MACRONIX
INTERNATIONAL CO., LTD.

# MX29LV040C

## 4M-BIT [512K x 8] CMOS SINGLE VOLTAGE 3V ONLY EQUAL SECTOR FLASH MEMORY

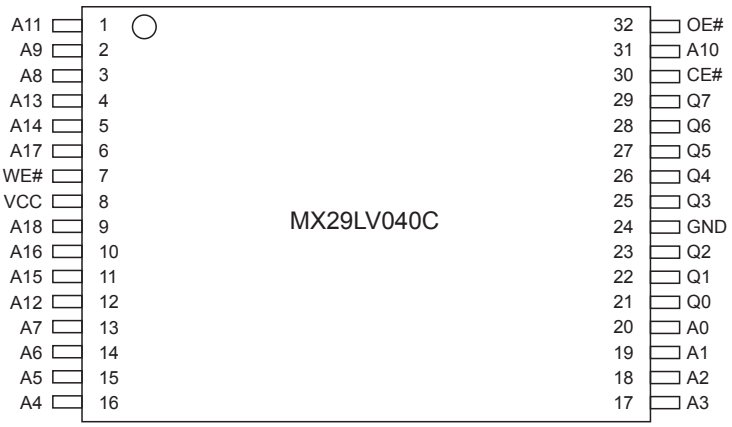
## FEATURES

- Extended single - supply voltage range 2.7V to 3.6V
- 524,288 x 8 only
- Single power supply operation
  - 3.0V only operation for read, erase and program operation
- **Fully compatible with MX29LV040 device**
- Fast access time: 55Q/70/90ns
- Low power consumption
  - 30mA maximum active current
  - 0.2uA typical standby current
- Command register architecture
  - 8 equal sector of 64K-Byte each
  - Byte Programming (9us typical)
  - Sector Erase (Sector structure 64K-Byte x8)
- Auto Erase (chip & sector) and Auto Program
  - Automatically erase any combination of sectors with Erase Suspend capability
  - Automatically program and verify data at specified address
- Erase suspend/Erase Resume
  - Suspends sector erase operation to read data from, or program data to, any sector that is not being erased, then resumes the erase
- Status Reply
  - Data# Polling & Toggle bit for detection of program and erase operation completion
- Sector protection
  - Hardware method to disable any combination of sectors from program or erase operations
  - Any combination of sectors can be erased with erase suspend/resume function
- CFI (Common Flash Interface) compliant
  - Flash device parameters stored on the device and provide the host system to access
- 100,000 minimum erase/program cycles
- Latch-up protected to 100mA from -1V to VCC+1V
- Package type:
  - 32-pin PLCC
  - 32-pin TSOP (8mmx20mm, 8mmx14mm)
  - **All devices are RoHS Compliant**

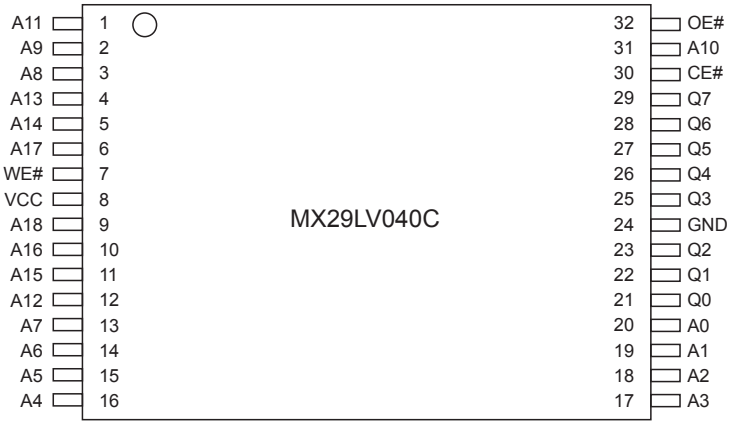
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## PIN CONFIGURATIONS

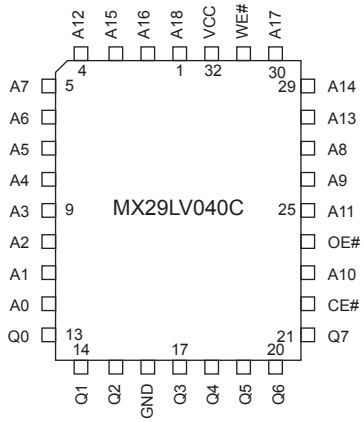
### 32 TSOP (Standard Type) (8mm x 20mm)




### 32 TSOP (8mm x 14mm)




### 32 PLCC

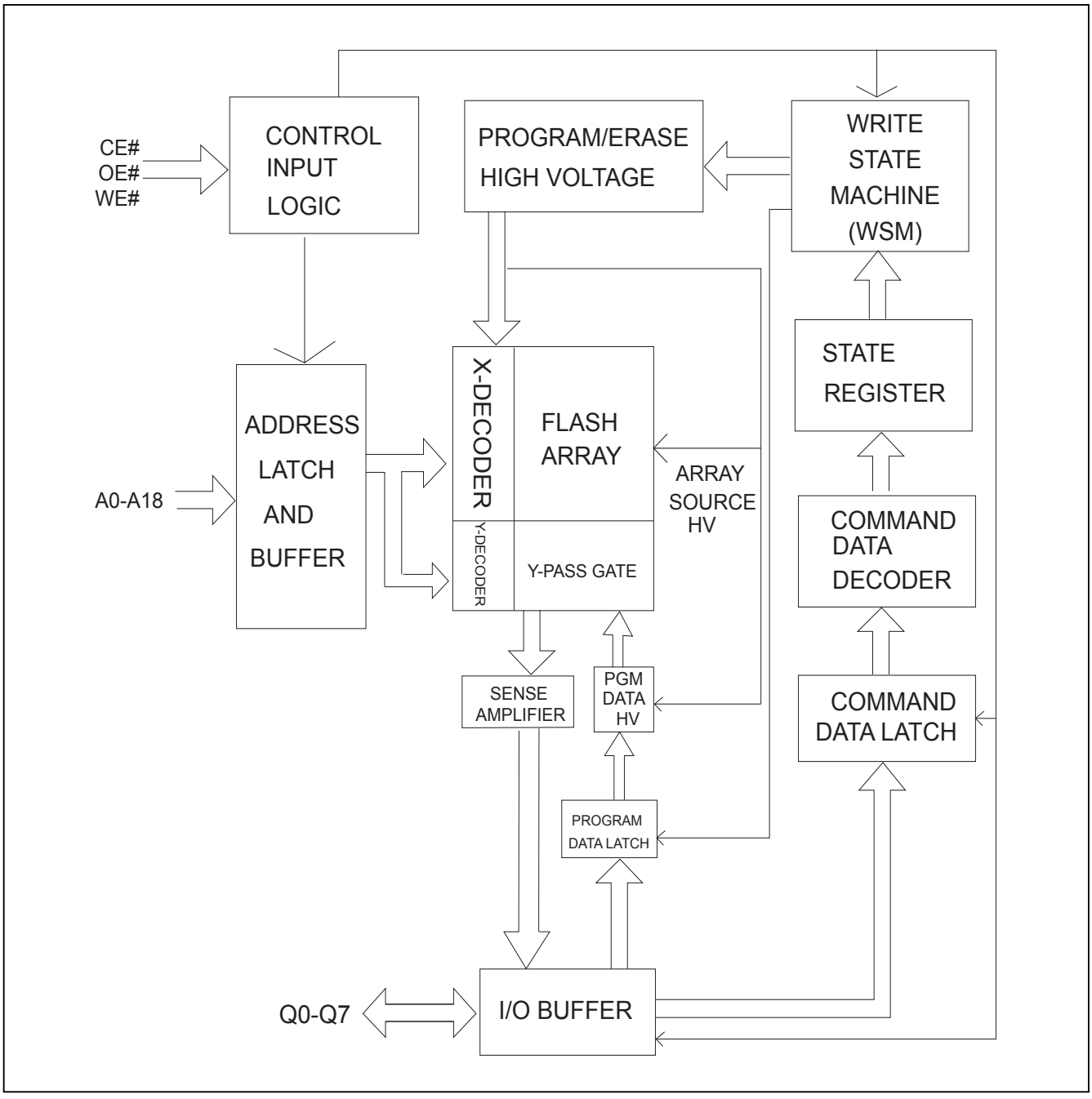



## PIN DESCRIPTION

| SYMBOL | PIN NAME |
|---|---|
| A0~A18 | Address Input |
| Q0~Q7 | Data Input/Output |
| CE# | Chip Enable Input |
| WE# | Write Enable Input |
| OE# | Output Enable Input |
| GND | Ground Pin |
| VCC | +3.0V single power supply |


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## BLOCK DIAGRAM





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**Table 1. SECTOR (GROUP) STRUCTURE**

| Sector | A18 | A17 | A16 | Address Range |
|---|---|---|---|---|
| SA0 | 0 | 0 | 0 | 00000h-0FFFFh |
| SA1 | 0 | 0 | 1 | 10000h-1FFFFh |
| SA2 | 0 | 1 | 0 | 20000h-2FFFFh |
| SA3 | 0 | 1 | 1 | 30000h-3FFFFh |
| SA4 | 1 | 0 | 0 | 40000h-4FFFFh |
| SA5 | 1 | 0 | 1 | 50000h-5FFFFh |
| SA6 | 1 | 1 | 0 | 60000h-6FFFFh |
| SA7 | 1 | 1 | 1 | 70000h-7FFFFh |

Note:All sectors are 64 Kbytes in size.


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**Table 2-1. BUS OPERATION**

| Operation | CE# | OE# | WE# | Address | Q7~Q0 |
|---|---|---|---|---|---|
| Read Mode | L | L | H | AIN | DOUT |
| Write | L | H | L | AIN | DIN |
| Standby Mode | Vcc±0.3V | X | X | X | High-Z |
| Output Disable | L | H | H | X | High-Z |

**Table 2-2. BUS OPERATION**

| Operation | CE# | OE# | WE# | A0 | A1 | A6 | A9 | Q7~Q0 |
|---|---|---|---|---|---|---|---|---|
| Read Silicon ID Manufactures Code | L | L | H | L | L | X | Vhv | C2H |
| Read Silicon ID Device Code | L | L | H | H | L | X | Vhv | 4FH |
| Sector Protect | L | Vhv | L | X | X | L | Vhv | X |
| Chip Unprotected | L | Vhv | L | X | X | H | Vhv | X |
| Sector Protect Verify | L | L | H | X | H | X | Vhv | Code(1) |

Notes:
1. Sector unprotected code:00h. Sector protected code:01h.
2. AM: MSB of address.
3. Sector addresses: A18~A16.
4. Vhv is 11.5V to 12.5V.
5. X means don't care.


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## WRITE COMMANDS/COMMAND SEQUENCES

To write a command to the device, system must drive WE# and CE# to Vil, and OE# to Vih. In a command cycle, all address are latched at the later falling edge of CE# and WE#, and all data are latched at the earlier rising edge of CE# and WE#.

Figure 1 illustrates the AC timing waveform of a write command, and Table 3 defines all the valid command sets of the device. System is not allowed to write invalid commands not defined in this datasheet. Writing an invalid command will bring the device to an undefined state.

## REQUIREMENTS FOR READING ARRAY DATA

Read array action is to read the data stored in the array. While the memory device is in powered up or has been reset, it will automatically enter the status of read array. If the microprocessor wants to read the data stored in the array, it has to drive CE# (device enable control pin) and OE# (Output control pin) as Vil, and input the address of the data to be read into address pin at the same time. After a period of read cycle (Tce or Taa), the data being read out will be displayed on output pin for microprocessor to access. If CE# or OE# is Vih, the output will be in tri-state, and there will be no data displayed on output pin at all.

After the memory device completes embedded operation (automatic Erase or Program), it will automatically return to the status of read array, and the device can read the data in any address in the array. In the process of erasing, if the device receives the Erase suspend command, erase operation will be stopped temporarily after a period of time no more than Tready1 and the device will return to the status of read array. At this time, the device can read the data stored in any address except the sector being erased in the array. In the status of erase suspend, if user wants to read the data in the sectors being erased, the device will output status data onto the output. Similarly, if program command is issued after erase suspend, after program operation is completed, system can still read array data in any address except the sectors to be erased.

The device needs to issue reset command to enable read array operation again in order to arbitrarily read the data in the array in the following two situations:

1. In program or erase operation, the programming or erasing failure causes Q5 to go high.

2. The device is in auto select mode or CFI mode.

In the two situations above, if reset command is not issued, the device is not in read array mode and system must issue reset command before reading array data.


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## SECTOR PROTECT OPERATION

When a sector is protected, program or erase operation will be disabled on that protected sector. MX29LV040C provides a methods for sector protection.

The method is asserting Vhv on A9 and OE# pins, with A6 and CE# at Vil. The protection operation begins at the falling edge of WE# and terminates at the rising edge. Contact Macronix for details.

## CHIP UNPROTECT OPERATION

MX29LV040C provides one methods for chip unprotect. The chip unprotect operation unprotects all sectors within the device. It is recommended to protect all sectors before activating chip unprotect mode. All sector groups are unprotected when shipped from the factory.

The method is asserting Vhv on A9 and OE# pins, with A6 at Vih and CE# at Vil (see Table 2). The unprotect operation begins at the falling edge of WE# and terminates at the rising edge. Contact Macronix for details.

## AUTOMATIC SELECT OPERATION

When the device is in Read array mode, erase-suspended read array mode or CFI mode, user can issue read silicon ID command to enter read silicon ID mode. After entering read silicon ID mode, user can query several silicon IDs continuously and does not need to issue read silicon ID mode again. When A0 is Low, device will output Macronix Manufacture ID C2. When A0 is high, device will output Device ID. In read silicon ID mode, issuing reset command will reset device back to read array mode or erase-suspended read array mode.

Another way to enter read silicon ID is to apply high voltage on A9 pin with CE#, OE#, A6 and A1 at Vil. While the high voltage of A9 pin is discharged, device will automatically leave read silicon ID mode and go back to read array mode or erase-suspended read array mode. When A0 is Low, device will output Macronix Manufacture ID C2. When A0 is high, device will output Device ID.

## VERIFY SECTOR PROTECT STATUS OPERATION

MX29LV040C provides hardware sector protection against Program and Erase operation for protected sectors. The sector protect status can be read through Sector Protect Verify command. This method requires Vhv on A9 pin, Vih on WE# and A1 pins, Vil on CE#, OE#, A6 and A0 pins, and sector address on A16 to A18 pins. If the read out data is 01H, the designated sector is protected. Oppositely, if the read out data is 00H, the designated sector is not protected.

## DATA PROTECTION

To avoid accidental erasure or programming of the device, the device is automatically reset to read array mode during power up. Besides, only after successful completion of the specified command sets will the device begin its erase or program operation.

Other features to protect the data from accidental alternation are described as followed.


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## LOW VCC WRITE INHIBIT

The device refuses to accept any write command when Vcc is less than 1.4V. This prevents data from spuriously altered. The device automatically resets itself when Vcc is lower than 1.4V and write cycles are ignored until Vcc is greater than 1.4V. System must provide proper signals on control pins after Vcc is larger than 1.4V to avoid unintentional program or erase operation

## WRITE PULSE "GLITCH" PROTECTION

CE#, WE#, OE# pulses shorter than 5ns are treated as glitches and will not be regarded as an effective write cycle.

## LOGICAL INHIBIT

A valid write cycle requires both CE# and WE# at Vil with OE# at Vih. Write cycle is ignored when either CE# at Vih, WE# a Vih, or OE# at Vil.

## POWER-UP SEQUENCE

Upon power up, MX29LV040C is placed in read array mode. Furthermore, program or erase operation will begin only after successful completion of specified command sequences.

