprogramming the AT49F002(N)(T) is performed by erasing a block of data and then programming on a byte by byte basis. The byte programming time is a fast 50  $\mu$ s. The end of a program cycle can be optionally detected by the  $\overline{DATA}$  polling feature. Once the end of a byte program cycle has been detected, a new access for a read or program can begin. The typical number of program and erase cycles is in excess of 10,000 cycles.

The device is erased by executing the erase command sequence; the device internally controls the erase operations. There are two 8K byte parameter block sections and two main memory blocks.

The device has the capability to protect the data in the boot block; this feature is enabled by a command sequence. The 16K-byte boot block section includes a reprogramming lock out feature to provide data integrity. The boot sector is designed to contain user secure code, and when the feature is enabled, the boot sector is protected from being reprogrammed.

In the AT49F002(N)(T), once the boot block programming lockout feature is enabled, the contents of the boot block are permanent and cannot be changed. In the AT49F002(T), once the boot block programming lockout feature is enabled, the contents of the boot block cannot be changed with input voltage levels of 5.5 volts or less.

### Block Diagram



## Device Operation

**READ:** The AT49F002(N)(T) is accessed like an EPROM. When  $\overline{CE}$  and  $\overline{OE}$  are low and  $\overline{WE}$  is high, the data stored at the memory location determined by the address pins is asserted on the outputs. The outputs are put in the high impedance state whenever  $\overline{CE}$  or  $\overline{OE}$  is high. This dual-line control gives designers flexibility in preventing bus contention.

**COMMAND SEQUENCES:** When the device is first powered on it will be reset to the read or standby mode depending upon the state of the control line inputs. In order to perform other device functions, a series of command sequences are entered into the device. The command sequences are shown in the Command Definitions table. The command sequences are written by applying a low pulse on the  $\overline{WE}$  or  $\overline{CE}$  input with  $\overline{CE}$  or  $\overline{WE}$  low (respectively) and  $\overline{OE}$  high. The address is latched on the falling edge of  $\overline{CE}$  or  $\overline{WE}$ , whichever occurs last. The data is latched by the first rising edge of  $\overline{CE}$  or  $\overline{WE}$ . Standard microprocessor write timings are used. The address locations used in the command sequences are not affected by entering the command sequences.

**RESET:** A  $\overline{RESET}$  input pin is provided to ease some system applications. When  $\overline{RESET}$  is at a logic high level, the device is in its standard operating mode. A low level on the  $\overline{RESET}$  input halts the present device operation and puts the outputs of the device in a high impedance state. If the  $\overline{RESET}$  pin makes a high to low transition during a program or erase operation, the operation may not be successfully completed and the operation will have to be repeated after a high level is applied to the  $\overline{RESET}$  pin. When a high level is reasserted on the  $\overline{RESET}$  pin, the device returns to the read or standby mode, depending upon the state of the control inputs. By applying a  $12V \pm 0.5V$  input signal to the  $\overline{RESET}$  pin, the boot block array can be reprogrammed even if the boot block lockout feature has been enabled (see Boot Block Programming Lockout Override section). The RESET feature is not available for the AT49F002N(T).

**ERASURE:** Before a byte can be reprogrammed, the main memory block or parameter block which contains the byte must be erased. The erased state of the memory bits is a logical "1". The entire device can be erased at one time by using a 6-byte software code. The software chip erase code consists of 6-byte load commands to specific address locations with a specific data pattern (please refer to the Chip Erase Cycle Waveforms).

After the software chip erase has been initiated, the device will internally time the erase operation so that no external clocks are required. The maximum time needed to erase the whole chip is  $t_{EC}$ . If the boot block lockout feature has been enabled, the data in the boot sector will not be erased.

**CHIP ERASE:** If the boot block lockout has been enabled, the Chip Erase function will erase Parameter Block 1, Parameter Block 2, Main Memory Block 1, and Main Memory Block 2 but not the boot block. If the Boot Block Lockout has not been enabled, the Chip Erase function will erase the entire chip. After the full chip erase the device will return back to read mode. Any command during chip erase will be ignored.

**SECTOR ERASE:** As an alternative to a full chip erase, the device is organized into sectors that can be individually erased. There are two 8K-byte parameter block sections and two main memory blocks. The 8K-byte parameter block sections can be independently erased and reprogrammed. The two main memory sections are designed to be used as alternative memory sectors. That is, whenever one of the blocks has been erased and reprogrammed, the other block should be erased and reprogrammed before the first block is again erased. The Sector Erase command is a six bus cycle operation. The sector address is latched on the falling  $\overline{WE}$  edge of the sixth cycle while the 30H data input command is latched at the rising edge of  $\overline{WE}$ . The sector erase starts after the rising edge of  $\overline{WE}$  of the sixth cycle. The erase operation is internally controlled; it will automatically time to completion.

**BYTE PROGRAMMING:** Once the memory array is erased, the device is programmed (to a logical "0") on a byte-by-byte basis. Please note that a data "0" cannot be programmed back to a "1"; only erase operations can convert "0"s to "1"s. Programming is accomplished via the internal device command register and is a 4 bus cycle operation (please refer to the Command Definitions table). The device will automatically generate the required internal program pulses.

The program cycle has addresses latched on the falling edge of  $\overline{WE}$  or  $\overline{CE}$ , whichever occurs last, and the data latched on the rising edge of  $\overline{WE}$  or  $\overline{CE}$ , whichever occurs first. Programming is completed after the specified  $t_{BP}$  cycle time. The  $\overline{DATA}$  polling feature may also be used to indicate the end of a program cycle.

**BOOT BLOCK PROGRAMMING LOCKOUT:** The device has one designated block that has a programming lockout feature. This feature prevents programming of data in the designated block once the feature has been enabled. The size of the block is 16K bytes. This block, referred to as the boot block, can contain secure code that is used to bring up the system. Enabling the lockout feature will allow the boot code to stay in the device while data in the rest of the device is updated. This feature does not have to be activated; the boot block's usage as a write protected region is optional to the user. The address range of the boot block is 00000 to 03FFF for the AT49F002(N) while the address

range of the boot block is 3C000 to 3FFFF for the AT49F002(N)T.

Once the feature is enabled, the data in the boot block can no longer be erased or programmed with input voltage levels of 5.5V or less. Data in the main memory block can still be changed through the regular programming method. To activate the lockout feature, a series of six program commands to specific addresses with specific data must be performed. Please refer to the Command Definitions table.

**BOOT BLOCK LOCKOUT DETECTION:** A software method is available to determine if programming of the boot block section is locked out. When the device is in the software product identification mode (see Software Product Identification Entry and Exit sections) a read from address location 00002H will show if programming the boot block is locked out for the AT49F002(N), and a read from address location 3C002H will show if programming the boot block is locked out for AT49F002(N)T. If the data on I/O0 is low, the boot block can be programmed; if the data on I/O0 is high, the program lockout feature has been activated and the block cannot be programmed. The software product identification exit code should be used to return to standard operation.

**BOOT BLOCK PROGRAMMING LOCKOUT OVERRIDE:** The user can override the boot block programming lockout by taking the  $\overline{\text{RESET}}$  pin to 12 volts. By doing this, protected boot block data can be altered through a chip erase, sector erase or word programming. When the  $\overline{\text{RESET}}$  pin is brought back to TTL levels the boot block programming lockout feature is again active. This feature is not available on the AT49F002N(T).

