

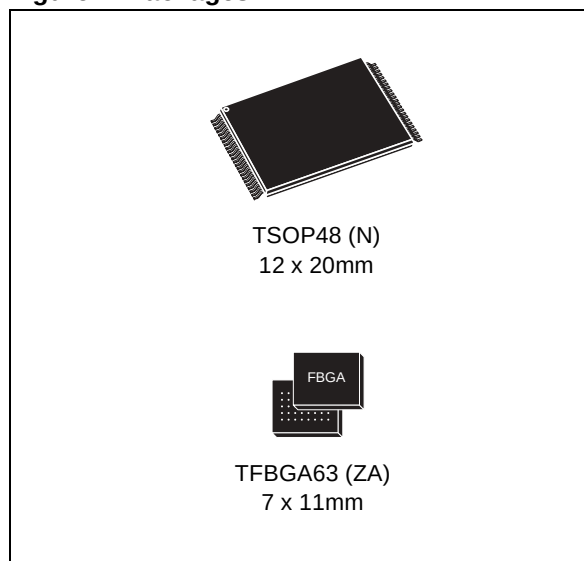


## 64 Mbit (8Mb x8 or 4Mb x16, Multiple Bank, Page, Boot Block) 3V Supply Flash Memory

### FEATURES SUMMARY

- **SUPPLY VOLTAGE**
  - $V_{CC} = 2.7V$  to  $3.6V$  for Program, Erase and Read
  - $V_{PP} = 12V$  for Fast Program (optional)
- **ASYNCHRONOUS PAGE READ MODE**
  - Page Width 4 Words
  - Page Access 25, 30ns
  - Random Access 70, 90ns
- **PROGRAMMING TIME**
  - $10\mu s$  per Byte/Word typical
  - 4 Words / 8 Bytes at-a-time Program
- **MEMORY BLOCKS**
  - Quadruple Bank Memory Array:  
8Mbit+24Mbit+24Mbit+8Mbit
  - Parameter Blocks (at both Top and Bottom)
- **DUAL OPERATIONS**
  - While Program or Erase in a group of banks (from 1 to 3), Read in any of the other banks
- **PROGRAM/ ERASE SUSPEND and RESUME MODES**
  - Read from any Block during Program Suspend
  - Read and Program another Block during Erase Suspend
- **UNLOCK BYPASS PROGRAM COMMAND**
  - Faster Production/Batch Programming
- $V_{PP}/WP$  PIN for FAST PROGRAM and WRITE PROTECT
- **TEMPORARY BLOCK UNPROTECTION MODE**
- **COMMON FLASH INTERFACE**
  - 64 bit Security Code
- **EXTENDED MEMORY BLOCK**
  - Extra block used as security block or to store additional information

Figure 1. Packages



- **LOW POWER CONSUMPTION**
  - Standby and Automatic Standby
- **100,000 PROGRAM/ERASE CYCLES per BLOCK**
- **ELECTRONIC SIGNATURE**
  - Manufacturer Code: 0020h
  - Device Code: 227Eh + 2202h + 2201h

## TABLE OF CONTENTS

|                                                        |           |
|--------------------------------------------------------|-----------|
| <b>FEATURES SUMMARY</b>                                | <b>1</b>  |
| Figure 1. Packages                                     | 1         |
| <b>SUMMARY DESCRIPTION</b>                             | <b>6</b>  |
| Figure 2. Logic Diagram                                | 6         |
| Table 1. Signal Names                                  | 6         |
| Figure 3. TSOP Connections                             | 7         |
| Figure 4. TFBGA Connections (Top view through package) | 8         |
| Table 2. Bank Architecture                             | 9         |
| Figure 5. Block Addresses (x8)                         | 9         |
| Figure 6. Block Addresses (x16)                        | 10        |
| <b>SIGNAL DESCRIPTIONS</b>                             | <b>11</b> |
| Address Inputs (A0-A21)                                | 11        |
| Data Inputs/Outputs (DQ0-DQ7)                          | 11        |
| Data Inputs/Outputs (DQ8-DQ14)                         | 11        |
| Data Input/Output or Address Input (DQ15A-1)           | 11        |
| Chip Enable ( $\overline{E}$ )                         | 11        |
| Output Enable ( $\overline{G}$ )                       | 11        |
| Write Enable ( $\overline{W}$ )                        | 11        |
| V <sub>PP</sub> /Write Protect (V <sub>PP</sub> /WP)   | 11        |
| Reset/Block Temporary Unprotect ( $\overline{RP}$ )    | 11        |
| Ready/Busy Output ( $\overline{RB}$ )                  | 12        |
| Byte/Word Organization Select ( $\overline{BYTE}$ )    | 12        |
| V <sub>CC</sub> Supply Voltage (2.7V to 3.6V)          | 12        |
| V <sub>SS</sub> Ground                                 | 12        |
| <b>BUS OPERATIONS</b>                                  | <b>13</b> |
| Bus Read                                               | 13        |
| Bus Write                                              | 13        |
| Output Disable                                         | 13        |
| Standby                                                | 13        |
| Automatic Standby                                      | 13        |
| <b>Special Bus Operations</b>                          | <b>13</b> |
| Electronic Signature                                   | 13        |
| Block Protect and Chip Unprotect                       | 13        |
| Table 3. Bus Operations, $\overline{BYTE} = V_{IL}$    | 14        |
| Table 4. Bus Operations, $\overline{BYTE} = V_{IH}$    | 14        |
| <b>COMMAND INTERFACE</b>                               | <b>15</b> |
| Read/Reset Command                                     | 15        |
| Auto Select Command                                    | 15        |
| Read CFI Query Command                                 | 15        |

|                                                                                |           |
|--------------------------------------------------------------------------------|-----------|
| <b>Program Command</b> .....                                                   | <b>16</b> |
| <b>Fast Program Commands</b> .....                                             | <b>16</b> |
| Double Word Program Command. ....                                              | 16        |
| Quadruple Word Program Command.....                                            | 16        |
| Double Byte Program Command. ....                                              | 16        |
| Quadruple Byte Program Command. ....                                           | 16        |
| Octuple Byte Program Command.....                                              | 16        |
| <b>Unlock Bypass Command</b> .....                                             | <b>17</b> |
| <b>Unlock Bypass Program Command</b> .....                                     | <b>17</b> |
| <b>Unlock Bypass Reset Command</b> .....                                       | <b>17</b> |
| <b>Chip Erase Command</b> .....                                                | <b>17</b> |
| <b>Block Erase Command</b> .....                                               | <b>18</b> |
| <b>Erase Suspend Command</b> .....                                             | <b>18</b> |
| <b>Erase Resume Command</b> .....                                              | <b>18</b> |
| <b>Program Suspend Command</b> .....                                           | <b>18</b> |
| <b>Program Resume Command</b> .....                                            | <b>19</b> |
| <b>Enter Extended Block Command</b> .....                                      | <b>19</b> |
| <b>Exit Extended Block Command</b> .....                                       | <b>19</b> |
| <b>Block Protect and Chip Unprotect Commands</b> .....                         | <b>19</b> |
| Table 5. Commands, 16-bit mode, $\overline{\text{BYTE}} = V_{\text{IH}}$ ..... | 20        |
| Table 6. Commands, 8-bit mode, $\text{BYTE} = V_{\text{IL}}$ .....             | 21        |
| Table 7. Program, Erase Times and Program, Erase Endurance Cycles .....        | 22        |
| <b>STATUS REGISTER</b> .....                                                   | <b>23</b> |
| Data Polling Bit (DQ7). ....                                                   | 23        |
| Toggle Bit (DQ6).....                                                          | 23        |
| Error Bit (DQ5). ....                                                          | 23        |
| Erase Timer Bit (DQ3). ....                                                    | 23        |
| Alternative Toggle Bit (DQ2).....                                              | 23        |
| Table 8. Status Register Bits .....                                            | 24        |
| Figure 7. Data Polling Flowchart. ....                                         | 24        |
| Figure 8. Toggle Flowchart. ....                                               | 24        |
| <b>DUAL OPERATIONS AND MULTIPLE BANK ARCHITECTURE</b> .....                    | <b>25</b> |
| Table 9. Dual Operations Allowed In Other Banks .....                          | 25        |
| Table 10. Dual Operations Allowed In Same Bank .....                           | 26        |
| <b>MAXIMUM RATING</b> .....                                                    | <b>27</b> |
| Table 11. Absolute Maximum Ratings .....                                       | 27        |
| <b>DC and AC PARAMETERS</b> .....                                              | <b>28</b> |
| Table 12. Operating and AC Measurement Conditions .....                        | 28        |
| Figure 9. AC Measurement I/O Waveform .....                                    | 28        |
| Figure 10.AC Measurement Load Circuit .....                                    | 28        |
| Table 13. Device Capacitance .....                                             | 28        |
| Table 14. DC Characteristics .....                                             | 29        |

|                                                                                                        |           |
|--------------------------------------------------------------------------------------------------------|-----------|
| Figure 11. Random Read AC Waveforms . . . . .                                                          | 30        |
| Figure 12. Page Read AC Waveforms . . . . .                                                            | 30        |
| Table 15. Read AC Characteristics . . . . .                                                            | 31        |
| Figure 13. Write AC Waveforms, Write Enable Controlled . . . . .                                       | 32        |
| Table 16. Write AC Characteristics, Write Enable Controlled . . . . .                                  | 32        |
| Figure 14. Write AC Waveforms, Chip Enable Controlled . . . . .                                        | 33        |
| Table 17. Write AC Characteristics, Chip Enable Controlled . . . . .                                   | 33        |
| Figure 15. Toggle and Alternative Toggle Bits Mechanism, Chip Enable Controlled . . . . .              | 34        |
| Figure 16. Toggle and Alternative Toggle Bits Mechanism, Output Enable Controlled . . . . .            | 34        |
| Table 18. Toggle and Alternative Toggle Bits AC Characteristics . . . . .                              | 34        |
| Figure 17. Reset/Block Temporary Unprotect AC Waveforms . . . . .                                      | 35        |
| Table 19. Reset/Block Temporary Unprotect AC Characteristics . . . . .                                 | 35        |
| Figure 18. Accelerated Program Timing Waveforms . . . . .                                              | 35        |
| <b>PACKAGE MECHANICAL . . . . .</b>                                                                    | <b>36</b> |
| Figure 19. TSOP48 – 48 lead Plastic Thin Small Outline, 12 x 20mm, Package Outline . . . . .           | 36        |
| Table 20. TSOP48 – 48 lead Plastic Thin Small Outline, 12 x 20mm, Package Mechanical Data . . . . .    | 36        |
| Figure 20. TFBGA63 7x11mm - 6x8 active ball array, 0.8mm pitch, Package Outline . . . . .              | 37        |
| Table 21. TFBGA63 7x11mm - 6x8 active ball array, 0.8mm pitch, Package Mechanical Data . . . . .       | 37        |
| <b>PART NUMBERING . . . . .</b>                                                                        | <b>38</b> |
| Table 22. Ordering Information Scheme . . . . .                                                        | 38        |
| <b>APPENDIX A. BLOCK ADDRESSES . . . . .</b>                                                           | <b>39</b> |
| Table 23. Block Addresses . . . . .                                                                    | 39        |
| <b>APPENDIX B. COMMON FLASH INTERFACE (CFI) . . . . .</b>                                              | <b>44</b> |
| Table 24. Query Structure Overview . . . . .                                                           | 44        |
| Table 25. CFI Query Identification String . . . . .                                                    | 44        |
| Table 26. CFI Query System Interface Information . . . . .                                             | 45        |
| Table 27. Device Geometry Definition . . . . .                                                         | 45        |
| Table 28. Primary Algorithm-Specific Extended Query Table . . . . .                                    | 46        |
| Table 29. Security Code Area . . . . .                                                                 | 47        |
| <b>APPENDIX C. EXTENDED MEMORY BLOCK . . . . .</b>                                                     | <b>48</b> |
| <b>Factory Locked Extended Block . . . . .</b>                                                         | <b>48</b> |
| <b>Customer Lockable Extended Block . . . . .</b>                                                      | <b>48</b> |
| Table 30. Extended Block Address and Data . . . . .                                                    | 48        |
| <b>APPENDIX D. BLOCK PROTECTION . . . . .</b>                                                          | <b>49</b> |
| <b>Programmer Technique . . . . .</b>                                                                  | <b>49</b> |
| <b>In-System Technique . . . . .</b>                                                                   | <b>49</b> |
| Table 31. Programmer Technique Bus Operations, $\overline{\text{BYTE}} = V_{IH}$ or $V_{IL}$ . . . . . | 49        |
| Figure 21. Programmer Equipment Group Protect Flowchart . . . . .                                      | 50        |
| Figure 22. Programmer Equipment Chip Unprotect Flowchart . . . . .                                     | 51        |

---

|                                                              |           |
|--------------------------------------------------------------|-----------|
| Figure 23.In-System Equipment Group Protect Flowchart .....  | 52        |
| Figure 24.In-System Equipment Chip Unprotect Flowchart ..... | 53        |
| <b>REVISION HISTORY .....</b>                                | <b>54</b> |
| Table 32. Document Revision History .....                    | 54        |

### SUMMARY DESCRIPTION

The M29DW640D is a 64 Mbit (8Mb x8 or 4Mb x16) non-volatile memory that can be read, erased and reprogrammed. These operations can be performed using a single low voltage (2.7 to 3.6V) supply. On power-up the memory defaults to its Read mode.

The device features an asymmetrical block architecture, with 16 parameter and 126 main blocks, divided into four Banks, A, B, C and D, providing multiple Bank operations. While programming or erasing is underway in one group of banks (from 1 to 3), reading can be conducted in any of the other banks. The bank architecture is summarized in Table 2. Eight of the Parameter Blocks are at the top of the memory address space, and eight are at the bottom.

The M29DW640D has one extra 256 Byte block (Extended Block) that can be accessed using a dedicated command. The Extended Block can be protected and so is useful for storing security information. However the protection is irreversible, once protected the protection cannot be undone.

Each block can be erased independently, so it is possible to preserve valid data while old data is erased. The blocks can be protected to prevent accidental Program or Erase commands from modifying the memory. Program and Erase commands are written to the Command Interface of the memory. An on-chip Program/Erase Controller simplifies the process of programming or erasing the memory by taking care of all of the special operations that are required to update the memory contents. The end of a program or erase operation can be detected and any error conditions identified. The command set required to control the memory is consistent with JEDEC standards.

Chip Enable, Output Enable and Write Enable signals control the bus operation of the memory. They allow simple connection to most microprocessors, often without additional logic.

The memory is offered in TSOP48 (12x20mm) and TFBGA63 (7x11mm, 0.8mm pitch) packages. The memory is supplied with all the bits erased (set to '1').

Figure 2. Logic Diagram

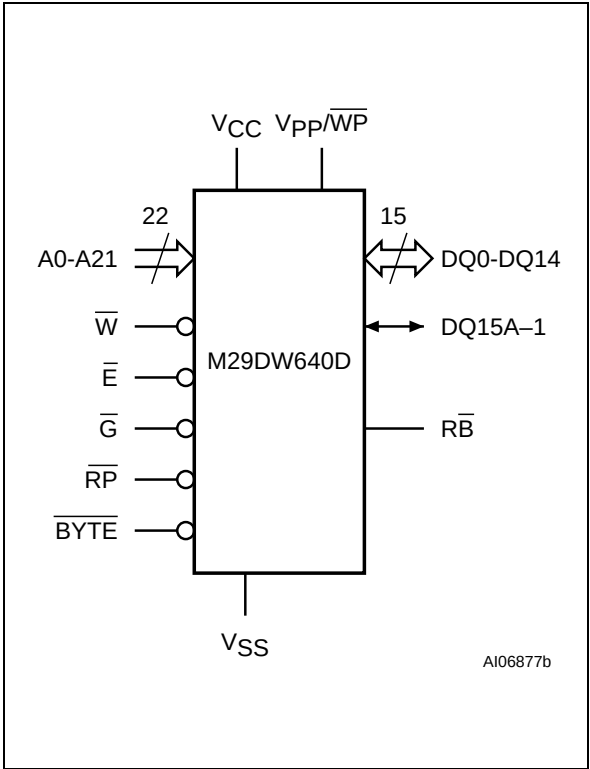


Table 1. Signal Names

|                      |                                    |
|----------------------|------------------------------------|
| A0-A21               | Address Inputs                     |
| DQ0-DQ7              | Data Inputs/Outputs                |
| DQ8-DQ14             | Data Inputs/Outputs                |
| DQ15A-1              | Data Input/Output or Address Input |
| $\overline{E}$       | Chip Enable                        |
| $\overline{G}$       | Output Enable                      |
| $\overline{W}$       | Write Enable                       |
| $\overline{RP}$      | Reset/Block Temporary Unprotect    |
| $\overline{RB}$      | Ready/Busy Output                  |
| $\overline{BYTE}$    | Byte/Word Organization Select      |
| VCC                  | Supply Voltage                     |
| VPP/ $\overline{WP}$ | VPP/Write Protect                  |
| VSS                  | Ground                             |
| NC                   | Not Connected Internally           |

Figure 3. TSOP Connections

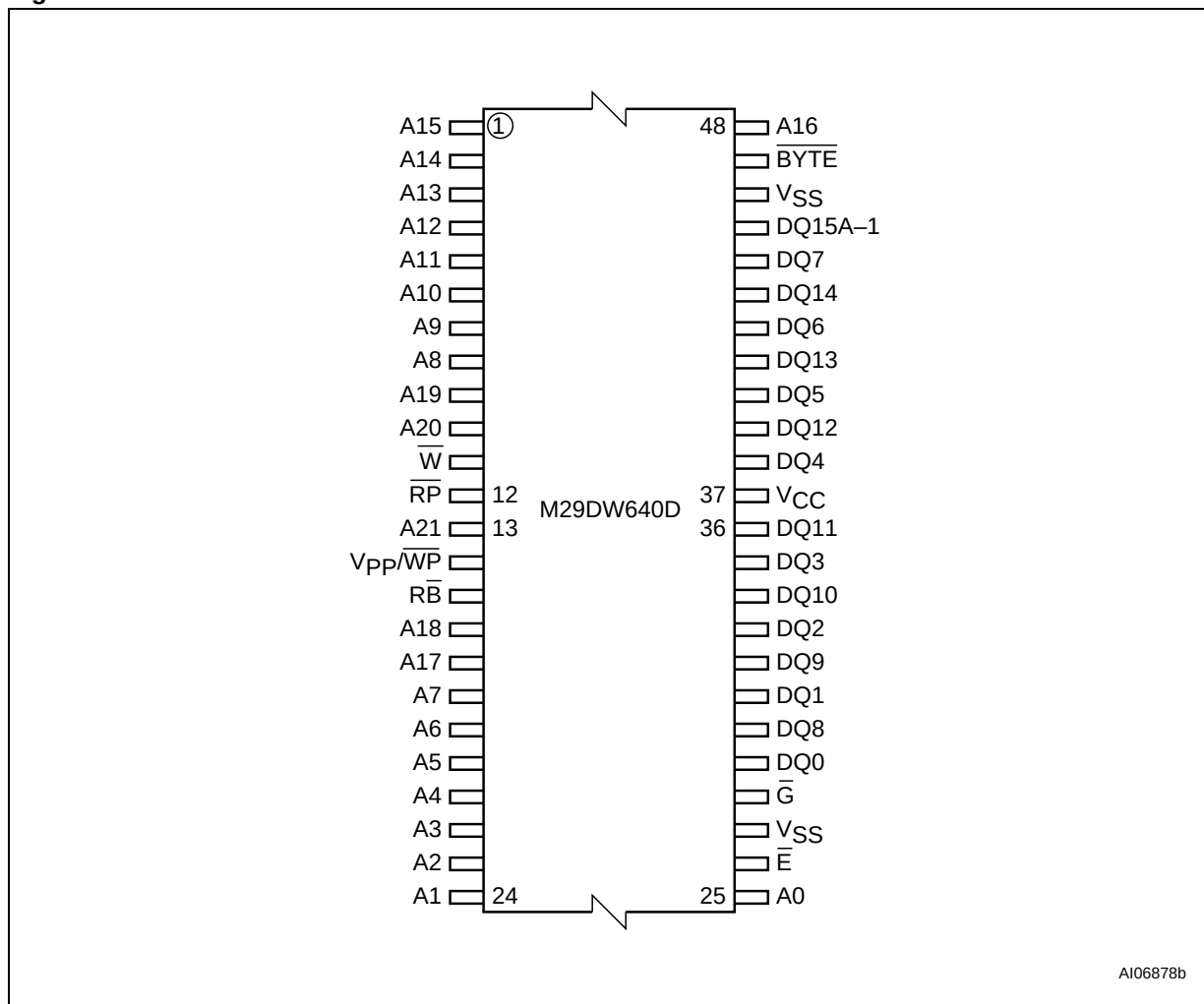


Figure 4. TFBGA Connections (Top view through package)