## POWER-UP WRITE INHIBIT

When WE#, CE# is held at Vil and OE# is held at Vih during power up, the device ignores the first command on the rising edge of WE#.

## POWER SUPPLY DECOUPLING

A 0.1uF capacitor should be connected between the Vcc and GND to reduce the noise effect.


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## TABLE 3. MX29LV040C COMMAND DEFINITIONS

| Command | | Read Mode | Reset Mode | Automatic Select | | | Program | Chip Erase | Sector Erase | CFI Read | Erase Suspend | Erase Resume |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Silicon ID | Device ID | Sector Protect Verify | | | | | | |
| 1st Bus Cyc | Addr | Addr | XXX | 555 | 555 | 555 | 555 | 555 | 555 | AA | XXX | XXX |
| | Data | Data | F0 | AA | AA | AA | AA | AA | AA | 98 | B0 | 30 |
| 2nd Bus Cyc | Addr | | | 2AA | 2AA | 2AA | 2AA | 2AA | 2AA | | | |
| | Data | | | 55 | 55 | 55 | 55 | 55 | 55 | | | |
| 3rd Bus Cyc | Addr | | | 555 | 555 | 555 | 555 | 555 | 555 | | | |
| | Data | | | 90 | 90 | 90 | A0 | 80 | 80 | | | |
| 4th Bus Cyc | Addr | | | X00 | X01 | (Sector) X02 | Addr | 555 | 555 | | | |
| | Data | | | C2 | 4F | 00/01 | Data | AA | AA | | | |
| 5th Bus Cyc | Addr | | | | | | | 2AA | 2AA | | | |
| | Data | | | | | | | 55 | 55 | | | |
| 6th Bus Cyc | Addr | | | | | | | 555 | Sector | | | |
| | Data | | | | | | | 10 | 30 | | | |

Notes:
1. It is not allowed to adopt any other code which is not in the above command definition table.


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## RESET

In the following situations, executing reset command will reset device back to read array mode:

- Among erase command sequence (before the full command set is completed)
- Sector erase time-out period
- Erase fail (while Q5 is high)
- Among program command sequence (before the full command set is completed, erase-suspended program included)
- Program fail (while Q5 is high, and erase-suspended program fail is included)
- Read silicon ID mode
- Sector protect verify
- CFI mode

While device is at the status of program fail or erase fail (Q5 is high), user must issue reset command to reset device back to read array mode. While the device is in read silicon ID mode, sector protect verify or CFI mode, user must issue reset command to reset device back to read array mode.

When the device is in the progress of programming (not program fail) or erasing (not erase fail), device will ignore reset command.


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## AUTOMATIC PROGRAMMING

The MX29LV040C can provide the user program function by the form of Byte-Mode. As long as the users enter the right cycle defined in the Table.3 (including 2 unlock cycles and A0H), any data user inputs will automatically be programmed into the array.

Once the program function is executed, the internal write state controller will automatically execute the algorithms and timings necessary for program and verification, which includes generating suitable program pulse, verifying whether the threshold voltage of the programmed cell is high enough and repeating the program pulse if any of the cells does not pass verification. Meanwhile, the internal control will prohibit the programming to cells that pass verification while the other cells fail in verification in order to avoid over-programming. With the internal write state controller, the device requires the user to write the program command and data only.

Programming will only change the bit status from "1" to "0". That is to say, it is impossible to convert the bit status from "0" to "1" by programming. Meanwhile, the internal write verification only detects the errors of the "1" that is not successfully programmed to "0".

Any command written to the device during programming will be ignored except hardware reset, which will terminate the program operation after a period of time no more than Tready1. When the embedded program algorithm is complete or the program operation is terminated by hardware reset, the device will return to the reading array data mode.

The typical chip program time at room temperature of the MX29LV040C is less than 4.5 seconds.

When the embedded program operation is on going, user can confirm if the embedded operation is finished or not by the following methods:

| Status | Q7 | Q6 | Q5 |
|---|---|---|---|
| In progress*1 | Q7# | Toggling | 0 |
| Finished | Q7 | Stop toggling | 0 |
| Exceed time limit | Q7# | Toggling | 1 |

*1: The status "in progress" means both program mode and erase-suspended program mode.
*2: When an attempt is made to program a protected sector, Q7 will output its complement data or Q6 continues to toggle for about 1us or less and the device returns to read array state without programing the data in the protected sector.


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## CHIP ERASE

Chip Erase is to erase all the data with "1" and "0" as all "1". It needs 6 cycles to write the action in, and the first two cycles are "unlock" cycles, the third one is a configuration cycle, the fourth and fifth are also "unlock" cycles, and the sixth cycle is the chip erase operation.

During chip erasing, all the commands will not be accepted except hardware reset or the working voltage is too low that chip erase will be interrupted. After Chip Erase, the chip will return to the state of Read Array.

When the embedded chip erase operation is on going, user can confirm if the embedded operation is finished or not by the following methods:

| Status | Q7 | Q6 | Q5 | Q2 |
|---|---|---|---|---|
| In progress | 0 | Toggling | 0 | Toggling |
| Finished | 1 | Stop toggling | 0 | 1 |
| Exceed time limit | 0 | Toggling | 1 | Toggling |

## SECTOR ERASE

Sector Erase is to erase all the data in a sector with "1" and "0" as all "1". It requires six command cycles to issue. The first two cycles are "unlock cycles", the third one is a configuration cycle, the fourth and fifth are also "unlock cycles" and the sixth cycle is the sector erase command. After the sector erase command sequence is issued, there is a time-out period of 50us counted internally. During the time-out period, additional sector address and sector erase command can be written multiply. Once user enters another sector erase command, the time-out period of 50us is recounted. If user enters any command other than sector erase or erase suspend during time-out period, the erase command would be aborted and the device is reset to read array condition. The number of sectors could be from one sector to all sectors. After time-out period passing by, additional erase command is not accepted and erase embedded operation begins.

During sector erasing, all commands will not be accepted except hardware reset and erase suspend and user can check the status as chip erase.

When the embedded erase operation is on going, user can confirm if the embedded operation is finished or not by the following methods:

| Status | Q7 | Q6 | Q5 | Q3 | Q2 |
|---|---|---|---|---|---|
| Time-out period | 0 | Toggling | 0 | 0 | Toggling |
| In progress | 0 | Toggling | 0 | 1 | Toggling |
| Finished | 1 | Stop toggling | 0 | 1 | 1 |
| Exceed time limit | 0 | Toggling | 1 | 1 | Toggling |

*1: The status Q3 is the time-out period indicator. When Q3=0, the device is in time-out period and is acceptible to another sector address to be erased. When Q3=1, the device is in erase operation and only erase suspend is valid.
*2: When an attempt is made to erase a protected sector, Q7 will output its complement data or Q6 continues to toggle for 100us or less and the device returned to read array status without erasing the data in the protected sector.


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## SECTOR ERASE SUSPEND

During sector erasure, sector erase suspend is the only valid command. If user issue erase suspend command in the time-out period of sector erasure, device time-out period will be over immediately and the device will go back to erase-suspended read array mode. If user issue erase suspend command during the sector erase is being operated, device will suspend the ongoing erase operation, and after the Tready1 (<=20us) suspend finishes and the device will enter erase-suspended read array mode. User can judge if the device has finished erase suspend through Q6, Q7, and RY/BY#.

After device has entered erase-suspended read array mode, user can read other sectors not at erase suspend by the speed of Taa; while reading the sector in erase-suspend mode, device will output its status. User can use Q6 and Q2 to judge the sector is erasing or the erase is suspended.

| Status | Q7 | Q6 | Q5 | Q3 | Q2 |
|---|---|---|---|---|---|
| Erase suspend read in erase suspended sector | 1 | No toggle | 0 | N/A | Toggle |
| Erase suspend read in non-erase suspended sector | Data | Data | Data | Data | Data |
| Erase suspend program in non-erase suspended sector | Q7# | Toggle | 0 | N/A | N/A |

When the device has suspended erasing, user can execute the command sets except sector erase and chip erase, such as read silicon ID, sector protect verify, program, CFI query and erase resume.

## SECTOR ERASE RESUME

Sector erase resume command is valid only when the device is in erase suspend state. After erase resume, user can issue another erase suspend command, but there should be a 400uS interval between erase resume and the next erase suspend. If user issue infinite suspend-resume loop, or suspend-resume exceeds 1024 times, the time for erasing will increase.


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## QUERY COMMAND AND COMMON FLASH INTERFACE (CFI) MODE

MX29LV040C features CFI mode. Host system can retrieve the operating characteristics, structure and vendor-specified information such as identifying information, memory size, byte configuration, operating voltages and timing information of this device by CFI mode. If the system writes the CFI Query command "98h", to address "55h"/"AAh", the device will enter the CFI Query Mode, any time the device is ready to read array data. The system can read CFI information at the addresses given in Table 4.

Once user enters CFI query mode, user can not issue any other commands except reset command. The reset command is required to exit CFI mode and go back to the mode before entering CFI. The system can write the CFI Query command only when the device is in read mode, erase suspend, standby mode or automatic select mode.

**Table 4-1. CFI mode: Identification Data Values**
(All values in these tables are in hexadecimal)

| Description | Address (h) (Byte Mode) | Data (h) |
|---|---|---|
| Query-unique ASCII string "QRY" | 10 | 0051 |
| | 11 | 0052 |
| | 12 | 0059 |
| Primary vendor command set and control interface ID code | 13 | 0002 |
| | 14 | 0000 |
| Address for primary algorithm extended query table | 15 | 0040 |
| | 16 | 0000 |
| Alternate vendor command set and control interface ID code (none) | 17 | 0000 |
| | 18 | 0000 |
| Address for alternate algorithm extended query table (none) | 19 | 0000 |
| | 1A | 0000 |

**Table 4-2. CFI Mode: System Interface Data Values**

| Description | Address (h) (Byte Mode) | Data (h) |
|---|---|---|
| Vcc supply minimum program/erase voltage | 1B | 0027 |
| Vcc supply maximum program/erase voltage | 1C | 0036 |
| VPP supply minimum program/erase voltage | 1D | 0000 |
| VPP supply maximum program/erase voltage | 1E | 0000 |
| Typical timeout per single word/byte write, $2^n$ us | 1F | 0004 |
| Typical timeout for maximum-size buffer write, $2^n$ us | 20 | 0000 |
| Typical timeout per individual block erase, $2^n$ ms | 21 | 000A |
| Typical timeout for full chip erase, $2^n$ ms | 22 | 0000 |
| Maximum timeout for word/byte write, $2^n$ times typical | 23 | 0005 |
| Maximum timeout for buffer write, $2^n$ times typical | 24 | 0000 |
| Maximum timeout per individual block erase, $2^n$ times typical | 25 | 0004 |
| Maximum timeout for chip erase, $2^n$ times typical | 26 | 0000 |


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**Table 4-3. CFI Mode: Device Geometry Data Values**

| Description | Address (h) (Byte Mode) | Data (h) |
|---|---|---|
| Device size = $2^n$ in number of bytes | 27 | 0013 |
| Flash device interface description (02=asynchronous x8/x16) | 28 | 0000 |
| | 29 | 0000 |
| Maximum number of bytes in buffer write = $2^n$ (not support) | 2A | 0000 |
| | 2B | 0000 |
| Number of erase regions within device | 2C | 0001 |
| Index for Erase Bank Area 1 | 2D | 0007 |
| | 2E | 0000 |
| | 2F | 0000 |
| | 30 | 0001 |
| Index for Erase Bank Area 2 | 31 | 0000 |
| | 32 | 0000 |
| | 33 | 0000 |
| | 34 | 0000 |
| Index for Erase Bank Area 3 | 35 | 0000 |
| | 36 | 0000 |
| | 37 | 0000 |
| | 38 | 0000 |
| Index for Erase Bank Area 4 | 39 | 0000 |
| | 3A | 0000 |
| | 3B | 0000 |
| | 3C | 0000 |


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**Table 4-4. CFI Mode: Primary Vendor-Specific Extended Query Data Values**

| Description | Address (h) (Byte Mode) | Data (h) |
|---|---|---|
| Query - Primary extended table, unique ASCII string, PRI | 40 | 0050 |
| | 41 | 0052 |
| | 42 | 0049 |
| Major version number, ASCII | 43 | 0031 |
| Minor version number, ASCII | 44 | 0030 |
| Unlock recognizes address (0= recognize, 1= don't recognize) | 45 | 0001 |
| Erase suspend (2= to both read and program) | 46 | 0002 |
| Sector protect (N= # of sectors/group) | 47 | 0001 |
| Temporary sector unprotect (1=supported) | 48 | 0001 |
| Sector protect/Chip unprotect scheme | 49 | 0004 |
| Simultaneous R/W operation (0=not supported) | 4A | 0000 |
| Burst mode (0=not supported) | 4B | 0000 |
| Page mode (0=not supported) | 4C | 0000 |


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## ABSOLUTE MAXIMUM STRESS RATINGS

| | | |
|---|---|---|
| Surrounding Temperature with Bias | | -65°C to +125°C |
| Storage Temperature | | -65°C to +150°C |
| Voltage Range | VCC | -0.5V to +4.0 V |
| | A9 and OE# | -0.5 V to +12.5 V |
| | The other pins | -0.5V to Vcc +0.5V |
| Output Short Circuit Current (less than one second) | | 200 mA |

## OPERATING TEMPERATURE AND VOLTAGE

| | | |
|---|---|---|
| **Commercial (C) Grade** | Surrounding Temperature ($T_A$) | 0°C to +70°C |
| **Industrial (I) Grade** | Surrounding Temperature ($T_A$) | -40°C to +85°C |
| **VCC Supply Voltages** | VCC range | +2.7 V to 3.6 V |

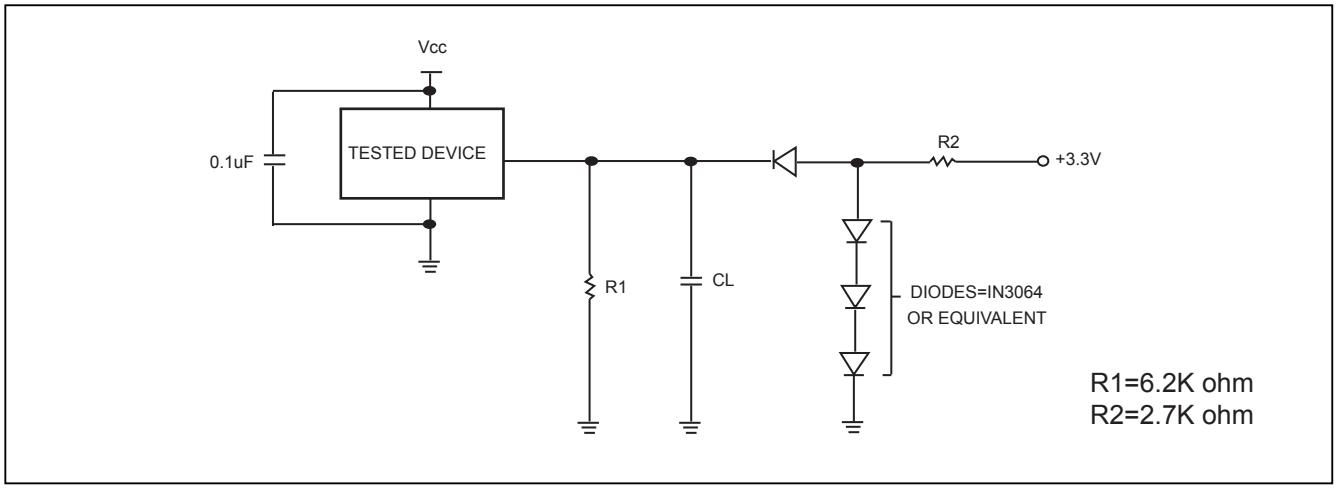

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## DC CHARACTERISTICS

| Symbol | Description | Min. | Typ. | Max. | Remark |
|---|---|---|---|---|---|
| Iilk | Input Leak | | | ± 1.0uA | |
| Iilk9 | A9 Leak | | | 35uA | A9=12.5V |
| Iolk | Output Leak | | | ± 1.0uA | |
| Icr1 | Read Current(5MHz) | | 7mA | 12mA | CE#=Vil, OE#=Vih |
| Icr2 | Read Current(1MHz) | | 2mA | 4mA | CE#=Vil, OE#=Vih |
| Icw | Write Current | | 15mA | 30mA | CE#=Vil, OE#=Vih, WE#=Vil |
| Isb | Standby Current | | 0.2uA | 5uA | Vcc=Vcc max, other pin disable |
| Isbs | Sleep Mode Current | | 0.2uA | 5uA | |
| Vil | Input Low Voltage | -0.5V | | 0.8V | |
| Vih | Input High Voltage | 0.7xVcc | | Vcc+0.3V | |
| Vhv | Very High Voltage for hardware Protect/Unprotect/Auto Select | 11.5V | | 12.5V | |
| Vol | Output Low Voltage | | | 0.45V | Iol=4.0mA |
| Voh1 | Ouput High Voltage | 0.85xVcc | | | Ioh1=-2mA |
| Voh2 | Ouput High Voltage | Vcc-0.4V | | | Ioh2=-100uA |

