

Preliminary W49F020



256K × 8 CMOS FLASH MEMORY

GENERAL DESCRIPTION

The W49F020 is a 2-megabit, 5-volt only CMOS flash memory organized as 256K × 8 bits. The device can be programmed and erased in-system with a standard 5V power supply. A 12-volt V_{PP} is not required. The unique cell architecture of the W49F020 results in fast program/erase operations with extremely low current consumption (compared to other comparable 5-volt flash memory products). The device can also be programmed and erased using standard EPROM programmers.

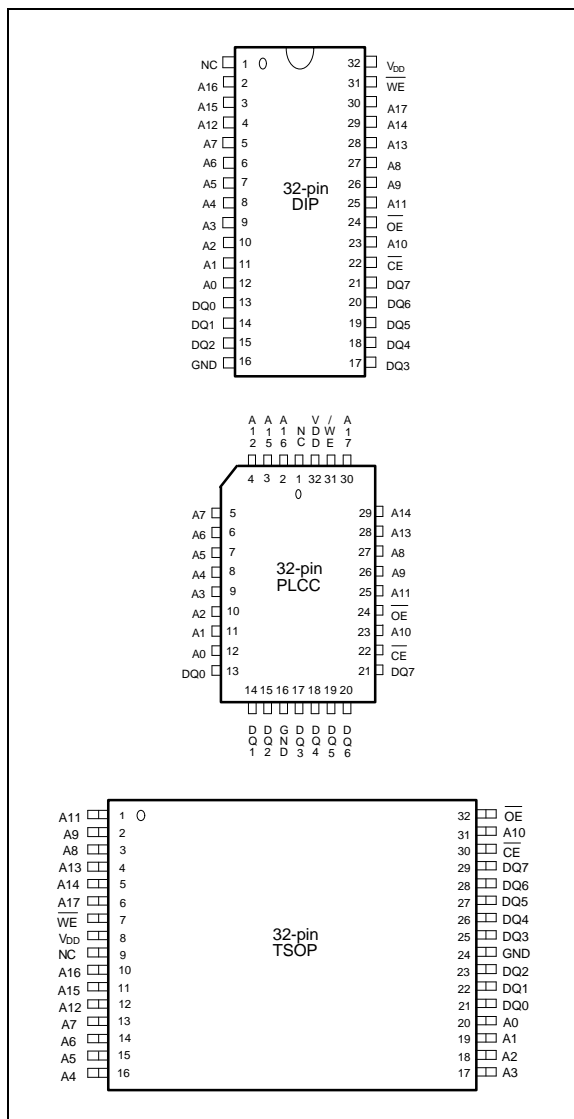
FEATURES

- Single 5-volt operations:
 - 5-volt Read
 - 5-volt Erase
 - 5-volt Program
- Fast Program operation:
 - Byte-by-Byte programming: 50 μS (max.)
- Fast Erase operation: 100 mS (typ.)
- Fast Read access time: 70/90 nS
- Endurance: 1K/10K cycles (typ.)
- Twenty-year data retention
- Hardware data protection
- One 8K byte Boot Block with Lockout protection
- Low power consumption
 - Active current: 25 mA (typ.)
 - Standby current: 20 μA (typ.)
- Automatic program and erase timing with internal V_{PP} generation
- End of program or erase detection
 - Toggle bit
 - Data polling
- Latched address and data
- TTL compatible I/O
- JEDEC standard byte-wide pinouts
- Available packages: 32-pin DIP and 32-pin TSOP and 32-pin-PLCC

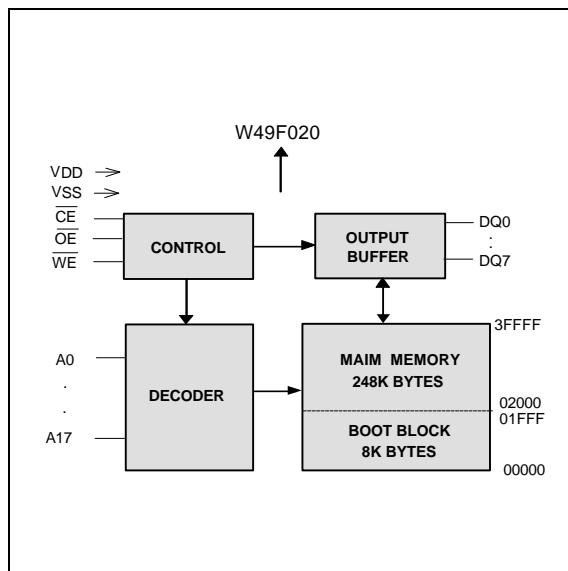
Preliminary W49F020



PIN CONFIGURATIONS



BLOCK DIAGRAM



PIN DESCRIPTION

| SYMBOL | PIN NAME |
|-----------------|---------------------|
| A0-A17 | Address Inputs |
| DQ0-DQ7 | Data Inputs/Outputs |
| \overline{CE} | Chip Enable |
| \overline{OE} | Output Enable |
| \overline{WE} | Write Enable |
| VDD | Power Supply |
| GND | Ground |
| NC | No Connection |



FUNCTIONAL DESCRIPTION

Read Mode

The read operation of the W49F020 is controlled by \overline{CE} and \overline{OE} , both of which have to be low for the host to obtain data from the outputs. \overline{CE} is used for device selection. When \overline{CE} is high, the chip is de-selected and only standby power will be consumed. \overline{OE} is the output control and is used to gate data from the output pins. The data bus is in high impedance state when either \overline{CE} or \overline{OE} is high. Refer to the timing waveforms for further details.

Boot Block Operation

There is an 8K-byte boot block in this device, which can be used to store boot code. The boot block locates in the first 8K bytes of the memory with the address range from 0000(hex) to 1FFF(hex). For the specific code, please see Command Codes for Boot Block Lockout Enable.

When the boot block is enabled, data for the designated block cannot be erased or programmed (programming lockout); other memory locations can be changed by the regular programming method. When the boot block programming lockout feature is activated, the chip erase function cannot erase the boot block any longer.

In order to detect whether the boot block feature is set on the 8K-bytes block or not, users can perform software command sequence to check it. First, enter the product identification mode (see Command Codes for Identification/Boot Block Lockout Detection for specific code), and then read from address "0002 hex". If the output data is "1," the boot block programming lockout feature is activated; if the output data is "0," the lockout feature is inactivated and the block can be erased/programmed.

To return to normal operation, perform a three-byte command sequence (or an alternate single-word command) to exit the identification mode. For the specific code, see Command Codes for Identification/Boot Block Lockout Detection.

Chip Erase Operation

The chip-erase mode can be initiated by a six-word command sequence. After the command loading cycle, the device enters the internal chip erase mode, which is automatically timed and will be completed in a fast 100 mS (typical). The host system is not required to provide any control or timing during this operation. If the boot block programming lockout is activated, only the data in the main memory blocks will be erased to FF(hex), and the data in the boot block will not be erased (remains same as before the chip erase operation). The entire memory array will be erased to FF hex by the chip erase operation if the boot block programming lockout feature is not activated. Once the boot block lockout feature is activated, the chip erase function erase the main memory block but not the boot block. The device will automatically return to normal read mode after the erase operation completed. Data polling and/or Toggle Bits can be used to detect end of erase cycle.