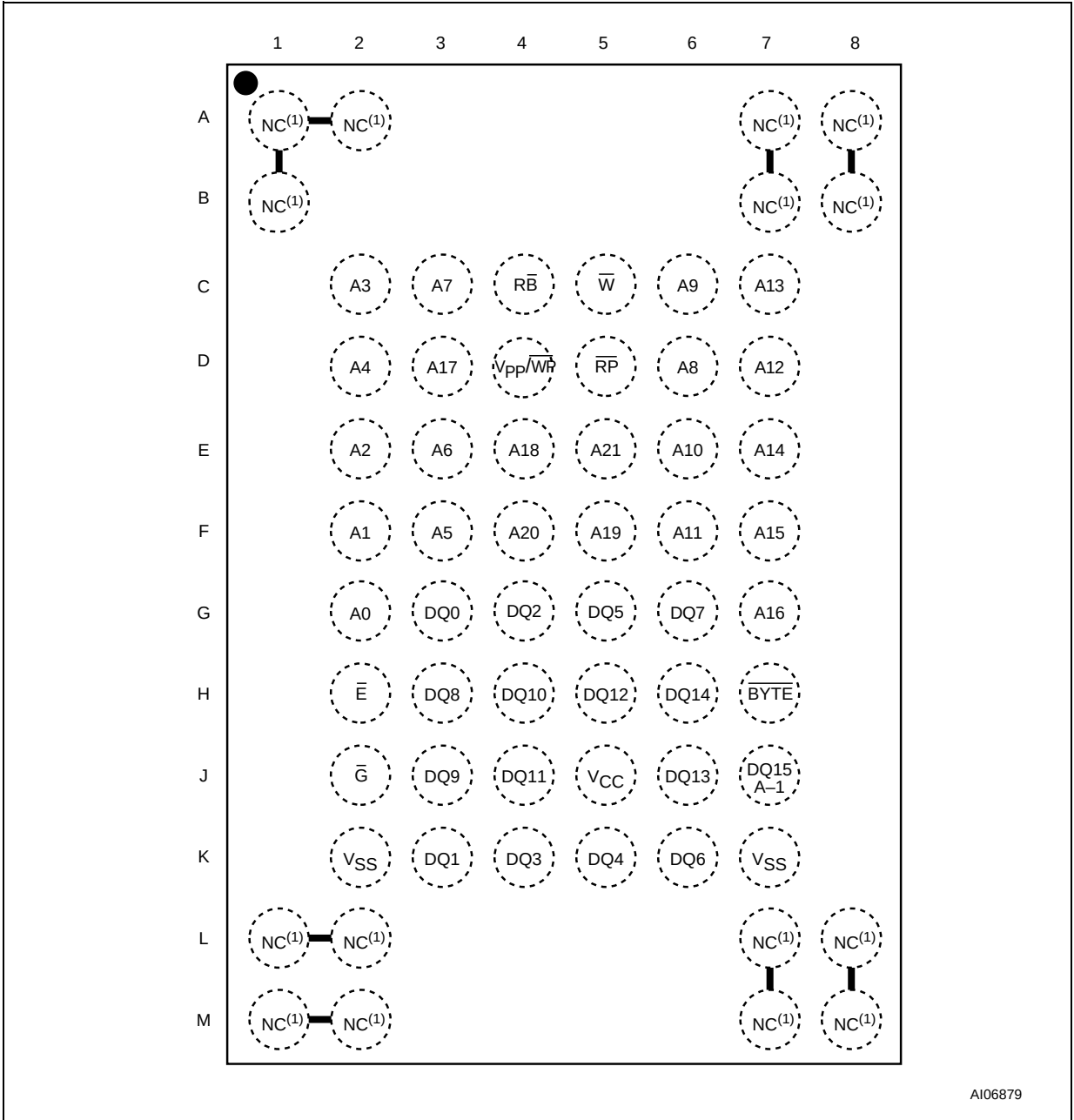
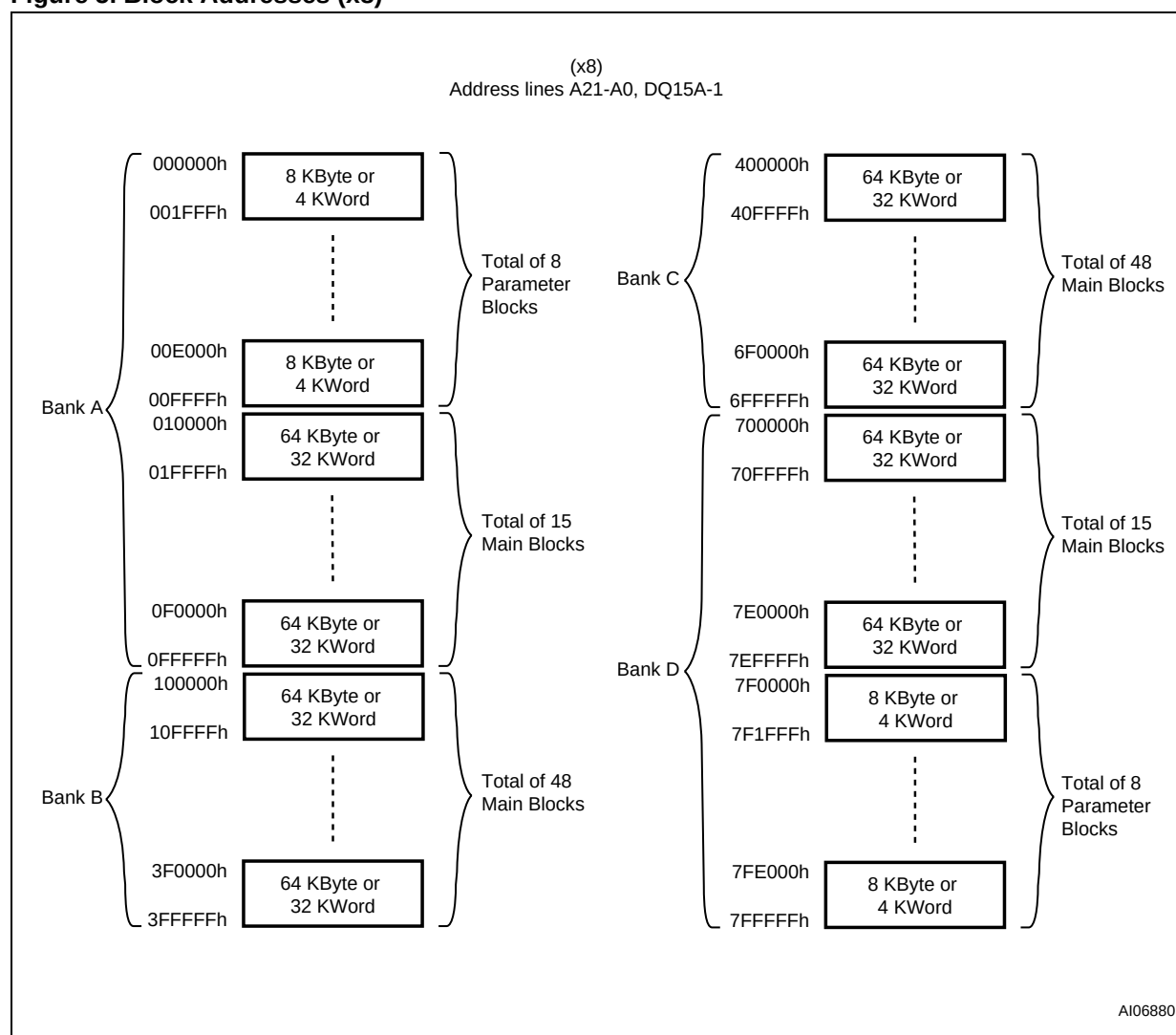


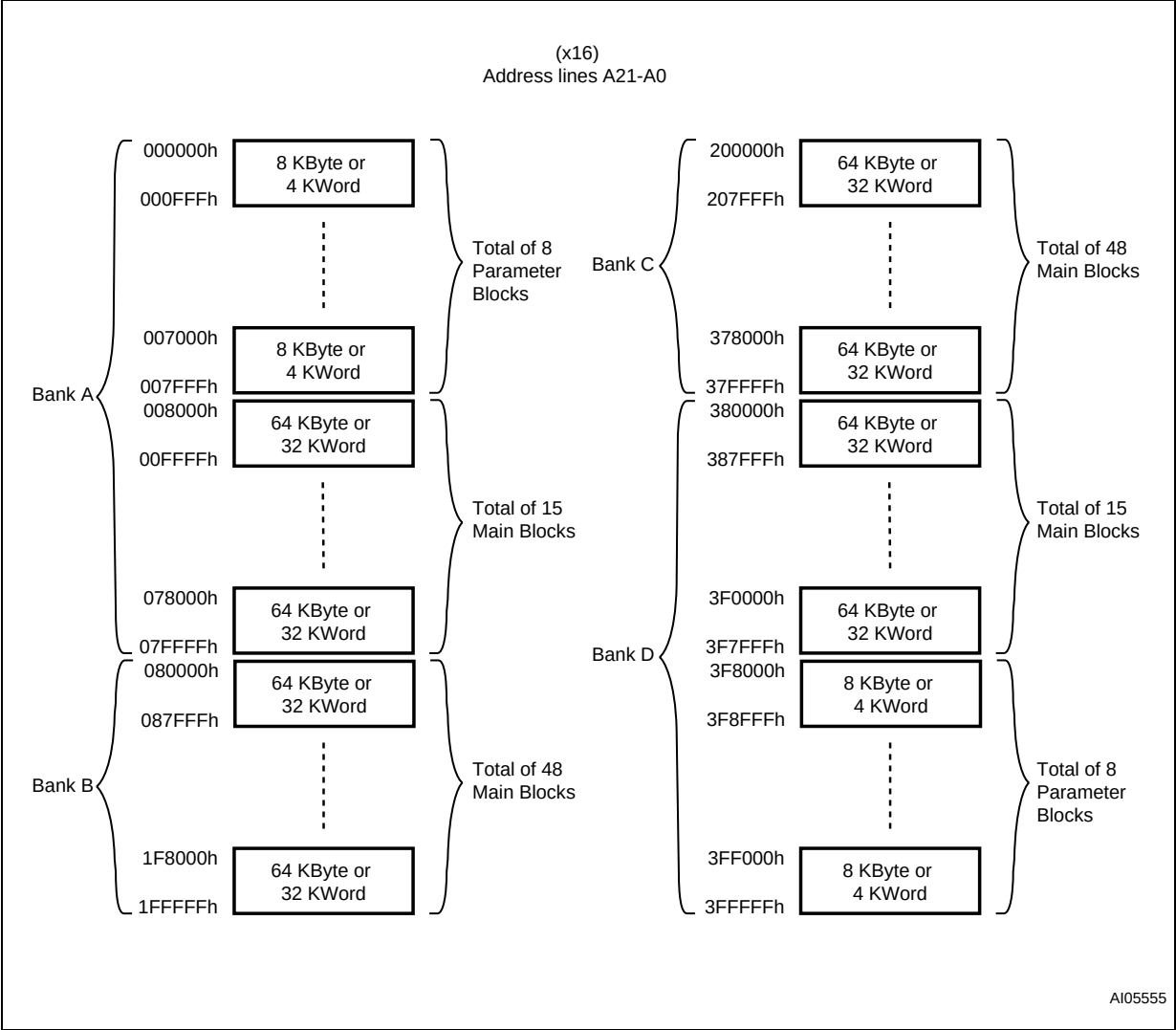
**Table 2. Bank Architecture**

| Bank | Bank Size | Parameter Blocks |                 | Main Blocks   |                   |
|------|-----------|------------------|-----------------|---------------|-------------------|
|      |           | No. of Blocks    | Block Size      | No. of Blocks | Block Size        |
| A    | 8 Mbit    | 8                | 8KByte/ 4 KWord | 15            | 64KByte/ 32 KWord |
| B    | 24 Mbit   | —                | —               | 48            | 64KByte/ 32 KWord |
| C    | 24 Mbit   | —                | —               | 48            | 64KByte/ 32 KWord |
| D    | 8 Mbit    | 8                | 8KByte/ 4 KWord | 15            | 64KByte/ 32 KWord |

**Figure 5. Block Addresses (x8)**

Note: Also see Appendix A, Table 23 for a full listing of the Block Addresses.

Figure 6. Block Addresses (x16)



Note: Also see Appendix A, Table 23 for a full listing of the Block Addresses.

## SIGNAL DESCRIPTIONS

See [Figure 2., Logic Diagram](#), and [Table 1., Signal Names](#), for a brief overview of the signals connected to this device.

**Address Inputs (A0-A21).** The Address Inputs select the cells in the memory array to access during Bus Read operations. During Bus Write operations they control the commands sent to the Command Interface of the internal state machine.

**Data Inputs/Outputs (DQ0-DQ7).** The Data I/O outputs the data stored at the selected address during a Bus Read operation. During Bus Write operations they represent the commands sent to the Command Interface of the internal state machine.

**Data Inputs/Outputs (DQ8-DQ14).** The Data I/O outputs the data stored at the selected address during a Bus Read operation when BYTE is High,  $V_{IH}$ . When BYTE is Low,  $V_{IL}$ , these pins are not used and are high impedance. During Bus Write operations the Command Register does not use these bits. When reading the Status Register these bits should be ignored.

**Data Input/Output or Address Input (DQ15A-1).**

When  $\overline{BYTE}$  is High,  $V_{IH}$ , this pin behaves as a Data Input/Output pin (as DQ8-DQ14). When  $\overline{BYTE}$  is Low,  $V_{IL}$ , this pin behaves as an address pin; DQ15A-1 Low will select the LSB of the addressed Word, DQ15A-1 High will select the MSB. Throughout the text consider references to the Data Input/Output to include this pin when  $\overline{BYTE}$  is High and references to the Address Inputs to include this pin when  $\overline{BYTE}$  is Low except when stated explicitly otherwise.

**Chip Enable ( $\overline{E}$ ).** The Chip Enable,  $\overline{E}$ , activates the memory, allowing Bus Read and Bus Write operations to be performed. When Chip Enable is High,  $V_{IH}$ , all other pins are ignored.

**Output Enable ( $\overline{G}$ ).** The Output Enable,  $\overline{G}$ , controls the Bus Read operation of the memory.

**Write Enable ( $\overline{W}$ ).** The Write Enable,  $\overline{W}$ , controls the Bus Write operation of the memory's Command Interface.

**$V_{PP}$ /Write Protect ( $\overline{V_{PP}/WP}$ ).** The  $V_{PP}$ /Write Protect pin provides two functions. The  $V_{PP}$  function allows the memory to use an external high voltage power supply to reduce the time required for Program operations. This is achieved by bypassing the unlock cycles and/or using the multiple Word (2 or 4 at-a-time) or multiple Byte Program (2, 4 or 8 at-a-time) commands. The Write Protect function provides a hardware method of protecting the four outermost boot blocks (two at the top, and two at the bottom of the address space).

When  $V_{PP}$ /Write Protect is Low,  $V_{IL}$ , the memory protects the four outermost boot blocks; Program and Erase operations in these blocks are ignored while  $V_{PP}$ /Write Protect is Low, even when RP is at  $V_{ID}$ .

When  $V_{PP}$ /Write Protect is High,  $V_{IH}$ , the memory reverts to the previous protection status of the four outermost boot blocks (two at the top, and two at the bottom of the address space). Program and Erase operations can now modify the data in these blocks unless the blocks are protected using Block Protection.

When  $V_{PP}$ /Write Protect is raised to  $V_{PP}$  the memory automatically enters the Unlock Bypass mode. When  $V_{PP}$ /Write Protect returns to  $V_{IH}$  or  $V_{IL}$  normal operation resumes. During Unlock Bypass Program operations the memory draws  $I_{PP}$  from the pin to supply the programming circuits. See the description of the Unlock Bypass command in the Command Interface section. The transitions from  $V_{IH}$  to  $V_{PP}$  and from  $V_{PP}$  to  $V_{IH}$  must be slower than  $t_{VHVPP}$ , see [Figure 18](#).

Never raise  $V_{PP}$ /Write Protect to  $V_{PP}$  from any mode except Read mode, otherwise the memory may be left in an indeterminate state.

The  $V_{PP}$ /Write Protect pin must not be left floating or unconnected or the device may become unreliable. A 0.1 $\mu$ F capacitor should be connected between the  $V_{PP}$ /Write Protect pin and the  $V_{SS}$  Ground pin to decouple the current surges from the power supply. The PCB track widths must be sufficient to carry the currents required during Unlock Bypass Program,  $I_{PP}$ .

**Reset/Block Temporary Unprotect ( $\overline{RP}$ ).** The Reset/Block Temporary Unprotect pin can be used to apply a Hardware Reset to the memory or to temporarily unprotect all Blocks that have been protected.

Note that if  $\overline{V_{PP}/WP}$  is at  $V_{IL}$ , then the four outermost boot blocks will remain protected even if RP is at  $V_{ID}$ .

A Hardware Reset is achieved by holding Reset/Block Temporary Unprotect Low,  $V_{IL}$ , for at least  $t_{LPX}$ . After Reset/Block Temporary Unprotect goes High,  $V_{IH}$ , the memory will be ready for Bus Read and Bus Write operations after  $t_{PHEL}$  or  $t_{RHEL}$ , whichever occurs last. See the Ready/Busy Output section, [Table 19](#) and [Figure 17., Reset/Block Temporary Unprotect AC Waveforms](#).

Holding  $\overline{RP}$  at  $V_{ID}$  will temporarily unprotect the protected Blocks in the memory. Program and Erase operations on all blocks will be possible. The transition from  $V_{IH}$  to  $V_{ID}$  must be slower than  $t_{PHPHH}$ .

**Ready/Busy Output ( $\overline{RB}$ ).** The Ready/Busy pin is an open-drain output that can be used to identify when the device is performing a Program or Erase operation. During Program or Erase operations Ready/Busy is Low,  $V_{OL}$ . Ready/Busy is high-impedance during Read mode, Auto Select mode and Erase Suspend mode.

After a Hardware Reset, Bus Read and Bus Write operations cannot begin until Ready/Busy becomes high-impedance. See Table 19 and Figure 17., [Reset/Block Temporary Unprotect AC Waveforms](#).

The use of an open-drain output allows the Ready/Busy pins from several memories to be connected to a single pull-up resistor. A Low will then indicate that one, or more, of the memories is busy.

**Byte/Word Organization Select (BYTE).** The Byte/Word Organization Select pin is used to switch between the x8 and x16 Bus modes of the memory. When Byte/Word Organization Select is Low,  $V_{IL}$ , the memory is in x8 mode, when it is High,  $V_{IH}$ , the memory is in x16 mode.

**$V_{CC}$  Supply Voltage (2.7V to 3.6V).**  $V_{CC}$  provides the power supply for all operations (Read, Program and Erase).

The Command Interface is disabled when the  $V_{CC}$  Supply Voltage is less than the Lockout Voltage,  $V_{LKO}$ . This prevents Bus Write operations from accidentally damaging the data during power up, power down and power surges. If the Program/Erase Controller is programming or erasing during this time then the operation aborts and the memory contents being altered will be invalid.

A 0.1 $\mu$ F capacitor should be connected between the  $V_{CC}$  Supply Voltage pin and the  $V_{SS}$  Ground pin to decouple the current surges from the power supply. The PCB track widths must be sufficient to carry the currents required during Program and Erase operations,  $I_{CC3}$ .

**$V_{SS}$  Ground.**  $V_{SS}$  is the reference for all voltage measurements. The device features two  $V_{SS}$  pins both of which must be connected to the system ground.

## BUS OPERATIONS

There are five standard bus operations that control the device. These are Bus Read (Random and Page modes), Bus Write, Output Disable, Standby and Automatic Standby.

Using the multiple bank architecture of the M29DW640D, while programming or erasing is underway in one group of banks (from 1 to 3), reading can be conducted in any of the other banks. Write operations are only allowed in one bank at a time.

See Tables 3 and 4, Bus Operations, for a summary. Typically glitches of less than 5ns on Chip Enable, Write Enable, and Reset pins are ignored by the memory and do not affect bus operations.

**Bus Read.** Bus Read operations read from the memory cells, or specific registers in the Command Interface. To speed up the read operation the memory array can be read in Page mode where data is internally read and stored in a page buffer. The Page has a size of 4 Words and is addressed by the address inputs A0-A1.

A valid Bus Read operation involves setting the desired address on the Address Inputs, applying a Low signal,  $V_{IL}$ , to Chip Enable and Output Enable and keeping Write Enable High,  $V_{IH}$ . The Data Inputs/Outputs will output the value, see Figure 11., Random Read AC Waveforms, Figure 12., Page Read AC Waveforms, and Table 15., Read AC Characteristics, for details of when the output becomes valid.

**Bus Write.** Bus Write operations write to the Command Interface. A valid Bus Write operation begins by setting the desired address on the Address Inputs. The Address Inputs are latched by the Command Interface on the falling edge of Chip Enable or Write Enable, whichever occurs last. The Data Inputs/Outputs are latched by the Command Interface on the rising edge of Chip Enable or Write Enable, whichever occurs first. Output Enable must remain High,  $V_{IH}$ , during the whole Bus Write operation. See Figures 13 and 14, Write AC Waveforms, and Tables 16 and 17, Write AC Characteristics, for details of the timing requirements.

**Output Disable.** The Data Inputs/Outputs are in the high impedance state when Output Enable is High,  $V_{IH}$ .

**Standby.** When Chip Enable is High,  $V_{IH}$ , the memory enters Standby mode and the Data Inputs/Outputs pins are placed in the high-impedance state. To reduce the Supply Current to the Standby Supply Current,  $I_{CC2}$ , Chip Enable should be held within  $V_{CC} \pm 0.2V$ . For the Standby current level see Table 14., DC Characteristics.

During program or erase operations the memory will continue to use the Program/Erase Supply Current,  $I_{CC3}$ , for Program or Erase operations until the operation completes.

**Automatic Standby.** If CMOS levels ( $V_{CC} \pm 0.2V$ ) are used to drive the bus and the bus is inactive for 300ns or more the memory enters Automatic Standby where the internal Supply Current is reduced to the Standby Supply Current,  $I_{CC2}$ . The Data Inputs/Outputs will still output data if a Bus Read operation is in progress.

### Special Bus Operations

Additional bus operations can be performed to read the Electronic Signature and also to apply and remove Block Protection. These bus operations are intended for use by programming equipment and are not usually used in applications. They require  $V_{ID}$  to be applied to some pins.

**Electronic Signature.** The memory has two codes, the manufacturer code and the device code, that can be read to identify the memory. These codes can be read by applying the signals listed in Tables 3 and 4, Bus Operations.

**Block Protect and Chip Unprotect.** Groups of blocks can be protected against accidental Program or Erase. The Protection Groups are shown in Appendix A, Table 23., Block Addresses. The whole chip can be unprotected to allow the data inside the blocks to be changed.

The  $V_{PP}$ /Write Protect pin can be used to protect the four outermost boot blocks. When  $V_{PP}$ /Write Protect is at  $V_{IL}$  the four outermost boot blocks are protected and remain protected regardless of the Block Protection Status or the Reset/Block Temporary Unprotect pin status.

Block Protect and Chip Unprotect operations are described in Appendix D.