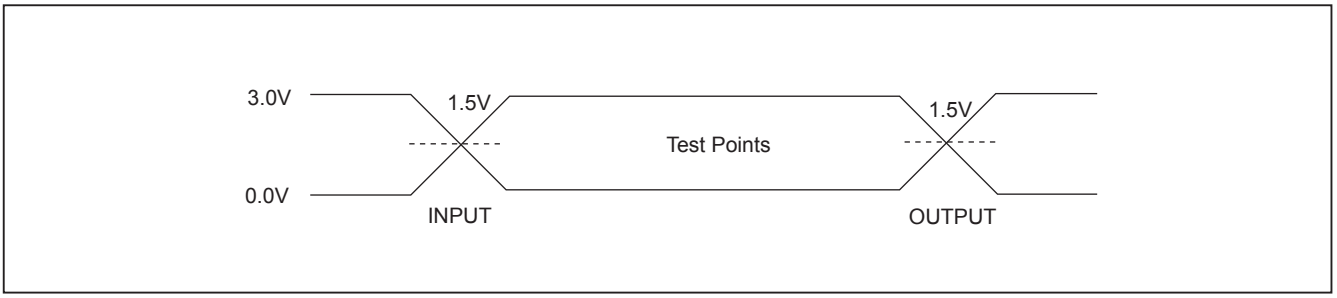

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## SWITCHING TEST CIRCUITS




Test Condition
Output Load : 1 TTL gate
Output Load Capacitance,CL : 30pF(70ns)/100pF(90ns)
Rise/Fall Times : 5ns
In/Out reference levels :1.5V

## SWITCHING TEST WAVEFORMS





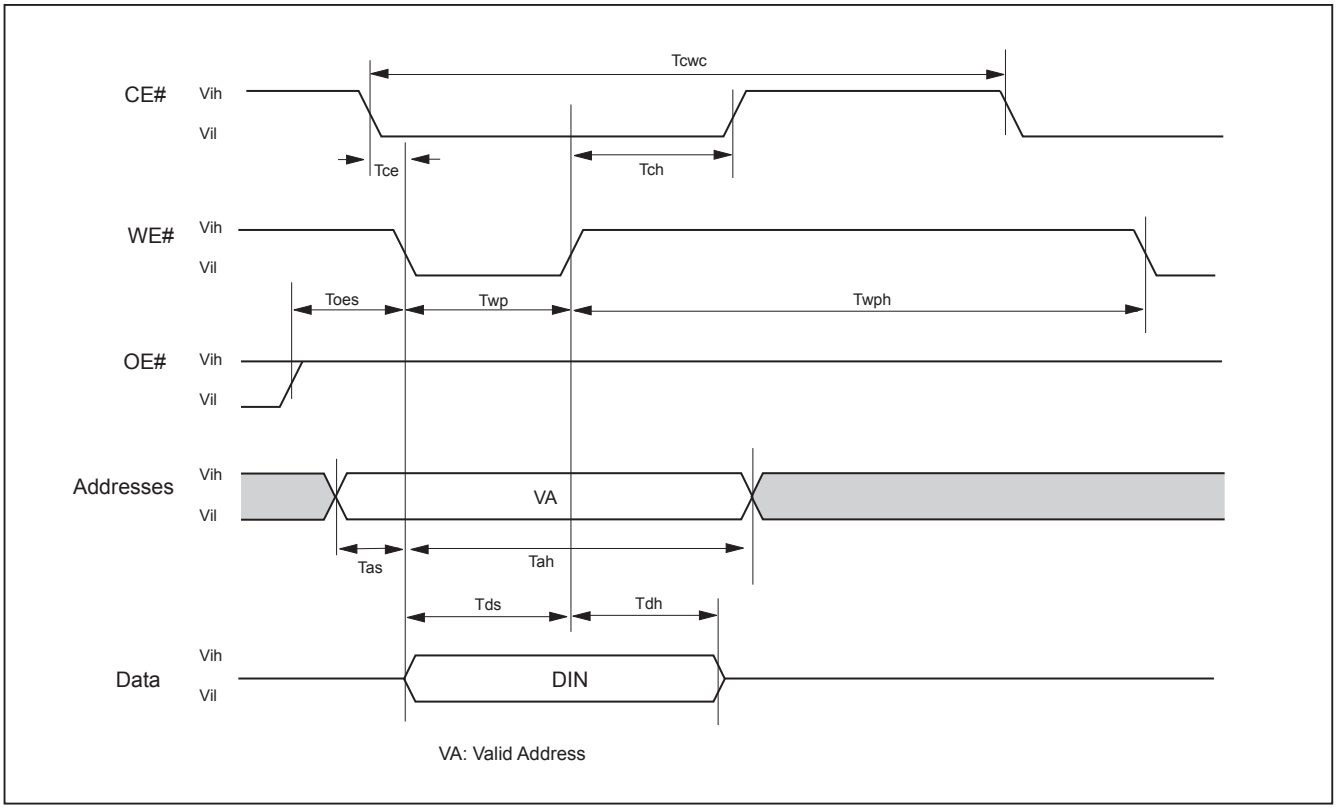
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## AC CHARACTERISTICS

| Symbol | Description | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Taa | Valid data output after address | | | | 55/70/90 | ns |
| Tce | Valid data output after CE# low | | | | 55/70/90 | ns |
| Toe | Valid data output after OE# low | | | | 30/30/35 | ns |
| Tdf | Data output floating after OE# high or CE# high | | | | 25/25/30 | ns |
| Toh | Output hold time from the earliest rising edge of address, CE#, OE# | | 0 | | | ns |
| Trc | Read period time | | 55/70/90 | | | ns |
| Twc | Write period time | | 70/90 | | | ns |
| Tcwc | Command write period time | | 70/90 | | | ns |
| Tas | Address setup time | | 0 | | | ns |
| Tah | Address hold time | | 45 | | | ns |
| Tds | Data setup time | | 35/45 | | | ns |
| Tdh | Data hold time | | 0 | | | ns |
| Tvcs | Vcc setup time | | 50 | | | us |
| Tcs | Chip enable Setup time | | 0 | | | ns |
| Tch | Chip enable hold time | | 0 | | | ns |
| Toes | Output enable setup time | | 0 | | | ns |
| Toeh | Output enable hold time | Read | 0 | | | ns |
| | | Toggle & Data# Polling | 10 | | | ns |
| Tws | WE# setup time | | 0 | | | ns |
| Twh | WE# hold time | | 0 | | | ns |
| Tcep | CE# pulse width | | 35 | | | ns |
| Tceph | CE# pulse width high | | 30 | | | ns |
| Twp | WE# pulse width | | 35 | | | ns |
| Twph | WE# pulse width high | | 30 | | | ns |
| Tghwl | Read recover time before write | | 0 | | | ns |
| Tghel | Read recover time before write | | 0 | | | ns |
| Twhwh1 | Program operation | | | 9 | | us |
| Twhwh2 | Sector erase operation | | | 0.7 | | sec |
| Tbal | Sector add hold time | | | | 50 | us |


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**Figure 1. COMMAND WRITE OPERATION**