**PRODUCT IDENTIFICATION:** The product identification mode identifies the device and manufacturer as Atmel. It may be accessed by hardware or software operation. The hardware operation mode can be used by an external programmer to identify the correct programming algorithm for the Atmel product.

For details, see Operating Modes (for hardware operation) or Software Product Identification. The manufacturer and device code is the same for both modes.

**DATA POLLING:** The AT49F002(N)(T) features  $\overline{\text{DATA}}$  polling to indicate the end of a program cycle. During a program cycle an attempted read of the last byte loaded will result in the complement of the loaded data on I/O7. Once the program cycle has been completed, true data is valid on all outputs and the next cycle may begin.  $\overline{\text{DATA}}$  polling may begin at any time during the program cycle.

**TOGGLE BIT:** In addition to  $\overline{\text{DATA}}$  polling the AT49F002(N)(T) provides another method for determining the end of a program or erase cycle. During a program or erase operation, successive attempts to read data from the device will result in I/O6 toggling between one and zero. Once the program cycle has completed, I/O6 will stop toggling and valid data will be read. Examining the toggle bit may begin at any time during a program cycle.

**HARDWARE DATA PROTECTION:** Hardware features protect against inadvertent programs to the AT49F002(N)(T) in the following ways: (a)  $V_{\text{CC}}$  sense: if  $V_{\text{CC}}$  is below 3.8V (typical), the program function is inhibited. (b) Program inhibit: holding any one of  $\overline{\text{OE}}$  low,  $\overline{\text{CE}}$  high or  $\overline{\text{WE}}$  high inhibits program cycles. (c) Noise filter: pulses of less than 15 ns (typical) on the  $\overline{\text{WE}}$  or  $\overline{\text{CE}}$  inputs will not initiate a program cycle.

**Command Definition (in Hex)<sup>(1)</sup>**

| Command Sequence                  | Bus Cycles | 1st Bus Cycle |                  | 2nd Bus Cycle |      | 3rd Bus Cycle |      | 4th Bus Cycle |                 | 5th Bus Cycle |      | 6th Bus Cycle     |      |
|-----------------------------------|------------|---------------|------------------|---------------|------|---------------|------|---------------|-----------------|---------------|------|-------------------|------|
|                                   |            | Addr          | Data             | Addr          | Data | Addr          | Data | Addr          | Data            | Addr          | Data | Addr              | Data |
| Read                              | 1          | Addr          | D <sub>OUT</sub> |               |      |               |      |               |                 |               |      |                   |      |
| Chip Erase                        | 6          | 5555          | AA               | 2AAA          | 55   | 5555          | 80   | 5555          | AA              | 2AAA          | 55   | 5555              | 10   |
| Sector Erase                      | 6          | 5555          | AA               | 2AAA          | 55   | 5555          | 80   | 5555          | AA              | 2AAA          | 55   | SA <sup>(4)</sup> | 30   |
| Byte Program                      | 4          | 5555          | AA               | 2AAA          | 55   | 5555          | A0   | Addr          | D <sub>IN</sub> |               |      |                   |      |
| Boot Block Lockout <sup>(2)</sup> | 6          | 5555          | AA               | 2AAA          | 55   | 5555          | 80   | 5555          | AA              | 2AAA          | 55   | 5555              | 40   |
| Product ID Entry                  | 3          | 5555          | AA               | 2AAA          | 55   | 5555          | 90   |               |                 |               |      |                   |      |
| Product ID Exit <sup>(3)</sup>    | 3          | 5555          | AA               | 2AAA          | 55   | 5555          | F0   |               |                 |               |      |                   |      |
| Product ID Exit <sup>(3)</sup>    | 1          | XXXX          | F0               |               |      |               |      |               |                 |               |      |                   |      |

- Notes:
- The DATA FORMAT in each bus cycle is as follows: I/O7 - I/O0 (Hex)
  - The 16K byte boot sector has the address range 00000H to 03FFFH for the AT49F002(N) and 3C000H to 3FFFFH for the AT49F002(N)T
  - Either one of the Product ID Exit commands can be used.
  - SA = sector addresses:  
 For the AT49F002(N):  
 SA = 00000 to 03FFF for BOOT BLOCK  
 Nothing will happen and the device goes back to the read mode in 100 ns  
 SA = 04000 to 05FFF for PARAMETER BLOCK 1  
 SA = 06000 to 07FFF for PARAMETER BLOCK 2  
 SA = 08000 to 1FFFF for MAIN MEMORY ARRAY BLOCK 1  
 This command will erase - PB1, PB2 and MMB1  
 SA = 20000 to 3FFFF for MAIN MEMORY ARRAY BLOCK 2  
  
 For the AT49F002(N)T:  
 SA = 3C000 to 3FFFF for BOOT BLOCK  
 Nothing will happen and the device goes back to the read mode in 100 ns  
 SA = 3A000 to 3BFFF for PARAMETER BLOCK 1  
 SA = 38000 to 39FFF for PARAMETER BLOCK 2  
 SA = 20000 to 37FFF for MAIN MEMORY ARRAY BLOCK 1  
 This command will erase - PB1, PB2 and MMB1  
 SA = 00000 to 1FFFF for MAIN MEMORY ARRAY BLOCK 2

**Absolute Maximum Ratings\***

|                                                                           |                                 |
|---------------------------------------------------------------------------|---------------------------------|
| Temperature Under Bias .....                                              | -55°C to +125°C                 |
| Storage Temperature .....                                                 | -65°C to +150°C                 |
| All Input Voltages<br>(including NC Pins)<br>with Respect to Ground ..... | -0.6V to +6.25V                 |
| All Output Voltages<br>with Respect to Ground .....                       | -0.6V to V <sub>CC</sub> + 0.6V |
| Voltage on $\overline{OE}$<br>with Respect to Ground .....                | -0.6V to +13.5V                 |

\*NOTICE: Stresses beyond those listed under "Absolute 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 beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## DC and AC Operating Range

|                              |      | AT49F002(N)(T)-55 | AT49F002(N)(T)-70 | AT49F002(N)(T)-90 | AT49F002(N)(T)-12 |
|------------------------------|------|-------------------|-------------------|-------------------|-------------------|
| Operating Temperature (Case) | Com. | 0°C - 70°C        | 0°C - 70°C        | 0°C - 70°C        | 0°C - 70°C        |
|                              | Ind. | -40°C - 85°C      | -40°C - 85°C      | -40°C - 85°C      | -40°C - 85°C      |
| V <sub>CC</sub> Power Supply |      | 5V ± 10%          | 5V ± 10%          | 5V ± 10%          | 5V ± 10%          |