Table 3. Bus Operations,  $\overline{\text{BYTE}} = V_{\text{IL}}$ 

| Operation                          | $\overline{\text{E}}$ | $\overline{\text{G}}$ | $\overline{\text{W}}$ | Address Inputs  |                 |                 |                 |                 |                                                              | Data Inputs/Outputs |                                          |
|------------------------------------|-----------------------|-----------------------|-----------------------|-----------------|-----------------|-----------------|-----------------|-----------------|--------------------------------------------------------------|---------------------|------------------------------------------|
|                                    |                       |                       |                       | A21-A12         | A3              | A2              | A1              | A0              | others, DQ15A-1                                              | DQ14-DQ8            | DQ7-DQ0                                  |
| Bus Read                           | $V_{\text{IL}}$       | $V_{\text{IL}}$       | $V_{\text{IH}}$       | Cell Address    |                 |                 |                 |                 |                                                              | Hi-Z                | Data Output                              |
| Bus Write                          | $V_{\text{IL}}$       | $V_{\text{IH}}$       | $V_{\text{IL}}$       | Command Address |                 |                 |                 |                 |                                                              | Hi-Z                | Data Input                               |
| Output Disable                     | X                     | $V_{\text{IH}}$       | $V_{\text{IH}}$       | X               |                 |                 |                 |                 |                                                              | Hi-Z                | Hi-Z                                     |
| Standby                            | $V_{\text{IH}}$       | X                     | X                     | X               |                 |                 |                 |                 |                                                              | Hi-Z                | Hi-Z                                     |
| Read Manufacturer Code             | $V_{\text{IL}}$       | $V_{\text{IL}}$       | $V_{\text{IH}}$       | Bank Addr       | $V_{\text{IL}}$ | $V_{\text{IL}}$ | $V_{\text{IL}}$ | $V_{\text{IL}}$ | A6 = $V_{\text{IL}}$<br>A9 = $V_{\text{ID}}$ ,<br>others = X | Hi-Z                | 20h                                      |
| Read Device Code (Cycle 1)         | $V_{\text{IL}}$       | $V_{\text{IL}}$       | $V_{\text{IH}}$       |                 | $V_{\text{IL}}$ | $V_{\text{IL}}$ | $V_{\text{IL}}$ | $V_{\text{IH}}$ |                                                              | Hi-Z                | 7Eh                                      |
| Read Device Code (Cycle 2)         | $V_{\text{IL}}$       | $V_{\text{IL}}$       | $V_{\text{IH}}$       |                 | $V_{\text{IH}}$ | $V_{\text{IH}}$ | $V_{\text{IH}}$ | $V_{\text{IL}}$ |                                                              | Hi-Z                | 02h                                      |
| Read Device Code (Cycle 3)         | $V_{\text{IL}}$       | $V_{\text{IL}}$       | $V_{\text{IH}}$       |                 | $V_{\text{IH}}$ | $V_{\text{IH}}$ | $V_{\text{IH}}$ | $V_{\text{IH}}$ |                                                              | Hi-Z                | 01h                                      |
| Extended Block Indicator Bit (DQ7) | $V_{\text{IL}}$       | $V_{\text{IL}}$       | $V_{\text{IH}}$       | Bank A          | $V_{\text{IL}}$ | $V_{\text{IL}}$ | $V_{\text{IH}}$ | $V_{\text{IH}}$ |                                                              | Hi-Z                | 80h (factory locked)<br>00h (not locked) |
| Block Protection Verification      | $V_{\text{IL}}$       | $V_{\text{IL}}$       | $V_{\text{IH}}$       | Block Addr      | $V_{\text{IL}}$ | $V_{\text{IL}}$ | $V_{\text{IH}}$ | $V_{\text{IL}}$ |                                                              | Hi-Z                | 01h (protected)<br>00h (unprotected)     |

Note: X =  $V_{\text{IL}}$  or  $V_{\text{IH}}$ .Table 4. Bus Operations,  $\overline{\text{BYTE}} = V_{\text{IH}}$ 

| Operation                          | $\overline{\text{E}}$ | $\overline{\text{G}}$ | $\overline{\text{W}}$ | Address Inputs  |                 |                 |                 |                 |                                                              | Data Inputs/Outputs                          |  |
|------------------------------------|-----------------------|-----------------------|-----------------------|-----------------|-----------------|-----------------|-----------------|-----------------|--------------------------------------------------------------|----------------------------------------------|--|
|                                    |                       |                       |                       | A21-A12         | A3              | A2              | A1              | A0              | others                                                       | DQ15A-1, DQ14-DQ0                            |  |
| Bus Read                           | $V_{\text{IL}}$       | $V_{\text{IL}}$       | $V_{\text{IH}}$       | Cell Address    |                 |                 |                 |                 |                                                              | Data Output                                  |  |
| Bus Write                          | $V_{\text{IL}}$       | $V_{\text{IH}}$       | $V_{\text{IL}}$       | Command Address |                 |                 |                 |                 |                                                              | Data Input                                   |  |
| Output Disable                     | X                     | $V_{\text{IH}}$       | $V_{\text{IH}}$       | X               |                 |                 |                 |                 |                                                              | Hi-Z                                         |  |
| Standby                            | $V_{\text{IH}}$       | X                     | X                     | X               |                 |                 |                 |                 |                                                              | Hi-Z                                         |  |
| Read Manufacturer Code             | $V_{\text{IL}}$       | $V_{\text{IL}}$       | $V_{\text{IH}}$       | Bank Addr       | $V_{\text{IL}}$ | $V_{\text{IL}}$ | $V_{\text{IL}}$ | $V_{\text{IL}}$ | A6 = $V_{\text{IL}}$<br>A9 = $V_{\text{ID}}$ ,<br>others = X | 0020h                                        |  |
| Read Device Code (Cycle 1)         | $V_{\text{IL}}$       | $V_{\text{IL}}$       | $V_{\text{IH}}$       |                 | $V_{\text{IL}}$ | $V_{\text{IL}}$ | $V_{\text{IL}}$ | $V_{\text{IH}}$ |                                                              | 227Eh                                        |  |
| Read Device Code (Cycle 2)         | $V_{\text{IL}}$       | $V_{\text{IL}}$       | $V_{\text{IH}}$       |                 | $V_{\text{IH}}$ | $V_{\text{IH}}$ | $V_{\text{IH}}$ | $V_{\text{IL}}$ |                                                              | 2202h                                        |  |
| Read Device Code (Cycle 3)         | $V_{\text{IL}}$       | $V_{\text{IL}}$       | $V_{\text{IH}}$       |                 | $V_{\text{IH}}$ | $V_{\text{IH}}$ | $V_{\text{IH}}$ | $V_{\text{IH}}$ |                                                              | 2201h                                        |  |
| Extended Block Indicator Bit (DQ7) | $V_{\text{IL}}$       | $V_{\text{IL}}$       | $V_{\text{IH}}$       | Bank A          | $V_{\text{IL}}$ | $V_{\text{IL}}$ | $V_{\text{IH}}$ | $V_{\text{IH}}$ |                                                              | 0080h (factory locked)<br>0000h (not locked) |  |
| Block Protection Verification      | $V_{\text{IL}}$       | $V_{\text{IL}}$       | $V_{\text{IH}}$       | Block Addr      | $V_{\text{IL}}$ | $V_{\text{IL}}$ | $V_{\text{IH}}$ | $V_{\text{IL}}$ |                                                              | 0001h (protected)<br>0000h (unprotected)     |  |

Note: X =  $V_{\text{IL}}$  or  $V_{\text{IH}}$ .

## COMMAND INTERFACE

All Bus Write operations to the memory are interpreted by the Command Interface. Commands consist of one or more sequential Bus Write operations. Failure to observe a valid sequence of Bus Write operations will result in the memory returning to Read mode. The long command sequences are imposed to maximize data security.

The address used for the commands changes depending on whether the memory is in 16-bit or 8-bit mode. See either Table 5, or 6, depending on the configuration that is being used, for a summary of the commands.

### Read/Reset Command

The Read/Reset command returns the memory to its Read mode. It also resets the errors in the Status Register. Either one or three Bus Write operations can be used to issue the Read/Reset command.

The Read/Reset command can be issued, between Bus Write cycles before the start of a program or erase operation, to return the device to read mode. If the Read/Reset command is issued during the timeout of a Block erase operation then the memory will take up to 10 $\mu$ s to abort. During the abort period no valid data can be read from the memory. The Read/Reset command will not abort an Erase operation when issued while in Erase Suspend.

### Auto Select Command

The Auto Select command is used to read the Manufacturer Code and Device Code, the Block Protection Status and the Extended Block Indicator. It can be addressed to either Bank. Three consecutive Bus Write operations are required to issue the Auto Select command. The final Write cycle must be addressed to one of the Banks. Once the Auto Select command is issued Bus Read operations to the Bank where the command was issued output the Auto Select data. Bus Read operations to the other Bank will output the contents of the memory array. The memory remains in Auto Select mode until a Read/Reset or CFI Query command is issued. This command must be issued addressing the same Bank, as was given when entering Auto Select Mode.

In Auto Select mode the Manufacturer Code can be read using a read operation, A6 and A3 to A0 each held at V<sub>IL</sub>, and A21-A19 set to the Bank Address. The other address bits may be set to either V<sub>IL</sub> or V<sub>IH</sub>.

The Device Codes can be read using a read operation, A6 held at V<sub>IL</sub>, A3 to A0 each held at the levels given in Tables 3 and 4, and A21-A19 set to the

Bank Address. The other address bits may be set to either V<sub>IL</sub> or V<sub>IH</sub>.

The Block Protection Status of each block can be read using a read operation, A6 A3 A2 A0 each held at V<sub>IL</sub>, A1 held at V<sub>IH</sub>, and A21-A19 set to the Bank Address, and A18-A12 specifying the address of the block inside the Bank. The other address bits may be set to either V<sub>IL</sub> or V<sub>IH</sub>. If the addressed block is protected then 01h is output on Data Inputs/Outputs DQ0-DQ7, otherwise 00h is output.

The Extended Block Status of the Extended Block can be read using a read operation, A6, A3 and A2, at V<sub>IL</sub>, A0 and A1, at V<sub>IH</sub>, and A21-A19 set to Bank Address A. The other bits may be set to either V<sub>IL</sub> or V<sub>IH</sub> (Don't Care). If the Extended Block is "Factory Locked" then 80h is output on Data Input/Outputs DQ0-DQ7, otherwise 00h is output.

### Read CFI Query Command

The Read CFI Query Command is used to put the addressed bank in Read CFI Query mode. Once in Read CFI Query mode Bus Read operations to the same bank will output data from the Common Flash Interface (CFI) Memory Area. If the read operations are to a different bank from the one specified in the command then the read operations will output the contents of the memory array and not the CFI data.

One Bus Write cycle is required to issue the Read CFI Query Command. Care must be taken to issue the command to one of the banks (A21-A19) along with the address shown in Tables 3 and 4 (A-1, A0-A10). Once the command is issued subsequent Bus Read operations in the same bank (A21-A19) to the addresses shown in Appendix B (A7-A0), will read from the Common Flash Interface Memory Area.

This command is valid only when the device is in the Read Array or Autoselected mode. To enter Read CFI query mode from Auto Select mode, the Read CFI Query command must be issued to the same bank address as the Auto Select command, otherwise the device will not enter Read CFI Query mode.

The Read/Reset command must be issued to return the device to the previous mode (the Read Array mode or Autoselected mode). A second Read/Reset command would be needed if the device is to be put in the Read Array mode from Autoselected mode.

See Appendix B, Tables 24, 25, 26, 27, 28 and 29 for details on the information contained in the Common Flash Interface (CFI) memory area.

### Program Command

The Program command can be used to program a value to one address in the memory array at a time. The command requires four Bus Write operations, the final Write operation latches the address and data in the internal state machine and starts the Program/Erase Controller.

Programming can be suspended and then resumed by issuing a Program Suspend command and a Program Resume command, respectively (see [Program Suspend Command](#) and [Program Resume Command](#) paragraphs).

If the address falls in a protected block then the Program command is ignored, the data remains unchanged. The Status Register is never read and no error condition is given.

After programming has started, Bus Read operations in the Bank being programmed output the Status Register content, while Bus Read operations to the other Bank output the contents of the memory array. See the section on the Status Register for more details. Typical program times are given in Table 7.

After the program operation has completed the memory will return to the Read mode, unless an error has occurred. When an error occurs Bus Read operations to the Bank where the command was issued will continue to output the Status Register. A Read/Reset command must be issued to reset the error condition and return to Read mode.

Note that the Program command cannot change a bit set at '0' back to '1'. One of the Erase Commands must be used to set all the bits in a block or in the whole memory from '0' to '1'.

### Fast Program Commands

There are five Fast Program commands available to improve the programming throughput, by writing several adjacent Words or Bytes in parallel.

**Double Word Program Command.** This is used to write two adjacent Words in x16 mode, in parallel. The addresses of the two Words must differ only in A0.

Three bus write cycles are necessary to issue the command.

- The first bus cycle sets up the command.
- The second bus cycle latches the Address and the Data of the first Word to be written.
- The third bus cycle latches the Address and the Data of the second Word to be written and starts the Program/Erase Controller.

**Quadruple Word Program Command.** This is used to write a page of four adjacent Words, in x16 mode, in parallel. The addresses of the four Words must differ only in A1 and A0.

Five bus write cycles are necessary to issue the command.

- The first bus cycle sets up the command.
- The second bus cycle latches the Address and the Data of the first Word to be written.
- The third bus cycle latches the Address and the Data of the second Word to be written.
- The fourth bus cycle latches the Address and the Data of the third Word to be written.
- The fifth bus cycle latches the Address and the Data of the fourth Word to be written and starts the Program/Erase Controller.

**Double Byte Program Command.** This is used to write two adjacent Bytes in x8 mode, in parallel. The addresses of the two Bytes must differ only in DQ15A-1.

Three bus write cycles are necessary to issue the command.

- The first bus cycle sets up the command.
- The second bus cycle latches the Address and the Data of the first Byte to be written.
- The third bus cycle latches the Address and the Data of the second Byte to be written and starts the Program/Erase Controller.

**Quadruple Byte Program Command.** This is used to write four adjacent Bytes in x8 mode, in parallel. The addresses of the four Bytes must differ only in A0, DQ15A-1.

Five bus write cycles are necessary to issue the command.

- The first bus cycle sets up the command.
- The second bus cycle latches the Address and the Data of the first Byte to be written.
- The third bus cycle latches the Address and the Data of the second Byte to be written.
- The fourth bus cycle latches the Address and the Data of the third Byte to be written.
- The fifth bus cycle latches the Address and the Data of the fourth Byte to be written and starts the Program/Erase Controller.

**Octuple Byte Program Command.** This is used to write eight adjacent Bytes, in x8 mode, in parallel. The addresses of the eight Bytes must differ only in A1, A0 and DQ15A-1.

Nine bus write cycles are necessary to issue the command.

- The first bus cycle sets up the command.
- The second bus cycle latches the Address and the Data of the first Byte to be written.
- The third bus cycle latches the Address and the Data of the second Byte to be written.
- The fourth bus cycle latches the Address and the Data of the third Byte to be written.

- The fifth bus cycle latches the Address and the Data of the fourth Byte to be written.
- The sixth bus cycle latches the Address and the Data of the fifth Byte to be written.
- The seventh bus cycle latches the Address and the Data of the sixth Byte to be written.
- The eighth bus cycle latches the Address and the Data of the seventh Byte to be written.
- The ninth bus cycle latches the Address and the Data of the eighth Byte to be written and starts the Program/Erase Controller.

Only one bank can be programmed at any one time. The other bank must be in Read mode or Erase Suspend.

Fast programming should not be attempted when  $V_{PP}$  is not at  $V_{PPH}$ .

After programming has started, Bus Read operations in the Bank being programmed output the Status Register content, while Bus Read operations to the other Bank output the contents of the memory array.

Programming can be suspended and then resumed by issuing a Program Suspend command and a Program Resume command, respectively. (See [Program Suspend Command](#) and [Program Resume Command](#) paragraphs.)

After the program operation has completed the memory will return to the Read mode, unless an error has occurred. When an error occurs Bus Read operations to the Bank where the command was issued will continue to output the Status Register. A Read/Reset command must be issued to reset the error condition and return to Read mode.

Note that the Fast Program commands cannot change a bit set at '0' back to '1'. One of the Erase Commands must be used to set all the bits in a block or in the whole memory from '0' to '1'.

Typical Program times are given in [Table 7., Program, Erase Times and Program, Erase Endurance Cycles](#).

### Unlock Bypass Command

The Unlock Bypass command is used in conjunction with the Unlock Bypass Program command to program the memory faster than with the standard program commands. When the cycle time to the device is long, considerable time saving can be made by using these commands. Three Bus Write operations are required to issue the Unlock Bypass command.

Once the Unlock Bypass command has been issued the bank enters Unlock Bypass mode. The Unlock Bypass Program command can then be issued to program addresses within the bank, or the Unlock Bypass Reset command can be issued to

return the bank to Read mode. In Unlock Bypass mode the memory can be read as if in Read mode.

When  $V_{PP}$  is applied to the  $V_{PP}$ /Write Protect pin the memory automatically enters the Unlock Bypass mode and the Unlock Bypass Program command can be issued immediately.

### Unlock Bypass Program Command

The Unlock Bypass Program command can be used to program one address in the memory array at a time. The command requires two Bus Write operations, the final write operation latches the address and data in the internal state machine and starts the Program/Erase Controller.

The Program operation using the Unlock Bypass Program command behaves identically to the Program operation using the Program command. The operation cannot be aborted, a Bus Read operation to the Bank where the command was issued outputs the Status Register. See the Program command for details on the behavior.

### Unlock Bypass Reset Command

The Unlock Bypass Reset command can be used to return to Read/Reset mode from Unlock Bypass Mode. Two Bus Write operations are required to issue the Unlock Bypass Reset command. Read/Reset command does not exit from Unlock Bypass Mode.

### Chip Erase Command

The Chip Erase command can be used to erase the entire chip. Six Bus Write operations are required to issue the Chip Erase Command and start the Program/Erase Controller.

If any blocks are protected then these are ignored and all the other blocks are erased. If all of the blocks are protected the Chip Erase operation appears to start but will terminate within about 100 $\mu$ s, leaving the data unchanged. No error condition is given when protected blocks are ignored.

During the erase operation the memory will ignore all commands, including the Erase Suspend command. It is not possible to issue any command to abort the operation. Typical chip erase times are given in [Table 7](#). All Bus Read operations during the Chip Erase operation will output the Status Register on the Data Inputs/Outputs. See the section on the Status Register for more details.

After the Chip Erase operation has completed the memory will return to the Read Mode, unless an error has occurred. When an error occurs the memory will continue to output the Status Register. A Read/Reset command must be issued to reset the error condition and return to Read Mode.

The Chip Erase Command sets all of the bits in unprotected blocks of the memory to '1'. All previous data is lost.

### Block Erase Command

The Block Erase command can be used to erase a list of one or more blocks in one or more Banks. It sets all of the bits in the unprotected selected blocks to '1'. All previous data in the selected blocks is lost.

Six Bus Write operations are required to select the first block in the list. Each additional block in the list can be selected by repeating the sixth Bus Write operation using the address of the additional block. The Block Erase operation starts the Program/Erase Controller after a time-out period of 50 $\mu$ s after the last Bus Write operation. Once the Program/Erase Controller starts it is not possible to select any more blocks. Each additional block must therefore be selected within 50 $\mu$ s of the last block. The 50 $\mu$ s timer restarts when an additional block is selected. After the sixth Bus Write operation a Bus Read operation within the same Bank will output the Status Register. See the Status Register section for details on how to identify if the Program/Erase Controller has started the Block Erase operation.

If any selected blocks are protected then these are ignored and all the other selected blocks are erased. If all of the selected blocks are protected the Block Erase operation appears to start but will terminate within about 100 $\mu$ s, leaving the data unchanged. No error condition is given when protected blocks are ignored.

During the Block Erase operation the memory will ignore all commands except the Erase Suspend command and the Read/Reset command which is only accepted during the 50 $\mu$ s time-out period. Typical block erase times are given in Table 7.

After the Erase operation has started all Bus Read operations to the Banks being erased will output the Status Register on the Data Inputs/Outputs. See the section on the Status Register for more details.

After the Block Erase operation has completed the memory will return to the Read Mode, unless an error has occurred. When an error occurs Bus Read operations to the Banks where the command was issued will continue to output the Status Register. A Read/Reset command must be issued to reset the error condition and return to Read mode.

### Erase Suspend Command

The Erase Suspend command may be used to temporarily suspend a Block or multiple Block Erase operation. One Bus Write operation specifying the Bank Address of one of the Blocks being erased is required to issue the command. Issuing the Erase Suspend command returns the whole device to Read mode.

The Program/Erase Controller will suspend within the Erase Suspend Latency time (see Table 7 for value) of the Erase Suspend Command being issued. Once the Program/Erase Controller has stopped the memory will be set to Read mode and the Erase will be suspended. If the Erase Suspend command is issued during the period when the memory is waiting for an additional block (before the Program/Erase Controller starts) then the Erase is suspended immediately and will start immediately when the Erase Resume Command is issued. It is not possible to select any further blocks to erase after the Erase Resume.

During Erase Suspend it is possible to Read and Program cells in blocks that are not being erased; both Read and Program operations behave as normal on these blocks. If any attempt is made to program in a protected block or in the suspended block then the Program command is ignored and the data remains unchanged. The Status Register is not read and no error condition is given. Reading from blocks that are being erased will output the Status Register.

It is also possible to issue the Auto Select, Read CFI Query and Unlock Bypass commands during an Erase Suspend. The Read/Reset command must be issued to return the device to Read Array mode before the Resume command will be accepted.

During Erase Suspend a Bus Read operation to the Extended Block will output the Extended Block data. Once in the Extended Block mode, the Exit Extended Block command must be issued before the erase operation can be resumed.

### Erase Resume Command

The Erase Resume command is used to restart the Program/Erase Controller after an Erase Suspend. The command must include the Bank Address of the Erase-Suspended Bank, otherwise the Program/Erase Controller is not restarted.

The device must be in Read Array mode before the Resume command will be accepted. An Erase can be suspended and resumed more than once.

### Program Suspend Command

The Program Suspend command allows the system to interrupt a program operation so that data can be read from any block. When the Program Suspend command is issued during a program operation, the device suspends the program operation within the Program Suspend Latency time (see Table 7 for value) and updates the Status Register bits. The Bank Addresses of the Block being programmed must be specified in the Program Suspend command.

After the program operation has been suspended, the system can read array data from any address.

However, data read from Program-Suspended addresses is not valid.

The Program Suspend command may also be issued during a program operation while an erase is suspended. In this case, data may be read from any addresses not in Erase Suspend or Program Suspend. If a read is needed from the Extended Block area (One-time Program area), the user must use the proper command sequences to enter and exit this region.

The system may also issue the Auto Select command sequence when the device is in the Program Suspend mode. The system can read as many Auto Select codes as required. When the device exits the Auto Select mode, the device reverts to the Program Suspend mode, and is ready for another valid operation. See Auto Select command sequence for more information.

### **Program Resume Command**

After the Program Resume command is issued, the device reverts to programming. The controller can determine the status of the program operation using the DQ7 or DQ6 status bits, just as in the standard program operation. See Write Operation Status for more information.

The system must write the Program Resume command, specifying the Bank addresses of the Program-Suspended Block, to exit the Program Suspend mode and to continue the programming operation.

Further issuing of the Resume command is ignored. Another Program Suspend command can be written after the device has resumed programming.

### **Enter Extended Block Command**

The M29DW640D has one extra 256-Byte block (Extended Block) that can only be accessed using

the Enter Extended Block command. Three Bus write cycles are required to issue the Extended Block command. Once the command has been issued the device enters Extended Block mode where all Bus Read or Program operations to the 000000h-00007Fh (Word) or 000000h-0000FFh (Byte) addresses access the Extended Block. The Extended Block cannot be erased, and can be treated as one-time programmable (OTP) memory. In Extended Block mode only array cell locations (Bank A) with the same addresses as the Extended Block (000000h-00007Fh (Word) or 000000h-0000FFh (Byte)) are not accessible. In Extended Block mode dual operations are allowed and the Extended Block physically belongs to Bank A.

When in Extended Block mode, Erase, Chip Erase, Erase Suspend and Erase resume commands are not allowed.

To exit from the Extended Block mode the Exit Extended Block command must be issued.

The Extended Block can be protected, however once protected the protection cannot be undone.

### **Exit Extended Block Command**

The Exit Extended Block command is used to exit from the Extended Block mode and return the device to Read mode. Four Bus Write operations are required to issue the command.

### **Block Protect and Chip Unprotect Commands**

Groups of blocks can be protected against accidental Program or Erase. The Protection Groups are shown in Appendix A, [Table 23., Block Addresses](#). The whole chip can be unprotected to allow the data inside the blocks to be changed.

Block Protect and Chip Unprotect operations are described in Appendix D.

Table 5. Commands, 16-bit mode,  $\overline{\text{BYTE}} = V_{IH}$ 

| Command                       | Length | Bus Write Operations |      |     |      |              |      |     |      |     |      |     |      |
|-------------------------------|--------|----------------------|------|-----|------|--------------|------|-----|------|-----|------|-----|------|
|                               |        | 1st                  |      | 2nd |      | 3rd          |      | 4th |      | 5th |      | 6th |      |
|                               |        | Add                  | Data | Add | Data | Add          | Data | Add | Data | Add | Data | Add | Data |
| Read/Reset                    | 1      | X                    | F0   |     |      |              |      |     |      |     |      |     |      |
|                               | 3      | 555                  | AA   | 2AA | 55   | X            | F0   |     |      |     |      |     |      |
| Auto Select                   | 3      | 555                  | AA   | 2AA | 55   | (BKA)<br>555 | 90   |     |      |     |      |     |      |
| Program                       | 4      | 555                  | AA   | 2AA | 55   | 555          | A0   | PA  | PD   |     |      |     |      |
| Double Word Program           | 3      | 555                  | 50   | PA0 | PD0  | PA1          | PD1  |     |      |     |      |     |      |
| Quadruple Word Program        | 3      | 555                  | 56   | PA0 | PD0  | PA1          | PD1  | PA2 | PD2  | PA3 | PD3  |     |      |
| Unlock Bypass                 | 3      | 555                  | AA   | 2AA | 55   | 555          | 20   |     |      |     |      |     |      |
| Unlock Bypass Program         | 2      | X                    | A0   | PA  | PD   |              |      |     |      |     |      |     |      |
| Unlock Bypass Reset           | 2      | X                    | 90   | X   | 00   |              |      |     |      |     |      |     |      |
| Chip Erase                    | 6      | 555                  | AA   | 2AA | 55   | 555          | 80   | 555 | AA   | 2AA | 55   | 555 | 10   |
| Block Erase                   | 6+     | 555                  | AA   | 2AA | 55   | 555          | 80   | 555 | AA   | 2AA | 55   | BA  | 30   |
| Erase/Program Suspend         | 1      | BKA                  | B0   |     |      |              |      |     |      |     |      |     |      |
| Erase/Program Resume          | 1      | BKA                  | 30   |     |      |              |      |     |      |     |      |     |      |
| Read CFI Query <sup>(2)</sup> | 1      | (BKA)<br>55          | 98   |     |      |              |      |     |      |     |      |     |      |
| Enter Extended Block          | 3      | 555                  | AA   | 2AA | 55   | 555          | 88   |     |      |     |      |     |      |
| Exit Extended Block           | 4      | 555                  | AA   | 2AA | 55   | 555          | 90   | X   | 00   |     |      |     |      |

Note: 1. X Don't Care, PA Program Address, PD Program Data, BA Any address in the Block, BKA Bank Address. All values in the table are in hexadecimal.