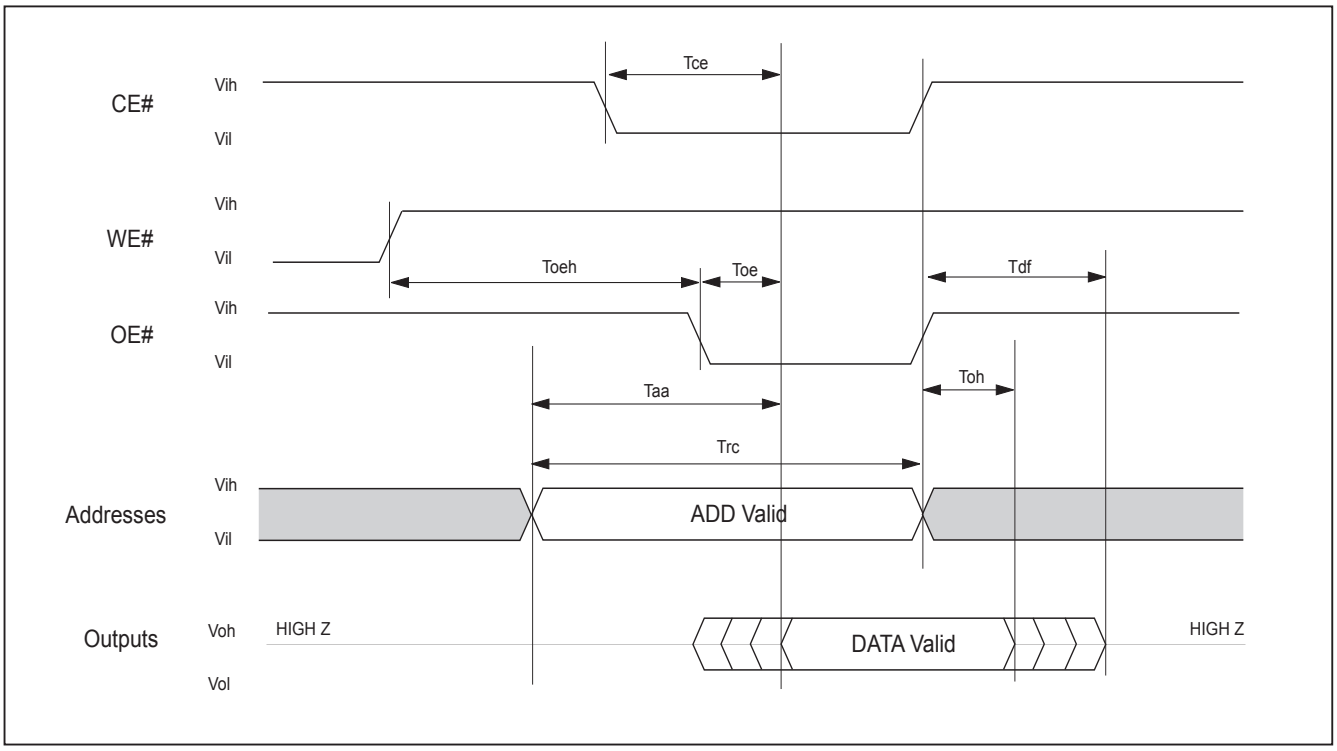




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## READ OPERATION

### Figure 2. READ TIMING WAVEFORMS

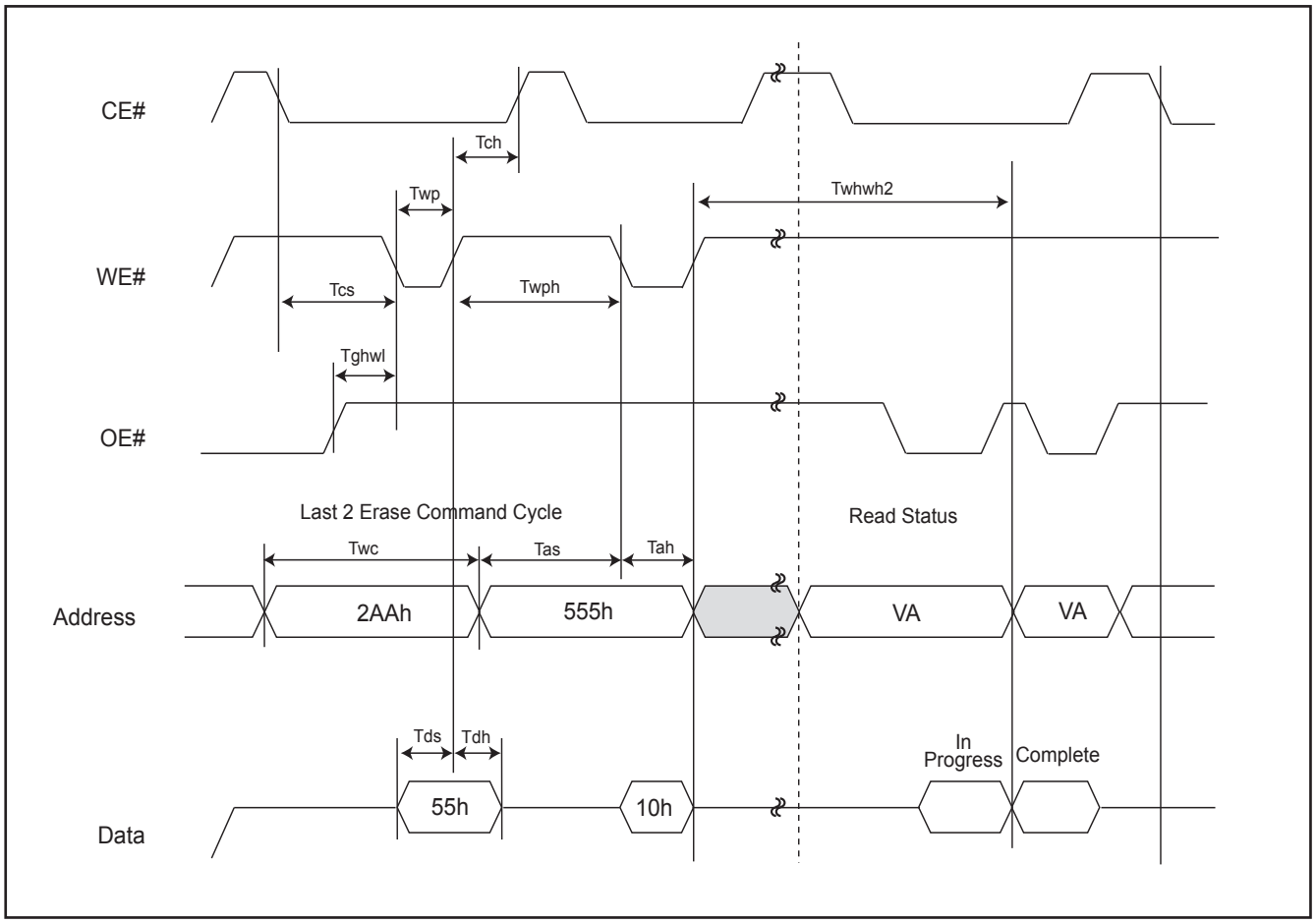




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## ERASE/PROGRAM OPERATION

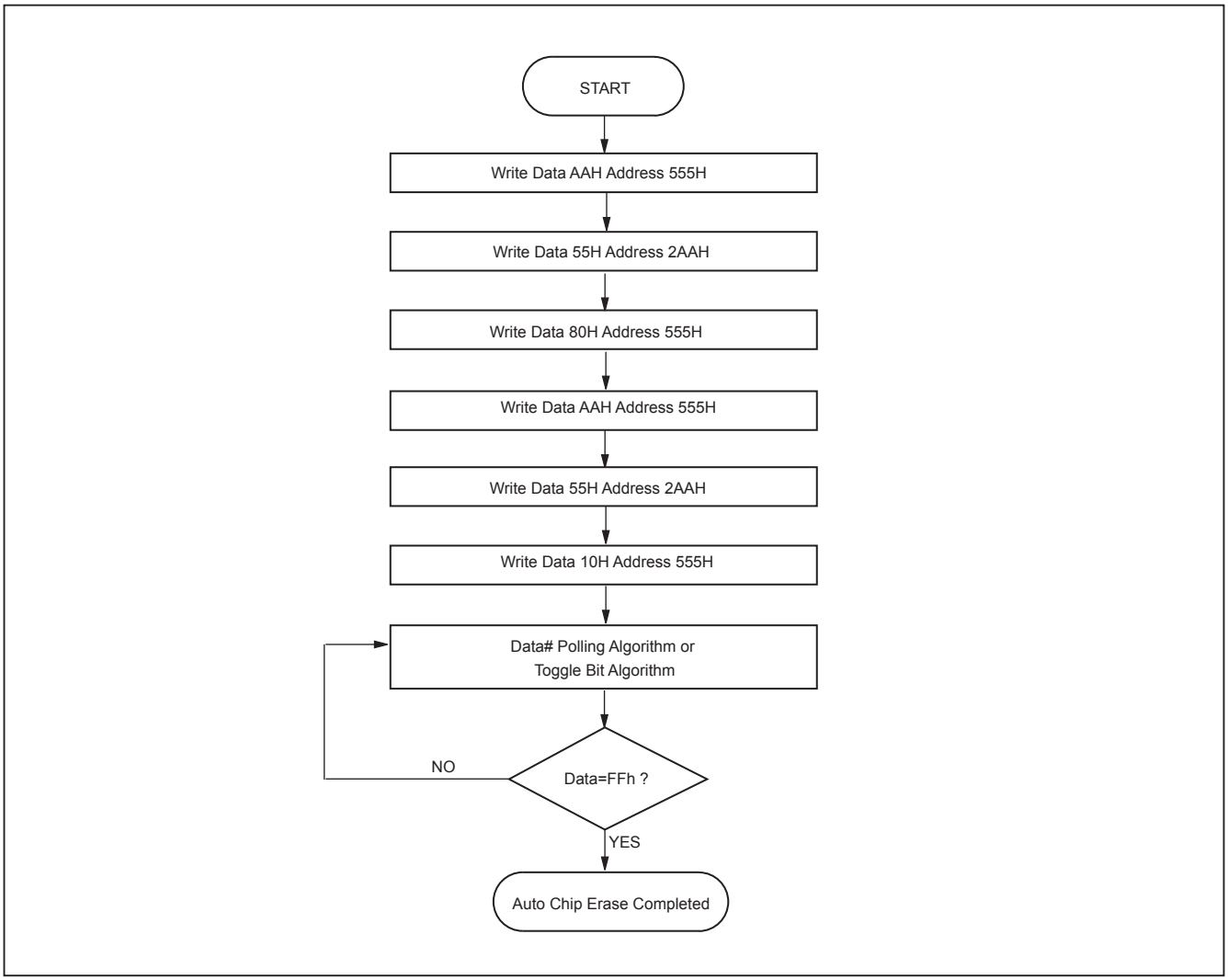
**Figure 3. AUTOMATIC CHIP ERASE TIMING WAVEFORM**





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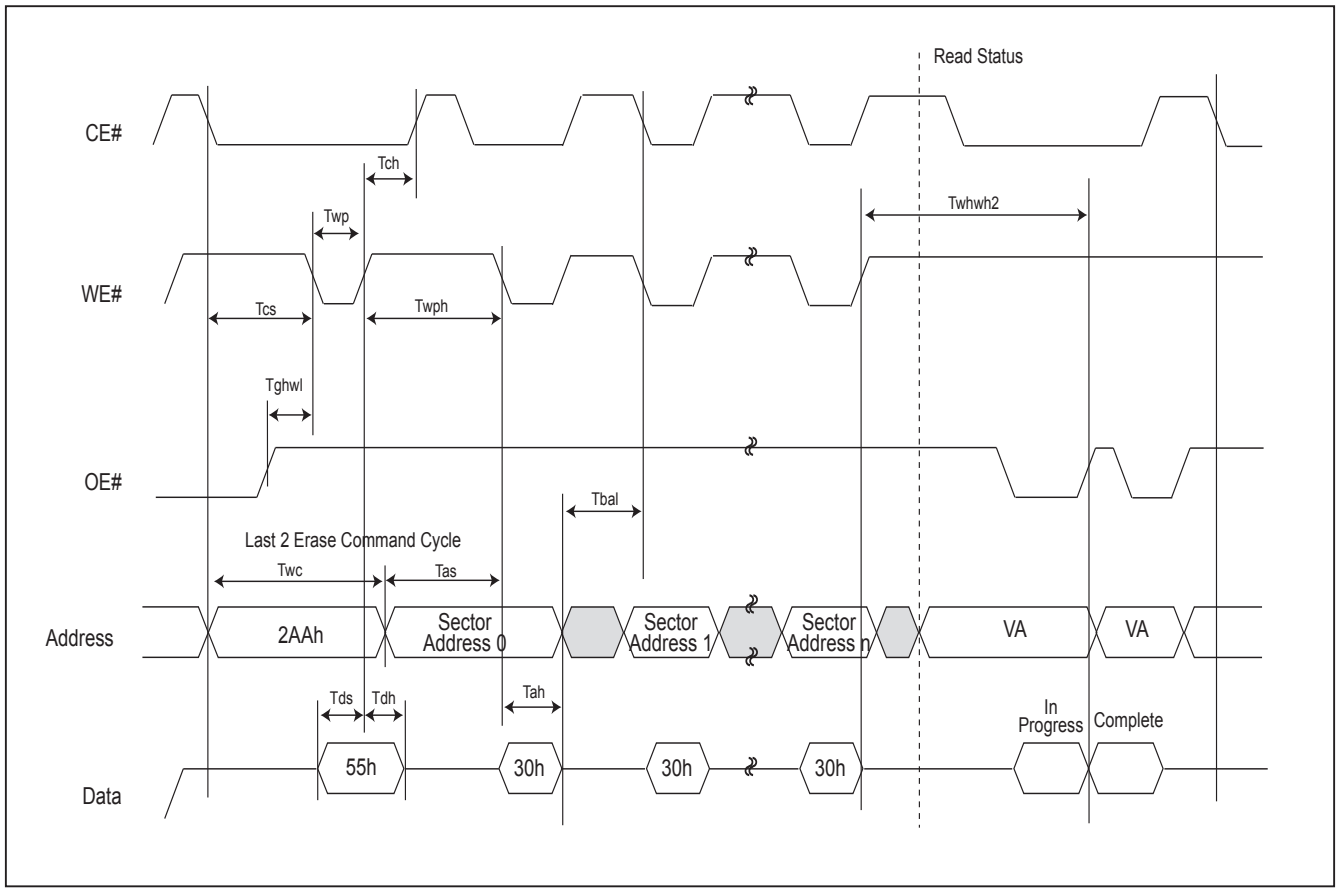
**Figure 4. AUTOMATIC CHIP ERASE ALGORITHM FLOWCHART**





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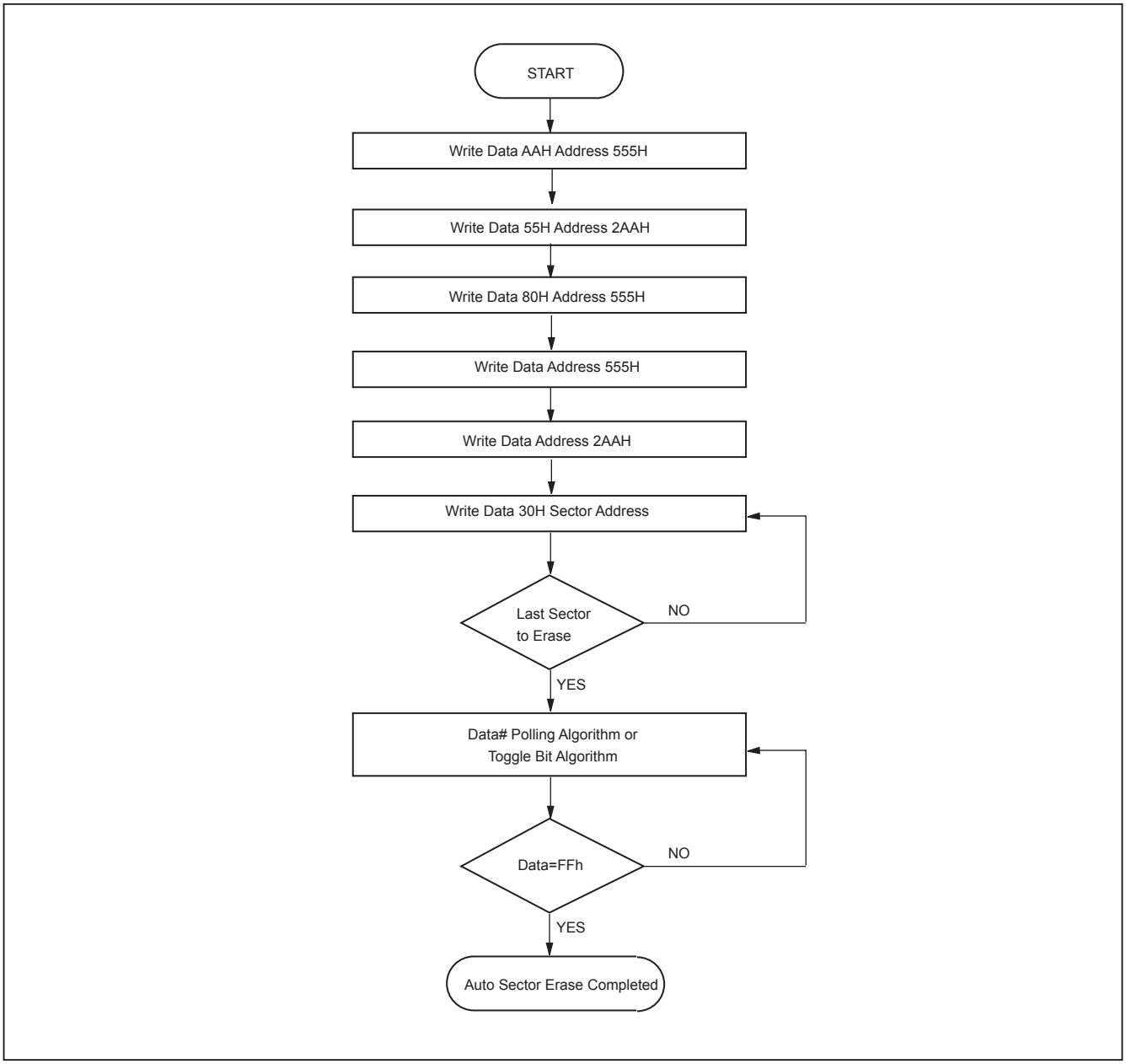
**Figure 5. AUTOMATIC SECTOR ERASE TIMING WAVEFORM**





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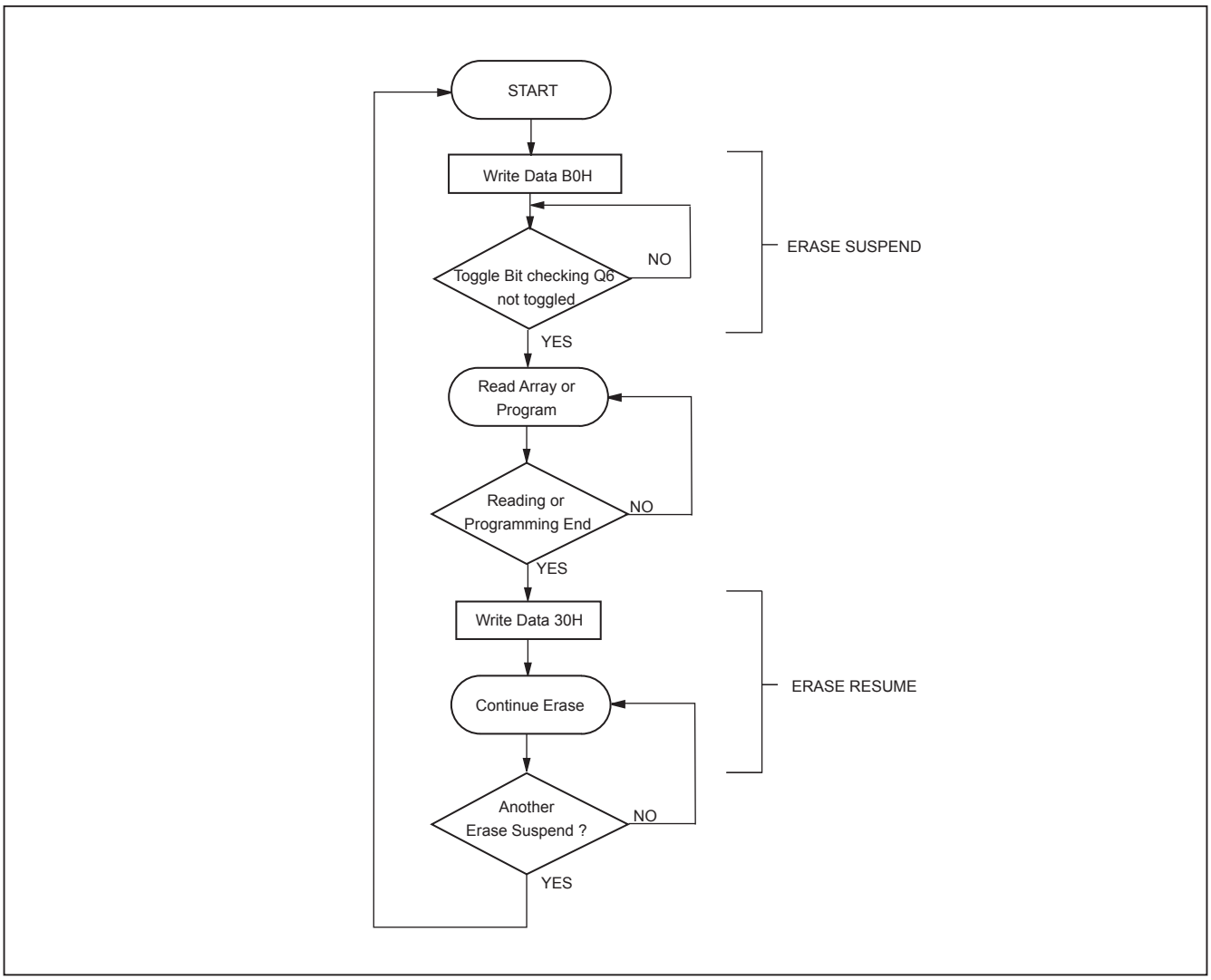
**Figure 6. AUTOMATIC SECTOR ERASE ALGORITHM FLOWCHART**