Program Operation

The W49F020 is programmed on a byte-by-byte basis. Program operation can only change logical data "1" to logical data "0." The erase operation (changed entire data in main memory blocks and/or boot block from "0" to "1") is needed before programming.

The program operation is initiated by a 4-word command cycle (see Command Codes for Byte Programming). The device will internally enter the program operation immediately after the byte-program command is entered. The internal program timer will automatically time-out (50 μ S max. -

Preliminary W49F020



TBP) when completing programming and return to normal read mode. Data polling and/or Toggle Bits can be used to detect end of program cycle.

Hardware Data Protection

The integrity of the data stored in the W49F020 is also hardware protected in the following ways:

- (1) Noise/Glitch Protection: A \overline{WE} pulse with less than 15 nS in duration will not initiate a write cycle.
- (2) V_{DD} Power Up/Down Detection: The programming operation is inhibited when V_{DD} is less than 2.5V typical.
- (3) Write Inhibit Mode: Forcing \overline{OE} low, \overline{CE} high, or \overline{WE} high will inhibit the write operation. This prevents inadvertent writes during power-up or power-down periods.
- (4) V_{DD} power-on delay: When V_{DD} has reached its sense level, the device will automatically time-out 5 mS before any write (erase/program) operation.

Data Polling (DQ7)- Write Status Detection

The W49F020 features a data polling function which used to indicate the end of a program or erase cycle. When the W49F020 is in the internal program or erase cycle, any attempt to read DQ7 of the last word loaded will receive the complement of the true data. Once the program or erase cycle is completed, DQ7 will show the true data. Note that DQ7 will show logical "0" during the erase cycle, and become logical "1" or true data when the erase cycle has been completed.

Toggle Bit (DQ6)- Write Status Detection

In addition to data polling, the W49F020 provides another method for determining the end of a program cycle. During the internal program or erase cycle, any consecutive attempts to read DQ6 will produce alternating 0's and 1's. When the program or erase cycle is completed, this toggling between 0's and 1's will stop. The device is then ready for the next operation.

Product Identification

The product ID operation outputs the manufacturer code and device code. Programming equipment automatically matches the device with its proper erase and programming algorithms.

The manufacturer and device codes can be accessed by software or hardware operation. In software access mode, a three-word (or JEDEC 3-word) command sequence can be used to access the product ID. A read from address 0000H outputs the manufacturer code DA(hex); and a read from address 0001H outputs the device code 8C(hex) for W49F020. The product ID operation can be terminated by a three-word command sequence or an alternated one-word command sequence (see Command Definition table).

In the hardware access mode, access to the product ID will be activated by forcing \overline{CE} and \overline{OE} low, \overline{WE} high, and raising A9 to 12 volts.

Preliminary W49F020



TABLE OF OPERATING MODES

Operating Mode Selection

(V_{HH} = 12V ± 5%)

| MODE | PINS | | | | |
|----------------|------------------------|------------------------|------------------------|--|----------------------------|
| | $\overline{\text{CE}}$ | $\overline{\text{OE}}$ | $\overline{\text{WE}}$ | ADDRESS | DQ. |
| Read | V _{IL} | V _{IL} | V _{IH} | A _{IN} | D _{out} |
| Write | V _{IL} | V _{IH} | V _{IL} | A _{IN} | D _{in} |
| Standby | V _{IH} | X | X | X | High Z |
| Write Inhibit | X | V _{IL} | X | X | High Z/D _{OUT} |
| | X | X | V _{IH} | X | High Z/D _{OUT} |
| Output Disable | X | V _{IH} | X | X | High Z |
| Product ID | V _{IL} | V _{IL} | V _{IH} | A ₀ = V _{IL} ; A ₁ –A ₁₇ = V _{IL} ; A ₉ = V _{HH} | Manufacturer Code DA (Hex) |
| | V _{IL} | V _{IL} | V _{IH} | A ₀ = V _{IL} ; A ₁ –A ₁₇ = V _{IL} ; A ₉ = V _{HH} | Device Code 8C (Hex) |

TABLE OF COMMAND DEFINITION

| COMMAND DESCRIPTION | NO. OF Cycles | 1ST CYCLE | 2ND CYCLE | 3RD CYCLE | 4TH CYCLE | 5TH CYCLE | 6TH CYCLE |
|--------------------------------|---------------|----------------------------------|------------|------------|---------------------------------|------------|------------|
| | | Addr. Data | Addr. Data | Addr. Data | Addr. Data | Addr. Data | Addr. Data |
| Read | 1 | A _{IN} D _{OUT} | | | | | |
| Chip Erase | 6 | 5555 AA | 2AAA 55 | 5555 80 | 5555 AA | 2AAA 55 | 5555 10 |
| Byte Program | 4 | 5555 AA | 2AAA 55 | 5555 A0 | A _{IN} D _{IN} | | |
| Boot Block Lockout | 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 ⁽¹⁾ | 3 | 5555 AA | 2AAA 55 | 5555 F0 | | | |
| Product ID Exit ⁽¹⁾ | 1 | XXXX F0 | | | | | |

Notes:

1. Address Format: A₁₄–A₀ (Hex); Data Format: D_{Q7}–D_{Q0} (Hex)
2. Either one of the two Product ID Exit commands can be used.

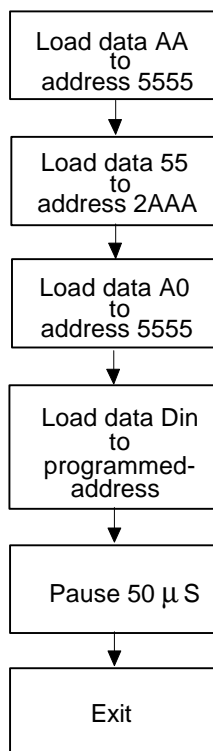


Command Codes for Byte Program

| WORD SEQUENCE | ADDRESS | DATA |
|---------------|--------------------|-----------------|
| 0 Write | 5555H | AAH |
| 1 Write | 2AAAH | 55H |
| 2 Write | 5555H | A0H |
| 3 Write | Programmed-Address | Programmed-Data |

Byte Program Flow Chart

Byte Program Command Flow



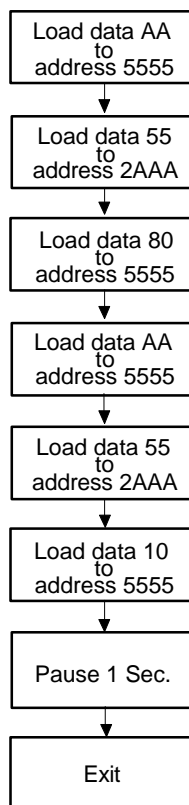
Notes for software program code:
Data Format: DQ7–DQ0 (Hex)
Address Format: A14–A0 (Hex)



Command Codes for Chip Erase

| BYTE SEQUENCE | ADDRESS | DATA |
|---------------|---------|------|
| 1 Write | 5555H | AAH |
| 2 Write | 2AAAH | 55H |
| 3 Write | 5555H | 80H |
| 4 Write | 5555H | AAH |
| 5 Write | 2AAAH | 55H |
| 6 Write | 5555H | 10H |

Chip Erase Acquisition Flow



Notes for chip erase:

Data Format: DQ7–DQ0 (Hex)

Address Format: A14–A0 (Hex)