2. Normally the Command Interface only uses A–1, A0-A10 and DQ0-DQ7 to verify the commands and A11-A21 are Don't Care, however for the Read CFI command A21-A14 must specify a bank address, and the subsequent read operations must be addressed to the same bank.

Table 6. Commands, 8-bit mode,  $\overline{\text{BYTE}} = V_{IL}$ 

| Command                       | Length | Bus Write Operations |      |     |      |              |      |     |      |     |      |     |      |     |      |     |      |     |      |
|-------------------------------|--------|----------------------|------|-----|------|--------------|------|-----|------|-----|------|-----|------|-----|------|-----|------|-----|------|
|                               |        | 1st                  |      | 2nd |      | 3rd          |      | 4th |      | 5th |      | 6th |      | 7th |      | 8th |      | 9th |      |
|                               |        | Add                  | Data | Add | Data | Add          | Data | Add | Data | Add | Data | Add | Data | Add | Data | Add | Data | Add | Data |
| Read/Reset                    | 1      | X                    | F0   |     |      |              |      |     |      |     |      |     |      |     |      |     |      |     |      |
|                               | 3      | AAA                  | AA   | 555 | 55   | X            | F0   |     |      |     |      |     |      |     |      |     |      |     |      |
| Auto Select                   | 3      | AAA                  | AA   | 555 | 55   | (BKA)<br>AAA | 90   |     |      |     |      |     |      |     |      |     |      |     |      |
| Program                       | 4      | AAA                  | AA   | 555 | 55   | AAA          | A0   | PA  | PD   |     |      |     |      |     |      |     |      |     |      |
| Double Byte Program           | 3      | AAA                  | 50   | PA0 | PD1  | PA1          | PD1  |     |      |     |      |     |      |     |      |     |      |     |      |
| Quadruple Byte Program        | 5      | AAA                  | 56   | PA0 | PD0  | PA1          | PD1  | PA2 | PD2  | PA3 | PD3  |     |      |     |      |     |      |     |      |
| Octuple Byte Program          | 5      | AAA                  | 8B   | PA0 | PD0  | PA1          | PD1  | PA2 | PD2  | PA3 | PD3  | PA4 | PD4  | PA5 | PD5  | PA6 | PD6  | PA7 | PD7  |
| Unlock Bypass                 | 3      | AAA                  | AA   | 555 | 55   | AAA          | 20   |     |      |     |      |     |      |     |      |     |      |     |      |
| Unlock Bypass Program         | 2      | X                    | A0   | PA  | PD   |              |      |     |      |     |      |     |      |     |      |     |      |     |      |
| Unlock Bypass Reset           | 2      | X                    | 90   | X   | 00   |              |      |     |      |     |      |     |      |     |      |     |      |     |      |
| Chip Erase                    | 6      | AAA                  | AA   | 555 | 55   | AAA          | 80   | AAA | AA   | 555 | 55   | AAA | 10   |     |      |     |      |     |      |
| Block Erase                   | 6 +    | AAA                  | AA   | 555 | 55   | AAA          | 80   | AAA | AA   | 555 | 55   | BA  | 30   |     |      |     |      |     |      |
| Erase/Program Suspend         | 1      | BKA                  | B0   |     |      |              |      |     |      |     |      |     |      |     |      |     |      |     |      |
| Erase/Program Resume          | 1      | BKA                  | 30   |     |      |              |      |     |      |     |      |     |      |     |      |     |      |     |      |
| Read CFI Query <sup>(2)</sup> | 1      | (BKA)<br>AA          | 98   |     |      |              |      |     |      |     |      |     |      |     |      |     |      |     |      |
| Enter Extended Block          | 3      | AAA                  | AA   | 555 | 55   | AAA          | 88   |     |      |     |      |     |      |     |      |     |      |     |      |
| Exit Extended Block           | 4      | AAA                  | AA   | 555 | 55   | AAA          | 90   | X   | 00   |     |      |     |      |     |      |     |      |     |      |

Note: 1. X Don't Care, PA Program Address, PD Program Data, BA Any address in the Block. All values in the table are in hexadecimal.

2. Normally the Command Interface only uses A–1, A0-A10 and DQ0-DQ7 to verify the commands and A11-A21 are Don't Care, however for the Read CFI command A21-A14 must specify a bank address, and the subsequent read operations must be addressed to the same bank.

**Table 7. Program, Erase Times and Program, Erase Endurance Cycles**

| Parameter                                     | Min     | Typ <sup>(1, 2)</sup> | Max <sup>(2)</sup> | Unit   |
|-----------------------------------------------|---------|-----------------------|--------------------|--------|
| Chip Erase                                    |         | 80                    | 400 <sup>(3)</sup> | s      |
| Block Erase (64 KBytes)                       |         | 0.8                   | 6 <sup>(4)</sup>   | s      |
| Erase Suspend Latency Time                    |         |                       | 50 <sup>(4)</sup>  | µs     |
| Byte Program (1, 2, 4 or 8 at-a-time)         |         | 10                    | 200 <sup>(3)</sup> | µs     |
| Word Program (1, 2 or 4 at-a-time)            |         | 10                    | 200 <sup>(3)</sup> | µs     |
| Chip Program (Byte by Byte)                   |         | 80                    | 400 <sup>(3)</sup> | s      |
| Chip Program (Word by Word)                   |         | 40                    | 200 <sup>(3)</sup> | s      |
| Chip Program (Quadruple Byte or Double Word)  |         | 20                    | 100 <sup>(3)</sup> | s      |
| Chip Program (Octuple Byte or Quadruple Word) |         | 10                    | 50 <sup>(3)</sup>  | s      |
| Program Suspend Latency Time                  |         |                       | 4                  | µs     |
| Program/Erase Cycles (per Block)              | 100,000 |                       |                    | cycles |
| Data Retention                                | 20      |                       |                    | years  |

Note: 1. Typical values measured at room temperature and nominal voltages.

2. Sampled, but not 100% tested.

3. Maximum value measured at worst case conditions for both temperature and V<sub>CC</sub> after 100,00 program/erase cycles.

4. Maximum value measured at worst case conditions for both temperature and V<sub>CC</sub>.

## STATUS REGISTER

The M29DW640D has one Status Register. The Status Register provides information on the current or previous Program or Erase operations executed in each bank. The various bits convey information and errors on the operation. Bus Read operations from any address within the Bank, always read the Status Register during Program and Erase operations. It is also read during Erase Suspend when an address within a block being erased is accessed.

The bits in the Status Register are summarized in [Table 8., Status Register Bits](#).

**Data Polling Bit (DQ7).** The Data Polling Bit can be used to identify whether the Program/Erase Controller has successfully completed its operation or if it has responded to an Erase Suspend. The Data Polling Bit is output on DQ7 when the Status Register is read.

During Program operations the Data Polling Bit outputs the complement of the bit being programmed to DQ7. After successful completion of the Program operation the memory returns to Read mode and Bus Read operations from the address just programmed output DQ7, not its complement.

During Erase operations the Data Polling Bit outputs '0', the complement of the erased state of DQ7. After successful completion of the Erase operation the memory returns to Read Mode.

In Erase Suspend mode the Data Polling Bit will output a '1' during a Bus Read operation within a block being erased. The Data Polling Bit will change from a '0' to a '1' when the Program/Erase Controller has suspended the Erase operation.

[Figure 7., Data Polling Flowchart](#), gives an example of how to use the Data Polling Bit. A Valid Address is the address being programmed or an address within the block being erased.

**Toggle Bit (DQ6).** The Toggle Bit can be used to identify whether the Program/Erase Controller has successfully completed its operation or if it has responded to an Erase Suspend. The Toggle Bit is output on DQ6 when the Status Register is read.

During Program and Erase operations the Toggle Bit changes from '0' to '1' to '0', etc., with successive Bus Read operations at any address. After successful completion of the operation the memory returns to Read mode.

During Erase Suspend mode the Toggle Bit will output when addressing a cell within a block being erased. The Toggle Bit will stop toggling when the Program/Erase Controller has suspended the Erase operation.

[Figure 8., Toggle Flowchart](#), gives an example of how to use the Data Toggle Bit. [Figures 15 and 16](#) describe Toggle Bit timing waveform.

**Error Bit (DQ5).** The Error Bit can be used to identify errors detected by the Program/Erase Controller. The Error Bit is set to '1' when a Program, Block Erase or Chip Erase operation fails to write the correct data to the memory. If the Error Bit is set a Read/Reset command must be issued before other commands are issued. The Error bit is output on DQ5 when the Status Register is read.

Note that the Program command cannot change a bit set to '0' back to '1' and attempting to do so will set DQ5 to '1'. A Bus Read operation to that address will show the bit is still '0'. One of the Erase commands must be used to set all the bits in a block or in the whole memory from '0' to '1'.

**Erase Timer Bit (DQ3).** The Erase Timer Bit can be used to identify the start of Program/Erase Controller operation during a Block Erase command. Once the Program/Erase Controller starts erasing the Erase Timer Bit is set to '1'. Before the Program/Erase Controller starts the Erase Timer Bit is set to '0' and additional blocks to be erased may be written to the Command Interface. The Erase Timer Bit is output on DQ3 when the Status Register is read.

**Alternative Toggle Bit (DQ2).** The Alternative Toggle Bit can be used to monitor the Program/Erase controller during Erase operations. The Alternative Toggle Bit is output on DQ2 when the Status Register is read.

During Chip Erase and Block Erase operations the Toggle Bit changes from '0' to '1' to '0', etc., with successive Bus Read operations from addresses within the blocks being erased. A protected block is treated the same as a block not being erased. Once the operation completes the memory returns to Read mode.

During Erase Suspend the Alternative Toggle Bit changes from '0' to '1' to '0', etc. with successive Bus Read operations from addresses within the blocks being erased. Bus Read operations to addresses within blocks not being erased will output the memory cell data as if in Read mode.

After an Erase operation that causes the Error Bit to be set the Alternative Toggle Bit can be used to identify which block or blocks have caused the error. The Alternative Toggle Bit changes from '0' to '1' to '0', etc. with successive Bus Read Operations from addresses within blocks that have not erased correctly. The Alternative Toggle Bit does not change if the addressed block has erased correctly.

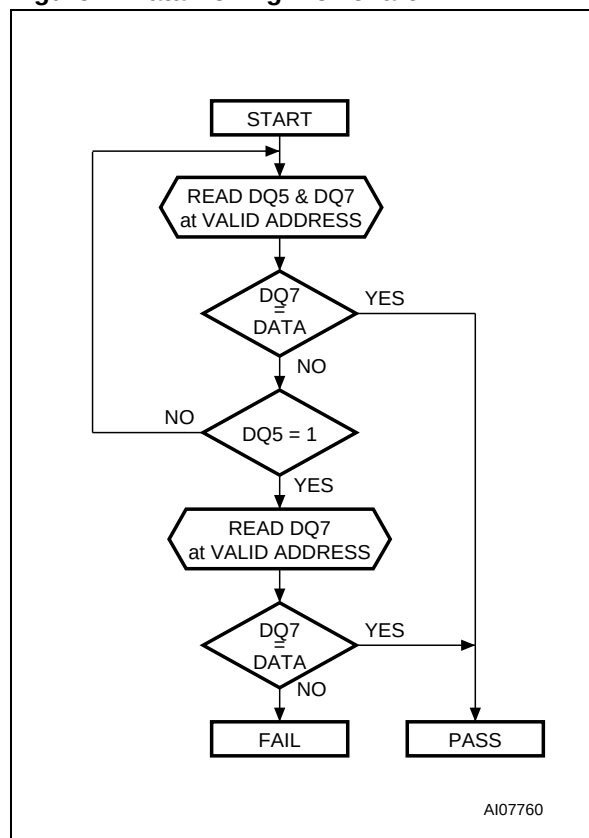
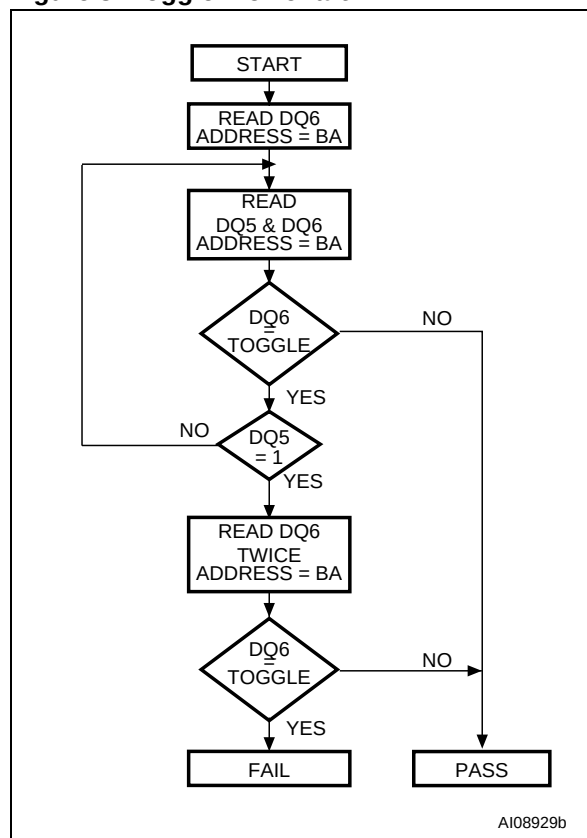
[Figures 15 and 16](#) describe Alternative Toggle Bit timing waveform.

**Table 8. Status Register Bits**

| Operation                    | Address              | DQ7                 | DQ6       | DQ5 | DQ3 | DQ2       | $\overline{RB}$ |
|------------------------------|----------------------|---------------------|-----------|-----|-----|-----------|-----------------|
| Program                      | Bank Address         | $\overline{DQ7}$    | Toggle    | 0   | –   | –         | 0               |
| Program During Erase Suspend | Bank Address         | $\overline{DQ7}$    | Toggle    | 0   | –   | –         | 0               |
| Program Error                | Bank Address         | $\overline{DQ7}$    | Toggle    | 1   | –   | –         | Hi-Z            |
| Chip Erase                   | Any Address          | 0                   | Toggle    | 0   | 1   | Toggle    | Hi-Z            |
| Block Erase before timeout   | Erasing Block        | 0                   | Toggle    | 0   | 0   | Toggle    | 0               |
|                              | Non-Erasing Block    | 0                   | Toggle    | 0   | 0   | No Toggle | 0               |
| Block Erase                  | Erasing Block        | 0                   | Toggle    | 0   | 1   | Toggle    | Hi-Z            |
|                              | Non-Erasing Block    | 0                   | Toggle    | 0   | 1   | No Toggle | 0               |
| Erase Suspend                | Erasing Block        | 1                   | No Toggle | 0   | –   | Toggle    | Hi-Z            |
|                              | Non-Erasing Block    | Data read as normal |           |     |     |           | Hi-Z            |
| Erase Error                  | Good Block Address   | 0                   | Toggle    | 1   | 1   | No Toggle | 0               |
|                              | Faulty Block Address | 0                   | Toggle    | 1   | 1   | Toggle    | 0               |

Note: 1. Unspecified data bits should be ignored.

2. Figures 15 and 16 describe Toggle and Alternative Toggle Bits timing waveforms.

**Figure 7. Data Polling Flowchart****Figure 8. Toggle Flowchart**

Note: BA = Address of Bank being Programmed or Erased.

## DUAL OPERATIONS AND MULTIPLE BANK ARCHITECTURE

The Multiple Bank Architecture of the M29DW640D gives greater flexibility for software developers to split the code and data spaces within the memory array. The Dual Operations feature simplifies the software management of the device by allowing code to be executed from one bank while another bank is being programmed or erased.

The Dual Operations feature means that while programming or erasing in one bank, read operations are possible in another bank with zero latency.

Only one bank at a time is allowed to be in program or erase mode. However, certain commands can cross bank boundaries, which means that during an operation only the banks that are not concerned with the cross bank operation are available for dual operations. For example, if a Block Erase command is issued to erase blocks in both Bank A and Bank B, then only Banks C or D are available

for read operations while the erase is being executed.

If a read operation is required in a bank, which is programming or erasing, the program or erase operation can be suspended.

Also if the suspended operation was erase then a program command can be issued to another block, so the device can have one block in Erase Suspend mode, one programming and other banks in read mode.

By using a combination of these features, read operations are possible at any moment in the M29DW640D device.

Tables 9 and 10 show the dual operations possible in other banks and in the same bank. Note that only the commonly used commands are represented in these tables.

**Table 9. Dual Operations Allowed In Other Banks**

| Status of bank <sup>(1)</sup> | Commands allowed in another bank <sup>(1)</sup> |                                     |                |             |         |       |                        |                       |
|-------------------------------|-------------------------------------------------|-------------------------------------|----------------|-------------|---------|-------|------------------------|-----------------------|
|                               | Read Array                                      | Read Status Register <sup>(6)</sup> | Read CFI Query | Auto Select | Program | Erase | Program/ Erase Suspend | Program/ Erase Resume |
| Idle                          | Yes                                             | Yes <sup>(2)</sup>                  | Yes            | Yes         | Yes     | Yes   | Yes <sup>(2)</sup>     | Yes <sup>(3)</sup>    |
| Programming                   | Yes                                             | No                                  | No             | No          | –       | –     | No                     | No                    |
| Erasing                       | Yes                                             | No                                  | No             | No          | –       | –     | No                     | No                    |
| Program Suspended             | Yes                                             | No                                  | Yes            | Yes         | No      | No    | –                      | Yes <sup>(5)</sup>    |
| Erase Suspended               | Yes                                             | No                                  | Yes            | Yes         | Yes     | No    | –                      | Yes <sup>(4)</sup>    |

Note: 1. If several banks are involved in a program or erase operation, then only the banks that are not concerned with the operation are available for dual operations.

2. Only after a program or erase operation in that bank.

3. Only after a Program or Erase Suspend command in that bank.

4. Only an Erase Resume is allowed if the bank was previously in Erase Suspend mode.

5. Only a Program Resume is allowed if the bank was previously in Program Suspend mode.

6. Read Status Register is not a command. The Status Register can be read during a block program or erase operation.

Table 10. Dual Operations Allowed In Same Bank

| Status of bank    | Commands allowed in same bank |                                     |                |             |                    |       |                        |                       |
|-------------------|-------------------------------|-------------------------------------|----------------|-------------|--------------------|-------|------------------------|-----------------------|
|                   | Read Array                    | Read Status Register <sup>(6)</sup> | Read CFI Query | Auto Select | Program            | Erase | Program/ Erase Suspend | Program/ Erase Resume |
| Idle              | Yes                           | Yes                                 | Yes            | Yes         | Yes                | Yes   | Yes <sup>(2)</sup>     | Yes <sup>(3)</sup>    |
| Programming       | No                            | Yes                                 | No             | No          | –                  | –     | Yes <sup>(4)</sup>     | –                     |
| Erasing           | No                            | Yes                                 | No             | No          | –                  | No    | Yes <sup>(5)</sup>     | –                     |
| Program Suspended | Yes <sup>(1)</sup>            | No                                  | Yes            | Yes         | No                 | –     | –                      | Yes                   |
| Erase Suspended   | Yes <sup>(1)</sup>            | Yes <sup>(7)</sup>                  | Yes            | Yes         | Yes <sup>(1)</sup> | No    | –                      | Yes                   |

Note: 1. Not allowed in the Block or Word that is being erased or programmed.  
2. Only after a program or erase operation in that bank.  
3. Only after a Program or Erase Suspend command in that bank.  
4. Only a Program Suspend.  
5. Only an Erase suspend.  
6. Read Status Register is not a command. The Status Register can be read during a block program or erase operation.  
7. The Status Register can be read by addressing the block being erase suspended.

## MAXIMUM RATING

Stressing the device above the rating listed in the Absolute Maximum Ratings table may cause permanent damage to the device. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability. These are stress ratings only and operation of the device at

these or any other conditions above those indicated in the Operating sections of this specification is not implied. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

**Table 11. Absolute Maximum Ratings**

| Symbol         | Parameter                                        | Min  | Max                | Unit |
|----------------|--------------------------------------------------|------|--------------------|------|
| $T_{BIAS}$     | Temperature Under Bias                           | -50  | 125                | °C   |
| $T_{STG}$      | Storage Temperature                              | -65  | 150                | °C   |
| $T_{LEAD}$     | Lead Temperature during Soldering <sup>(1)</sup> |      | 260 <sup>(2)</sup> | °C   |
| $V_{IO}$       | Input or Output Voltage <sup>(3,4)</sup>         | -0.6 | $V_{CC} + 0.6$     | V    |
| $V_{CC}$       | Supply Voltage                                   | -0.6 | 4                  | V    |
| $V_{ID}$       | Identification Voltage                           | -0.6 | 13.5               | V    |
| $V_{PP}^{(5)}$ | Program Voltage                                  | -0.6 | 13.5               | V    |

Note: 1. Compliant with the ECOPACK® 7191395 specification for Lead-free soldering processes.

2. Not exceeding 250°C for more than 30s, and peaking at 260°C.

3. Minimum voltage may undershoot to -2V during transition and for less than 20ns during transitions.

4. Maximum voltage may overshoot to  $V_{CC} + 2V$  during transition and for less than 20ns during transitions.

5.  $V_{PP}$  must not remain at 12V for more than a total of 80hrs.

# DC AND AC PARAMETERS

This section summarizes the operating measurement conditions, and the DC and AC characteristics of the device. The parameters in the DC and AC characteristics Tables that follow, are derived from tests performed under the Measurement

Conditions summarized in [Table 12., Operating and AC Measurement Conditions](#). Designers should check that the operating conditions in their circuit match the operating conditions when relying on the quoted parameters.