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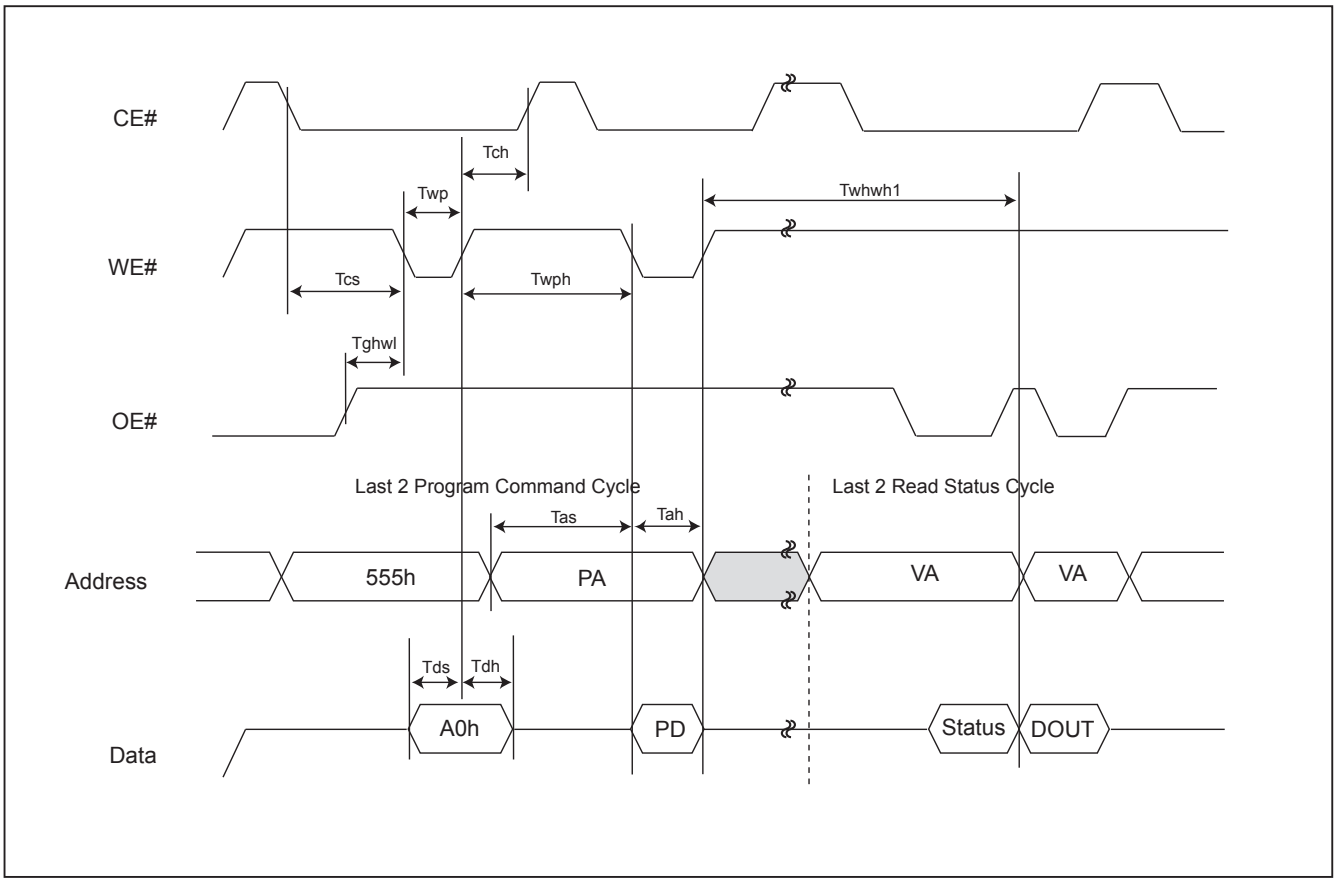
**Figure 7. ERASE SUSPEND/RESUME FLOWCHART**





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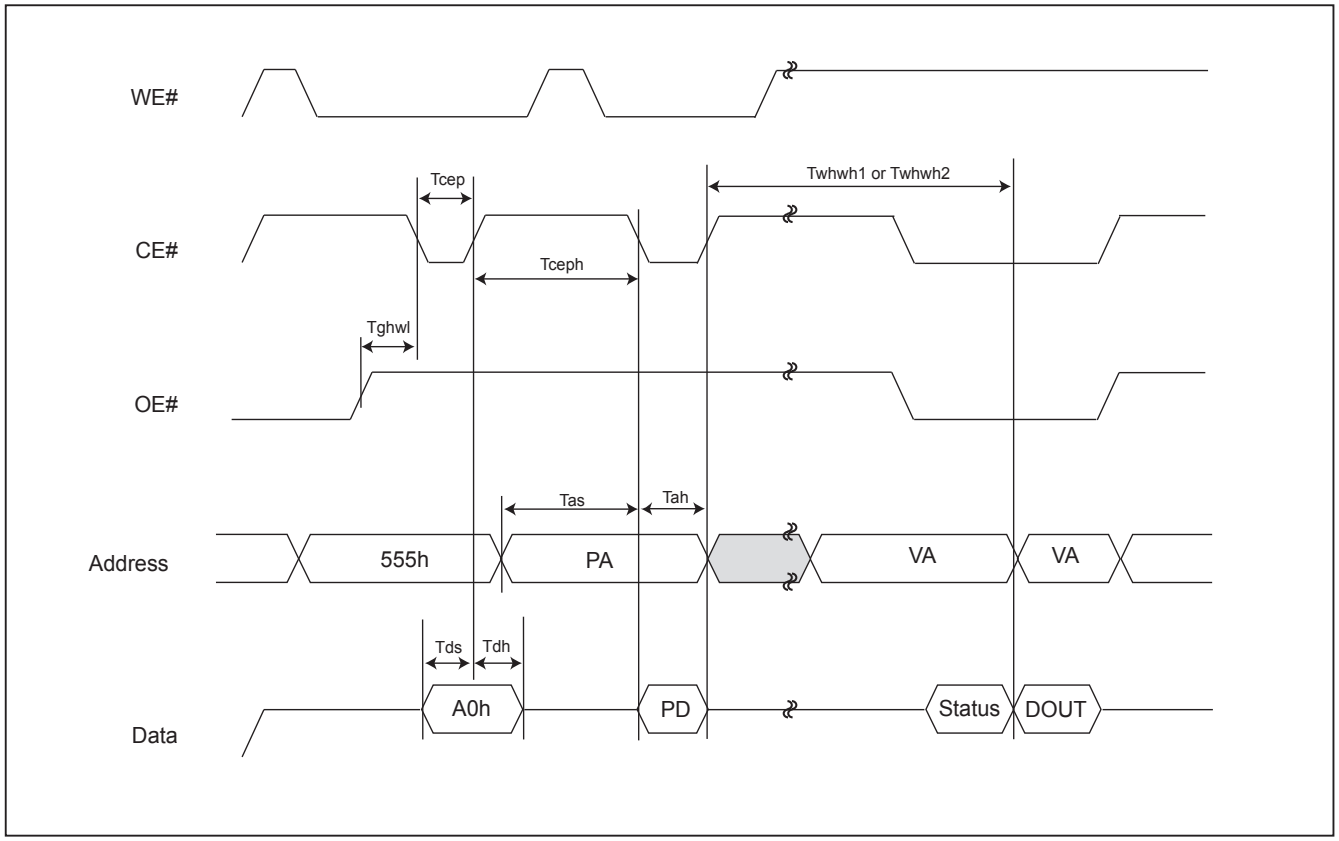
**Figure 8. AUTOMATIC PROGRAM TIMING WAVEFORMS**





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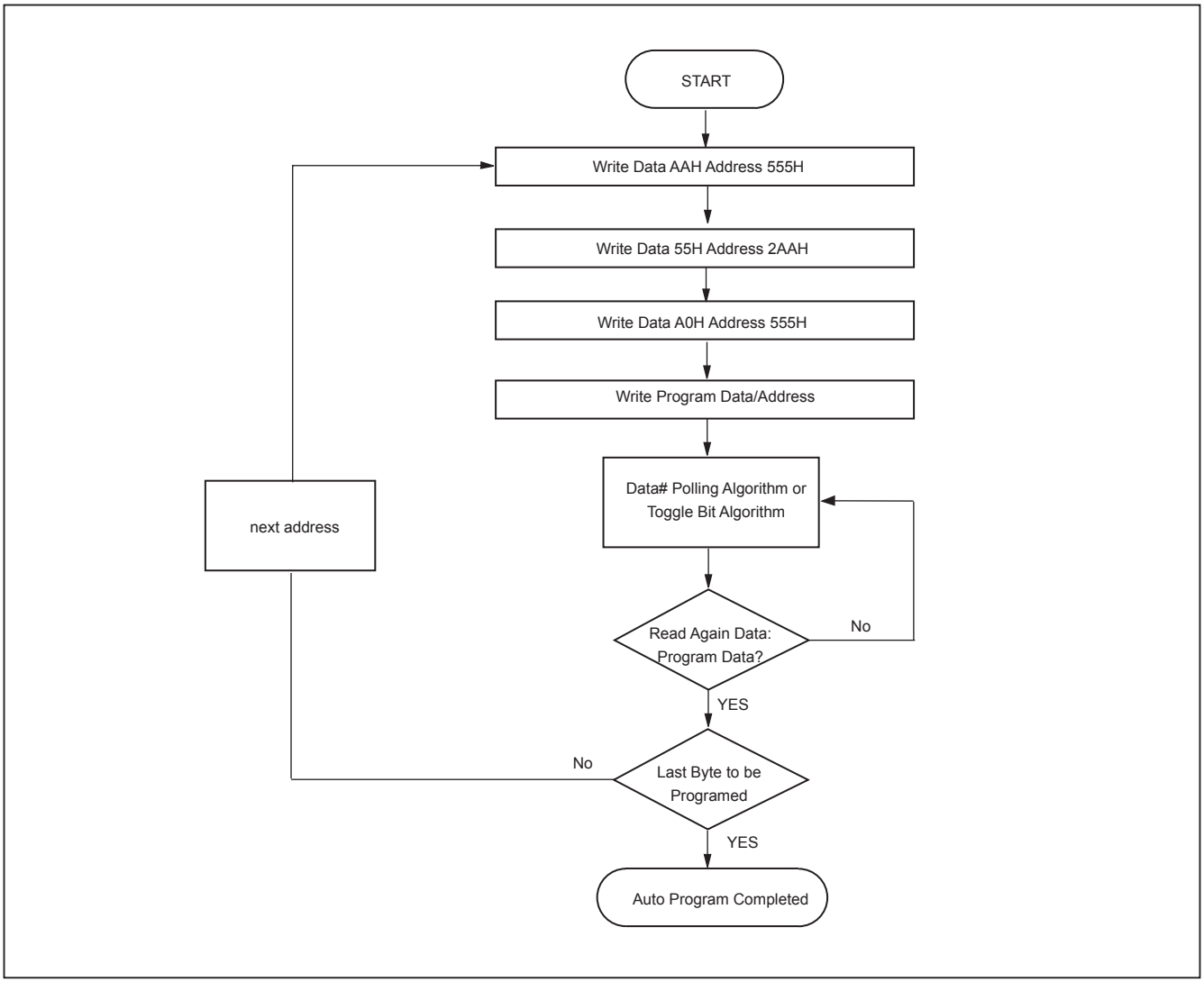
**Figure 9. CE# CONTROLLED WRITE TIMING WAVEFORM**





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**Figure 10. AUTOMATIC PROGRAMMING ALGORITHM FLOWCHART**

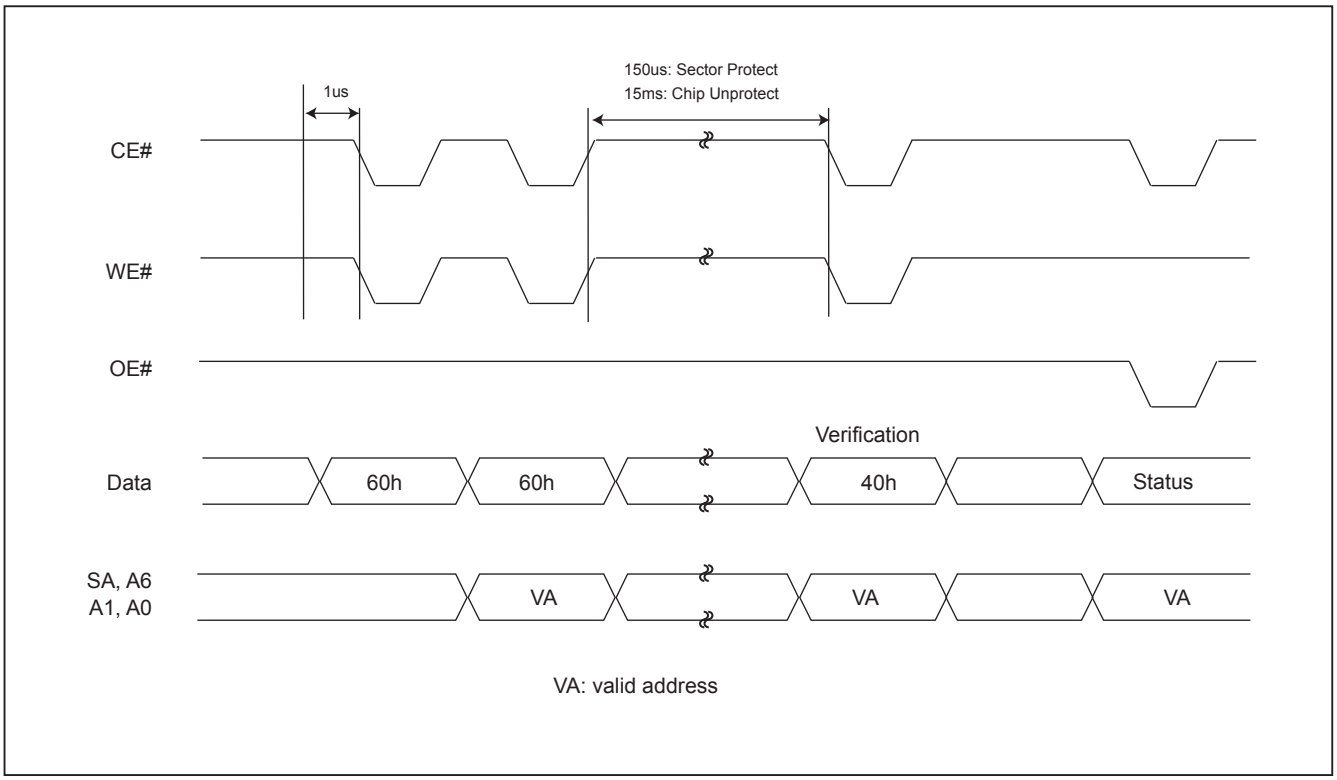




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## SECTOR PROTECT/CHIP UNPROTECT