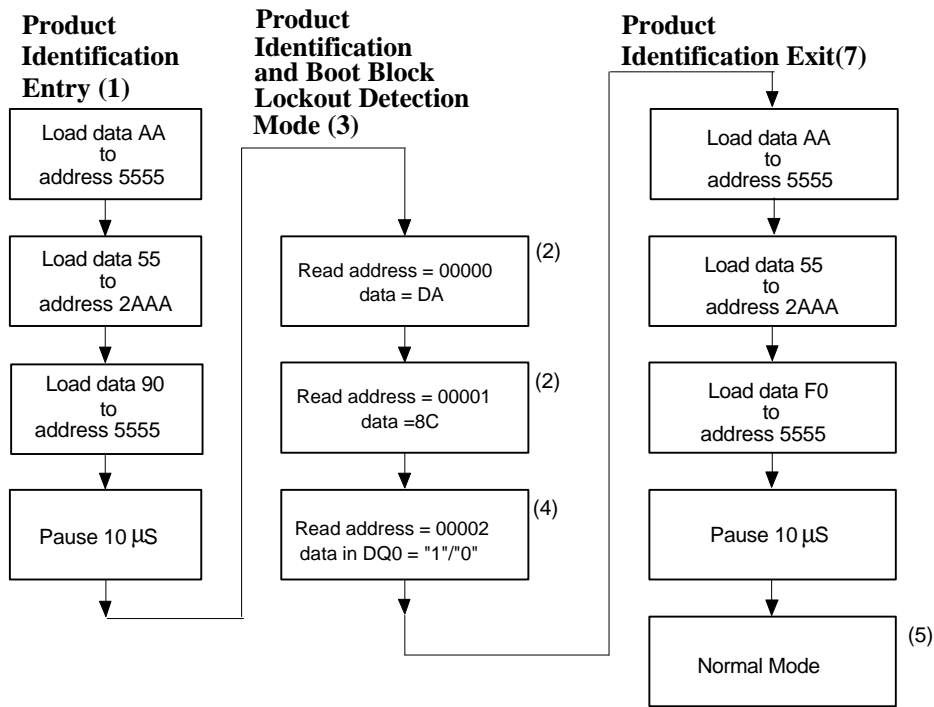
Preliminary W49F020



Command Codes for Product Identification and Boot Block Lockout Detection

| BYTE SEQUENCE | ALTERNATE PRODUCT (6) IDENTIFICATION/BOOT BLOCK LOCKOUT DETECTION ENTRY | | SOFTWARE PRODUCT IDENTIFICATION/BOOT BLOCK LOCKOUT DETECTION EXIT (7) | |
|---------------|---|------|---|------|
| | ADDRESS | DATA | ADDRESS | DATA |
| 1 Write | 5555 | AA | 5555H | AAH |
| 2 Write | 2AAA | 55 | 2AAAH | 55H |
| 3 Write | 5555 | 90 | 5555H | F0H |
| | Pause 10 μ S | | Pause 10 μ S | |

Software Product Identification and Boot Block Lockout Detection Acquisition Flow



Notes for software product identification/boot block lockout detection:

- (1) Data Format: DQ7–DQ0 (Hex); Address Format: A14–A0 (Hex)
- (2) A1–A17 = VIL; manufacture code is read for A0 = VIL; device code is read for A0 = VIH.
- (3) The device does not remain in identification and boot block lockout detection mode if power down.
- (4) If the output data in DQ0= " 1," the boot block programming lockout feature is activated; if the output data in DQ0= " 0," the lockout feature is inactivated and the block can be programmed.
- (5) The device returns to standard operation mode.
- (6) Optional 1-word cycle (write F0 hex at XXXX address) can be used to exit the product identification/boot block lockout detection.

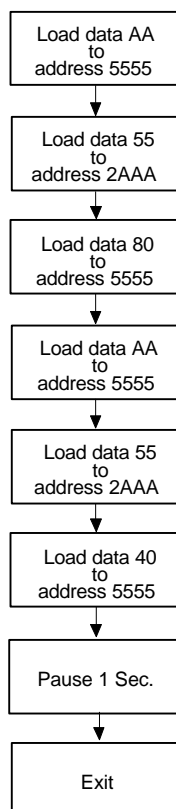


Command Codes for Boot Block Lockout Enable

| BYTE SEQUENCE | BOOT BLOCK LOCKOUT FEATURE SET | |
|---------------|--------------------------------|------|
| | ADDRESS | DATA |
| 1 Write | 5555H | AAH |
| 2 Write | 2AAAH | 55H |
| 3 Write | 5555H | 80H |
| 4 Write | 5555H | AAH |
| 5 Write | 2AAAH | 55H |
| 6 Write | 5555H | 40H |
| Pause 1 Sec. | | |

Boot Block Lockout Enable Acquisition Flow

Boot Block Lockout Feature Set Flow



Notes for boot block lockout enable:
 Data Format: DQ7–DQ0 (Hex)
 Address Format: A14–A0 (Hex)

Preliminary W49F020



DC CHARACTERISTICS

Absolute Maximum Ratings

| PARAMETER | RATING | UNIT |
|--|------------------------------|------|
| Power Supply Voltage to V _{SS} Potential | -0.5 to +7.0 | V |
| Operating Temperature | 0 to +70 | °C |
| Storage Temperature | -65 to +150 | °C |
| D.C. Voltage on Any Pin to Ground Potential except \overline{OE} | -0.5 to V _{DD} +1.0 | V |
| Transient Voltage (<20 nS) on Any Pin to Ground Potential | -1.0 to V _{DD} +1.0 | V |
| Voltage on \overline{OE} Pin to Ground Potential | -0.5 to 12.5 | V |

Note: Exposure to conditions beyond those listed under Absolute Maximum Ratings may adversely affect the life and reliability of the device.

DC Operating Characteristics

(V_{DD} = 5.0V ±10%, V_{SS} = 0V, T_A = 0 to 70° C)

| PARAMETER | SYM. | TEST CONDITIONS | LIMITS | | | UNIT |
|--|------------------|---|--------|------|----------------------|------|
| | | | MIN. | TYP. | MAX. | |
| Power Supply Current | I _{CC} | $\overline{CE} = \overline{OE} = V_{IL}$, $\overline{WE} = V_{IH}$, all DQs open Address inputs = V _{IL} /V _{IH} , at f = 5 MHz | - | 25 | 50 | mA |
| Standby V _{DD} Current (TTL input) | I _{SB1} | $\overline{CE} = V_{IH}$, all DQs open Other inputs = V _{IL} /V _{IH} | - | 2 | 3 | mA |
| Standby V _{DD} Current (CMOS input) | I _{SB2} | $\overline{CE} = V_{DD} - 0.3V$, all DQs open Other inputs = V _{DD} - 0.3V/GND | - | 20 | 100 | μA |
| Input Leakage Current | I _{LI} | V _{IN} = GND to V _{DD} | - | - | 10 | μA |
| Output Leakage Current | I _{LO} | V _{OUT} = GND to V _{DD} | - | - | 10 | μA |
| Input Low Voltage | V _{IL} | - | -0.3 | - | 0.8 | V |
| Input High Voltage | V _{IH} | - | 2.0 | - | V _{DD} +0.5 | V |
| Output Low Voltage | V _{OL} | I _{OL} = 2.1 mA | - | - | 0.45 | V |
| Output High Voltage | V _{OH} | I _{OH} = -0.4 mA | 2.4 | - | - | V |