**Table 12. Operating and AC Measurement Conditions**

| Parameter                             | M29DW640D            |     |                      |     | Unit |
|---------------------------------------|----------------------|-----|----------------------|-----|------|
|                                       | 70                   |     | 90                   |     |      |
|                                       | Min                  | Max | Min                  | Max |      |
| V <sub>CC</sub> Supply Voltage        | 2.7                  | 3.6 | 2.7                  | 3.6 | V    |
| Ambient Operating Temperature         | −40                  | 85  | −40                  | 85  | °C   |
| Load Capacitance (C <sub>L</sub> )    | 30                   |     | 30                   |     | pF   |
| Input Rise and Fall Times             |                      | 10  |                      | 10  | ns   |
| Input Pulse Voltages                  | 0 to V <sub>CC</sub> |     | 0 to V <sub>CC</sub> |     | V    |
| Input and Output Timing Ref. Voltages | V <sub>CC</sub> /2   |     | V <sub>CC</sub> /2   |     | V    |

**Figure 9. AC Measurement I/O Waveform**

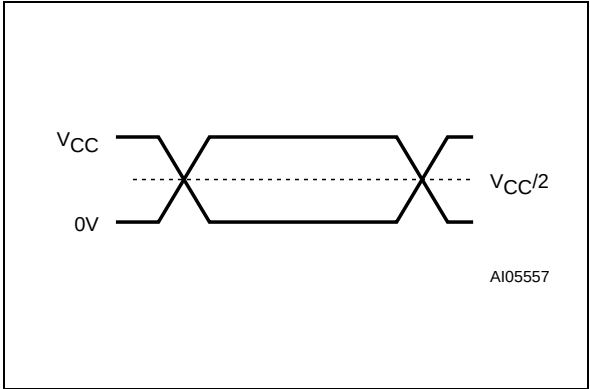


**Figure 10. AC Measurement Load Circuit**

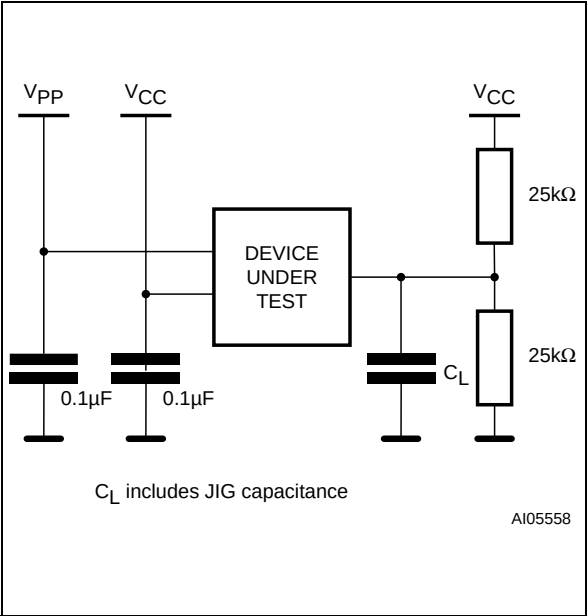


**Table 13. Device Capacitance**

| Symbol           | Parameter          | Test Condition        | Min | Max | Unit |
|------------------|--------------------|-----------------------|-----|-----|------|
| C <sub>IN</sub>  | Input Capacitance  | V <sub>IN</sub> = 0V  |     | 6   | pF   |
| C <sub>OUT</sub> | Output Capacitance | V <sub>OUT</sub> = 0V |     | 12  | pF   |

Note: Sampled only, not 100% tested.

Table 14. DC Characteristics

| Symbol            | Parameter                                               | Test Condition                                                | Min                                                     | Max            | Unit    |
|-------------------|---------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------|----------------|---------|
| $I_{LI}$          | Input Leakage Current                                   | $0V \leq V_{IN} \leq V_{CC}$                                  |                                                         | $\pm 1$        | $\mu A$ |
| $I_{LO}$          | Output Leakage Current                                  | $0V \leq V_{OUT} \leq V_{CC}$                                 |                                                         | $\pm 1$        | $\mu A$ |
| $I_{CC1}^{(2)}$   | Supply Current (Read)                                   | $\overline{E} = V_{IL}, \overline{G} = V_{IH},$<br>$f = 6MHz$ |                                                         | 10             | mA      |
| $I_{CC2}$         | Supply Current (Standby)                                | $\overline{E} = V_{CC} \pm 0.2V,$<br>$RP = V_{CC} \pm 0.2V$   |                                                         | 100            | $\mu A$ |
| $I_{CC3}^{(1,2)}$ | Supply Current (Program/Erase)                          | Program/Erase<br>Controller active                            | $V_{PP}/\overline{WP} =$<br>$V_{IL} \text{ or } V_{IH}$ | 20             | mA      |
|                   |                                                         |                                                               | $V_{PP}/\overline{WP} = V_{PP}$                         | 20             | mA      |
| $V_{IL}$          | Input Low Voltage                                       |                                                               | -0.5                                                    | 0.8            | V       |
| $V_{IH}$          | Input High Voltage                                      |                                                               | $0.7V_{CC}$                                             | $V_{CC} + 0.3$ | V       |
| $V_{PP}$          | Voltage for $V_{PP}/\overline{WP}$ Program Acceleration | $V_{CC} = 2.7V \pm 10\%$                                      | 11.5                                                    | 12.5           | V       |
| $I_{PP}$          | Current for $V_{PP}/\overline{WP}$ Program Acceleration | $V_{CC} = 2.7V \pm 10\%$                                      |                                                         | 15             | mA      |
| $V_{OL}$          | Output Low Voltage                                      | $I_{OL} = 1.8mA$                                              |                                                         | 0.45           | V       |
| $V_{OH}$          | Output High Voltage                                     | $I_{OH} = -100\mu A$                                          | $V_{CC} - 0.4$                                          |                | V       |
| $V_{ID}$          | Identification Voltage                                  |                                                               | 11.5                                                    | 12.5           | V       |
| $V_{LKO}$         | Program/Erase Lockout Supply Voltage                    |                                                               | 1.8                                                     | 2.3            | V       |

Note: 1. Sampled only, not 100% tested.

2. In Dual operations the Supply Current will be the sum of  $I_{CC1}$ (read) and  $I_{CC3}$  (program/erase).

Figure 11. Random Read AC Waveforms

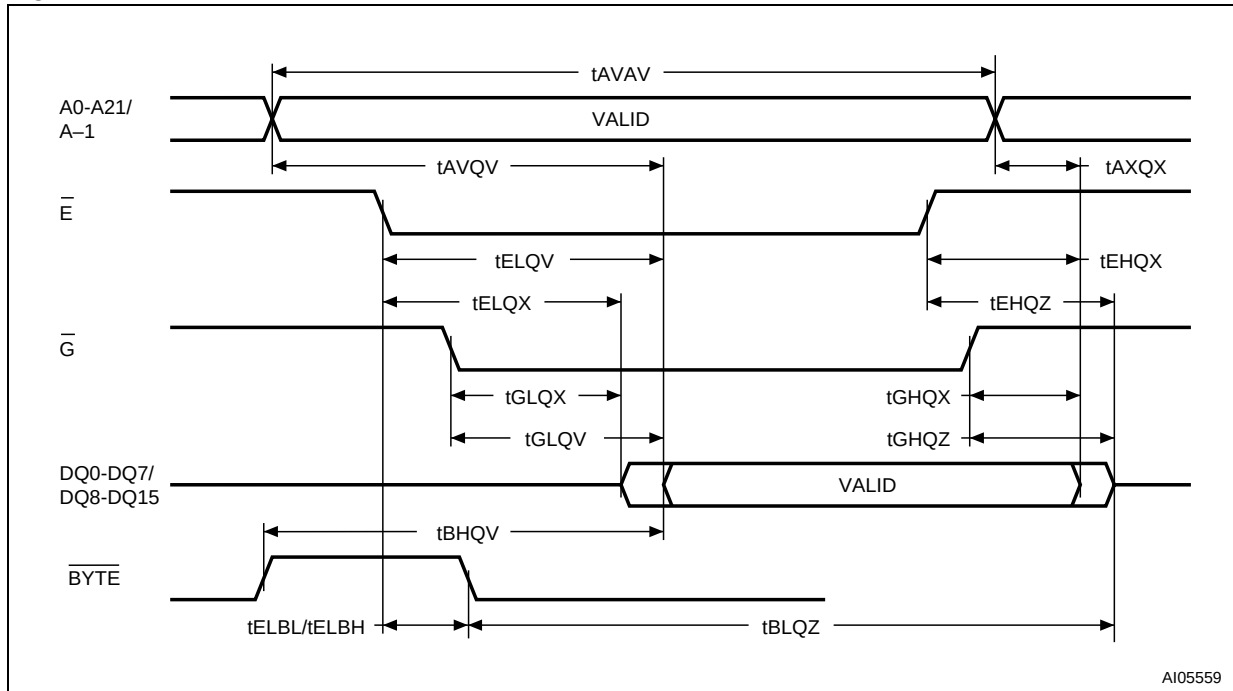


Figure 12. Page Read AC Waveforms

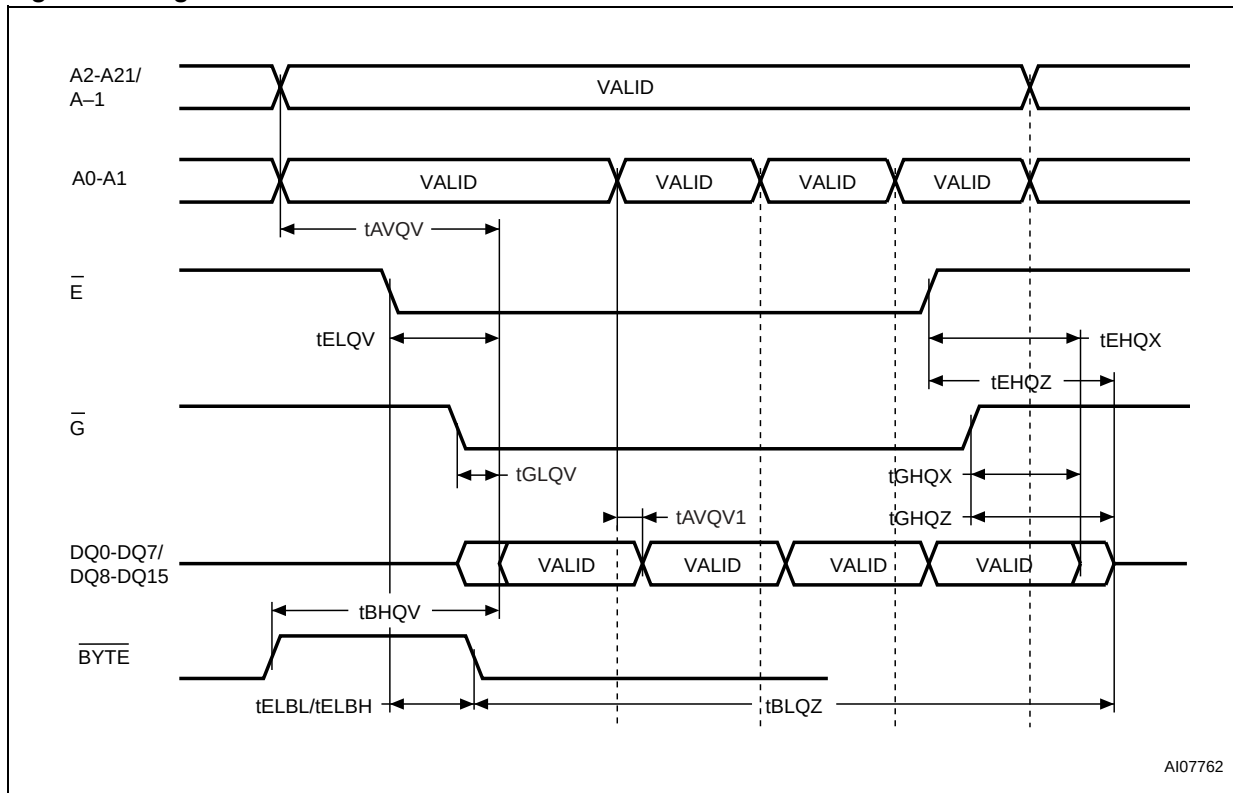
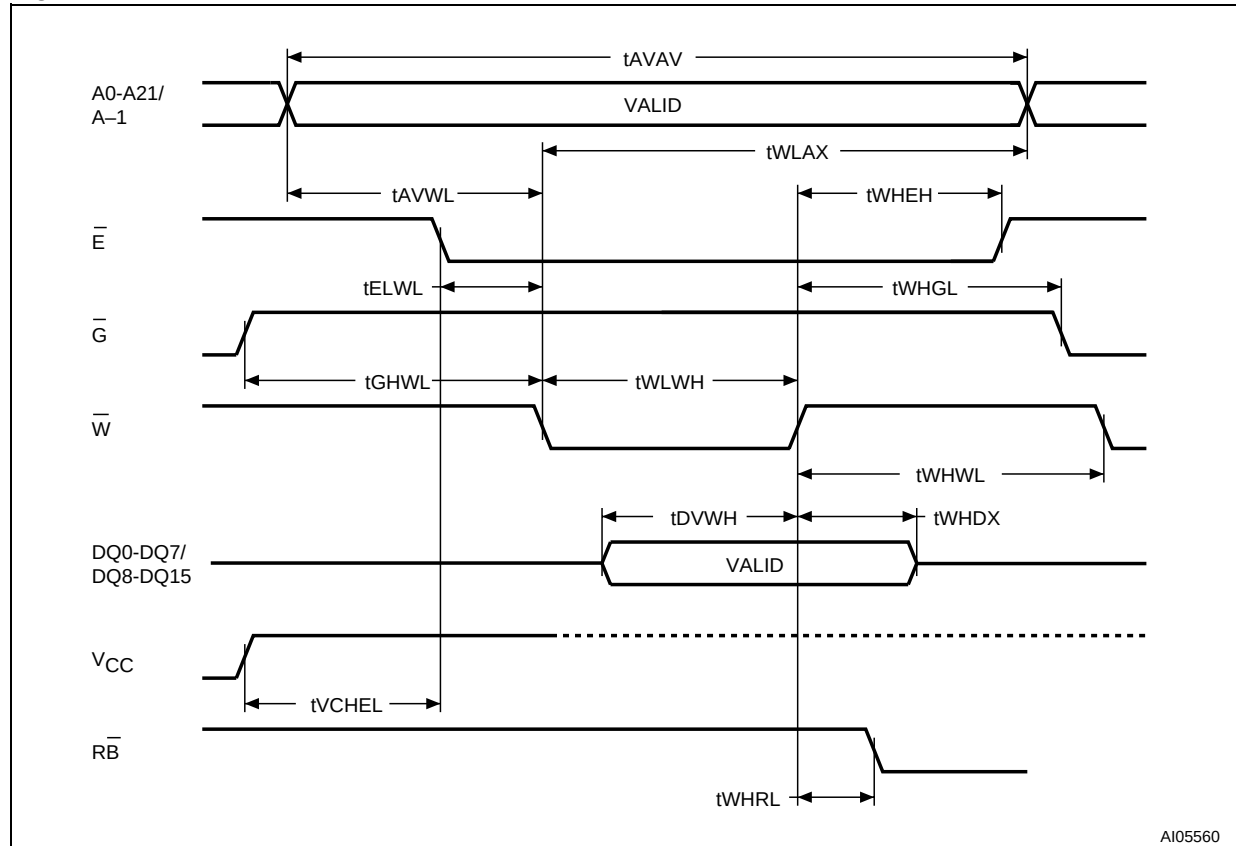


Table 15. Read AC Characteristics

| Symbol                                 | Alt                      | Parameter                                                             | Test Condition                           |     | M29DW640D |    | Unit |
|----------------------------------------|--------------------------|-----------------------------------------------------------------------|------------------------------------------|-----|-----------|----|------|
|                                        |                          |                                                                       |                                          |     | 70        | 90 |      |
| $t_{AVAV}$                             | $t_{RC}$                 | Address Valid to Next Address Valid                                   | $\overline{E} = V_{IL},$<br>$G = V_{IL}$ | Min | 70        | 90 | ns   |
| $t_{AVQV}$                             | $t_{ACC}$                | Address Valid to Output Valid                                         | $\overline{E} = V_{IL},$<br>$G = V_{IL}$ | Max | 70        | 90 | ns   |
| $t_{AVQV1}$                            | $t_{PAGE}$               | Address Valid to Output Valid (Page)                                  | $\overline{E} = V_{IL},$<br>$G = V_{IL}$ | Max | 25        | 30 | ns   |
| $t_{ELQX}^{(1)}$                       | $t_{LZ}$                 | Chip Enable Low to Output Transition                                  | $\overline{G} = V_{IL}$                  | Min | 0         | 0  | ns   |
| $t_{ELQV}$                             | $t_{CE}$                 | Chip Enable Low to Output Valid                                       | $\overline{G} = V_{IL}$                  | Max | 70        | 90 | ns   |
| $t_{GLQX}^{(1)}$                       | $t_{OLZ}$                | Output Enable Low to Output Transition                                | $\overline{E} = V_{IL}$                  | Min | 0         | 0  | ns   |
| $t_{GLQV}$                             | $t_{OE}$                 | Output Enable Low to Output Valid                                     | $\overline{E} = V_{IL}$                  | Max | 30        | 35 | ns   |
| $t_{EHQZ}^{(1)}$                       | $t_{HZ}$                 | Chip Enable High to Output Hi-Z                                       | $\overline{G} = V_{IL}$                  | Max | 25        | 30 | ns   |
| $t_{GHQZ}^{(1)}$                       | $t_{DF}$                 | Output Enable High to Output Hi-Z                                     | $\overline{E} = V_{IL}$                  | Max | 25        | 30 | ns   |
| $t_{EHQX}$<br>$t_{GHQX}$<br>$t_{AXQX}$ | $t_{OH}$                 | Chip Enable, Output Enable or Address Transition to Output Transition |                                          | Min | 0         | 0  | ns   |
| $t_{ELBL}$<br>$t_{ELBH}$               | $t_{ELFL}$<br>$t_{ELFH}$ | Chip Enable to $\overline{BYTE}$ Low or High                          |                                          | Max | 5         | 5  | ns   |
| $t_{BLQZ}$                             | $t_{FLQZ}$               | $\overline{BYTE}$ Low to Output Hi-Z                                  |                                          | Max | 25        | 30 | ns   |
| $t_{BHQV}$                             | $t_{FHQV}$               | $\overline{BYTE}$ High to Output Valid                                |                                          | Max | 30        | 40 | ns   |

Note: 1. Sampled only, not 100% tested.

Figure 13. Write AC Waveforms, Write Enable Controlled



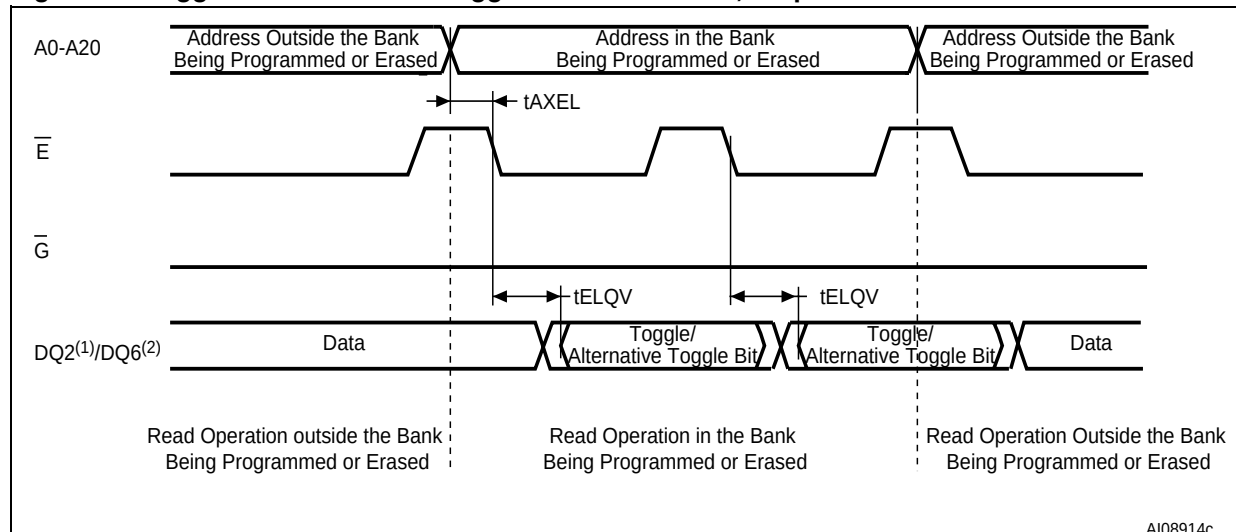
AI05560

Table 16. Write AC Characteristics, Write Enable Controlled

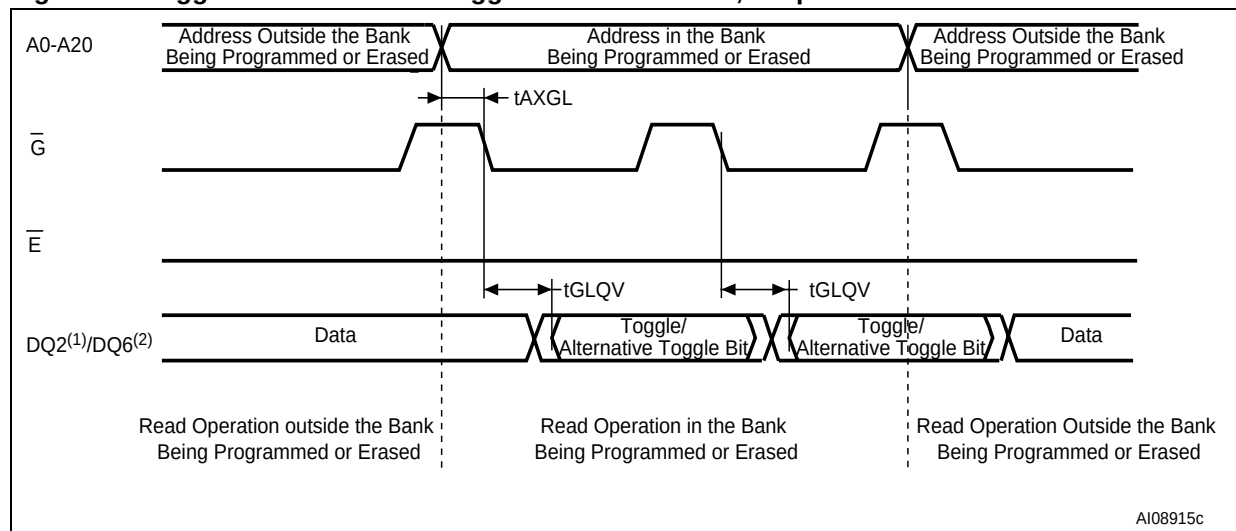
| Symbol           | Alt        | Parameter                              |     | M29DW640D |    | Unit    |
|------------------|------------|----------------------------------------|-----|-----------|----|---------|
|                  |            |                                        |     | 70        | 90 |         |
| $t_{AVAV}$       | $t_{WC}$   | Address Valid to Next Address Valid    | Min | 70        | 90 | ns      |
| $t_{ELWL}$       | $t_{CS}$   | Chip Enable Low to Write Enable Low    | Min | 0         | 0  | ns      |
| $t_{WLWH}$       | $t_{WP}$   | Write Enable Low to Write Enable High  | Min | 45        | 50 | ns      |
| $t_{DVWH}$       | $t_{DS}$   | Input Valid to Write Enable High       | Min | 45        | 50 | ns      |
| $t_{WHDX}$       | $t_{DH}$   | Write Enable High to Input Transition  | Min | 0         | 0  | ns      |
| $t_{WHEH}$       | $t_{CH}$   | Write Enable High to Chip Enable High  | Min | 0         | 0  | ns      |
| $t_{WHWL}$       | $t_{WPH}$  | Write Enable High to Write Enable Low  | Min | 30        | 30 | ns      |
| $t_{AVWL}$       | $t_{AS}$   | Address Valid to Write Enable Low      | Min | 0         | 0  | ns      |
| $t_{WLAX}$       | $t_{AH}$   | Write Enable Low to Address Transition | Min | 45        | 50 | ns      |
| $t_{GHWL}$       |            | Output Enable High to Write Enable Low | Min | 0         | 0  | ns      |
| $t_{WHGL}$       | $t_{OEHL}$ | Write Enable High to Output Enable Low | Min | 0         | 0  | ns      |
| $t_{WHRL}^{(1)}$ | $t_{BUSY}$ | Program/Erase Valid to $\bar{RB}$ Low  | Max | 30        | 35 | ns      |
| $t_{VCHL}$       | $t_{VCS}$  | $V_{CC}$ High to Chip Enable Low       | Min | 50        | 50 | $\mu s$ |

Note: 1. Sampled only, not 100% tested.



**Figure 15. Toggle and Alternative Toggle Bits Mechanism, Chip Enable Controlled**

Note: 1. The Toggle bit is output on DQ6.  
2. The Alternative Toggle bit is output on DQ2.