## Operating Modes

| Mode                         | $\overline{CE}$ | $\overline{OE}$  | $\overline{WE}$ | $\overline{RESET}^{(6)}$ | Ai                                                                                     | I/O                              |
|------------------------------|-----------------|------------------|-----------------|--------------------------|----------------------------------------------------------------------------------------|----------------------------------|
| Read                         | V <sub>IL</sub> | V <sub>IL</sub>  | V <sub>IH</sub> | V <sub>IH</sub>          | Ai                                                                                     | D <sub>OUT</sub>                 |
| Program/Erase <sup>(2)</sup> | V <sub>IL</sub> | V <sub>IH</sub>  | V <sub>IL</sub> | V <sub>IH</sub>          | Ai                                                                                     | D <sub>IN</sub>                  |
| Standby/Write Inhibit        | V <sub>IH</sub> | X <sup>(1)</sup> | X               | V <sub>IH</sub>          | X                                                                                      | High Z                           |
| Program Inhibit              | X               | X                | V <sub>IH</sub> | V <sub>IH</sub>          |                                                                                        |                                  |
|                              | X               | V <sub>IL</sub>  | X               | V <sub>IH</sub>          |                                                                                        |                                  |
| Output Disable               | X               | V <sub>IH</sub>  | X               | V <sub>IH</sub>          |                                                                                        | High Z                           |
| Reset                        | X               | X                | X               | V <sub>IL</sub>          | X                                                                                      | High Z                           |
| Product Identification       |                 |                  |                 |                          |                                                                                        |                                  |
| Hardware                     | V <sub>IL</sub> | V <sub>IL</sub>  | V <sub>IH</sub> |                          | A1 - A17 = V <sub>IL</sub> , A9 = V <sub>H</sub> , <sup>(3)</sup> A0 = V <sub>IL</sub> | Manufacturer Code <sup>(4)</sup> |
|                              |                 |                  |                 |                          | A1 - A17 = V <sub>IL</sub> , A9 = V <sub>H</sub> , <sup>(3)</sup> A0 = V <sub>IH</sub> | Device Code <sup>(4)</sup>       |
| Software <sup>(5)</sup>      |                 |                  |                 |                          | A0 = V <sub>IL</sub> , A1 - A17 = V <sub>IL</sub>                                      | Manufacturer Code <sup>(4)</sup> |
|                              |                 |                  |                 |                          | A0 = V <sub>IH</sub> , A1 - A17 = V <sub>IL</sub>                                      | Device Code <sup>(4)</sup>       |

- Notes:
1. X can be V<sub>IL</sub> or V<sub>IH</sub>.
  2. Refer to AC Programming Waveforms.
  3. V<sub>H</sub> = 12.0V ± 0.5V.
  4. Manufacturer Code: 1FH, Device Code: 07H - AT49F002(N), 08H - AT49F002(N)T
  5. See details under Software Product Identification Entry/Exit.
  6. This pin is not available on the AT49F002N(T).

## DC Characteristics

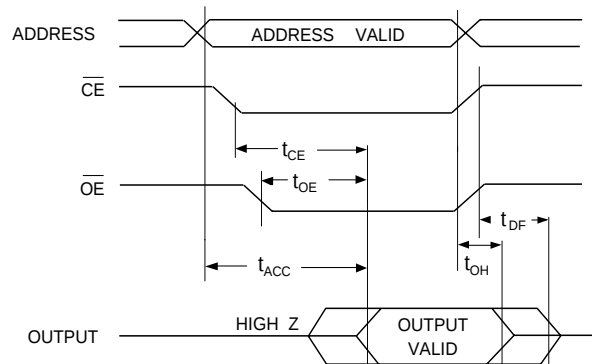
| Symbol                         | Parameter                            | Condition                                          | Min  | Max  | Units |
|--------------------------------|--------------------------------------|----------------------------------------------------|------|------|-------|
| I <sub>LI</sub>                | Input Load Current                   | V <sub>IN</sub> = 0V to V <sub>CC</sub>            |      | 10   | μA    |
| I <sub>LO</sub>                | Output Leakage Current               | V <sub>I/O</sub> = 0V to V <sub>CC</sub>           |      | 10   | μA    |
| I <sub>SB1</sub>               | V <sub>CC</sub> Standby Current CMOS | $\overline{CE} = V_{CC} - 0.3V$ to V <sub>CC</sub> | Com. | 100  | μA    |
|                                |                                      |                                                    | Ind. | 300  | μA    |
| I <sub>SB2</sub>               | V <sub>CC</sub> Standby Current TTL  | $\overline{CE} = 2.0V$ to V <sub>CC</sub>          |      | 3    | mA    |
| I <sub>CC</sub> <sup>(1)</sup> | V <sub>CC</sub> Active Current       | f = 5 MHz; I <sub>OUT</sub> = 0 mA                 |      | 50   | mA    |
| V <sub>IL</sub>                | Input Low Voltage                    |                                                    |      | 0.8  | V     |
| V <sub>IH</sub>                | Input High Voltage                   |                                                    | 2.0  |      | V     |
| V <sub>OL</sub>                | Output Low Voltage                   | I <sub>OL</sub> = 2.1 mA                           |      | 0.45 | V     |
| V <sub>OH1</sub>               | Output High Voltage                  | I <sub>OH</sub> = -400 μA                          | 2.4  |      | V     |
| V <sub>OH2</sub>               | Output High Voltage CMOS             | I <sub>OH</sub> = -100 μA; V <sub>CC</sub> = 4.5V  | 4.2  |      | V     |

- Note:
1. In the erase mode, I<sub>CC</sub> is 90 mA.

## AC Read Characteristics

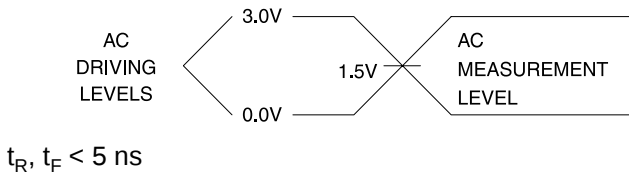
| Symbol                            | Parameter                                                                               | AT49F002(N)(T) |     |     |     |     |     |     |     | Units |
|-----------------------------------|-----------------------------------------------------------------------------------------|----------------|-----|-----|-----|-----|-----|-----|-----|-------|
|                                   |                                                                                         | -55            |     | -70 |     | -90 |     | -12 |     |       |
|                                   |                                                                                         | Min            | Max | Min | Max | Min | Max | Min | Max |       |
| t <sub>ACC</sub>                  | Address to Output Delay                                                                 |                | 55  |     | 70  |     | 90  |     | 120 | ns    |
| t <sub>CE</sub> <sup>(1)</sup>    | $\overline{CE}$ to Output Delay                                                         |                | 55  |     | 70  |     | 90  |     | 120 | ns    |
| t <sub>OE</sub> <sup>(2)</sup>    | $\overline{OE}$ to Output Delay                                                         | 0              | 30  | 0   | 35  | 0   | 40  | 0   | 50  | ns    |
| t <sub>DF</sub> <sup>(3)(4)</sup> | $\overline{CE}$ or $\overline{OE}$ to Output Float                                      | 0              | 25  | 0   | 25  | 0   | 25  | 0   | 30  | ns    |
| t <sub>OH</sub>                   | Output Hold from $\overline{OE}$ , $\overline{CE}$ or Address, whichever occurred first | 0              |     | 0   |     | 0   |     | 0   |     | ns    |

## AC Read Waveforms (1)(2)(3)(4)

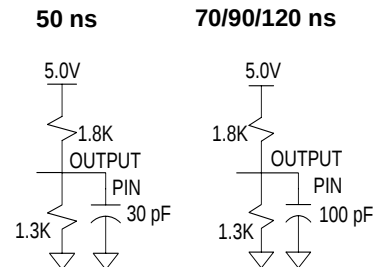


- Notes:
- $\overline{CE}$  may be delayed up to  $t_{ACC} - t_{CE}$  after the address transition without impact on  $t_{ACC}$ .
  - $\overline{OE}$  may be delayed up to  $t_{CE} - t_{OE}$  after the falling edge of  $\overline{CE}$  without impact on  $t_{CE}$  or by  $t_{ACC} - t_{OE}$  after an address change without impact on  $t_{ACC}$ .
  - $t_{DF}$  is specified from  $\overline{OE}$  or  $\overline{CE}$  whichever occurs first ( $CL = 5 \text{ pF}$ ).
  - This parameter is characterized and is not 100% tested.