Preliminary W49F020



Power-up Timing

| PARAMETER | SYMBOL | TYPICAL | UNIT |
|-----------------------------|------------|---------|---------|
| Power-up to Read Operation | TPU. READ | 100 | μ S |
| Power-up to Write Operation | TPU. WRITE | 5 | mS |

CAPACITANCE

($V_{DD} = 5.0V$, $T_A = 25^\circ C$, $f = 1 MHz$)

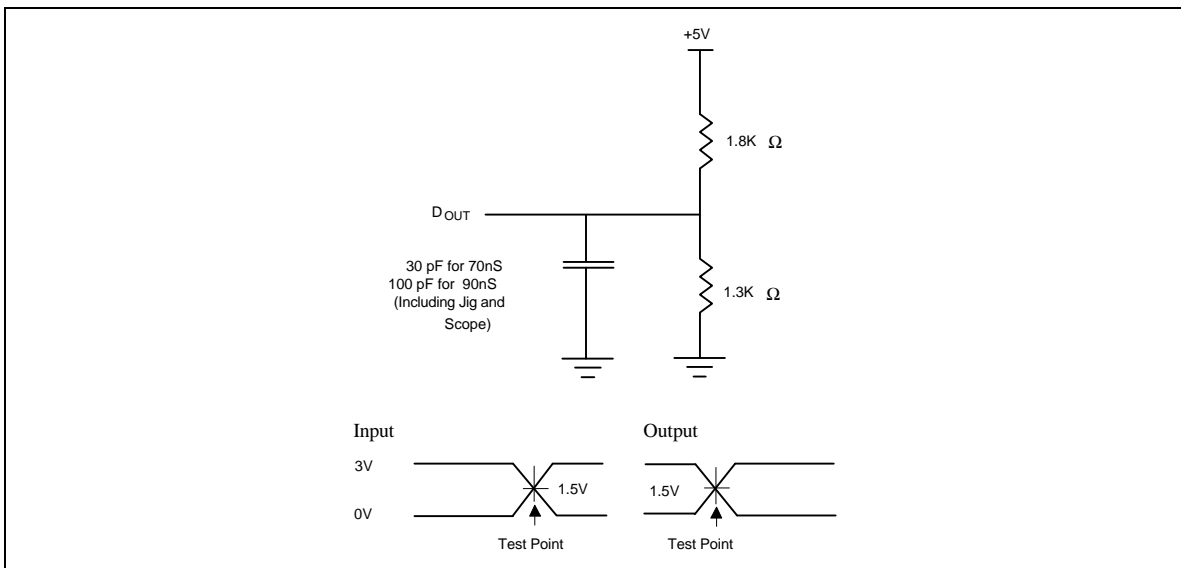
| PARAMETER | SYMBOL | CONDITIONS | MAX. | UNIT |
|---------------------|------------------|----------------|------|------|
| I/O Pin Capacitance | C _{I/O} | $V_{I/O} = 0V$ | 12 | pf |
| Input Capacitance | C _{IN} | $V_{IN} = 0V$ | 6 | pf |

AC CHARACTERISTICS

AC Test Conditions

| PARAMETER | CONDITIONS |
|---------------------------|--|
| Input Pulse Levels | 0V to 3.0V |
| Input Rise/Fall Time | < 5 nS |
| Input/Output Timing Level | 1.5V/1.5V |
| Output Load | 1 TTL Gate and $C_L = 100 pF$ for 90nS $C_L = 30 pF$ for 70nS |

AC Test Load and Waveform



Preliminary W49F020



AC Characteristics, continued

Read Cycle Timing Parameters

($V_{CC} = 5.0V \pm 10\%$, $V_{CC} = 0V$, $T_A = 0$ to $70^\circ C$)

| PARAMETER | SYM. | W49F020-70 | | W49F020-90 | | UNIT |
|---------------------------------------|-----------|------------|------|------------|------|------|
| | | MIN. | MAX. | MIN. | MAX. | |
| Read Cycle Time | T_{RC} | 70 | - | 90 | - | nS |
| Chip Enable Access Time | T_{CE} | - | 70 | - | 90 | nS |
| Address Access Time | T_{AA} | - | 70 | - | 90 | nS |
| Output Enable Access Time | T_{OE} | - | 35 | - | 40 | nS |
| \overline{CE} Low to Active Output | T_{CLZ} | 0 | - | 0 | - | nS |
| \overline{OE} Low to Active Output | T_{OLZ} | 0 | - | 0 | - | nS |
| \overline{CE} High to High-Z Output | T_{CHZ} | - | 25 | - | 25 | nS |
| \overline{OE} High to High-Z Output | T_{OHZ} | - | 25 | - | 25 | nS |
| Output Hold from Address Change | T_{OH} | 0 | - | 0 | - | nS |

Write Cycle Timing Parameters

| PARAMETER | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|--|-----------|------|------|------|---------|
| Address Setup Time | T_{AS} | 0 | - | - | nS |
| Address Hold Time | T_{AH} | 50 | - | - | nS |
| \overline{WE} and \overline{CE} Setup Time | T_{CS} | 0 | - | - | nS |
| \overline{WE} and \overline{CE} Hold Time | T_{CH} | 0 | - | - | nS |
| \overline{OE} High Setup Time | T_{OES} | 0 | - | - | nS |
| \overline{OE} High Hold Time | T_{OEH} | 0 | - | - | nS |
| \overline{CE} Pulse Width | T_{CP} | 100 | - | - | nS |
| \overline{WE} Pulse Width | T_{WP} | 100 | - | - | nS |
| \overline{WE} High Width | T_{WPH} | 100 | - | - | nS |
| Data Setup Time | T_{DS} | 50 | - | - | nS |
| Data Hold Time | T_{DH} | 0 | - | - | nS |
| Byte programming Time | T_{BP} | - | 10 | 50 | μS |
| Erase Cycle Time | T_{EC} | - | 0.1 | 1 | S |

Note: All AC timing signals observe the following guidelines for determining setup and hold times:

(a) High level signal's reference level is V_{IH} and (b) low level signal's reference level is V_{IL} .