**Figure 16. Toggle and Alternative Toggle Bits Mechanism, Output Enable Controlled**

Note: 1. The Toggle bit is output on DQ6.  
2. The Alternative Toggle bit is output on DQ2.

**Table 18. Toggle and Alternative Toggle Bits AC Characteristics**

| Symbol     | Alt | Parameter                               |     | M29DW640D |    | Unit |
|------------|-----|-----------------------------------------|-----|-----------|----|------|
|            |     |                                         |     | 70        | 90 |      |
| $t_{AXEL}$ |     | Address Transition to Chip Enable Low   | Min | 10        | 10 | ns   |
| $t_{AXGL}$ |     | Address Transition to Output Enable Low | Min | 10        | 10 | ns   |

Note:  $t_{ELQV}$  and  $t_{GLQV}$  values are presented in [Table 15., Read AC Characteristics](#).

Figure 17. Reset/Block Temporary Unprotect AC Waveforms

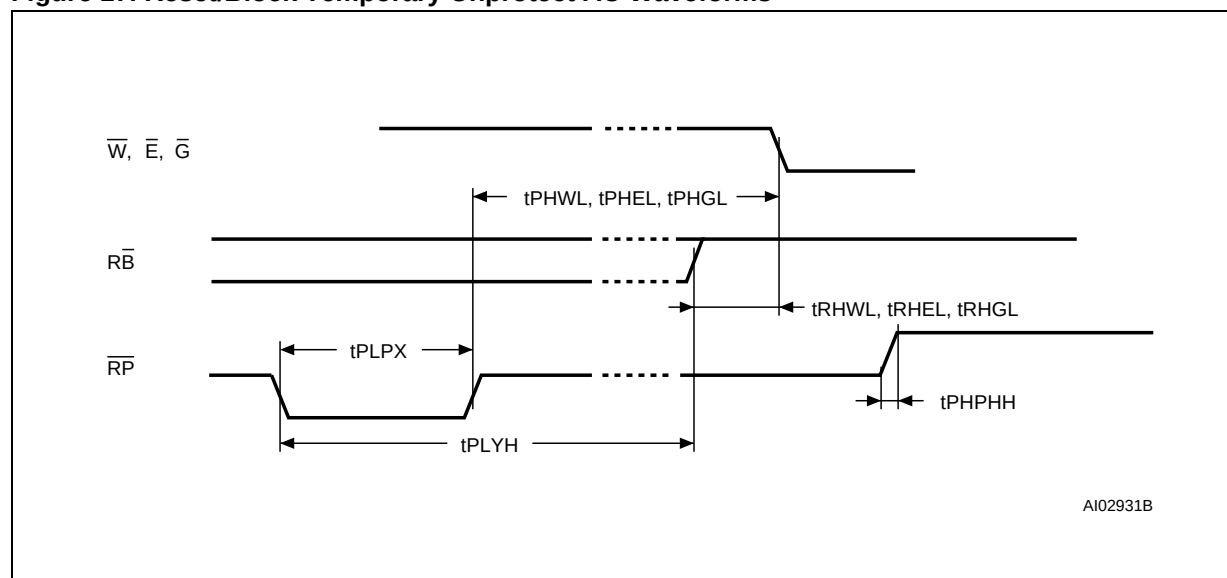
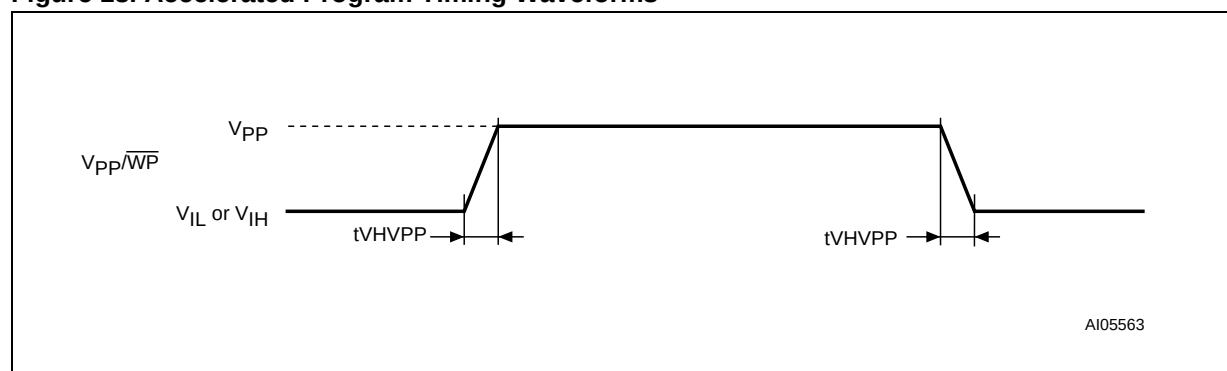


Table 19. Reset/Block Temporary Unprotect AC Characteristics

| Symbol                                                   | Alt         | Parameter                                                                    |     | M29DW640D |     | Unit    |
|----------------------------------------------------------|-------------|------------------------------------------------------------------------------|-----|-----------|-----|---------|
|                                                          |             |                                                                              |     | 70        | 90  |         |
| $t_{PHWL}^{(1)}$<br>$t_{PHEL}^{(1)}$<br>$t_{PHGL}^{(1)}$ | $t_{RH}$    | $\overline{RP}$ High to Write Enable Low, Chip Enable Low, Output Enable Low | Min | 50        | 50  | ns      |
| $t_{RHWL}^{(1)}$<br>$t_{RHEL}^{(1)}$<br>$t_{RHGL}^{(1)}$ | $t_{RB}$    | $\overline{RB}$ High to Write Enable Low, Chip Enable Low, Output Enable Low | Min | 0         | 0   | ns      |
| $t_{PLPX}$                                               | $t_{RP}$    | $\overline{RP}$ Pulse Width                                                  | Min | 500       | 500 | ns      |
| $t_{PLYH}$                                               | $t_{READY}$ | $\overline{RP}$ Low to Read Mode                                             | Max | 50        | 50  | $\mu s$ |
| $t_{PHPH}^{(1)}$                                         | $t_{VIDR}$  | $\overline{RP}$ Rise Time to $V_{ID}$                                        | Min | 500       | 500 | ns      |
| $t_{VHVPP}^{(1)}$                                        |             | $V_{PP}$ Rise and Fall Time                                                  | Min | 250       | 250 | ns      |

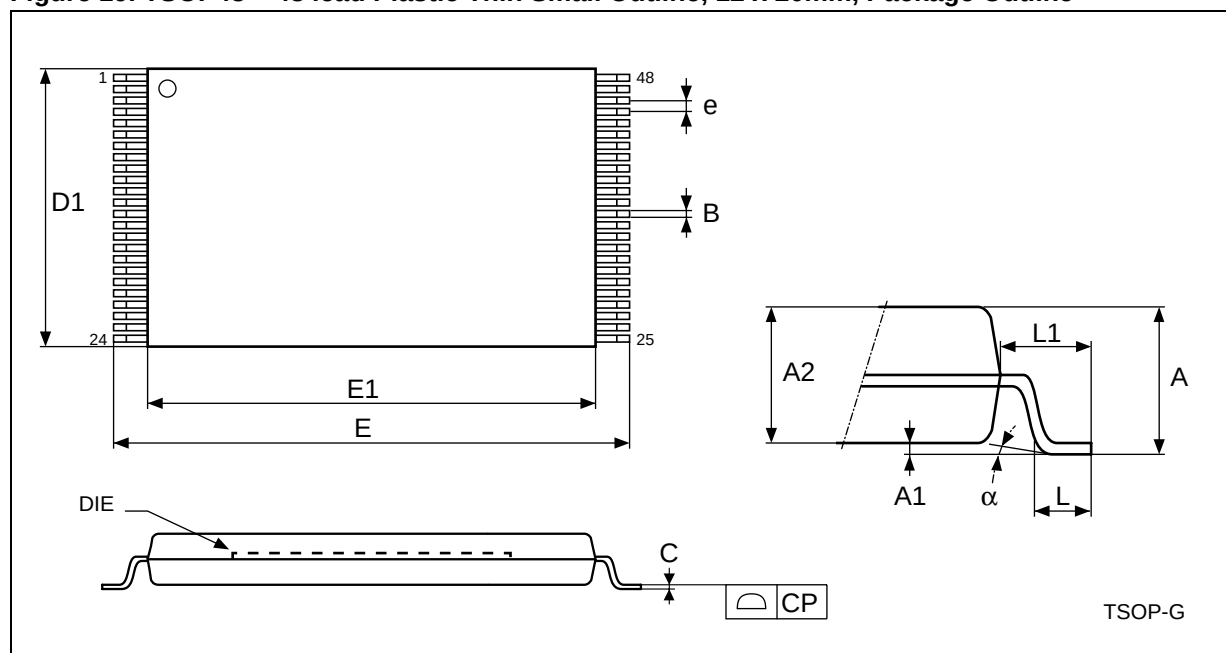
Note: 1. Sampled only, not 100% tested.

Figure 18. Accelerated Program Timing Waveforms



## PACKAGE MECHANICAL

Figure 19. TSOP48 – 48 lead Plastic Thin Small Outline, 12 x 20mm, Package Outline

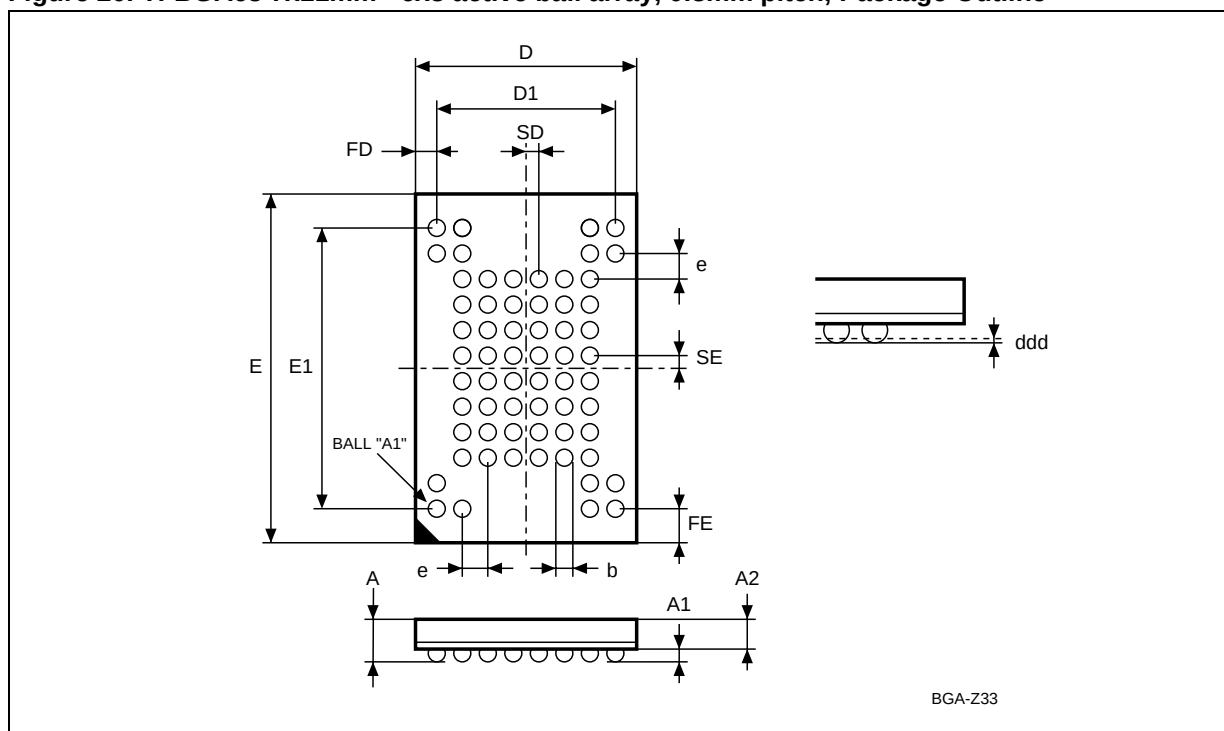


Note: Drawing is not to scale.

Table 20. TSOP48 – 48 lead Plastic Thin Small Outline, 12 x 20mm, Package Mechanical Data

| Symbol   | millimeters |        |        | inches |        |        |
|----------|-------------|--------|--------|--------|--------|--------|
|          | Typ         | Min    | Max    | Typ    | Min    | Max    |
| A        |             |        | 1.200  |        |        | 0.0472 |
| A1       | 0.100       | 0.050  | 0.150  | 0.0039 | 0.0020 | 0.0059 |
| A2       | 1.000       | 0.950  | 1.050  | 0.0394 | 0.0374 | 0.0413 |
| B        | 0.220       | 0.170  | 0.270  | 0.0087 | 0.0067 | 0.0106 |
| C        |             | 0.100  | 0.210  |        | 0.0039 | 0.0083 |
| CP       |             |        | 0.080  |        |        | 0.0031 |
| D1       | 12.000      | 11.900 | 12.100 | 0.4724 | 0.4685 | 0.4764 |
| E        | 20.000      | 19.800 | 20.200 | 0.7874 | 0.7795 | 0.7953 |
| E1       | 18.400      | 18.300 | 18.500 | 0.7244 | 0.7205 | 0.7283 |
| e        | 0.500       | –      | –      | 0.0197 | –      | –      |
| L        | 0.600       | 0.500  | 0.700  | 0.0236 | 0.0197 | 0.0276 |
| L1       | 0.800       |        |        | 0.0315 |        |        |
| $\alpha$ | 3           | 0      | 5      | 3      | 0      | 5      |

Figure 20. TFBGA63 7x11mm - 6x8 active ball array, 0.8mm pitch, Package Outline



Note: Drawing is not to scale.

Table 21. TFBGA63 7x11mm - 6x8 active ball array, 0.8mm pitch, Package Mechanical Data

| Symbol | millimeters |        |        | inches |        |        |
|--------|-------------|--------|--------|--------|--------|--------|
|        | Typ         | Min    | Max    | Typ    | Min    | Max    |
| A      |             |        | 1.200  |        |        | 0.0472 |
| A1     |             | 0.250  |        |        | 0.0098 |        |
| A2     |             |        | 0.900  |        |        | 0.0354 |
| b      |             | 0.350  | 0.450  |        | 0.0138 | 0.0177 |
| D      | 7.000       | 6.900  | 7.100  | 0.2756 | 0.2717 | 0.2795 |
| D1     | 5.600       | —      | —      | 0.2205 | —      | —      |
| ddd    | —           | —      | 0.100  | —      | —      | 0.0039 |
| E      | 11.000      | 10.900 | 11.100 | 0.4331 | 0.4291 | 0.4370 |
| E1     | 8.800       | —      | —      | 0.3465 | —      | —      |
| e      | 0.800       | —      | —      | 0.0315 | —      | —      |
| FD     | 0.700       | —      | —      | 0.0276 | —      | —      |
| FE     | 1.100       | —      | —      | 0.0433 | —      | —      |
| SD     | 0.400       | —      | —      | 0.0157 | —      | —      |
| SE     | 0.400       | —      | —      | 0.0157 | —      | —      |

PART NUMBERING

Table 22. Ordering Information Scheme

|                                                             |           |    |   |   |   |
|-------------------------------------------------------------|-----------|----|---|---|---|
| Example:                                                    | M29DW640D | 70 | N | 1 | T |
| <b>Device Type</b>                                          |           |    |   |   |   |
| M29                                                         |           |    |   |   |   |
| <b>Architecture</b>                                         |           |    |   |   |   |
| D = Dual or Multiple Bank                                   |           |    |   |   |   |
| <b>Operating Voltage</b>                                    |           |    |   |   |   |
| W = V <sub>CC</sub> = 2.7 to 3.6V                           |           |    |   |   |   |
| <b>Device Function</b>                                      |           |    |   |   |   |
| 640D = 64 Mbit (x8/x16), Boot Block, 8+24+24+8 partitioning |           |    |   |   |   |
| <b>Speed</b>                                                |           |    |   |   |   |
| 70 = 70ns                                                   |           |    |   |   |   |
| 90 = 90ns                                                   |           |    |   |   |   |
| <b>Package</b>                                              |           |    |   |   |   |
| N = TSOP48: 12 x 20 mm                                      |           |    |   |   |   |
| ZA = FBGA63: 7 x 11mm, 0.80 mm pitch                        |           |    |   |   |   |
| <b>Temperature Range</b>                                    |           |    |   |   |   |
| 1 = 0 to 70 °C                                              |           |    |   |   |   |
| 6 = -40 to 85 °C                                            |           |    |   |   |   |
| <b>Option</b>                                               |           |    |   |   |   |
| Blank = Standard Packing                                    |           |    |   |   |   |
| T = Tape & Reel Packing                                     |           |    |   |   |   |
| E = Lead-free Package, Standard Packing                     |           |    |   |   |   |
| F = Lead-free Package, Tape & Reel Packing                  |           |    |   |   |   |

Note: This product is also available with the Extended Block factory locked. For further details and ordering information contact your nearest ST sales office.

Devices are shipped from the factory with the memory content bits erased to '1'.  
For a list of available options (Speed, Package, etc.) or for further information on any aspect of this device, please contact your nearest ST Sales Office.

## APPENDIX A. BLOCK ADDRESSES

Table 23. Block Addresses

| Bank   | Block | (KBytes/<br>KWords) | Protection Block<br>Group | (x8)                           | (x16)                          |
|--------|-------|---------------------|---------------------------|--------------------------------|--------------------------------|
| Bank A | 0     | 8/4                 | Protection Group          | 000000h-001FFFh <sup>(1)</sup> | 000000h-000FFFh <sup>(1)</sup> |
|        | 1     | 8/4                 | Protection Group          | 002000h-003FFFh <sup>(1)</sup> | 001000h-001FFFh <sup>(1)</sup> |
|        | 2     | 8/4                 | Protection Group          | 004000h-005FFFh <sup>(1)</sup> | 002000h-002FFFh <sup>(1)</sup> |
|        | 3     | 8/4                 | Protection Group          | 006000h-007FFFh <sup>(1)</sup> | 003000h-003FFFh <sup>(1)</sup> |
|        | 4     | 8/4                 | Protection Group          | 008000h-009FFFh <sup>(1)</sup> | 004000h-004FFFh <sup>(1)</sup> |
|        | 5     | 8/4                 | Protection Group          | 00A000h-00BFFFh <sup>(1)</sup> | 005000h-005FFFh <sup>(1)</sup> |
|        | 6     | 8/4                 | Protection Group          | 00C000h-00DFFFh <sup>(1)</sup> | 006000h-006FFFh <sup>(1)</sup> |
|        | 7     | 8/4                 | Protection Group          | 00E000h-00FFFFh <sup>(1)</sup> | 007000h-007FFFh <sup>(1)</sup> |
|        | 8     | 64/32               | Protection Group          | 010000h-01FFFFh                | 008000h-00FFFFh                |
|        | 9     | 64/32               |                           | 020000h-02FFFFh                | 010000h-017FFFh                |
|        | 10    | 64/32               |                           | 030000h-03FFFFh                | 018000h-01FFFFh                |
|        | 11    | 64/32               | Protection Group          | 040000h-04FFFFh                | 020000h-027FFFh                |
|        | 12    | 64/32               |                           | 050000h-05FFFFh                | 028000h-02FFFFh                |
|        | 13    | 64/32               |                           | 060000h-06FFFFh                | 030000h-037FFFh                |
|        | 14    | 64/32               |                           | 070000h-07FFFFh                | 038000h-03FFFFh                |
|        | 15    | 64/32               | Protection Group          | 080000h-08FFFFh                | 040000h-047FFFh                |
|        | 16    | 64/32               |                           | 090000h-09FFFFh                | 048000h-04FFFFh                |
|        | 17    | 64/32               |                           | 0A0000h-0AFFFFh                | 050000h-057FFFh                |
|        | 18    | 64/32               |                           | 0B0000h-0BFFFFh                | 058000h-05FFFFh                |
|        | 19    | 64/32               | Protection Group          | 0C0000h-0CFFFFh                | 060000h-067FFFh                |
|        | 20    | 64/32               |                           | 0D0000h-0DFFFFh                | 068000h-06FFFFh                |
|        | 21    | 64/32               |                           | 0E0000h-0EFFFFh                | 070000h-077FFFh                |
|        | 22    | 64/32               |                           | 0F0000h-0FFFFFh                | 078000h-07FFFFh                |

| Bank   | Block | (KBytes/<br>KWords) | Protection Block<br>Group | (x8)            | (x16)           |
|--------|-------|---------------------|---------------------------|-----------------|-----------------|
| Bank B | 23    | 64/32               | Protection Group          | 100000h-10FFFFh | 080000h-087FFFh |
|        | 24    | 64/32               |                           | 110000h-11FFFFh | 088000h-08FFFFh |
|        | 25    | 64/32               |                           | 120000h-12FFFFh | 090000h-097FFFh |
|        | 26    | 64/32               |                           | 130000h-13FFFFh | 098000h-09FFFFh |
|        | 27    | 64/32               | Protection Group          | 140000h-14FFFFh | 0A0000h-0A7FFFh |
|        | 28    | 64/32               |                           | 150000h-15FFFFh | 0A8000h-0AFFFFh |
|        | 29    | 64/32               |                           | 160000h-16FFFFh | 0B0000h-0B7FFFh |
|        | 30    | 64/32               |                           | 170000h-17FFFFh | 0B8000h-0BFFFFh |
|        | 31    | 64/32               | Protection Group          | 180000h-18FFFFh | 0C0000h-0C7FFFh |
|        | 32    | 64/32               |                           | 190000h-19FFFFh | 0C8000h-0CFFFFh |
|        | 33    | 64/32               |                           | 1A0000h-1AFFFFh | 0D0000h-0D7FFFh |
|        | 34    | 64/32               |                           | 1B0000h-1BFFFFh | 0D8000h-0DFFFFh |
|        | 35    | 64/32               | Protection Group          | 1C0000h-1CFFFFh | 0E0000h-0E7FFFh |
|        | 36    | 64/32               |                           | 1D0000h-1DFFFFh | 0E8000h-0EFFFFh |
|        | 37    | 64/32               |                           | 1E0000h-1EFFFFh | 0F0000h-0F7FFFh |
|        | 38    | 64/32               |                           | 1F0000h-1FFFFFh | 0F8000h-0FFFFFh |
|        | 39    | 64/32               | Protection Group          | 200000h-20FFFFh | 100000h-107FFFh |
|        | 40    | 64/32               |                           | 210000h-21FFFFh | 108000h-10FFFFh |
|        | 41    | 64/32               |                           | 220000h-22FFFFh | 110000h-117FFFh |
|        | 42    | 64/32               |                           | 230000h-23FFFFh | 118000h-11FFFFh |
|        | 43    | 64/32               | Protection Group          | 240000h-24FFFFh | 120000h-127FFFh |
|        | 44    | 64/32               |                           | 250000h-25FFFFh | 128000h-12FFFFh |
|        | 45    | 64/32               |                           | 260000h-26FFFFh | 130000h-137FFFh |
|        | 46    | 64/32               |                           | 270000h-27FFFFh | 138000h-13FFFFh |
|        | 47    | 64/32               | Protection Group          | 280000h-28FFFFh | 140000h-147FFFh |
|        | 48    | 64/32               |                           | 290000h-29FFFFh | 148000h-14FFFFh |
|        | 49    | 64/32               |                           | 2A0000h-2AFFFFh | 150000h-157FFFh |
|        | 50    | 64/32               |                           | 2B0000h-2BFFFFh | 158000h-15FFFFh |
|        | 51    | 64/32               | Protection Group          | 2C0000h-2CFFFFh | 160000h-167FFFh |
|        | 52    | 64/32               |                           | 2D0000h-2DFFFFh | 168000h-16FFFFh |
|        | 53    | 64/32               |                           | 2E0000h-2EFFFFh | 170000h-177FFFh |
|        | 54    | 64/32               |                           | 2F0000h-2FFFFFh | 178000h-17FFFFh |