## Input Test Waveform and Measurement Level



## Output Load Test



## Pin Capacitance

$f = 1 \text{ MHz}$ ,  $T = 25^\circ\text{C}^{(1)}$

| Symbol    | Typ | Max | Units | Conditions     |
|-----------|-----|-----|-------|----------------|
| $C_{IN}$  | 4   | 6   | pF    | $V_{IN} = 0V$  |
| $C_{OUT}$ | 8   | 12  | pF    | $V_{OUT} = 0V$ |

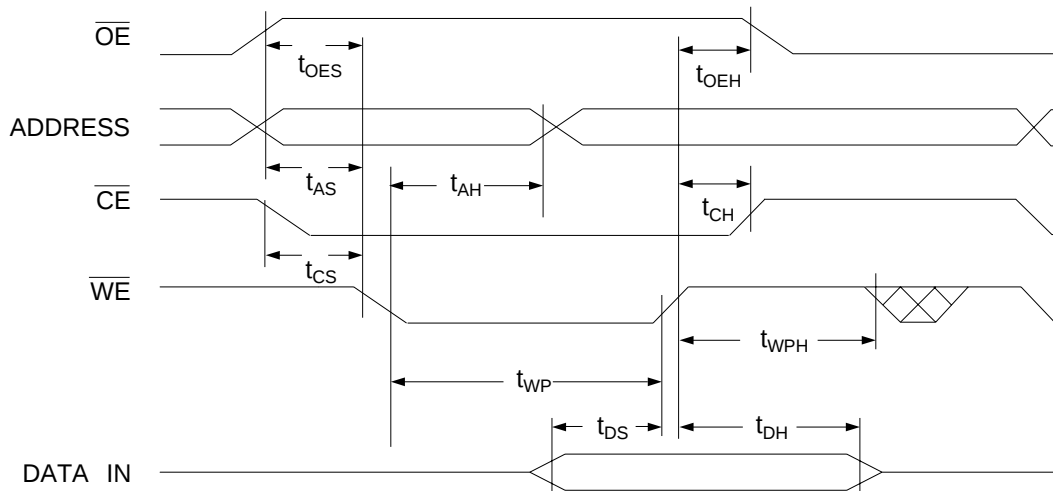
- Note:
- This parameter is characterized and is not 100% tested.

## AC Byte Load Characteristics

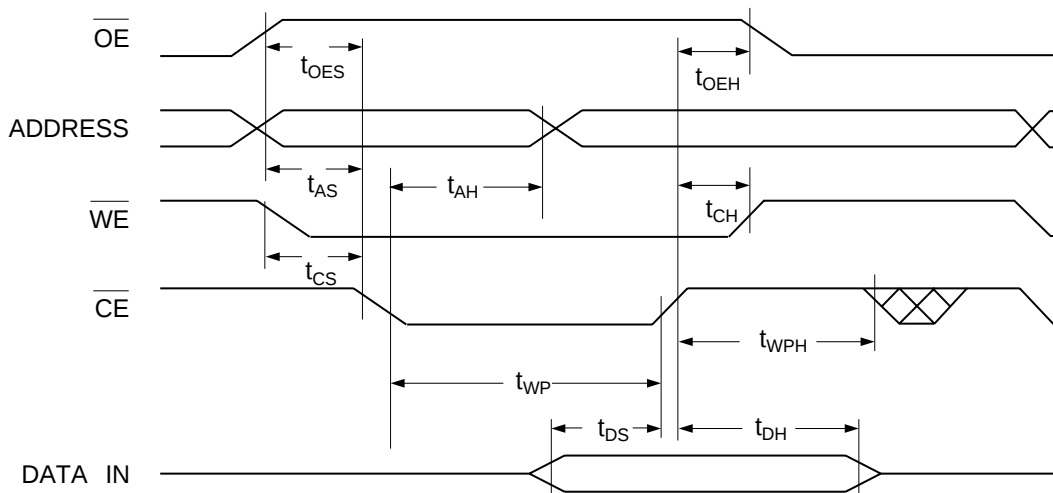
| Symbol            | Parameter                                                | Min | Max | Units |
|-------------------|----------------------------------------------------------|-----|-----|-------|
| $t_{AS}, t_{OES}$ | Address, $\overline{OE}$ Set-up Time                     | 0   |     | ns    |
| $t_{AH}$          | Address Hold Time                                        | 50  |     | ns    |
| $t_{CS}$          | Chip Select Set-up Time                                  | 0   |     | ns    |
| $t_{CH}$          | Chip Select Hold Time                                    | 0   |     | ns    |
| $t_{WP}$          | Write Pulse Width ( $\overline{WE}$ or $\overline{CE}$ ) | 90  |     | ns    |
| $t_{DS}$          | Data Set-up Time                                         | 50  |     | ns    |
| $t_{DH}, t_{OEh}$ | Data, $\overline{OE}$ Hold Time                          | 0   |     | ns    |
| $t_{WPH}$         | Write Pulse Width High                                   | 90  |     | ns    |