Preliminary W49F020



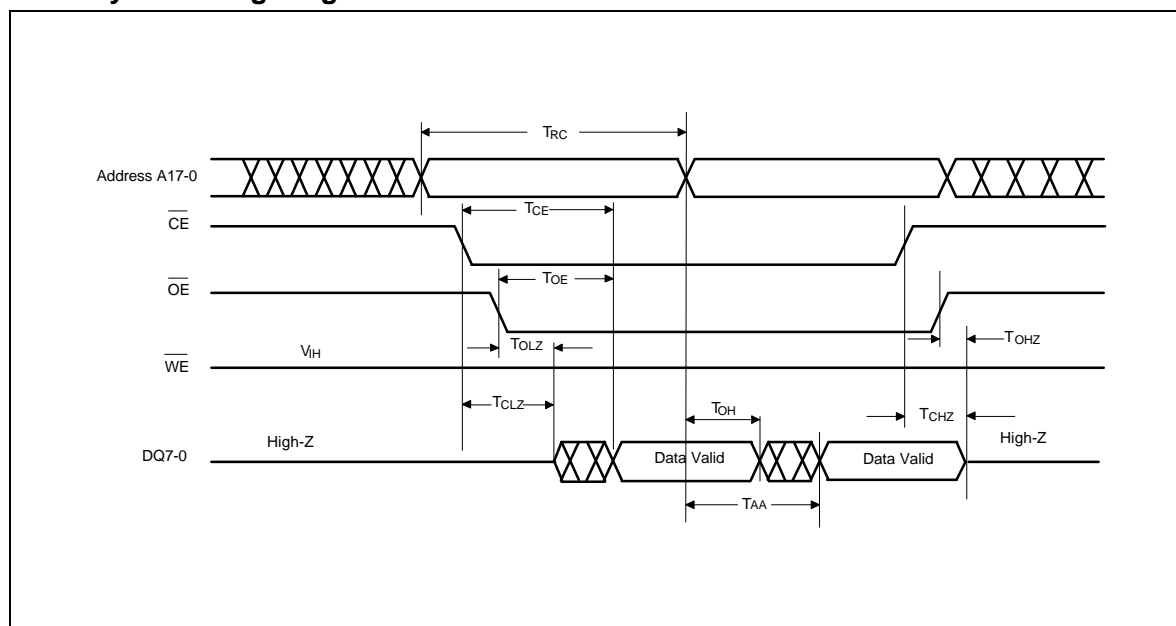
AC Characteristics, continued

Data Polling and Toggle Bit Timing Parameters

| PARAMETER | SYM. | W49F020-70 | | W49F020-90 | | UNIT |
|--|------|------------|------|------------|------|------|
| | | MIN. | MAX. | MIN. | MAX. | |
| \overline{OE} to Data Polling Output Delay | TOEP | - | 35 | - | 40 | nS |
| \overline{CE} to Data Polling Output Delay | TCEP | - | 70 | - | 90 | nS |
| \overline{OE} to Toggle Bit Output Delay | TOET | - | 35 | - | 40 | nS |
| \overline{CE} to Toggle Bit Output Delay | TCET | - | 70 | - | 90 | nS |