| Bank   | Block | (KBytes/<br>KWords) | Protection Block<br>Group | (x8)             | (x16)            |
|--------|-------|---------------------|---------------------------|------------------|------------------|
| Bank B | 55    | 64/32               | Protection Group          | 300000h-30FFFFh  | 180000h-187FFFh  |
|        | 56    | 64/32               |                           | 310000h-31FFFFh  | 188000h-18FFFFh  |
|        | 57    | 64/32               |                           | 320000h-32FFFFh  | 190000h-197FFFh  |
|        | 58    | 64/32               |                           | 330000h-33FFFFh  | 198000h-19FFFFh  |
|        | 59    | 64/32               | Protection Group          | 340000h-34FFFFh  | 1A0000h-1A7FFFh  |
|        | 60    | 64/32               |                           | 350000h-35FFFFh  | 1A8000h-1AFFFFh  |
|        | 61    | 64/32               |                           | 360000h-36FFFFh  | 1B0000h-1B7FFFh  |
|        | 62    | 64/32               |                           | 370000h-37FFFFh  | 1B8000h-1BFFFFh  |
|        | 63    | 64/32               | Protection Group          | 380000h-38FFFFh  | 1C0000h-1C7FFFh  |
|        | 64    | 64/32               |                           | 390000h-39FFFFh  | 1C8000h-1CFFFFh  |
|        | 65    | 64/32               |                           | 3A0000h-3AFFFFh  | 1D0000h-1D7FFFh  |
|        | 66    | 64/32               |                           | 3B0000h-3BFFFFh  | 1D8000h-1DFFFFh  |
|        | 67    | 64/32               | Protection Group          | 3C0000h-3CFFFFh  | 1E0000h-1E7FFFh  |
|        | 68    | 64/32               |                           | 3D0000h-3DFFFFh  | 1E8000h-1EFFFFh  |
|        | 69    | 64/32               |                           | 3E0000h-3EFFFFh  | 1F0000h-1F7FFFh  |
|        | 70    | 64/32               |                           | 3F0000h-3FFFFFFh | 1F8000h-1FFFFFFh |
| Bank C | 71    | 64/32               | Protection Group          | 400000h-40FFFFh  | 200000h-207FFFh  |
|        | 72    | 64/32               |                           | 410000h-41FFFFh  | 208000h-20FFFFh  |
|        | 73    | 64/32               |                           | 420000h-42FFFFh  | 210000h-217FFFh  |
|        | 74    | 64/32               |                           | 430000h-43FFFFh  | 218000h-21FFFFh  |
|        | 75    | 64/32               | Protection Group          | 440000h-44FFFFh  | 220000h-227FFFh  |
|        | 76    | 64/32               |                           | 450000h-45FFFFh  | 228000h-22FFFFh  |
|        | 77    | 64/32               |                           | 460000h-46FFFFh  | 230000h-237FFFh  |
|        | 78    | 64/32               |                           | 470000h-47FFFFh  | 238000h-23FFFFh  |
|        | 79    | 64/32               | Protection Group          | 480000h-48FFFFh  | 240000h-247FFFh  |
|        | 80    | 64/32               |                           | 490000h-49FFFFh  | 248000h-24FFFFh  |
|        | 81    | 64/32               |                           | 4A0000h-4AFFFFh  | 250000h-257FFFh  |
|        | 82    | 64/32               |                           | 4B0000h-4BFFFFh  | 258000h-25FFFFh  |
|        | 83    | 64/32               | Protection Group          | 4C0000h-4CFFFFh  | 260000h-267FFFh  |
|        | 84    | 64/32               |                           | 4D0000h-4DFFFFh  | 268000h-26FFFFh  |
|        | 85    | 64/32               |                           | 4E0000h-4EFFFFh  | 270000h-277FFFh  |
|        | 86    | 64/32               |                           | 4F0000h-4FFFFFFh | 278000h-27FFFFh  |

| Bank   | Block | (KBytes/<br>KWords) | Protection Block<br>Group | (x8)             | (x16)            |
|--------|-------|---------------------|---------------------------|------------------|------------------|
| Bank C | 87    | 64/32               | Protection Group          | 500000h–50FFFFh  | 280000h–287FFFh  |
|        | 88    | 64/32               |                           | 510000h–51FFFFh  | 288000h–28FFFFh  |
|        | 89    | 64/32               |                           | 520000h–52FFFFh  | 290000h–297FFFh  |
|        | 90    | 64/32               |                           | 530000h–53FFFFh  | 298000h–29FFFFh  |
|        | 91    | 64/32               | Protection Group          | 540000h–54FFFFh  | 2A0000h–2A7FFFh  |
|        | 92    | 64/32               |                           | 550000h–55FFFFh  | 2A8000h–2AFFFFh  |
|        | 93    | 64/32               |                           | 560000h–56FFFFh  | 2B0000h–2B7FFFh  |
|        | 94    | 64/32               |                           | 570000h–57FFFFh  | 2B8000h–2BFFFFh  |
|        | 95    | 64/32               | Protection Group          | 580000h–58FFFFh  | 2C0000h–2C7FFFh  |
|        | 96    | 64/32               |                           | 590000h–59FFFFh  | 2C8000h–2CFFFFh  |
|        | 97    | 64/32               |                           | 5A0000h–5AFFFFh  | 2D0000h–2D7FFFh  |
|        | 98    | 64/32               |                           | 5B0000h–5BFFFFh  | 2D8000h–2DFFFFh  |
|        | 99    | 64/32               | Protection Group          | 5C0000h–5CFFFFh  | 2E0000h–2E7FFFh  |
|        | 100   | 64/32               |                           | 5D0000h–5DFFFFh  | 2E8000h–2EFFFFh  |
|        | 101   | 64/32               |                           | 5E0000h–5EFFFFh  | 2F0000h–2F7FFFh  |
|        | 102   | 64/32               |                           | 5F0000h–5FFFFFFh | 2F8000h–2FFFFFFh |
|        | 103   | 64/32               | Protection Group          | 600000h–60FFFFh  | 300000h–307FFFh  |
|        | 104   | 64/32               |                           | 610000h–61FFFFh  | 308000h–30FFFFh  |
|        | 105   | 64/32               |                           | 620000h–62FFFFh  | 310000h–317FFFh  |
|        | 106   | 64/32               |                           | 630000h–63FFFFh  | 318000h–31FFFFh  |
|        | 107   | 64/32               | Protection Group          | 640000h–64FFFFh  | 320000h–327FFFh  |
|        | 108   | 64/32               |                           | 650000h–65FFFFh  | 328000h–32FFFFh  |
|        | 109   | 64/32               |                           | 660000h–66FFFFh  | 330000h–337FFFh  |
|        | 110   | 64/32               |                           | 670000h–67FFFFh  | 338000h–33FFFFh  |
|        | 111   | 64/32               | Protection Group          | 680000h–68FFFFh  | 340000h–347FFFh  |
|        | 112   | 64/32               |                           | 690000h–69FFFFh  | 348000h–34FFFFh  |
|        | 113   | 64/32               |                           | 6A0000h–6AFFFFh  | 350000h–357FFFh  |
|        | 114   | 64/32               |                           | 6B0000h–6BFFFFh  | 358000h–35FFFFh  |
|        | 115   | 64/32               | Protection Group          | 6C0000h–6CFFFFh  | 360000h–367FFFh  |
|        | 116   | 64/32               |                           | 6D0000h–6DFFFFh  | 368000h–36FFFFh  |
|        | 117   | 64/32               |                           | 6E0000h–6EFFFFh  | 370000h–377FFFh  |
|        | 118   | 64/32               |                           | 6F0000h–6FFFFFFh | 378000h–37FFFFh  |

| Bank   | Block | (KBytes/<br>KWords) | Protection Block<br>Group | (x8)             | (x16)            |
|--------|-------|---------------------|---------------------------|------------------|------------------|
| Bank D | 119   | 64/32               | Protection Group          | 700000h–70FFFFh  | 380000h–387FFFh  |
|        | 120   | 64/32               |                           | 710000h–71FFFFh  | 388000h–38FFFFh  |
|        | 121   | 64/32               |                           | 720000h–72FFFFh  | 390000h–397FFFh  |
|        | 122   | 64/32               |                           | 730000h–73FFFFh  | 398000h–39FFFFh  |
|        | 123   | 64/32               | Protection Group          | 740000h–74FFFFh  | 3A0000h–3A7FFFh  |
|        | 124   | 64/32               |                           | 750000h–75FFFFh  | 3A8000h–3AFFFFh  |
|        | 125   | 64/32               |                           | 760000h–76FFFFh  | 3B0000h–3B7FFFh  |
|        | 126   | 64/32               |                           | 770000h–77FFFFh  | 3B8000h–3BFFFFh  |
|        | 127   | 64/32               | Protection Group          | 780000h–78FFFFh  | 3C0000h–3C7FFFh  |
|        | 128   | 64/32               |                           | 790000h–79FFFFh  | 3C8000h–3CFFFFh  |
|        | 129   | 64/32               |                           | 7A0000h–7AFFFFh  | 3D0000h–3D7FFFh  |
|        | 130   | 64/32               |                           | 7B0000h–7BFFFFh  | 3D8000h–3DFFFFh  |
|        | 131   | 64/32               | Protection Group          | 7C0000h–7CFFFFh  | 3E0000h–3E7FFFh  |
|        | 132   | 64/32               |                           | 7D0000h–7DFFFFh  | 3E8000h–3EFFFFh  |
|        | 133   | 64/32               |                           | 7E0000h–7EFFFFh  | 3F0000h–3F7FFFh  |
|        | 134   | 8/4                 | Protection Group          | 7F0000h–7F1FFFh  | 3F8000h–3F8FFFh  |
|        | 135   | 8/4                 | Protection Group          | 7F2000h–7F3FFFh  | 3F9000h–3F9FFFh  |
|        | 136   | 8/4                 | Protection Group          | 7F4000h–7F5FFFh  | 3FA000h–3FAFFFh  |
|        | 137   | 8/4                 | Protection Group          | 7F6000h–7F7FFFh  | 3FB000h–3FBFFFh  |
|        | 138   | 8/4                 | Protection Group          | 7F8000h–7F9FFFh  | 3FC000h–3FCFFFh  |
|        | 139   | 8/4                 | Protection Group          | 7FA000h–7FBFFFh  | 3FD000h–3FDFFFh  |
|        | 140   | 8/4                 | Protection Group          | 7FC000h–7FDFFFh  | 3FE000h–3FEFFFh  |
|        | 141   | 8/4                 | Protection Group          | 7FE000h–7FFFFFFh | 3FF000h–3FFFFFFh |

## APPENDIX B. COMMON FLASH INTERFACE (CFI)

The Common Flash Interface is a JEDEC approved, standardized data structure that can be read from the Flash memory device. It allows a system software to query the device to determine various electrical and timing parameters, density information and functions supported by the memory. The system can interface easily with the device, enabling the software to upgrade itself when necessary.

When the Read CFI Query command is issued the addressed bank enters Read CFI Query mode and

read operations in the same bank (A21-A19) output the CFI data. Tables 24, 25, 26, 27, 28 and 29 show the addresses (A-1, A0-A10) used to retrieve the data.

The CFI data structure also contains a security area where a 64 bit unique security number is written (see Table 29., Security Code Area). This area can be accessed only in Read mode by the final user. It is impossible to change the security number after it has been written by ST.

**Table 24. Query Structure Overview**

| Address |     | Sub-section Name                                | Description                                                         |
|---------|-----|-------------------------------------------------|---------------------------------------------------------------------|
| x16     | x8  |                                                 |                                                                     |
| 10h     | 20h | CFI Query Identification String                 | Command set ID and algorithm data offset                            |
| 1Bh     | 36h | System Interface Information                    | Device timing & voltage information                                 |
| 27h     | 4Eh | Device Geometry Definition                      | Flash device layout                                                 |
| 40h     | 80h | Primary Algorithm-specific Extended Query table | Additional information specific to the Primary Algorithm (optional) |
| 61h     | C2h | Security Code Area                              | 64 bit unique device number                                         |

Note: Query data are always presented on the lowest order data outputs.

**Table 25. CFI Query Identification String**

| Address |     | Data  | Description                                                                                              | Value          |
|---------|-----|-------|----------------------------------------------------------------------------------------------------------|----------------|
| x16     | x8  |       |                                                                                                          |                |
| 10h     | 20h | 0051h | Query Unique ASCII String "QRY"                                                                          | "Q"            |
| 11h     | 22h | 0052h |                                                                                                          | "R"            |
| 12h     | 24h | 0059h |                                                                                                          | "Y"            |
| 13h     | 26h | 0002h | Primary Algorithm Command Set and Control Interface ID code 16 bit ID code defining a specific algorithm | AMD Compatible |
| 14h     | 28h | 0000h |                                                                                                          |                |
| 15h     | 2Ah | 0040h | Address for Primary Algorithm extended Query table (see Table 28)                                        | P = 40h        |
| 16h     | 2Ch | 0000h |                                                                                                          |                |
| 17h     | 2Eh | 0000h | Alternate Vendor Command Set and Control Interface ID Code second vendor - specified algorithm supported | NA             |
| 18h     | 30h | 0000h |                                                                                                          |                |
| 19h     | 32h | 0000h | Address for Alternate Algorithm extended Query table                                                     | NA             |
| 1Ah     | 34h | 0000h |                                                                                                          |                |

Note: Query data are always presented on the lowest order data outputs (DQ7-DQ0) only. DQ8-DQ15 are '0'.

Table 26. CFI Query System Interface Information

| Address |     | Data  | Description                                                                                                                         | Value  |
|---------|-----|-------|-------------------------------------------------------------------------------------------------------------------------------------|--------|
| x16     | x8  |       |                                                                                                                                     |        |
| 1Bh     | 36h | 0027h | V <sub>CC</sub> Logic Supply Minimum Program/Erase voltage<br>bit 7 to 4BCD value in volts<br>bit 3 to 0BCD value in 100 mV         | 2.7V   |
| 1Ch     | 38h | 0036h | V <sub>CC</sub> Logic Supply Maximum Program/Erase voltage<br>bit 7 to 4BCD value in volts<br>bit 3 to 0BCD value in 100 mV         | 3.6V   |
| 1Dh     | 3Ah | 00B5h | V <sub>PP</sub> [Programming] Supply Minimum Program/Erase voltage<br>bit 7 to 4HEX value in volts<br>bit 3 to 0BCD value in 100 mV | 11.5V  |
| 1Eh     | 3Ch | 00C5h | V <sub>PP</sub> [Programming] Supply Maximum Program/Erase voltage<br>bit 7 to 4HEX value in volts<br>bit 3 to 0BCD value in 100 mV | 12.5V  |
| 1Fh     | 3Eh | 0004h | Typical timeout per single Byte/Word program = 2 <sup>n</sup> μs                                                                    | 16μs   |
| 20h     | 40h | 0000h | Typical timeout for minimum size write buffer program = 2 <sup>n</sup> μs                                                           | NA     |
| 21h     | 42h | 000Ah | Typical timeout per individual block erase = 2 <sup>n</sup> ms                                                                      | 1s     |
| 22h     | 44h | 0000h | Typical timeout for full Chip Erase = 2 <sup>n</sup> ms                                                                             | NA     |
| 23h     | 46h | 0004h | Maximum timeout for Byte/Word program = 2 <sup>n</sup> times typical                                                                | 256 μs |
| 24h     | 48h | 0000h | Maximum timeout for write buffer program = 2 <sup>n</sup> times typical                                                             | NA     |
| 25h     | 4Ah | 0003h | Maximum timeout per individual block erase = 2 <sup>n</sup> times typical                                                           | 8s     |
| 26h     | 4Ch | 0000h | Maximum timeout for Chip Erase = 2 <sup>n</sup> times typical                                                                       | NA     |

Table 27. Device Geometry Definition

| Address    |            | Data           | Description                                                                                                                            | Value             |
|------------|------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| x16        | x8         |                |                                                                                                                                        |                   |
| 27h        | 4Eh        | 0017h          | Device Size = 2 <sup>n</sup> in number of Bytes                                                                                        | 8 MBytes          |
| 28h<br>29h | 50h<br>52h | 0002h<br>0000h | Flash Device Interface Code description                                                                                                | x8, x16<br>Async. |
| 2Ah<br>2Bh | 54h<br>56h | 0003h<br>0000h | Maximum number of Bytes in multi-Byte program or page = 2 <sup>n</sup>                                                                 | 8                 |
| 2Ch        | 58h        | 0003h          | Number of Erase Block Regions <sup>(1)</sup> . It specifies the number of regions containing contiguous Erase Blocks of the same size. | 3                 |
| 2Dh<br>2Eh | 5Ah<br>5Ch | 0007h<br>0000h | Erase Block Region 1 Information<br>Number of Erase Blocks of identical size = 0007h+1                                                 | 8                 |
| 2Fh<br>30h | 5Eh<br>60h | 0020h<br>0000h | Erase Block Region 1 Information<br>Block size in Region 1 = 0020h * 256 Byte                                                          | 8 KBytes          |
| 31h<br>32h | 62h<br>64h | 007Dh<br>0000h | Erase Block Region 2 Information<br>Number of Erase Blocks of identical size = 007Dh+1                                                 | 126               |
| 33h<br>34h | 66h<br>68h | 0000h<br>0001h | Erase Block Region 2 Information<br>Block size in Region 2 = 0100h * 256 Byte                                                          | 64 KBytes         |

## M29DW640D

| Address                  |                          | Data                             | Description                                                                              | Value    |
|--------------------------|--------------------------|----------------------------------|------------------------------------------------------------------------------------------|----------|
| x16                      | x8                       |                                  |                                                                                          |          |
| 35h<br>36h               | 6Ah<br>6Ch               | 0007h<br>0000h                   | Erase Block Region 3 information<br>Number of Erase Blocks of identical size = 0007h + 1 | 8        |
| 37h<br>38h               | 6Eh<br>70h               | 0020h<br>0000h                   | Erase Block Region 3 information<br>Block size in region 3 = 0020h * 256 Bytes           | 8 KBytes |
| 39h<br>3Ah<br>3Bh<br>3Ch | 72h<br>74h<br>76h<br>78h | 0000h<br>0000h<br>0000h<br>0000h | Erase Block Region 4 information                                                         |          |

Note: 1. Erase Block Region 1 corresponds to addresses 000000h to 007FFFh; Erase block Region 2 corresponds to addresses 008000h to 3F7FFFh and Erase Block Region 3 corresponds to addresses 3F8000h to 3FFFFFFh.

**Table 28. Primary Algorithm-Specific Extended Query Table**

| Address           |                   | Data                    | Description                                                                                                             | Value             |
|-------------------|-------------------|-------------------------|-------------------------------------------------------------------------------------------------------------------------|-------------------|
| x16               | x8                |                         |                                                                                                                         |                   |
| 40h<br>41h<br>42h | 80h<br>82h<br>84h | 0050h<br>0052h<br>0049h | Primary Algorithm extended Query table unique ASCII string "PRI"                                                        | "P"<br>"R"<br>"I" |
| 43h               | 86h               | 0031h                   | Major version number, ASCII                                                                                             | "1"               |
| 44h               | 88h               | 0033h                   | Minor version number, ASCII                                                                                             | "3"               |
| 45h               | 8Ah               | 0000h                   | Address Sensitive Unlock (bits 1 to 0)<br>00 = required, 01 = not required<br>Silicon Revision Number (bits 7 to 2)     | Yes               |
| 46h               | 8Ch               | 0002h                   | Erase Suspend<br>00 = not supported, 01 = Read only, 02 = Read and Write                                                | 2                 |
| 47h               | 8Eh               | 0001h                   | Block Protection<br>00 = not supported, x = number of sectors in per group                                              | 1                 |
| 48h               | 90h               | 0001h                   | Temporary Block Unprotect<br>00 = not supported, 01 = supported                                                         | Yes               |
| 49h               | 92h               | 0005h                   | Block Protect /Unprotect<br>04 = M29W400B<br>05 = M29DW640D                                                             | 5                 |
| 4Ah               | 94h               | 0077h                   | Simultaneous Operations,<br>x = number of blocks (excluding Bank A)                                                     | 119               |
| 4Bh               | 96h               | 0000h                   | Burst Mode, 00 = not supported, 01 = supported                                                                          | No                |
| 4Ch               | 98h               | 0001h                   | Page Mode, 00 = not supported, 01 = 4 page Word, 02 = 8 page Word                                                       | Yes               |
| 4Dh               | 9Ah               | 00B5h                   | V <sub>PP</sub> Supply Minimum Program/Erase voltage<br>bit 7 to 4 HEX value in volts<br>bit 3 to 0 BCD value in 100 mV | 11.5V             |
| 4Eh               | 9Ch               | 00C5h                   | V <sub>PP</sub> Supply Maximum Program/Erase voltage<br>bit 7 to 4 HEX value in volts<br>bit 3 to 0 BCD value in 100 mV | 12.5V             |

| Address |     | Data  | Description                                                                                                                                                                                             | Value |
|---------|-----|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| x16     | x8  |       |                                                                                                                                                                                                         |       |
| 4Fh     | 9Eh | 0001h | Top/Bottom Boot Block Flag<br>00h = uniform device<br>01h = 8 x8 KByte Blocks, Top and Bottom Boot with Write Protect<br>02h = Bottom boot device<br>03h = Top Boot Device<br>04h = Both Top and Bottom | T/B   |
| 50h     | A0h | 0001h | Program Suspend, 00 = not supported, 01 = supported                                                                                                                                                     | Yes   |
| 57h     | AEh | 0004h | Bank Organization, 00 = data at 4Ah is zero<br>X = number of banks                                                                                                                                      | 4     |
| 58h     | B0h | 0017h | Bank A information<br>X = number of blocks in Bank A                                                                                                                                                    | 23    |
| 59h     | B2h | 0030h | Bank B information<br>X = number of blocks in Bank B                                                                                                                                                    | 48    |
| 5Ah     | B4h | 0030h | Bank C information<br>X = number of blocks in Bank C                                                                                                                                                    | 48    |
| 5Bh     | B6h | 0017h | Bank D information<br>X = number of blocks in Bank D                                                                                                                                                    | 23    |

Table 29. Security Code Area

| Address |          | Data | Description                  |
|---------|----------|------|------------------------------|
| x16     | x8       |      |                              |
| 61h     | C3h, C2h | XXXX | 64 bit: unique device number |
| 62h     | C5h, C4h | XXXX |                              |
| 63h     | C7h, C6h | XXXX |                              |
| 64h     | C9h, C8h | XXXX |                              |

## APPENDIX C. EXTENDED MEMORY BLOCK

The M29DW640D has an extra block, the Extended Block, that can be accessed using a dedicated command.

This Extended Block is 128 Words in x16 mode and 256 Bytes in x8 mode. It is used as a security block (to provide a permanent security identification number) or to store additional information.

The Extended Block is either Factory Locked or Customer Lockable, its status is indicated by bit DQ7. This bit is permanently set to either '1' or '0' at the factory and cannot be changed. When set to '1', it indicates that the device is factory locked and the Extended Block is protected. When set to '0', it indicates that the device is customer lockable and the Extended Block is unprotected. Bit DQ7 being permanently locked to either '1' or '0' is another security feature which ensures that a customer lockable device cannot be used instead of a factory locked one.