## AC Byte Load Waveforms

### $\overline{WE}$ Controlled



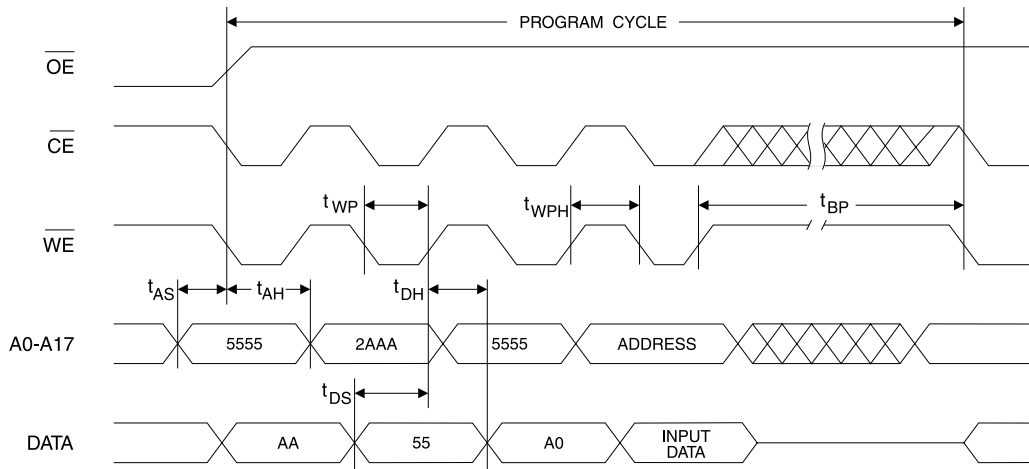
### $\overline{CE}$ Controlled



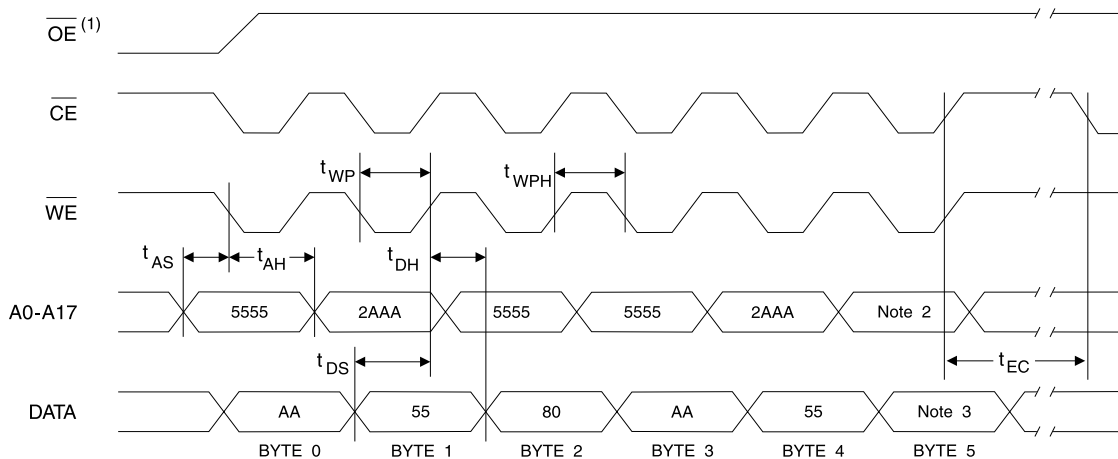
## Program Cycle Characteristics

| Symbol    | Parameter              | Min | Typ | Max | Units   |
|-----------|------------------------|-----|-----|-----|---------|
| $t_{BP}$  | Byte Programming Time  |     | 10  | 50  | $\mu s$ |
| $t_{AS}$  | Address Set-up Time    | 0   |     |     | ns      |
| $t_{AH}$  | Address Hold Time      | 50  |     |     | ns      |
| $t_{DS}$  | Data Set-up Time       | 50  |     |     | ns      |
| $t_{DH}$  | Data Hold Time         | 0   |     |     | ns      |
| $t_{WP}$  | Write Pulse Width      | 90  |     |     | ns      |
| $t_{WPH}$ | Write Pulse Width High | 90  |     |     | ns      |
| $t_{EC}$  | Erase Cycle Time       |     |     | 10  | seconds |

## Program Cycle Waveforms



## Sector or Chip Erase Cycle Waveforms



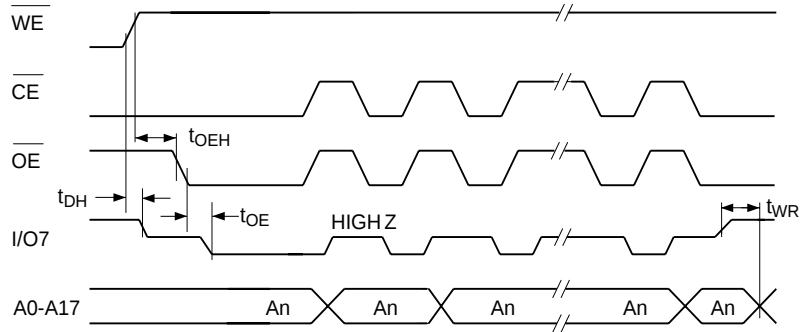
- Notes:
- $\overline{OE}$  must be high only when  $\overline{WE}$  and  $\overline{CE}$  are both low.
  - For chip erase, the address should be 5555. For sector erase, the address depends on what sector is to be erased. (See note 4 under command definitions.)
  - For chip erase, the data should be 10H, and for sector erase, the data should be 30H.

## Data Polling Characteristics<sup>(1)</sup>

| Symbol     | Parameter                                      | Min | Typ | Max | Units |
|------------|------------------------------------------------|-----|-----|-----|-------|
| $t_{DH}$   | Data Hold Time                                 | 10  |     |     | ns    |
| $t_{OE H}$ | $\overline{OE}$ Hold Time                      | 10  |     |     | ns    |
| $t_{OE}$   | $\overline{OE}$ to Output Delay <sup>(2)</sup> |     |     |     | ns    |
| $t_{WR}$   | Write Recovery Time                            | 0   |     |     | ns    |

Notes: 1. These parameters are characterized and not 100% tested.  
2. See  $t_{OE}$  spec in AC Read Characteristics.

## Data Polling Waveforms

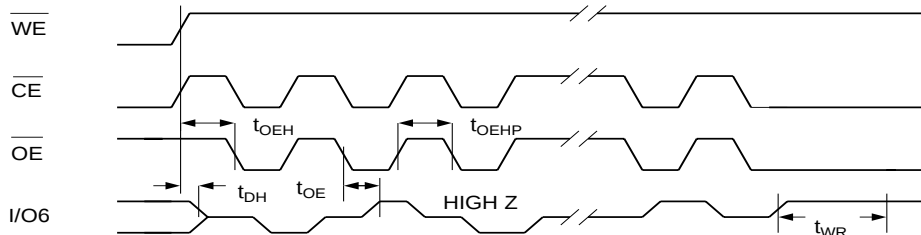


## Toggle Bit Characteristics<sup>(1)</sup>

| Symbol     | Parameter                                      | Min | Typ | Max | Units |
|------------|------------------------------------------------|-----|-----|-----|-------|
| $t_{DH}$   | Data Hold Time                                 | 10  |     |     | ns    |
| $t_{OE H}$ | $\overline{OE}$ Hold Time                      | 10  |     |     | ns    |
| $t_{OE}$   | $\overline{OE}$ to Output Delay <sup>(2)</sup> |     |     |     | ns    |
| $t_{OEHP}$ | $\overline{OE}$ High Pulse                     | 150 |     |     | ns    |
| $t_{WR}$   | Write Recovery Time                            | 0   |     |     | ns    |

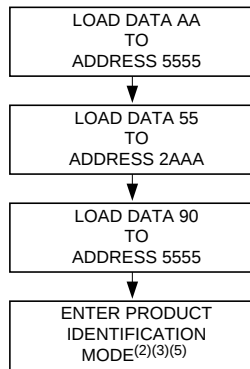
Notes: 1. These parameters are characterized and not 100% tested.  
2. See  $t_{OE}$  spec in AC Read Characteristics.

## Toggle Bit Waveforms<sup>(1)(2)(3)</sup>

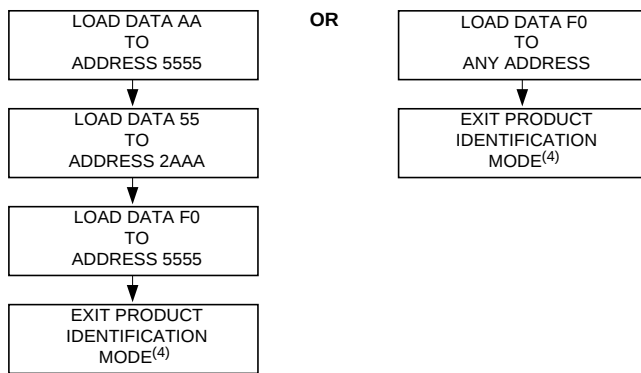


Notes: 1. Toggling either  $\overline{OE}$  or  $\overline{CE}$  or both  $\overline{OE}$  and  $\overline{CE}$  will operate toggle bit. The  $t_{OEHP}$  specification must be met by the toggling input(s).  
2. Beginning and ending state of I/O6 will vary.  
3. Any address location may be used but the address should not vary.