TIMING WAVEFORMS

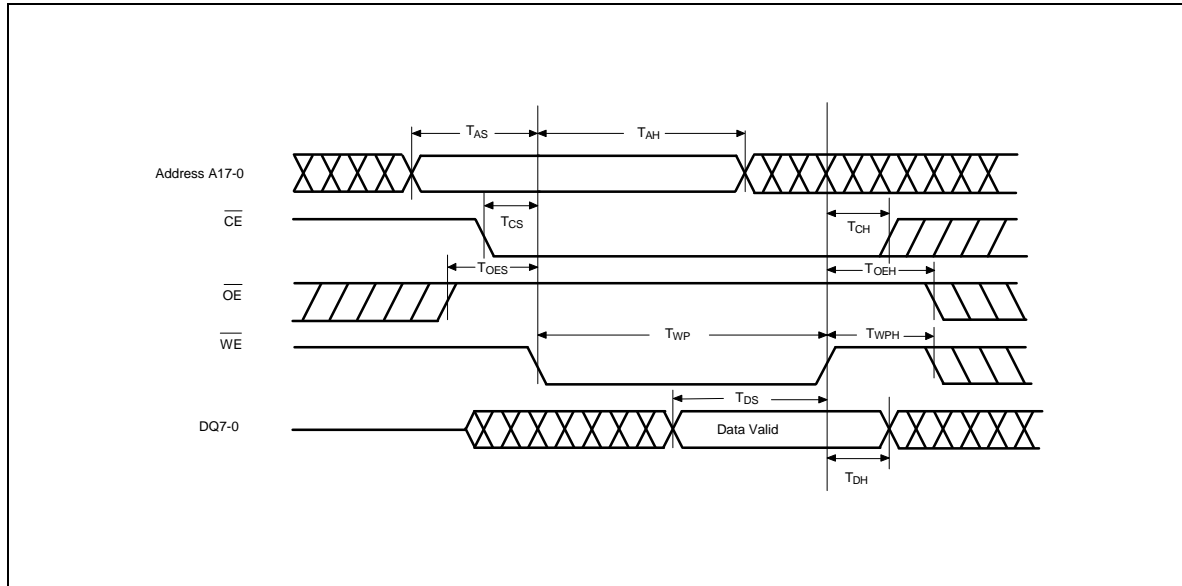
Read Cycle Timing Diagram



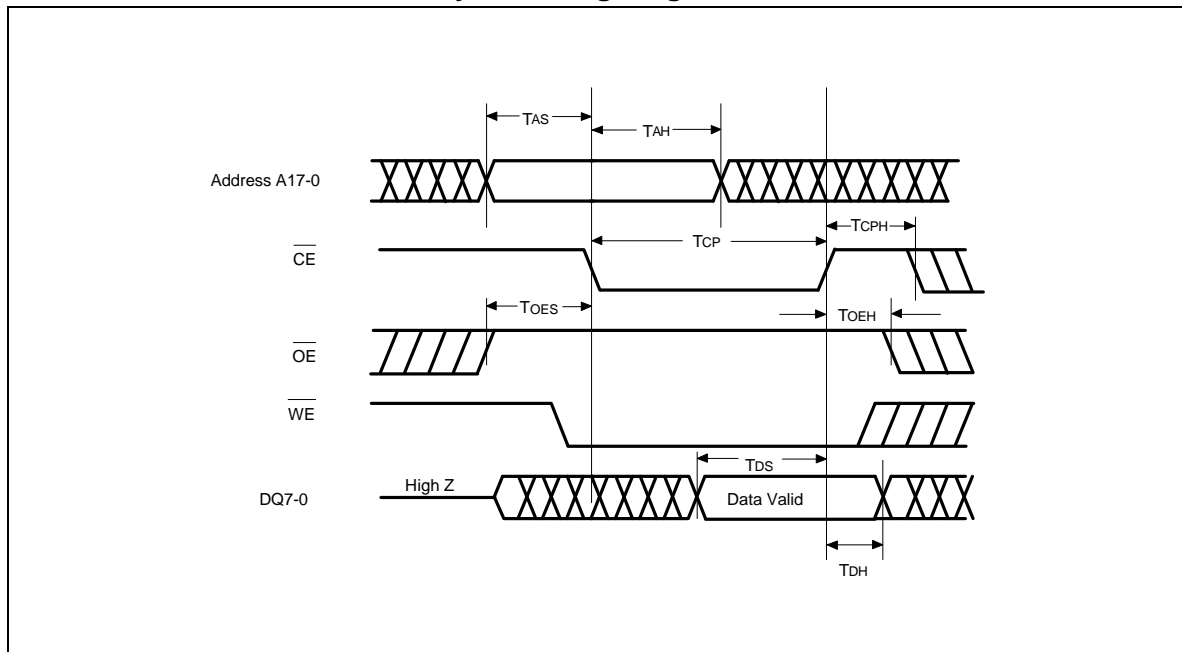


Timing Waveforms, continued

$\overline{\text{WE}}$ Controlled Command Write Cycle Timing Diagram



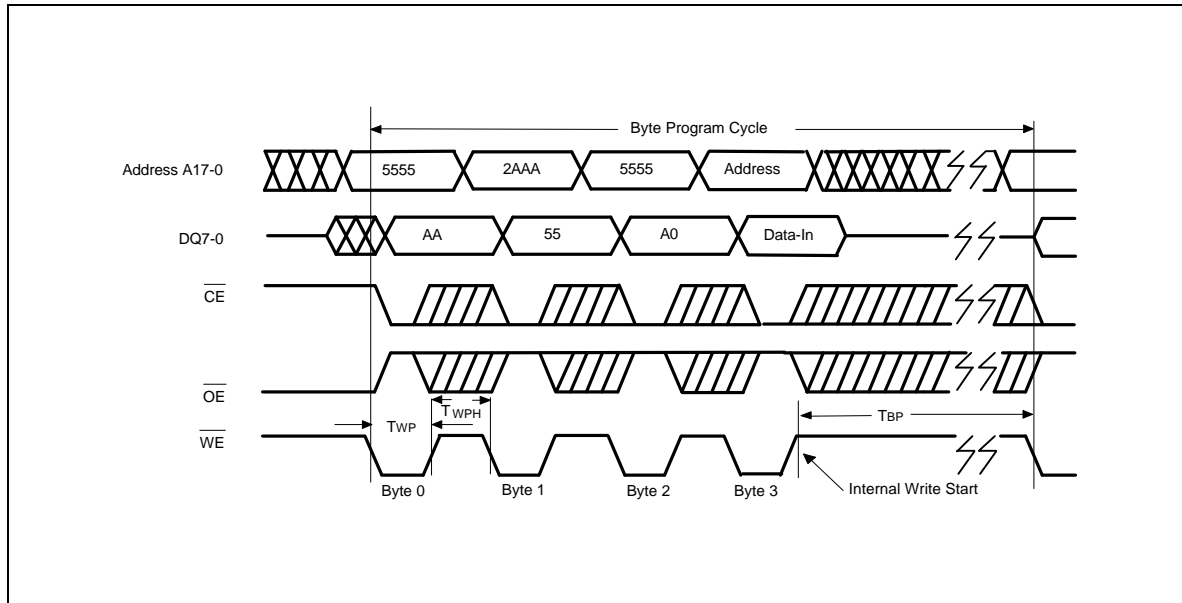
$\overline{\text{CE}}$ Controlled Command Write Cycle Timing Diagram