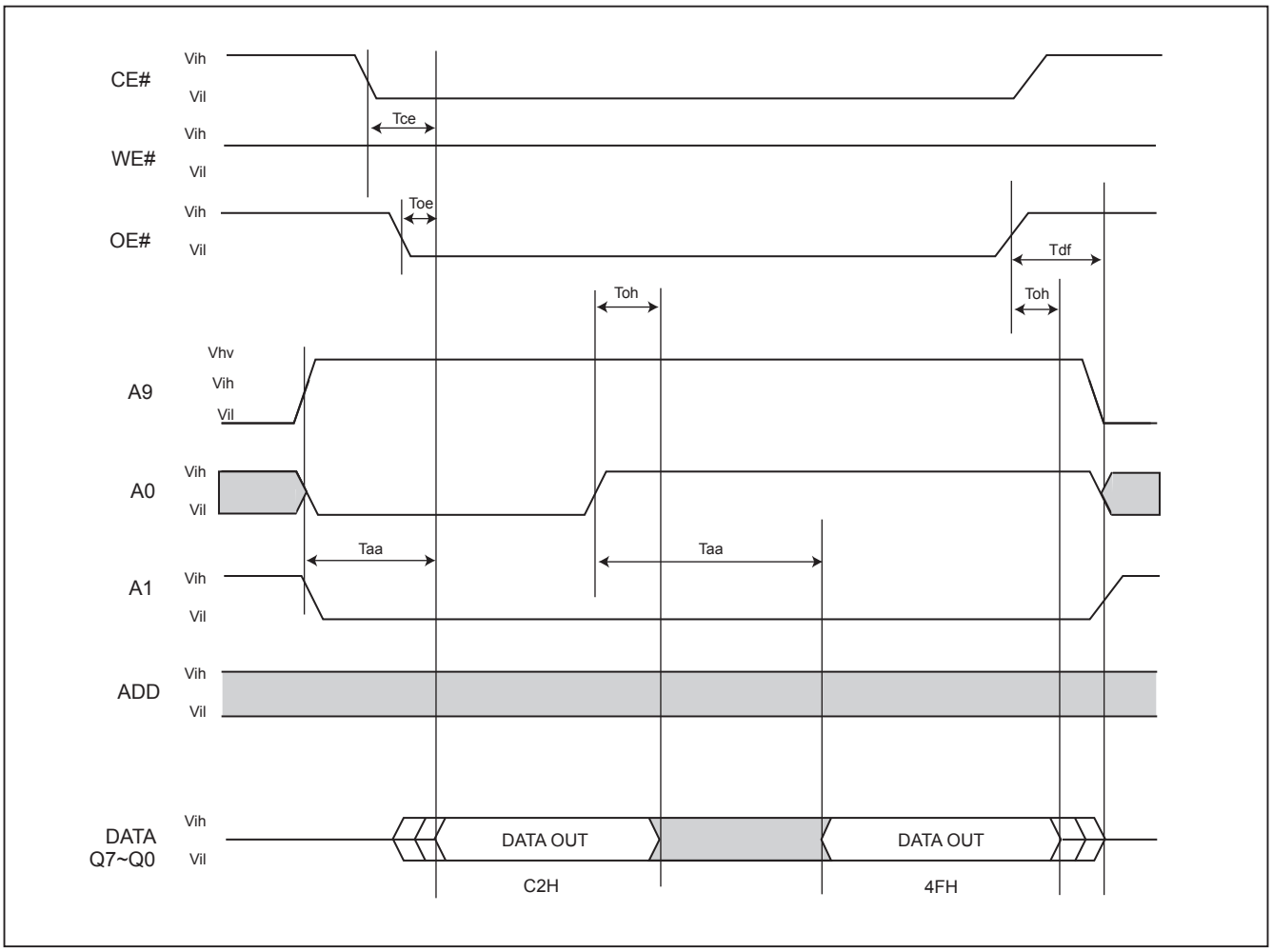
**Figure 11. SECTOR PROTECT/CHIP UNPROTECT WAVEFORM**





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**Figure 12. SILICON ID READ TIMING WAVEFORM**

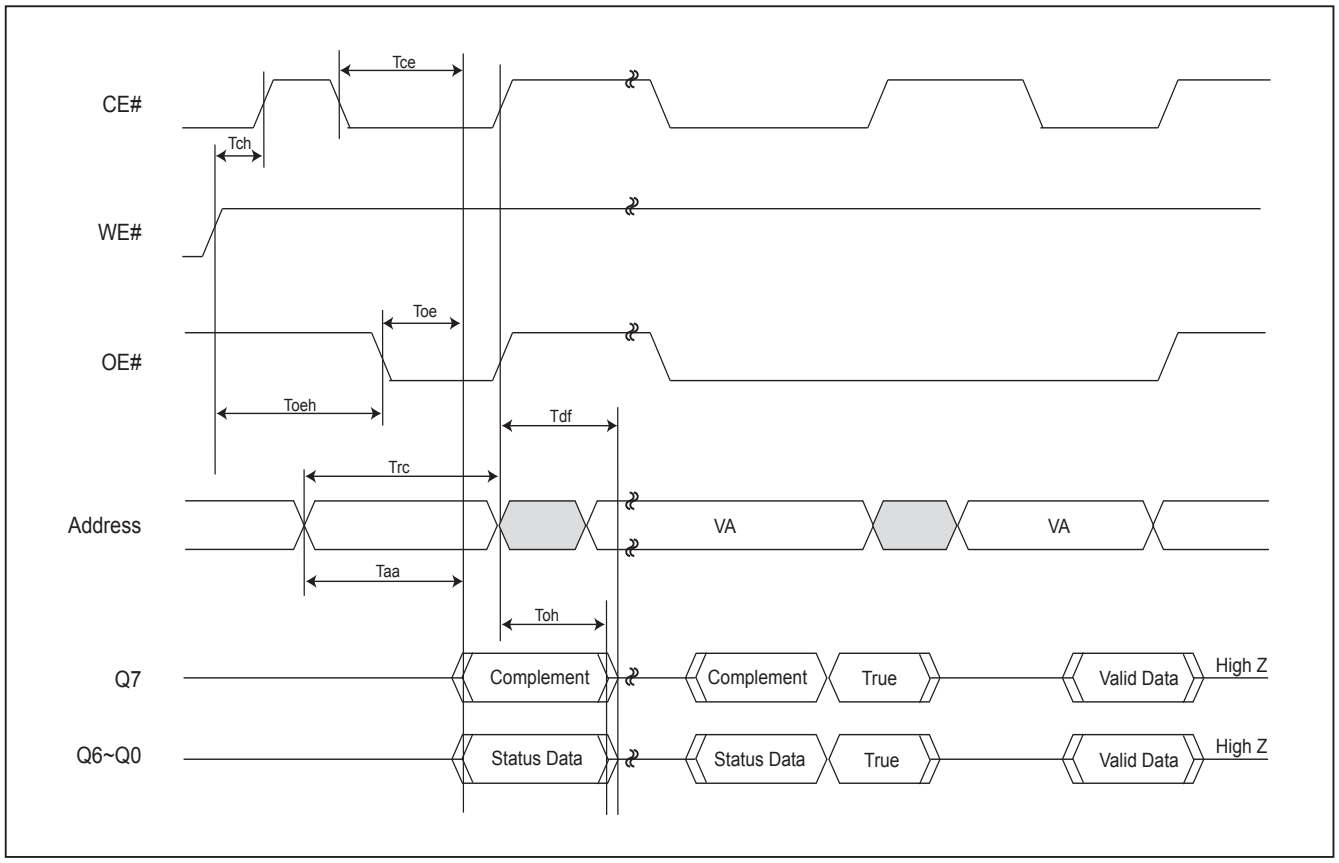




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## WRITE OPERATION STATUS

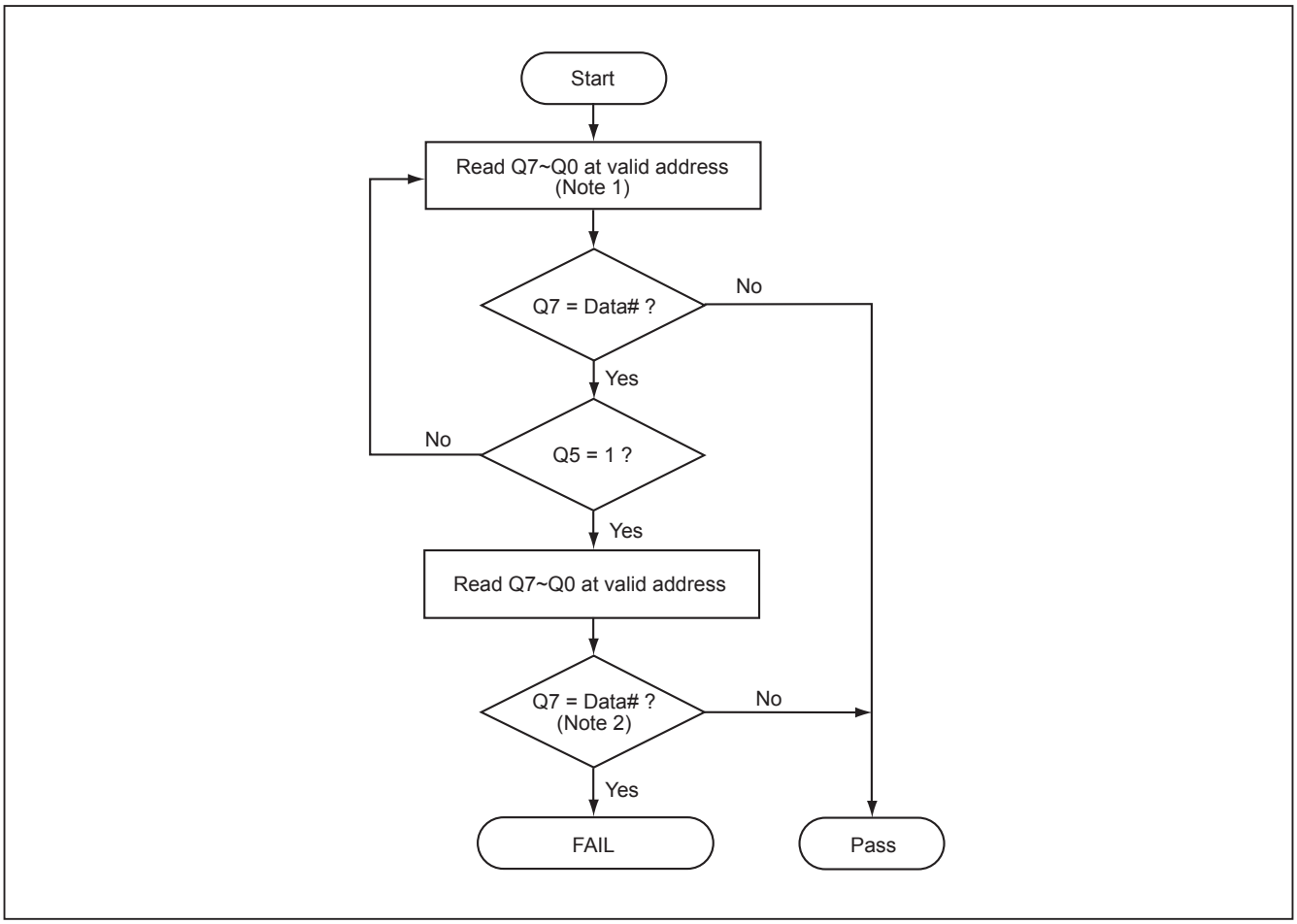
**Figure 13. DATA# POLLING TIMING WAVEFORMS (DURING AUTOMATIC ALGORITHMS)**





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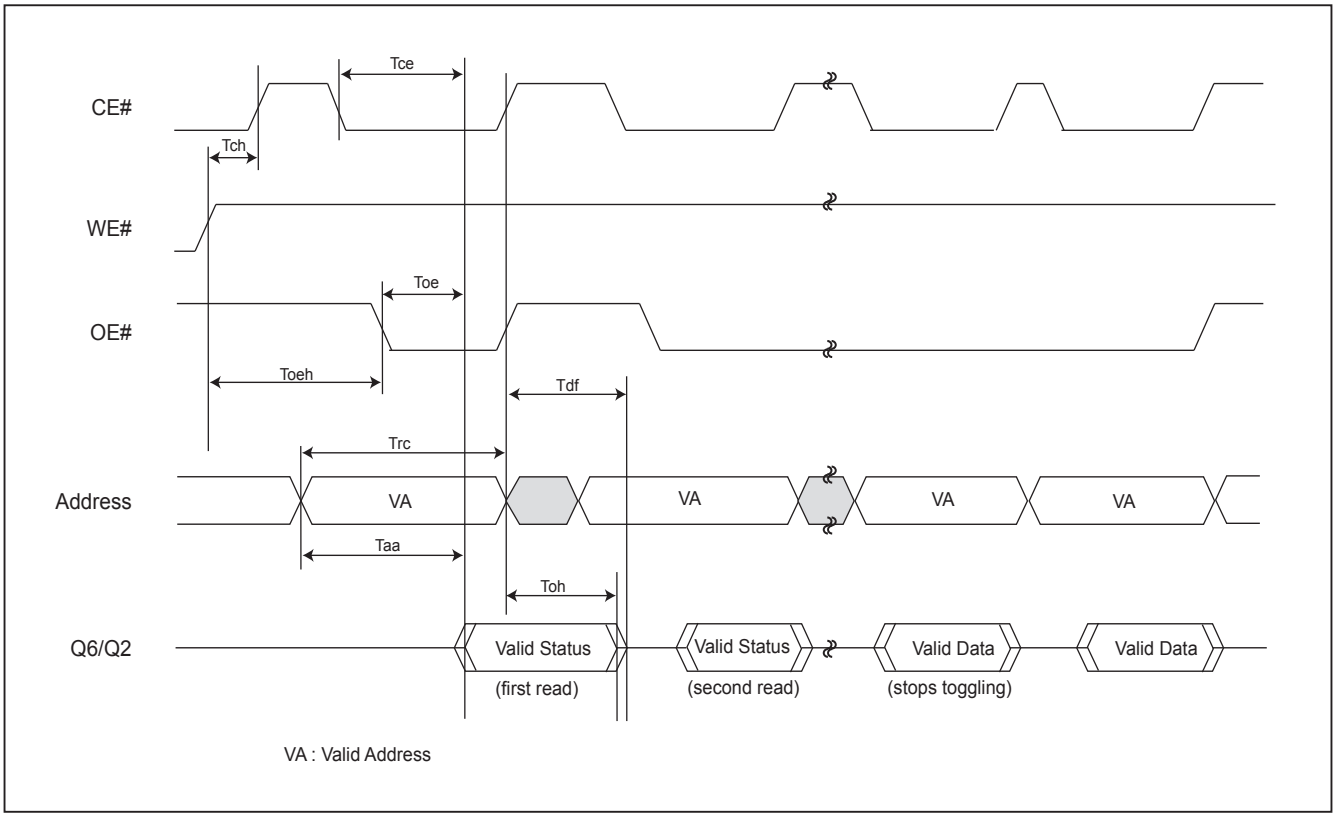
**Figure 14. DATA# POLLING ALGORITHM**




Notes:
1. For programming, valid address means program address.
   For erasing, valid address means erase sectors address.
2. Q7 should be rechecked even Q5="1" because Q7 may change simultaneously with Q5.