## Software Product Identification Entry<sup>(1)</sup>



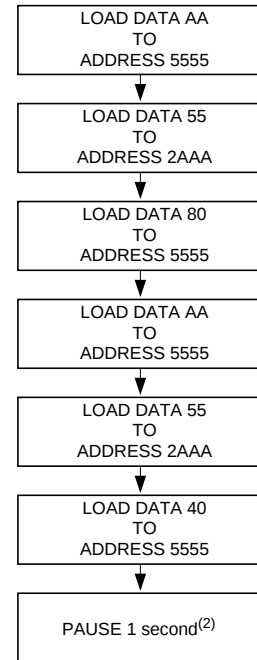
## Software Product Identification Exit<sup>(1)</sup>



Notes for software product identification

1. Data Format: I/O7 - I/O0 (Hex);  
Address Format: A14 - A0 (Hex).
2. A1 - A17 =  $V_{IL}$ .  
Manufacture Code is read for A0 =  $V_{IL}$ ;  
Device Code is read for A0 =  $V_{IH}$ .
3. The device does not remain in identification mode if powered down.
4. The device returns to standard operation mode.
5. Manufacturer Code: 1FH  
Device Code: 07H - AT49F002(N)  
08H - AT49F002(N)T

## Boot Block Lockout Feature Enable Algorithm<sup>(1)</sup>



Notes for boot block lockout feature enable:

1. Data Format: I/O7 - I/O0 (Hex);  
Address Format: A14 - A0 (Hex).
2. Boot block lockout feature enabled.



## AT49F002 Ordering Information

| t <sub>ACC</sub><br>(ns) | I <sub>CC</sub> (mA) |         | Ordering Code | Package | Operation Range              |
|--------------------------|----------------------|---------|---------------|---------|------------------------------|
|                          | Active               | Standby |               |         |                              |
| 55                       | 50                   | 0.1     | AT49F002-55JC | 32J     | Commercial<br>(0° to 70°C)   |
|                          |                      |         | AT49F002-55PC | 32P6    |                              |
|                          |                      |         | AT49F002-55TC | 32T     |                              |
|                          |                      |         | AT49F002-55VC | 32V     |                              |
|                          | 50                   | 0.3     | AT49F002-55JI | 32J     | Industrial<br>(-40° to 85°C) |
|                          |                      |         | AT49F002-55PI | 32P6    |                              |
|                          |                      |         | AT49F002-55TI | 32T     |                              |
|                          |                      |         | AT49F002-55VI | 32V     |                              |
| 70                       | 50                   | 0.1     | AT49F002-70JC | 32J     | Commercial<br>(0° to 70°C)   |
|                          |                      |         | AT49F002-70PC | 32P6    |                              |
|                          |                      |         | AT49F002-70TC | 32T     |                              |
|                          |                      |         | AT49F002-70VC | 32V     |                              |
|                          | 50                   | 0.3     | AT49F002-70JI | 32J     | Industrial<br>(-40° to 85°C) |
|                          |                      |         | AT49F002-70PI | 32P6    |                              |
|                          |                      |         | AT49F002-70TI | 32T     |                              |
|                          |                      |         | AT49F002-70VI | 32V     |                              |
| 90                       | 50                   | 0.1     | AT49F002-90JC | 32J     | Commercial<br>(0° to 70°C)   |
|                          |                      |         | AT49F002-90PC | 32P6    |                              |
|                          |                      |         | AT49F002-90TC | 32T     |                              |
|                          |                      |         | AT49F002-90VC | 32V     |                              |
|                          | 50                   | 0.3     | AT49F002-90JI | 32J     | Industrial<br>(-40° to 85°C) |
|                          |                      |         | AT49F002-90PI | 32P6    |                              |
|                          |                      |         | AT49F002-90TI | 32T     |                              |
|                          |                      |         | AT49F002-90VI | 32V     |                              |
| 120                      | 50                   | 0.1     | AT49F002-12JC | 32J     | Commercial<br>(0° to 70°C)   |
|                          |                      |         | AT49F002-12PC | 32P6    |                              |
|                          |                      |         | AT49F002-12TC | 32T     |                              |
|                          |                      |         | AT49F002-12VC | 32V     |                              |
|                          | 50                   | 0.3     | AT49F002-12JI | 32J     | Industrial<br>(-40° to 85°C) |
|                          |                      |         | AT49F002-12PI | 32P6    |                              |
|                          |                      |         | AT49F002-12TI | 32T     |                              |
|                          |                      |         | AT49F002-12VI | 32V     |                              |

| Package Type |                                                                |
|--------------|----------------------------------------------------------------|
| <b>32J</b>   | 32-lead, Plastic J-leaded Chip Carrier Package (PLCC)          |
| <b>32P6</b>  | 32-pin, 0.600" Wide, Plastic Dual Inline Package (PDIP)        |
| <b>32T</b>   | 32-lead, Plastic Thin Small Outline Package (TSOP) (8 x 20 mm) |
| <b>32V</b>   | 32-lead, Plastic Thin Small Outline Package (VSOP) (8 x 14 mm) |

**AT49F002N Ordering Information**

| <b>t<sub>ACC</sub><br/>(ns)</b> | <b>I<sub>CC</sub> (mA)</b> |                | <b>Ordering Code</b>                                                 | <b>Package</b>            | <b>Operation Range</b>       |
|---------------------------------|----------------------------|----------------|----------------------------------------------------------------------|---------------------------|------------------------------|
|                                 | <b>Active</b>              | <b>Standby</b> |                                                                      |                           |                              |
| 55                              | 50                         | 0.1            | AT49F002N-55JC<br>AT49F002N-55PC<br>AT49F002N-55TC<br>AT49F002N-55VC | 32J<br>32P6<br>32T<br>32V | Commercial<br>(0° to 70°C)   |
|                                 | 50                         | 0.3            | AT49F002N-55JI<br>AT49F002N-55PI<br>AT49F002N-55TI<br>AT49F002N-55VI | 32J<br>32P6<br>32T<br>32V | Industrial<br>(-40° to 85°C) |
| 70                              | 50                         | 0.1            | AT49F002N-70JC<br>AT49F002N-70PC<br>AT49F002N-70TC<br>AT49F002N-70VC | 32J<br>32P6<br>32T<br>32V | Commercial<br>(0° to 70°C)   |
|                                 | 50                         | 0.3            | AT49F002N-70JI<br>AT49F002N-70PI<br>AT49F002N-70TI<br>AT49F002N-70VI | 32J<br>32P6<br>32T<br>32V | Industrial<br>(-40° to 85°C) |
| 90                              | 50                         | 0.1            | AT49F002N-90JC<br>AT49F002N-90PC<br>AT49F002N-90TC<br>AT49F002N-90VC | 32J<br>32P6<br>32T<br>32V | Commercial<br>(0° to 70°C)   |
|                                 | 50                         | 0.3            | AT49F002N-90JI<br>AT49F002N-90PI<br>AT49F002N-90TI<br>AT49F002N-90VI | 32J<br>32P6<br>32T<br>32V | Industrial<br>(-40° to 85°C) |
| 120                             | 50                         | 0.1            | AT49F002N-12JC<br>AT49F002N-12PC<br>AT49F002N-12TC<br>AT49F002N-12VC | 32J<br>32P6<br>32T<br>32V | Commercial<br>(0° to 70°C)   |
|                                 | 50                         | 0.3            | AT49F002N-12JI<br>AT49F002N-12PI<br>AT49F002N-12TI<br>AT49F002N-12VI | 32J<br>32P6<br>32T<br>32V | Industrial<br>(-40° to 85°C) |

| <b>Package Type</b> |                                                                |
|---------------------|----------------------------------------------------------------|
| <b>32J</b>          | 32-lead, Plastic J-leaded Chip Carrier Package (PLCC)          |
| <b>32P6</b>         | 32-pin, 0.600" Wide, Plastic Dual Inline Package (PDIP)        |
| <b>32T</b>          | 32-lead, Plastic Thin Small Outline Package (TSOP) (8 x 20 mm) |
| <b>32V</b>          | 32-lead, Plastic Thin Small Outline Package (VSOP) (8 x 14 mm) |