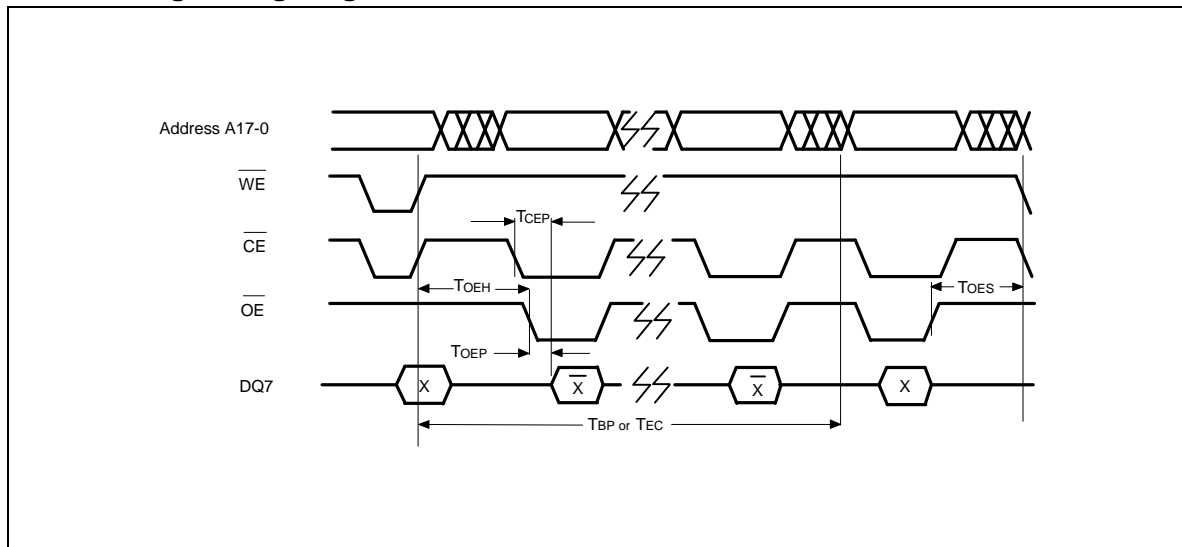


Timing Waveforms, continued

Program Cycle Timing Diagram



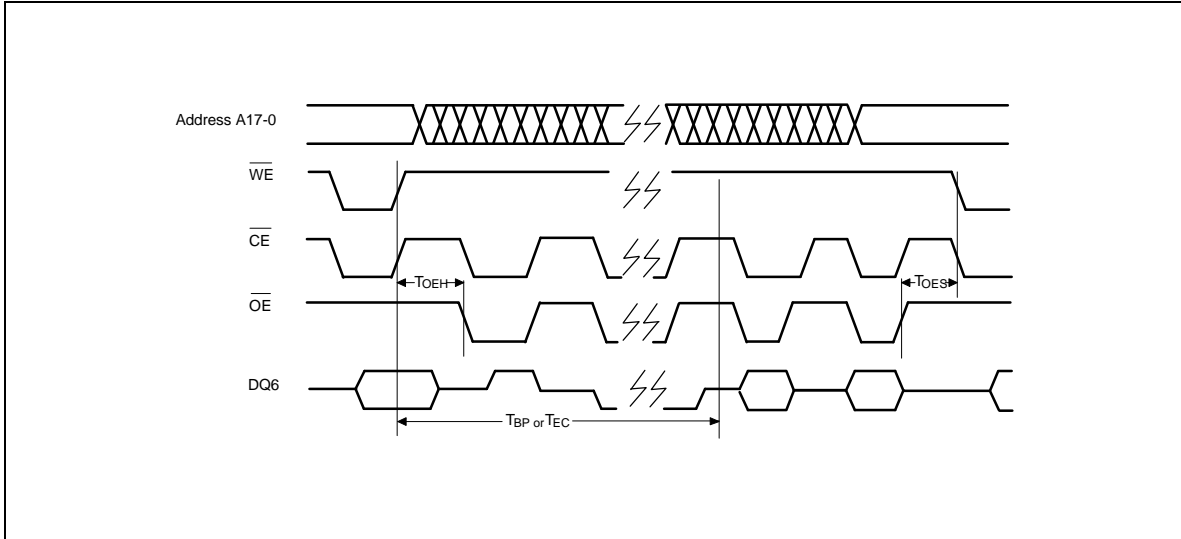
DATA Polling Timing Diagram



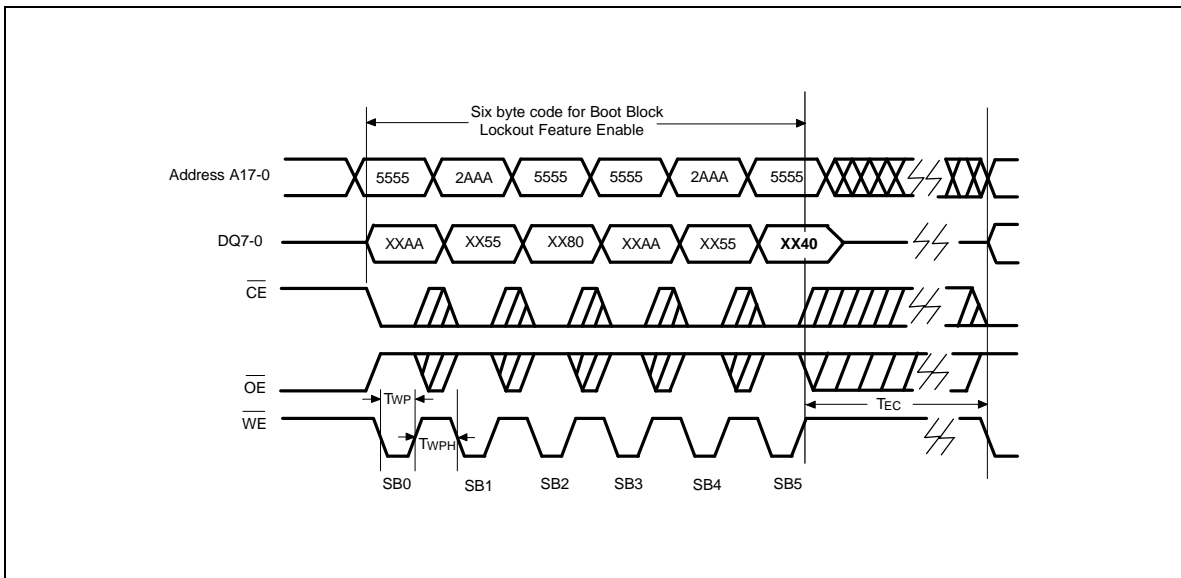


Timing Waveforms, continued

Toggle Bit Timing Diagram



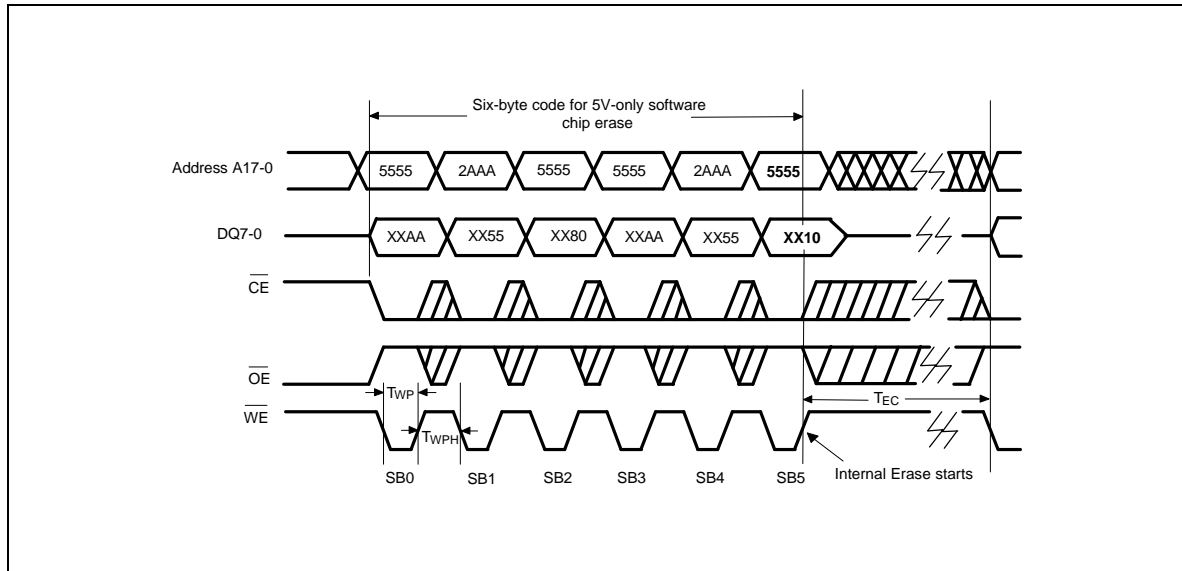
Boot Block Lockout Enable Timing Diagram





Timing Waveforms, continued

Chip Erase Timing Diagram



Preliminary W49F020



ORDERING INFORMATION

| PART NO. | ACCESS TIME (nS) | POWER SUPPLY CURRENT MAX. (mA) | STANDBY V _{DD} CURRENT MAX. (mA) | PACKAGE | CYCLE |
|--------------|------------------|--------------------------------|---|----------------------------|-------|
| W49F020-70 | 70 | 50 | 100 (CMOS) | 32-pin DIP | 1K |
| W49F020-90 | 90 | 50 | 100 (CMOS) | 32-pin DIP | 1K |
| W29F020Q-70 | 70 | 50 | 100 (CMOS) | 32-pin TSOP (8 mm × 20 mm) | 1K |
| W29F020Q-90 | 90 | 50 | 100 (CMOS) | 32-pin TSOP (8 mm × 20 mm) | 1K |
| W29F020P-70 | 70 | 50 | 100 (CMOS) | 32-pin PLCC | 1K |
| W29F020P-90 | 90 | 50 | 100 (CMOS) | 32-pin PLCC | 1K |
| W49F020-70B | 70 | 50 | 100 (CMOS) | 32-pin DIP | 10K |
| W49F020-90B | 90 | 50 | 100 (CMOS) | 32-pin DIP | 10K |
| W29F020Q-70B | 70 | 50 | 100 (CMOS) | 32-pin TSOP (8 mm × 20 mm) | 10K |
| W29F020Q-90B | 90 | 50 | 100 (CMOS) | 32-pin TSOP (8 mm × 20 mm) | 10K |
| W29F020P-70B | 70 | 50 | 100 (CMOS) | 32-pin PLCC | 10K |
| W29F020P-90B | 90 | 50 | 100 (CMOS) | 32-pin PLCC | 10K |

Notes:

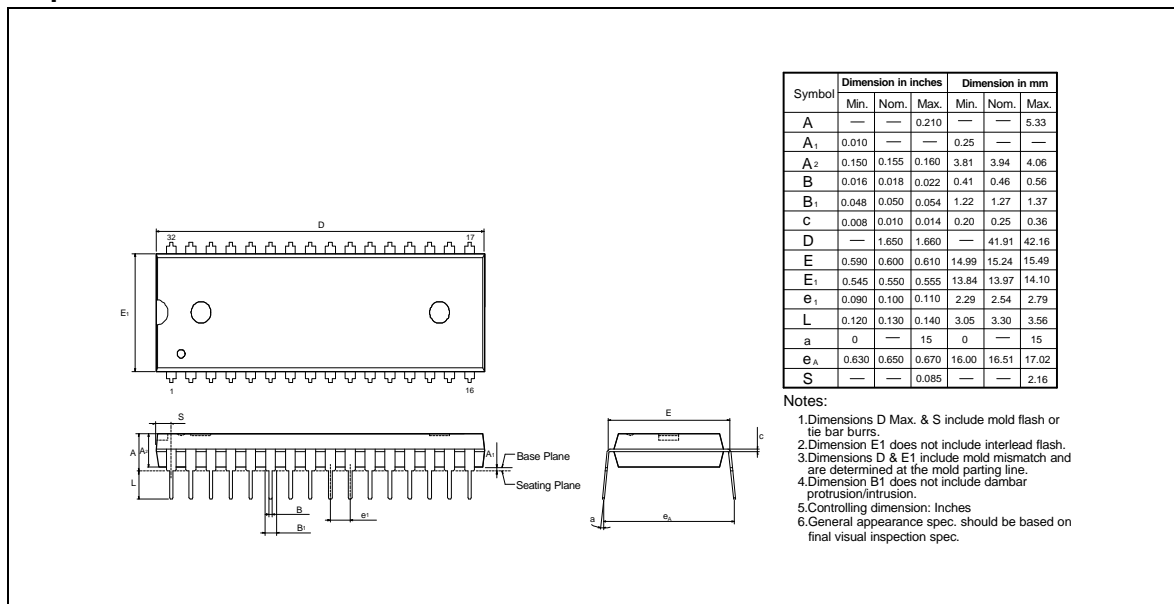
1. Winbond reserves the right to make changes to its products without prior notice.
2. Purchasers are responsible for performing appropriate quality assurance testing on products intended for use in applications where personal injury might occur as a consequence of product failure.
3. There are two kinds of boot block in this device. The part number shown in the Ordering Information table is only for Bottom Boot Block part, which is in the lower address range. For the requirement of the higher address range boot block, the Top Boot Block, please contact Winbond FAE for details.