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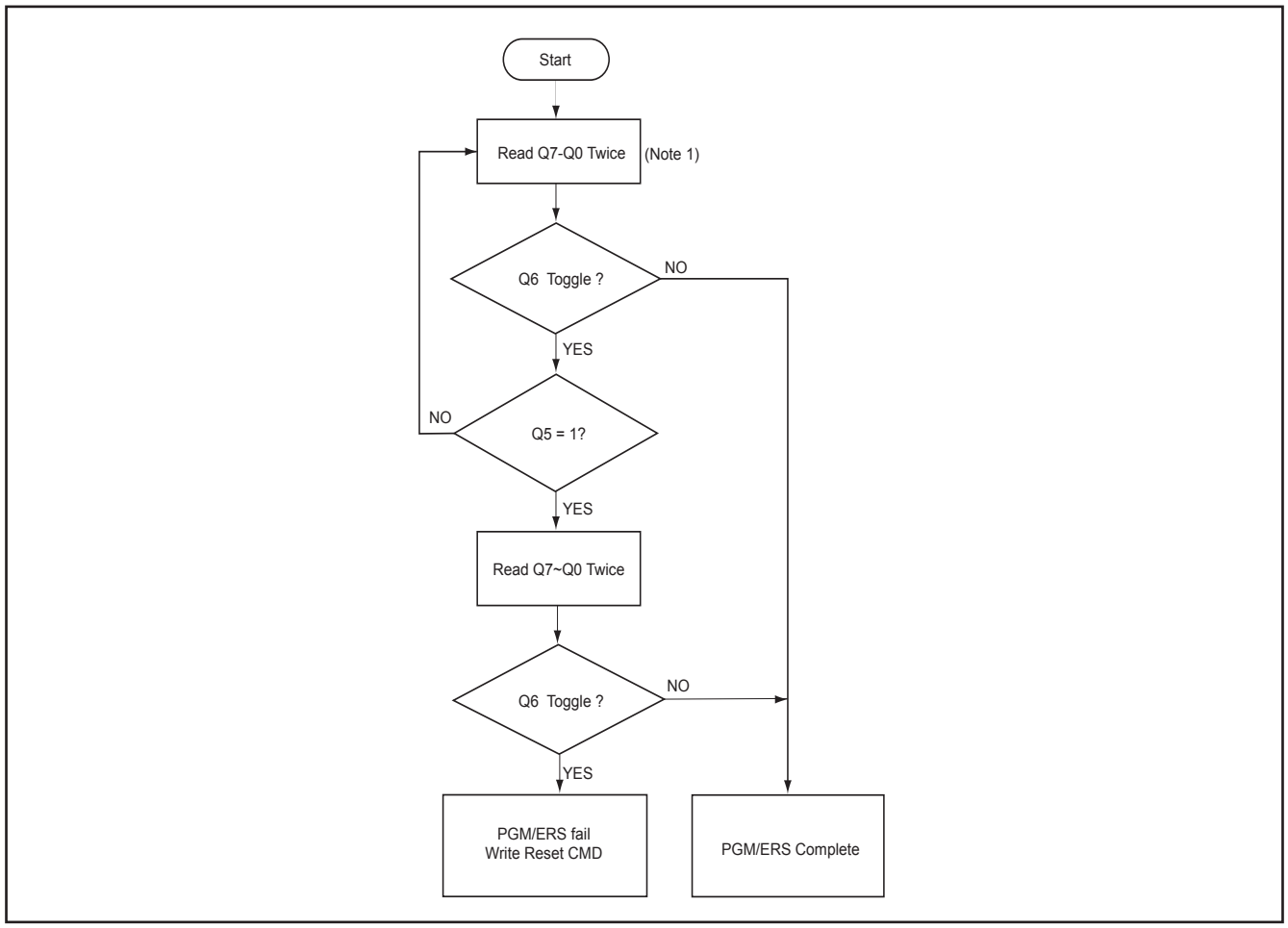
**Figure 15. TOGGLE BIT TIMING WAVEFORMS (DURING AUTOMATIC ALGORITHMS)**





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**Figure 16. TOGGLE BIT ALGORITHM**




Notes:
1. Read toggle bit twice to determine whether or not it is toggling.
2. Recheck toggle bit because it may stop toggling as Q5 changes to "1".


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## RECOMMENDED OPERATING CONDITIONS

### At Device Power-Up

AC timing illustrated in Figure A is recommended for the supply voltages and the control signals at device power-up. If the timing in the figure is ignored, the device may not operate correctly.

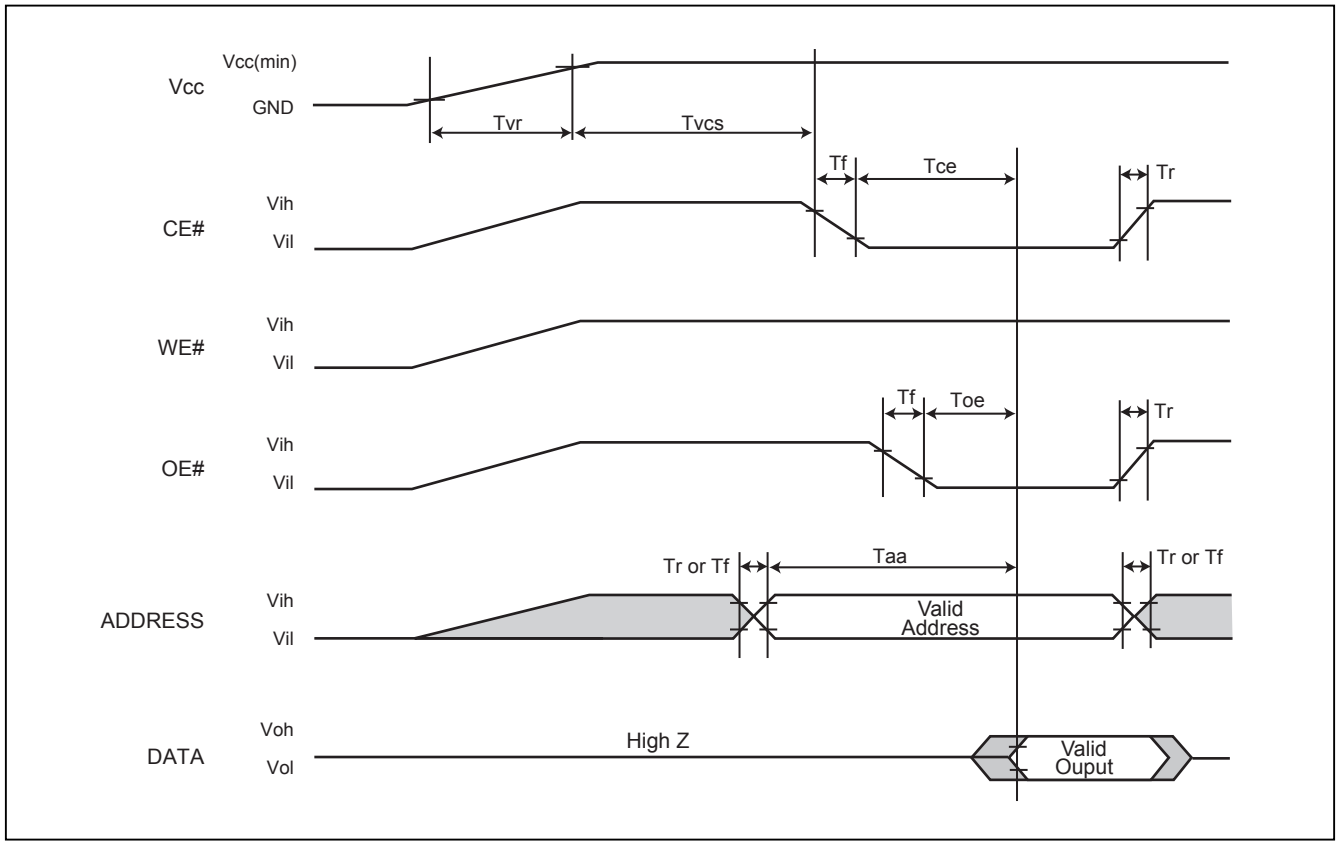



**Figure A. AC Timing at Device Power-Up**

| Symbol | Parameter | Min. | Max. | Unit |
|---|---|---|---|---|
| Tvr | Vcc Rise Time | 20 | 500000 | us/V |
| Tr | Input Signal Rise Time | | 20 | us/V |
| Tf | Input Signal Fall Time | | 20 | us/V |

Note: Not tested 100%.


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## ERASE AND PROGRAMMING PERFORMANCE

| Parameter | Limits | | | Units |
|---|---|---|---|---|
| | Min. | Typ. | Max. | |
| Chip Erase Time | | 4 | 32 | sec |
| Sector Erase Time | | 0.7 | 8 | sec |
| Erase/Program Cycles | 100,000 | | | Cycles |
| Chip Programming Time | | 4.5 | 13.5 | sec |
| Byte Programming Time | | 9 | 300 | us |

## DATA RETENTION

| Parameter | Condition | Min. | Max. | Unit |
|---|---|---|---|---|
| Data retention | 55˚C | 20 | | years |

## LATCH-UP CHARACTERISTICS

| | Min. | Max. |
|---|---|---|
| Input Voltage difference with GND on A9, OE# pins | -1.0V | 12.5V |
| Input Voltage difference with GND on all I/O pins | -1.0V | Vcc + 1.0V |
| Input current pulse | -100mA | +100mA |
| All pins included except Vcc. Test conditions: Vcc = 3.0V, one pin per testing | | |

## PIN CAPACITANCE

| Parameter Symbol | Parameter Description | Test Set | Max. | Unit |
|---|---|---|---|---|
| CIN2 | Control Pin Capacitance | VIN=0 | 12 | pF |
| COUT | Output Capacitance | VOUT=0 | 12 | pF |
| CIN | Input Capacitance | VIN=0 | 8 | pF |

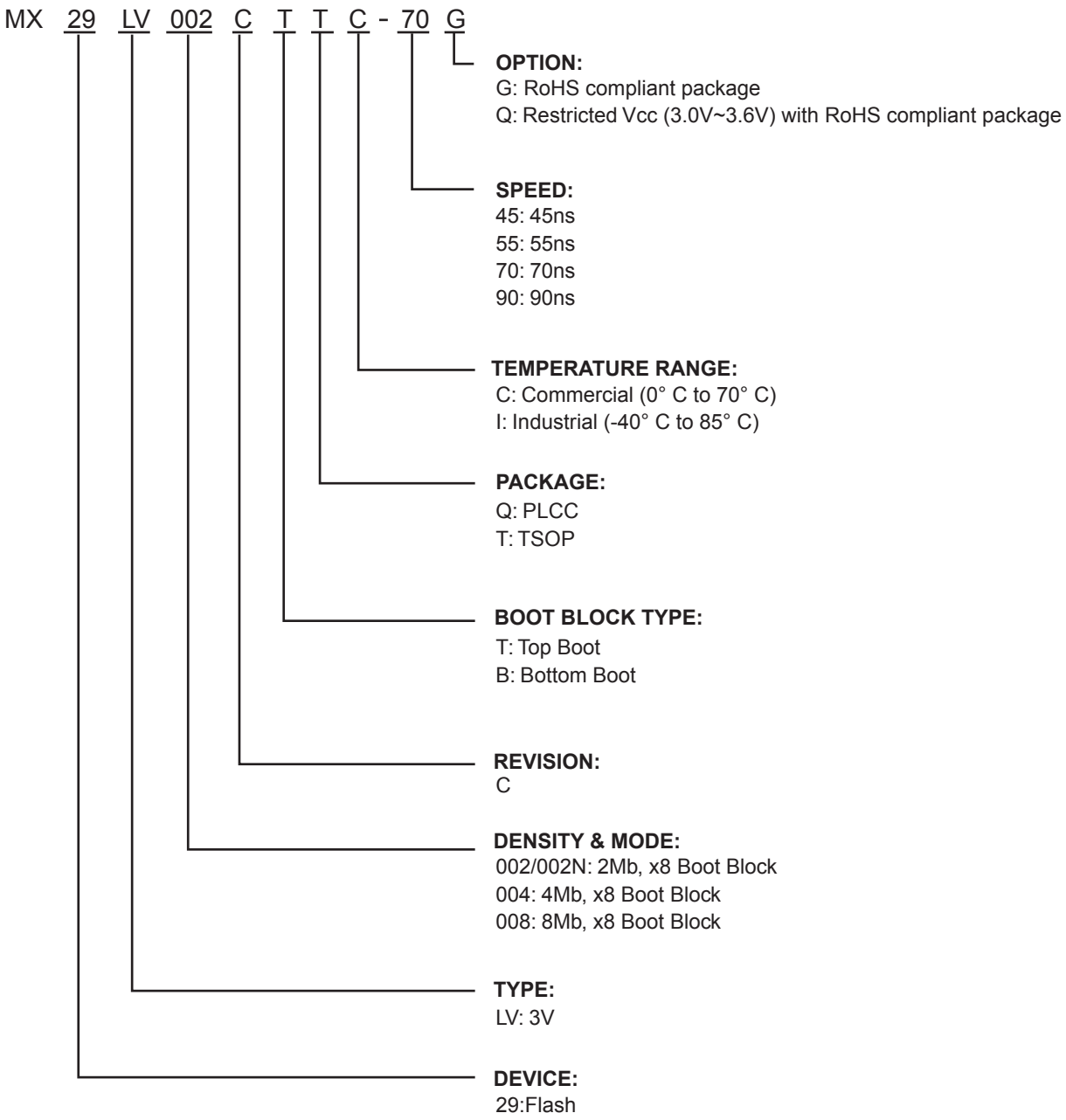

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## ORDERING INFORMATION

| PART NO. | ACCESS TIME (ns) | OPERATING CURRENT MAX. (mA) | STANDBY CURRENT MAX. (uA) | PACKAGE | Remark |
|---|---|---|---|---|---|
| MX29LV040CTC-55Q | 55 | 30 | 5 | 32 Pin TSOP (8x20 mm) | |
| MX29LV040CTC-70G | 70 | 30 | 5 | 32 Pin TSOP (8x20 mm) | |
| MX29LV040CTC-90G | 90 | 30 | 5 | 32 Pin TSOP (8x20 mm) | |
| MX29LV040CQC-55Q | 55 | 30 | 5 | 32 Pin PLCC | |
| MX29LV040CQC-70G | 70 | 30 | 5 | 32 Pin PLCC | |
| MX29LV040CQC-90G | 90 | 30 | 5 | 32 Pin PLCC | |
| MX29LV040CTI-55Q | 55 | 30 | 5 | 32 Pin TSOP (8x20 mm) | |
| MX29LV040CTI-70G | 70 | 30 | 5 | 32 Pin TSOP (8x20 mm) | |
| MX29LV040CTI-90G | 90 | 30 | 5 | 32 Pin TSOP (8x20 mm) | |
| MX29LV040CQI-55Q | 55 | 30 | 5 | 32 Pin PLCC | |
| MX29LV040CQI-70G | 70 | 30 | 5 | 32 Pin PLCC | |
| MX29LV040CQI-90G | 90 | 30 | 5 | 32 Pin PLCC | |
| MX29LV040CT2I-70G | 70 | 30 | 5 | 32 Pin TSOP (8x14 mm) | |
| MX29LV040CT2I-90G | 90 | 30 | 5 | 32 Pin TSOP (8x14 mm) | |