## AT49F002T Ordering Information

| t <sub>ACC</sub><br>(ns) | I <sub>CC</sub> (mA) |         | Ordering Code                                                        | Package                   | Operation Range              |
|--------------------------|----------------------|---------|----------------------------------------------------------------------|---------------------------|------------------------------|
|                          | Active               | Standby |                                                                      |                           |                              |
| 55                       | 50                   | 0.1     | AT49F002T-55JC<br>AT49F002T-55PC<br>AT49F002T-55TC<br>AT49F002T-55VC | 32J<br>32P6<br>32T<br>32V | Commercial<br>(0° to 70°C)   |
|                          | 50                   | 0.3     | AT49F002T-55JI<br>AT49F002T-55PI<br>AT49F002T-55TI<br>AT49F002T-55VI | 32J<br>32P6<br>32T<br>32V | Industrial<br>(-40° to 85°C) |
| 70                       | 50                   | 0.1     | AT49F002T-70JC<br>AT49F002T-70PC<br>AT49F002T-70TC<br>AT49F002T-70VC | 32J<br>32P6<br>32T<br>32V | Commercial<br>(0° to 70°C)   |
|                          | 50                   | 0.3     | AT49F002T-70JI<br>AT49F002T-70PI<br>AT49F002T-70TI<br>AT49F002T-70VI | 32J<br>32P6<br>32T<br>32V | Industrial<br>(-40° to 85°C) |
| 90                       | 50                   | 0.1     | AT49F002T-90JC<br>AT49F002T-90PC<br>AT49F002T-90TC<br>AT49F002T-90VC | 32J<br>32P6<br>32T<br>32V | Commercial<br>(0° to 70°C)   |
|                          | 50                   | 0.3     | AT49F002T-90JI<br>AT49F002T-90PI<br>AT49F002T-90TI<br>AT49F002T-90VI | 32J<br>32P6<br>32T<br>32V | Industrial<br>(-40° to 85°C) |
| 120                      | 50                   | 0.1     | AT49F002T-12JC<br>AT49F002T-12PC<br>AT49F002T-12TC<br>AT49F002T-12VC | 32J<br>32P6<br>32T<br>32V | Commercial<br>(0° to 70°C)   |
|                          | 50                   | 0.3     | AT49F002T-12JI<br>AT49F002T-12PI<br>AT49F002T-12TI<br>AT49F002T-12VI | 32J<br>32P6<br>32T<br>32V | Industrial<br>(-40° to 85°C) |

| Package Type |                                                                |
|--------------|----------------------------------------------------------------|
| <b>32J</b>   | 32-lead, Plastic J-leaded Chip Carrier Package (PLCC)          |
| <b>32P6</b>  | 32-pin, 0.600" Wide, Plastic Dual Inline Package (PDIP)        |
| <b>32T</b>   | 32-lead, Plastic Thin Small Outline Package (TSOP) (8 x 20 mm) |
| <b>32V</b>   | 32-lead, Plastic Thin Small Outline Package (VSOP) (8 x 14 mm) |

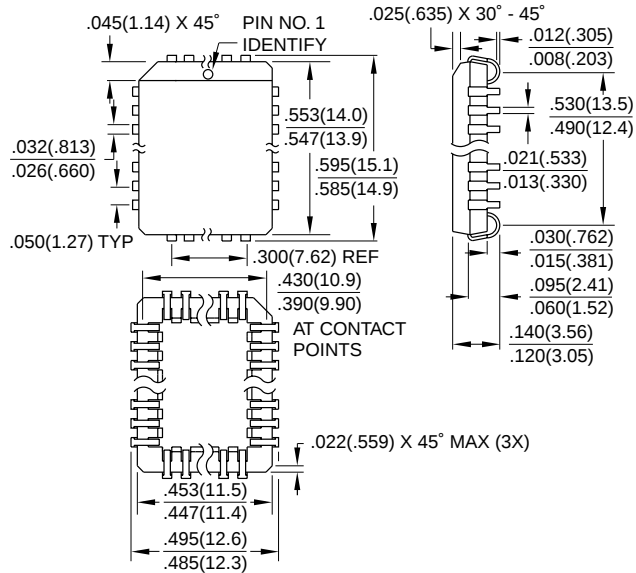
**AT49F002NT Ordering Information**

| <b>t<sub>ACC</sub><br/>(ns)</b> | <b>I<sub>CC</sub> (mA)</b> |                | <b>Ordering Code</b>                                                     | <b>Package</b>            | <b>Operation Range</b>       |
|---------------------------------|----------------------------|----------------|--------------------------------------------------------------------------|---------------------------|------------------------------|
|                                 | <b>Active</b>              | <b>Standby</b> |                                                                          |                           |                              |
| 55                              | 50                         | 0.1            | AT49F002NT-55JC<br>AT49F002NT-55PC<br>AT49F002NT-55TC<br>AT49F002NT-55VC | 32J<br>32P6<br>32T<br>32V | Commercial<br>(0° to 70°C)   |
|                                 | 50                         | 0.3            | AT49F002NT-55JI<br>AT49F002NT-55PI<br>AT49F002NT-55TI<br>AT49F002NT-55VI | 32J<br>32P6<br>32T<br>32V | Industrial<br>(-40° to 85°C) |
| 70                              | 50                         | 0.1            | AT49F002NT-70JC<br>AT49F002NT-70PC<br>AT49F002NT-70TC<br>AT49F002NT-70VC | 32J<br>32P6<br>32T<br>32V | Commercial<br>(0° to 70°C)   |
|                                 | 50                         | 0.3            | AT49F002NT-70JI<br>AT49F002NT-70PI<br>AT49F002NT-70TI<br>AT49F002NT-70VI | 32J<br>32P6<br>32T<br>32V | Industrial<br>(-40° to 85°C) |
| 90                              | 50                         | 0.1            | AT49F002NT-90JC<br>AT49F002NT-90PC<br>AT49F002NT-90TC<br>AT49F002NT-90VC | 32J<br>32P6<br>32T<br>32V | Commercial<br>(0° to 70°C)   |
|                                 | 50                         | 0.3            | AT49F002NT-90JI<br>AT49F002NT-90PI<br>AT49F002NT-90TI<br>AT49F002NT-90VI | 32J<br>32P6<br>32T<br>32V | Industrial<br>(-40° to 85°C) |
| 120                             | 50                         | 0.1            | AT49F002NT-12JC<br>AT49F002NT-12PC<br>AT49F002NT-12TC<br>AT49F002NT-12VC | 32J<br>32P6<br>32T<br>32V | Commercial<br>(0° to 70°C)   |
|                                 | 50                         | 0.3            | AT49F002NT-12JI<br>AT49F002NT-12PI<br>AT49F002NT-12TI<br>AT49F002NT-12VI | 32J<br>32P6<br>32T<br>32V | Industrial<br>(-40° to 85°C) |