Preliminary W49F020

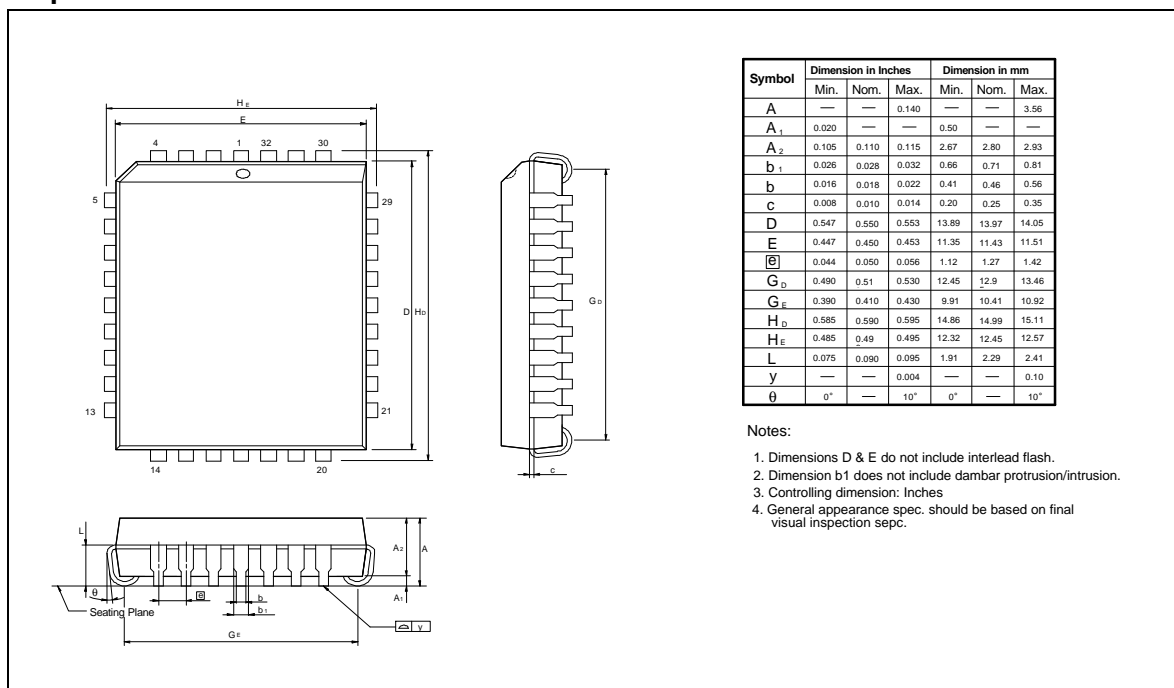


PACKAGE DIMENSIONS

32-pin P-DIP



32-pin PLCC

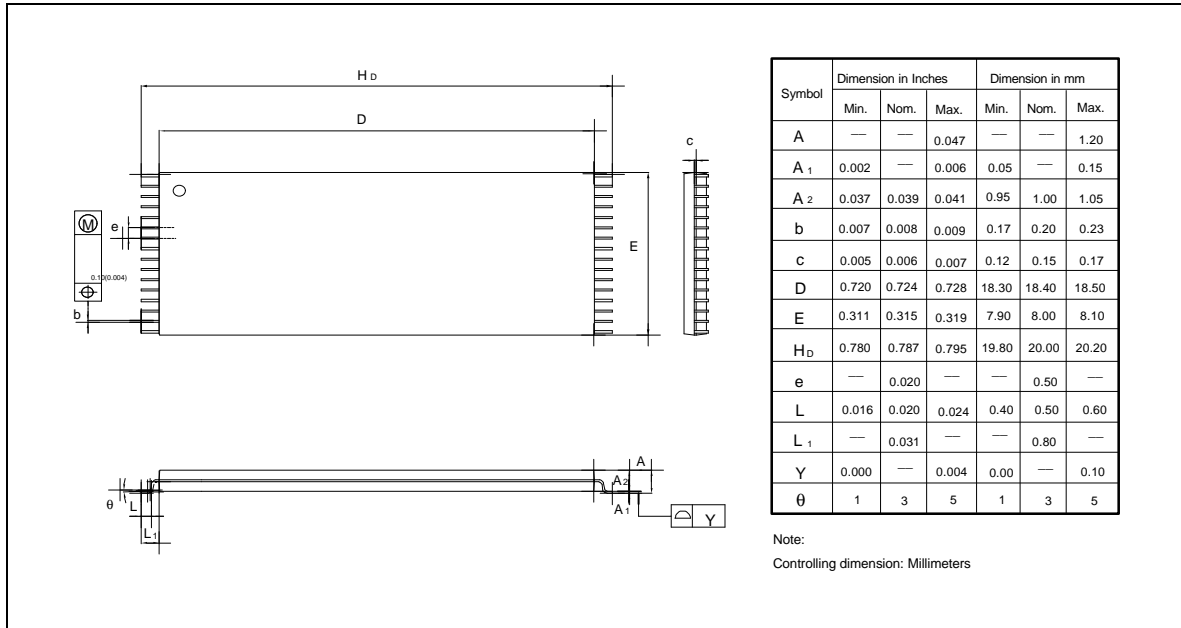


Preliminary W49F020



Package Dimensions, continued

32-pin TSOP



Preliminary W49F020



VERSION HISTORY

| VERSION | DATE | PAGE | DESCRIPTION |
|---------|-----------|------|----------------|
| A1 | Oct. 1999 | - | Initial Issued |



Headquarters

No. 4, Creation Rd. III,
Science-Based Industrial Park,
Hsinchu, Taiwan
TEL: 886-3-5770066
FAX: 886-3-5796096
<http://www.winbond.com.tw/>
Voice & Fax-on-demand: 886-2-27197006

Taipei Office

11F, No. 115, Sec. 3, Min-Sheng East Rd.,
Taipei, Taiwan
TEL: 886-2-27190505
FAX: 886-2-27197502

Winbond Electronics (H.K.) Ltd.

Rm. 803, World Trade Square, Tower II,
123 Hoi Bun Rd., Kwun Tong,
Kowloon, Hong Kong
TEL: 852-27513100
FAX: 852-27552064

Winbond Electronics North America Corp.

Winbond Memory Lab.
Winbond Microelectronics Corp.
Winbond Systems Lab.
2727 N. First Street, San Jose,
CA 95134, U.S.A.
TEL: 408-9436666
FAX: 408-5441798

Note: All data and specifications are subject to change without notice.