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## PART NAME DESCRIPTION

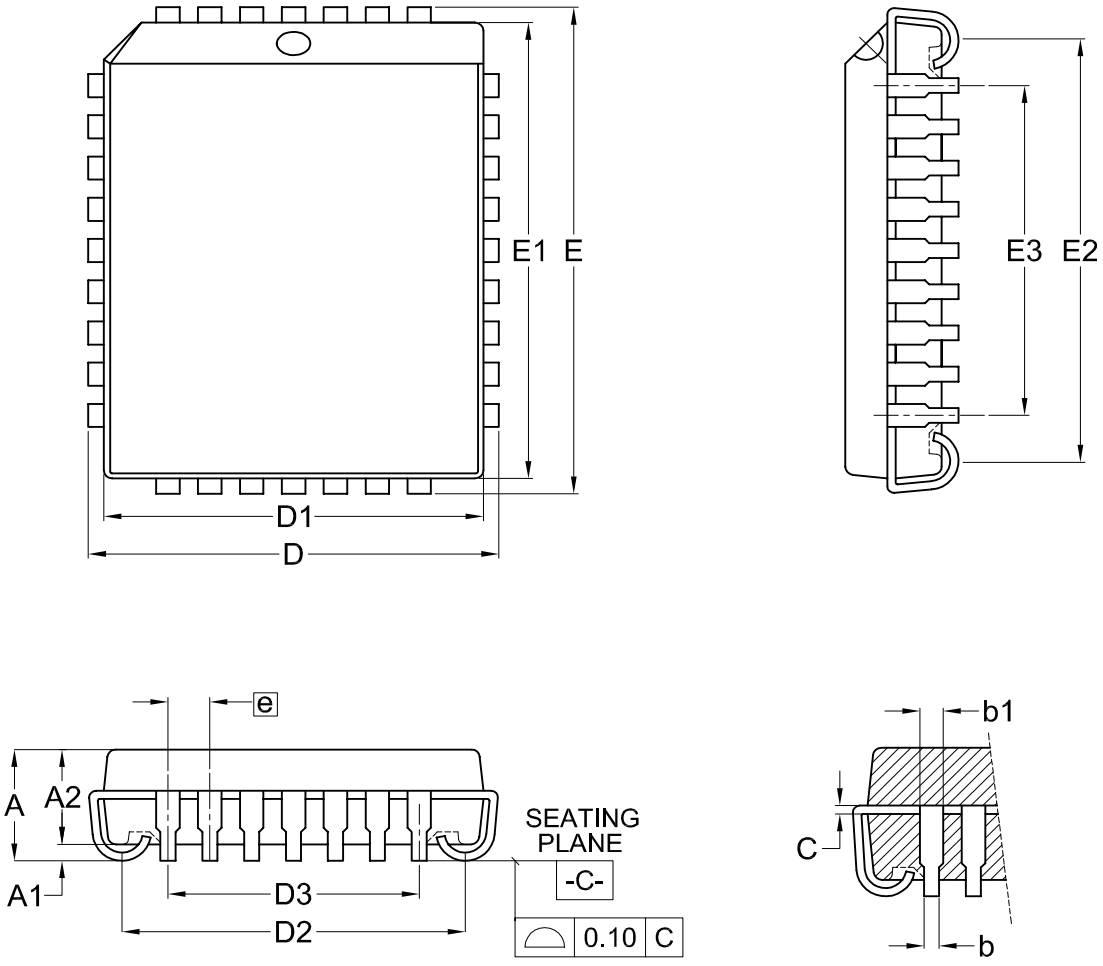




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## PACKAGE INFORMATION

Doc. Title: Package Outline for 32L PLCC



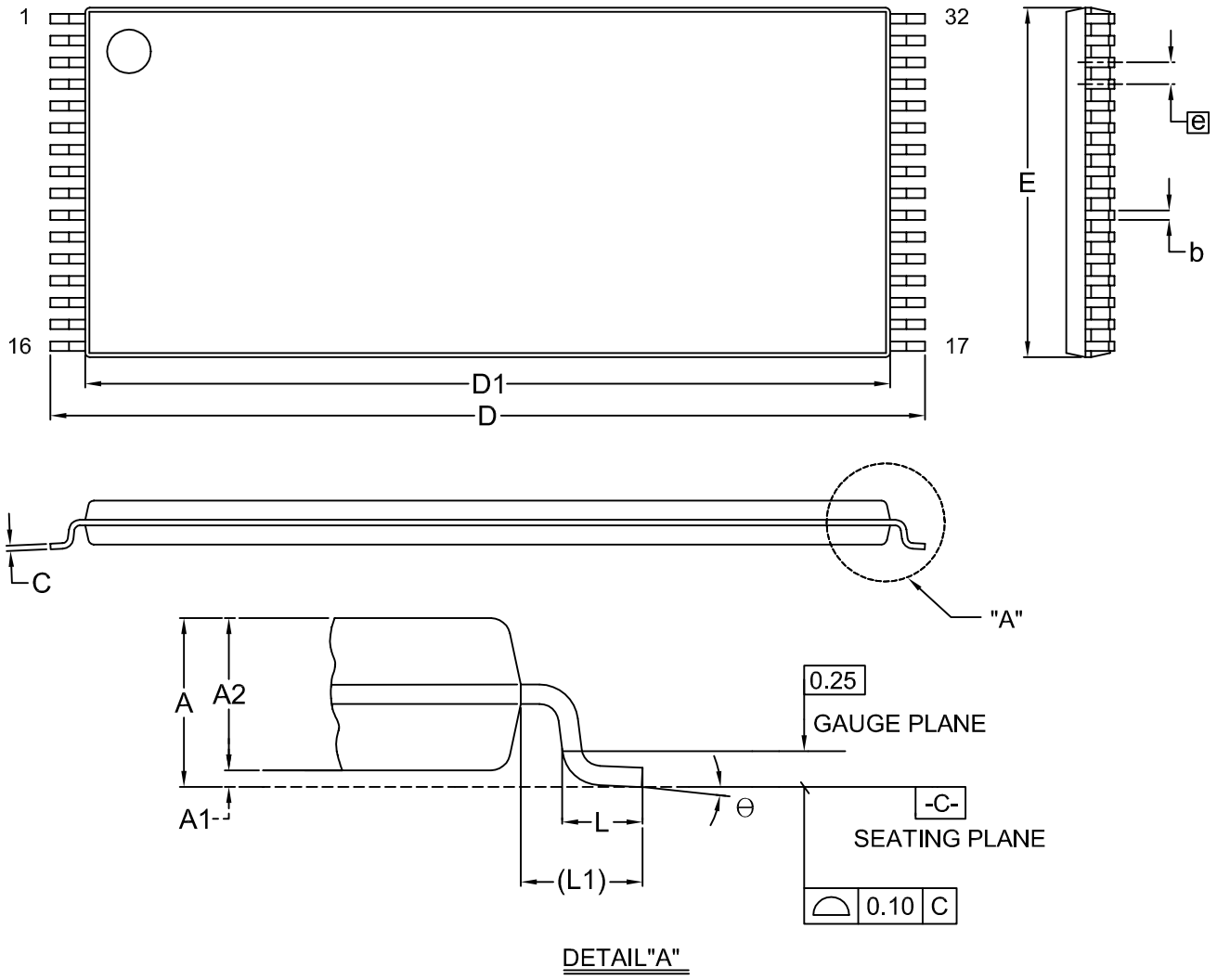

Dimensions (inch dimensions are derived from the original mm dimensions)

| SYMBOL / UNIT | | A | A1 | A2 | b | b1 | C | D | D1 | D2 | D3 | E | E1 | E2 | E3 | e |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | Min. | — | 0.38 | 2.69 | 0.38 | 0.61 | 0.20 | 12.32 | 11.36 | 10.11 | | 14.86 | 13.98 | 12.65 | | |
| | Nom. | — | 0.58 | 2.79 | 0.46 | 0.71 | 0.25 | 12.45 | 11.43 | 10.41 | 7.62 | 14.99 | 14.05 | 12.95 | 10.16 | 1.27 |
| | Max. | 3.55 | 0.81 | 2.89 | 0.54 | 0.81 | 0.30 | 12.58 | 11.50 | 10.71 | | 15.12 | 14.12 | 13.25 | | |
| Inch | Min. | --- | 0.015 | 0.106 | 0.015 | 0.024 | 0.008 | 0.485 | 0.447 | 0.398 | | 0.585 | 0.550 | 0.498 | | |
| | Nom. | --- | 0.023 | 0.110 | 0.018 | 0.028 | 0.010 | 0.490 | 0.450 | 0.410 | 0.300 | 0.590 | 0.553 | 0.510 | 0.400 | 0.050 |
| | Max. | 0.140 | 0.032 | 0.114 | 0.021 | 0.032 | 0.012 | 0.495 | 0.453 | 0.422 | | 0.595 | 0.556 | 0.522 | | |

| Dwg. No. | Revision | Reference | | | |
|---|---|---|---|---|---|
| | | JEDEC | EIAJ | | |
| 6110-2002 | 8 | MS-016 | | | |


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Doc. Title: Package Outline for TSOP(I) 32L (8X20mm)



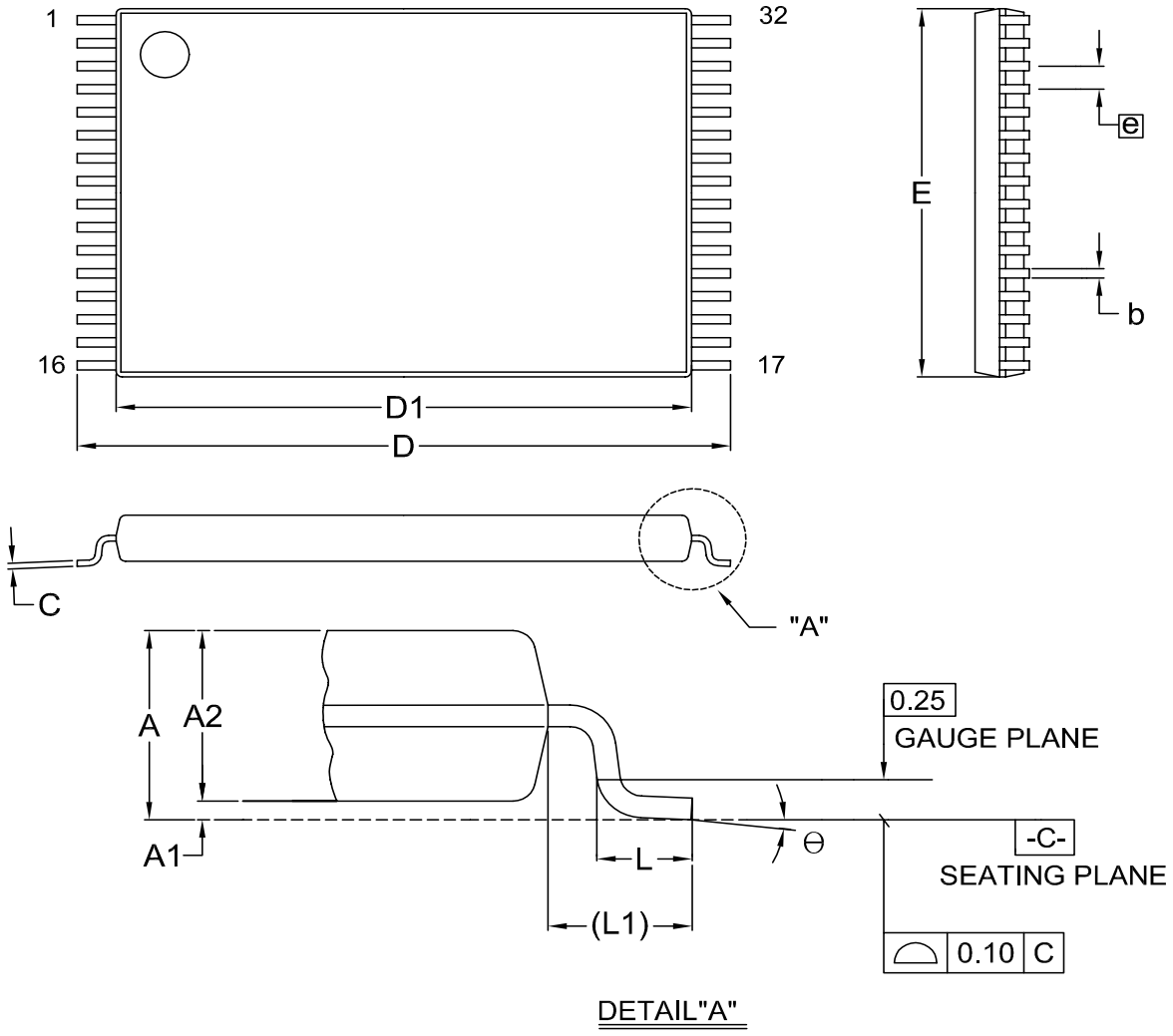

Dimensions (inch dimensions are derived from the original mm dimensions)

| SYMBOL / UNIT | | A | A1 | A2 | b | C | D | D1 | E | e | L | L1 | Θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | Min. | --- | 0.05 | 0.95 | 0.17 | 0.10 | 19.80 | 18.30 | 7.90 | | 0.50 | 0.70 | 0 |
| | Nom. | --- | 0.10 | 1.00 | 0.20 | 0.15 | 20.00 | 18.40 | 8.00 | 0.50 | 0.60 | 0.80 | 5 |
| | Max. | 1.20 | 0.15 | 1.05 | 0.27 | 0.21 | 20.20 | 18.50 | 8.10 | | 0.70 | 0.90 | 8 |
| Inch | Min. | --- | 0.002 | 0.037 | 0.007 | 0.004 | 0.780 | 0.720 | 0.311 | | 0.020 | 0.028 | 0 |
| | Nom. | --- | 0.004 | 0.039 | 0.008 | 0.006 | 0.787 | 0.724 | 0.315 | 0.020 | 0.024 | 0.031 | 5 |
| | Max. | 0.047 | 0.006 | 0.041 | 0.011 | 0.008 | 0.795 | 0.728 | 0.319 | | 0.028 | 0.035 | 8 |

| Dwg. No. | Revision | Reference | | | |
|---|---|---|---|---|---|
| | | JEDEC | EIAJ | | |
| 6110-1604 | 10 | MO-142 | | | |


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Doc. Title: Package Outline for TSOP(I) 32L (8X14mm)




DETAIL"A"

Dimensions (inch dimensions are derived from the original mm dimensions)

| SYMBOL / UNIT | | A | A1 | A2 | b | C | D | D1 | E | e | L | L1 | Θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | Min. | — | 0.05 | 0.95 | 0.17 | 0.10 | 13.80 | 12.30 | 7.90 | | 0.50 | 0.70 | 0 |
| | Nom. | --- | 0.10 | 1.00 | 0.20 | 0.15 | 14.00 | 12.40 | 8.00 | 0.50 | 0.60 | 0.80 | 5 |
| | Max. | 1.20 | 0.15 | 1.05 | 0.27 | 0.21 | 14.20 | 12.50 | 8.10 | | 0.70 | 0.90 | 8 |
| Inch | Min. | --- | 0.002 | 0.037 | 0.007 | 0.004 | 0.543 | 0.484 | 0.311 | | 0.020 | 0.028 | 0 |
| | Nom. | — | 0.004 | 0.039 | 0.008 | 0.006 | 0.551 | 0.488 | 0.315 | 0.020 | 0.024 | 0.031 | 5 |
| | Max. | 0.047 | 0.006 | 0.041 | 0.011 | 0.008 | 0.559 | 0.492 | 0.319 | | 0.028 | 0.035 | 8 |

| Dwg. No. | Revision | Reference | | | |
|---|---|---|---|---|---|
| | | JEDEC | EIAJ | | |
| 6110-1603 | 6 | MO-142 | | | |


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## REVISION HISTORY

| Revision No. | Description | Page | Date |
|---|---|---|---|
| 1.0 | 1. Removed "Preliminary" | P1 | JUN/30/2005 |
| | 2. Added "Recommended Operating Conditions" | P43 | |
| 1.1 | 1. Modified "Low power consumption--active current" from 20mA(Max.) to 30mA(Max.) | P1 | AUG/30/2005 |
| | 2. Added description about Pb-free devices are RoHS Compliant | P1 | |
| 1.2 | 1. Modified Erase Resume from delay 10ms to delay 400us | P12,32 | JAN/17/2006 |
| 1.3 | 1. Modified table 15. CFI mode | P45,46 | APR/24/2006 |
| | 2. Added VLKO description | P15,18 | |
| 1.4 | 1. Modified CFI mode | P45,46 | JUL/11/2006 |
| 1.5 | 1. Datasheet format changed | All | AUG/15/2006 |
| 1.6 | 1. Data modification | All | AUG/16/2006 |
| 1.7 | 1. Data modification | All | AUG/17/2006 |
| 1.8 | 1. Added statement | P44 | NOV/06/2006 |
| 1.9 | 1. Revised statement | P14 | DEC/28/2007 |
| 2.0 | 1. Added note 1 into table 3. Command Definitions | P9 | JAN/17/2008 |
| 2.1 | 1. Modified Figure 9. CE# Controlled Write Timing Waveform | P29 | FEB/21/2008 |
| 2.2 | 1. Revised Twc, Tcwc, Tds AC timing spec | P20 | JUL/31/2008 |
| 2.3 | 1. Added 32-TSOP (8mm x 14mm) package information | P1,2,39 P40,43 | MAR/25/2009 |
| 2.4 | 1. Added data retention table | P38 | AUG/21/2009 |
| | 2. Modified the sector erase time max from 15s to 8s | P38 | |
| | 3. Deleted Lead EPN | P39,40 | |
| 2.5 | 1. Modified description for RoHS compliance | P1,40 | DEC/15/2011 |
| | 2. Added note | P37 | |


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