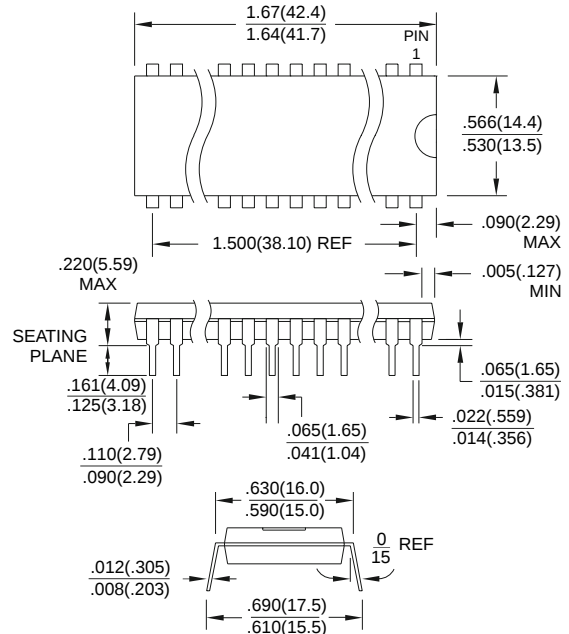
| <b>Package Type</b> |                                                                |
|---------------------|----------------------------------------------------------------|
| <b>32J</b>          | 32-lead, Plastic J-leaded Chip Carrier Package (PLCC)          |
| <b>32P6</b>         | 32-pin, 0.600" Wide, Plastic Dual Inline Package (PDIP)        |
| <b>32T</b>          | 32-lead, Plastic Thin Small Outline Package (TSOP) (8 x 20 mm) |
| <b>32V</b>          | 32-lead, Plastic Thin Small Outline Package (VSOP) (8 x 14 mm) |

## Packaging Information

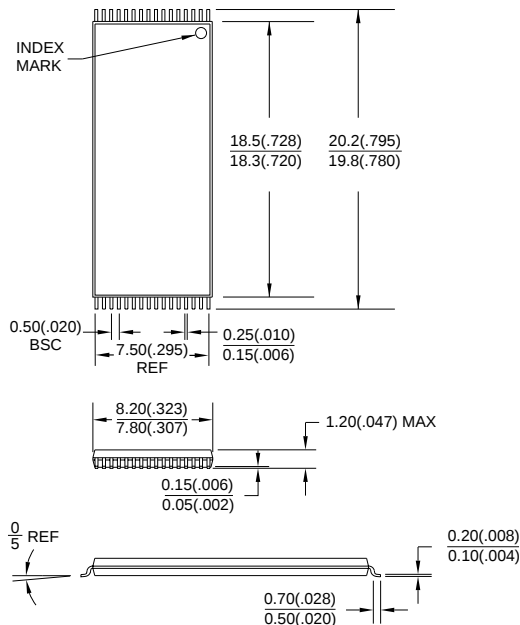
**32J, 32-lead, Plastic J-leaded Chip Carrier (PLCC)**  
Dimensions in Inches and (Millimeters)  
JEDEC STANDARD MS-016 AE



**32P6, 32-pin, 0.600" Wide, Plastic Dual Inline Package (PDIP)**  
Dimensions in Inches and (Millimeters)

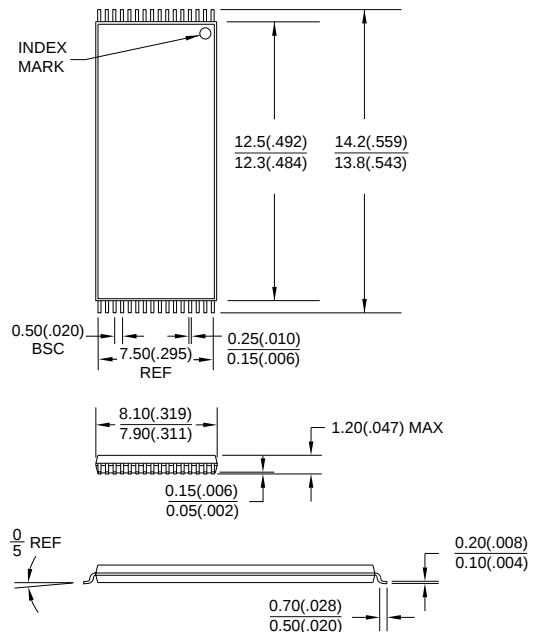


**32T, 32-lead, Plastic Thin Small Outline Package (TSOP)**  
Dimensions in Millimeters and (Inches)\*



\*Controlling dimension: millimeters

**32V, 32-lead, Plastic Thin Small Outline Package (TSOP)**  
Dimensions in Millimeters and (Inches)





## **Atmel Headquarters**

### ***Corporate Headquarters***

2325 Orchard Parkway  
San Jose, CA 95131  
TEL (408) 441-0311  
FAX (408) 487-2600

### ***Europe***

Atmel U.K., Ltd.  
Coliseum Business Centre  
Riverside Way  
Camberley, Surrey GU15 3YL  
England  
TEL (44) 1276-686-677  
FAX (44) 1276-686-697

### ***Asia***

Atmel Asia, Ltd.  
Room 1219  
Chinachem Golden Plaza  
77 Mody Road Tsimhatsui  
East Kowloon  
Hong Kong  
TEL (852) 2721-9778  
FAX (852) 2722-1369

### ***Japan***

Atmel Japan K.K.  
9F, Tonetsu Shinkawa Bldg.  
1-24-8 Shinkawa  
Chuo-ku, Tokyo 104-0033  
Japan  
TEL (81) 3-3523-3551  
FAX (81) 3-3523-7581

## **Atmel Operations**

### ***Atmel Colorado Springs***

1150 E. Cheyenne Mtn. Blvd.  
Colorado Springs, CO 80906  
TEL (719) 576-3300  
FAX (719) 540-1759

### ***Atmel Rousset***

Zone Industrielle  
13106 Rousset Cedex  
France  
TEL (33) 4-4253-6000  
FAX (33) 4-4253-6001

---

### ***Fax-on-Demand***

North America:  
1-(800) 292-8635  
International:  
1-(408) 441-0732

### ***e-mail***

[literature@atmel.com](mailto:literature@atmel.com)

### ***Web Site***

<http://www.atmel.com>

### ***BBS***

1-(408) 436-4309

## **© Atmel Corporation 1999.**

Atmel Corporation makes no warranty for the use of its products, other than those expressly contained in the Company's standard warranty which is detailed in Atmel's Terms and Conditions located on the Company's web site. The Company assumes no responsibility for any errors which may appear in this document, reserves the right to change devices or specifications detailed herein at any time without notice, and does not make any commitment to update the information contained herein. No licenses to patents or other intellectual property of Atmel are granted by the Company in connection with the sale of Atmel products, expressly or by implication. Atmel's products are not authorized for use as critical components in life support devices or systems.

Marks bearing ® and/or ™ are registered trademarks and trademarks of Atmel Corporation.

Terms and product names in this document may be trademarks of others.



Printed on recycled paper.

1017D-10/99/xM