Bit DQ7 is the most significant bit in the Extended Block Verify Code and a specific procedure must be followed to read it. See "Extended Block Indicator Bit" in Tables 3 and 4, [Bus Operations, BYTE = V<sub>IL</sub>](#) and [Bus Operations, BYTE = V<sub>IH</sub>](#), respectively, for details of how to read bit DQ7.

The Extended Block can only be accessed when the device is in Extended Block mode. For details of how the Extended Block mode is entered and exited, refer to the [Enter Extended Block Command](#) and [Exit Extended Block Command](#) paragraphs, and to Tables 5 and 6, "Commands, 16-bit mode, BYTE = V<sub>IH</sub>" and "Commands, 8-bit mode, BYTE = V<sub>IL</sub>", respectively.

### Factory Locked Extended Block

In devices where the Extended Block is factory locked, the Security Identification Number is written to the Extended Block address space (see [Table 30., Extended Block Address and Data](#)) in the factory. The DQ7 bit is set to '1' and the Extended Block cannot be unprotected.

### Customer Lockable Extended Block

A device where the Extended Block is customer lockable is delivered with the DQ7 bit set to '0' and the Extended Block unprotected. It is up to the customer to program and protect the Extended Block but care must be taken because the protection of the Extended Block is not reversible.

There are two ways of protecting the Extended Block:

- Issue the Enter Extended Block command to place the device in Extended Block mode, then use the In-System Technique with RP either at V<sub>IH</sub> or at V<sub>ID</sub> (refer to Appendix D, In-System Technique and to the corresponding flowcharts, Figures 23 and 24, for a detailed explanation of the technique).
- Issue the Enter Extended Block command to place the device in Extended Block mode, then use the Programmer Technique (refer to Appendix D, Programmer Technique and to the corresponding flowcharts, Figures 21 and 22, for a detailed explanation of the technique).

Once the Extended Block is programmed and protected, the Exit Extended Block command must be issued to exit the Extended Block mode and return the device to Read mode.

**Table 30. Extended Block Address and Data**

| Device    | Address <sup>(1)</sup> |                 | Data               |                                |                        |
|-----------|------------------------|-----------------|--------------------|--------------------------------|------------------------|
|           | x8                     | x16             | Factory Locked     |                                | Customer Lockable      |
| M29DW640D | 000000h-00000Fh        | 000000h-000007h | Random Number      | Security Identification Number | Determined by Customer |
|           | 000010h-000020h        | 000008h-00000Fh | ESN <sup>(2)</sup> |                                |                        |
|           | 000021h-0000FFh        | 000010h-00007Fh | Unavailable        |                                |                        |

Note: 1. See [Table 23., Block Addresses](#).

2. ENS = Electronic Serial Number.

## APPENDIX D. BLOCK PROTECTION

Block protection can be used to prevent any operation from modifying the data stored in the memory. The blocks are protected in groups, refer to Appendix A, Table 23 for details of the Protection Groups. Once protected, Program and Erase operations within the protected group fail to change the data.

There are three techniques that can be used to control Block Protection, these are the Programmer technique, the In-System technique and Temporary Unprotection. Temporary Unprotection is controlled by the Reset/Block Temporary Unprotection pin, RP; this is described in the Signal Descriptions section.

To protect the Extended Block issue the Enter Extended Block command and then use either the Programmer or In-System technique. Once protected issue the Exit Extended Block command to return to read mode. The Extended Block protection is irreversible, once protected the protection cannot be undone.

### Programmer Technique

The Programmer technique uses high ( $V_{ID}$ ) voltage levels on some of the bus pins. These cannot be achieved using a standard microprocessor bus, therefore the technique is recommended only for use in Programming Equipment.

To protect a group of blocks follow the flowchart in Figure 21., Programmer Equipment Group Protect Flowchart. To unprotect the whole chip it is necessary to protect all of the groups first, then all groups can be unprotected at the same time. To unprotect the chip follow Figure 22., Programmer Equipment Chip Unprotect Flowchart. Table 31., Programmer Technique Bus Operations,

BYTE =  $V_{IH}$  or  $V_{IL}$ , gives a summary of each operation.

The timing on these flowcharts is critical. Care should be taken to ensure that, where a pause is specified, it is followed as closely as possible. Do not abort the procedure before reaching the end. Chip Unprotect can take several seconds and a user message should be provided to show that the operation is progressing.

### In-System Technique

The In-System technique requires a high voltage level on the Reset/Blocks Temporary Unprotect pin, RP<sup>(1)</sup>. This can be achieved without violating the maximum ratings of the components on the microprocessor bus, therefore this technique is suitable for use after the memory has been fitted to the system.

To protect a group of blocks follow the flowchart in Figure 23., In-System Equipment Group Protect Flowchart. To unprotect the whole chip it is necessary to protect all of the groups first, then all the groups can be unprotected at the same time. To unprotect the chip follow Figure 24., In-System Equipment Chip Unprotect Flowchart.

The timing on these flowcharts is critical. Care should be taken to ensure that, where a pause is specified, it is followed as closely as possible. Do not allow the microprocessor to service interrupts that will upset the timing and do not abort the procedure before reaching the end. Chip Unprotect can take several seconds and a user message should be provided to show that the operation is progressing.

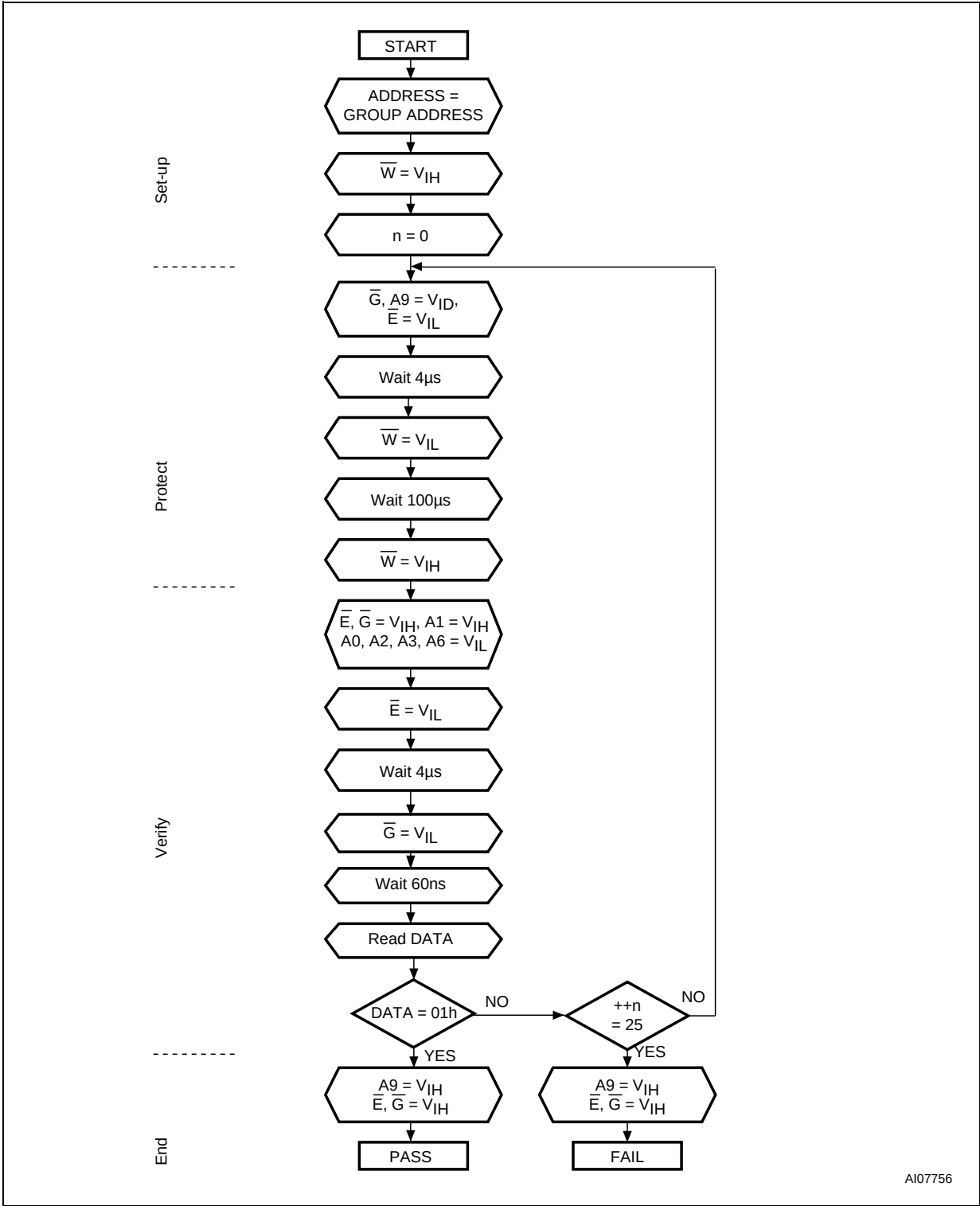
Note: 1. RP can be either at  $V_{IH}$  or at  $V_{ID}$  when using the In-System Technique to protect the Extended Block.

**Table 31. Programmer Technique Bus Operations, BYTE =  $V_{IH}$  or  $V_{IL}$**

| Operation                            | $\overline{E}$ | $\overline{G}$ | $\overline{W}$ | Address Inputs<br>A0-A21                                                                                                                  | Data Inputs/Outputs<br>DQ15A-1, DQ14-DQ0 |
|--------------------------------------|----------------|----------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| Block (Group) Protect <sup>(1)</sup> | $V_{IL}$       | $V_{ID}$       | $V_{IL}$ Pulse | A9 = $V_{ID}$ , A12-A21 Block Address<br>Others = X                                                                                       | X                                        |
| Chip Unprotect                       | $V_{ID}$       | $V_{ID}$       | $V_{IL}$ Pulse | A9 = $V_{ID}$ , A12 = $V_{IH}$ , A15 = $V_{IH}$<br>Others = X                                                                             | X                                        |
| Block (Group) Protect Verify         | $V_{IL}$       | $V_{IL}$       | $V_{IH}$       | A0 = $V_{IL}$ , A1 = $V_{IH}$ , A2 = $V_{IL}$ , A3 = $V_{IL}$ ,<br>A6 = $V_{IL}$ , A9 = $V_{ID}$ ,<br>A12-A21 Block Address<br>Others = X | Pass = xx01h<br>Retry = xx00h.           |
| Block (Group) Unprotect Verify       | $V_{IL}$       | $V_{IL}$       | $V_{IH}$       | A0 = $V_{IL}$ , A1 = $V_{IH}$ , A2 = $V_{IL}$ , A3 = $V_{IL}$ ,<br>A6 = $V_{IH}$ , A9 = $V_{ID}$ ,<br>A12-A21 Block Address<br>Others = X | Pass = xx00h<br>Retry = xx01h.           |

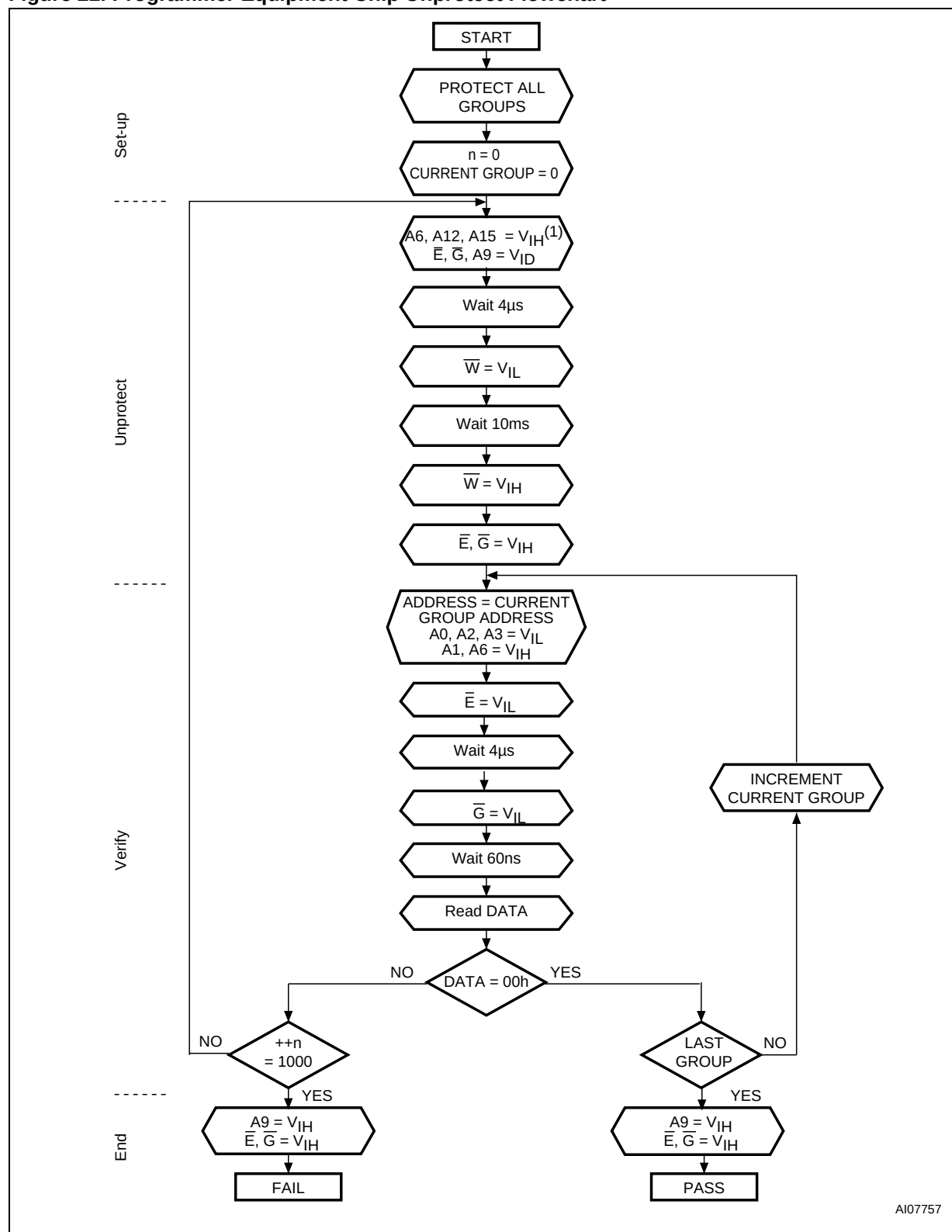
Note: 1. Block Protection Groups are shown in Appendix D, Table 23.

Figure 21. Programmer Equipment Group Protect Flowchart



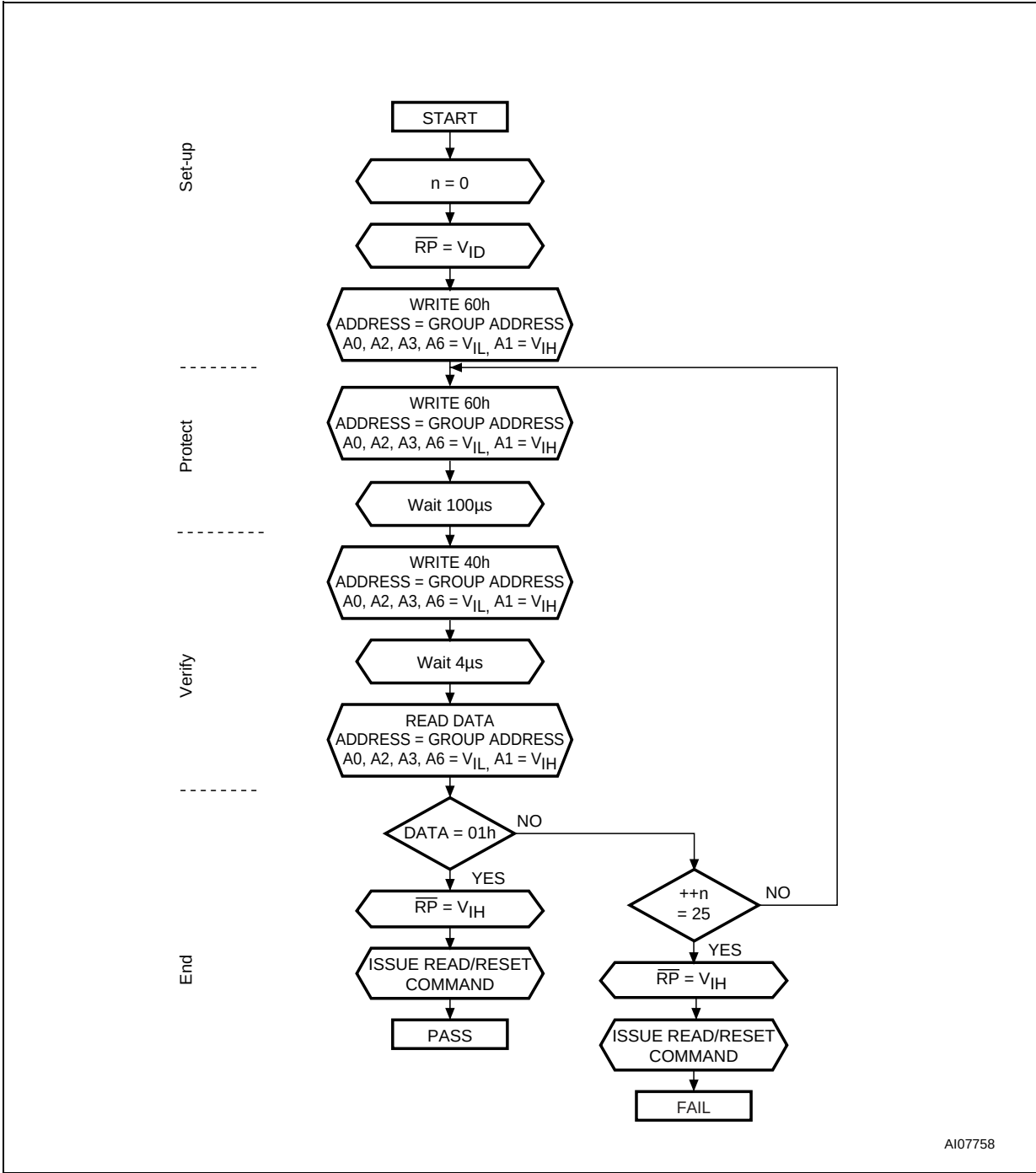
Note: 1. Block Protection Groups are shown in Appendix D, Table 23.

Figure 22. Programmer Equipment Chip Unprotect Flowchart



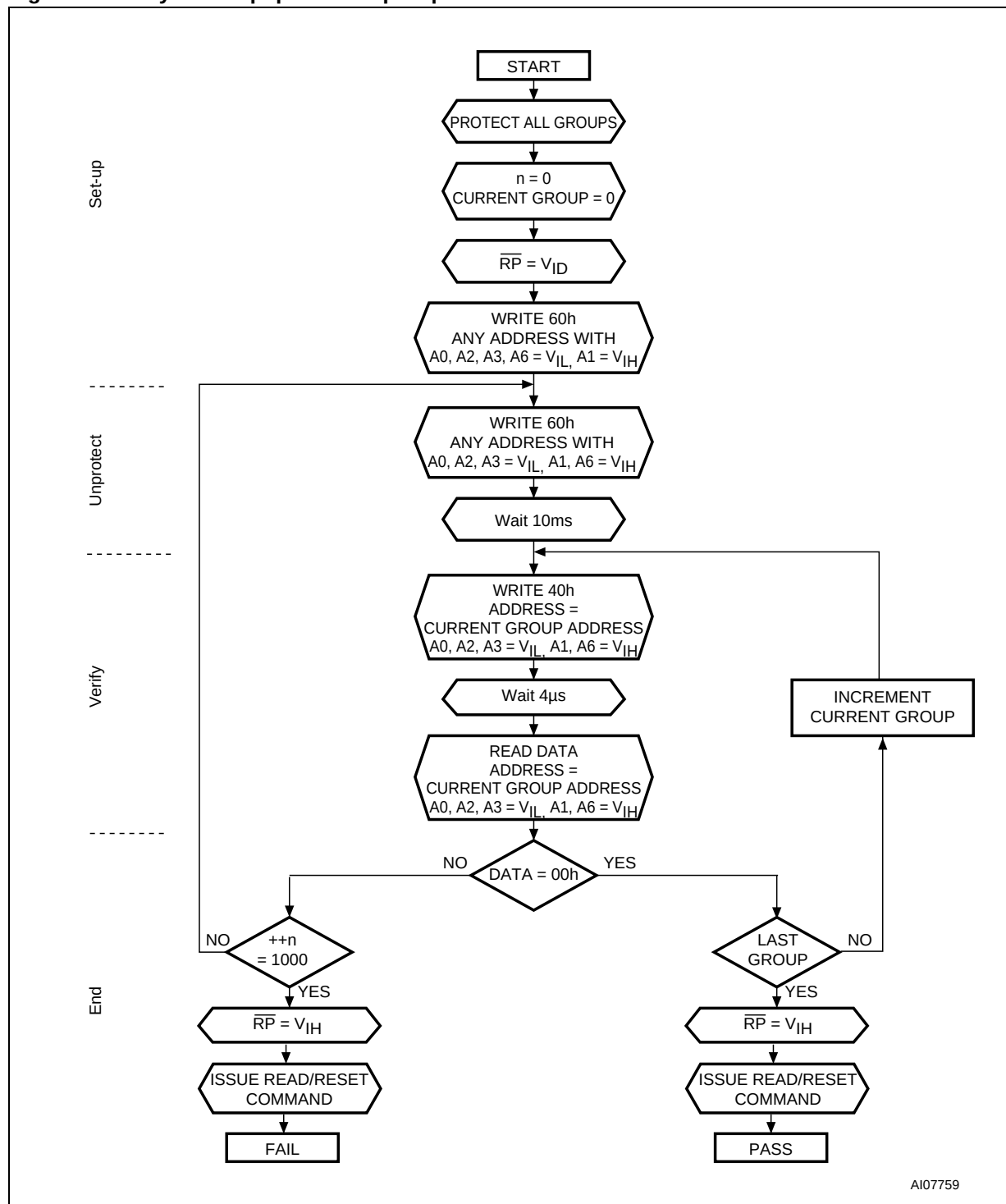
Note: 1. Block Protection Groups are shown in Appendix D, Table 23.

Figure 23. In-System Equipment Group Protect Flowchart



Note: 1. Block Protection Groups are shown in Appendix D, Table 23.  
2. RP can be either at VIH or at VID when using the In-System Technique to protect the Extended Block.

Figure 24. In-System Equipment Chip Unprotect Flowchart



Note: 1. Block Protection Groups are shown in Appendix D, Table 23.

## REVISION HISTORY

Table 32. Document Revision History

| Date        | Version | Revision Details                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10-Dec-2002 | 1.0     | Document written                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 27-Feb-2003 | 1.1     | Typical after 100k W/E Cycles column removed from <a href="#">Table 7., Program, Erase Times and Program, Erase Endurance Cycles</a> , and Data Retention and Erase Suspend Latency Time parameters added. Device code corrected. Address on DQ7-DQ0 modified for the cycle No.2 of the Read Device code in <a href="#">Table 3., Bus Operations, BYTE = V<sub>IL</sub></a> . Lead-free package options E and F added to <a href="#">Table 22., Ordering Information Scheme</a> .                                                                   |
| 01-Apr-2003 | 1.2     | Document Status promoted to Preliminary Data. Page mode added, Appendix C "Extended Memory Block" added. V <sub>SS</sub> signal description clarified. Parameter I <sub>ID</sub> removed from DC Characteristics Table. Read CFI Query command address clarified. Program Suspend Latency time added to <a href="#">Table 7., Program, Erase Times and Program, Erase Endurance Cycles</a> . Dual operations section added.                                                                                                                         |
| 15-May-2003 | 1.3     | Note added to <a href="#">Table 22., Ordering Information Scheme</a> . <a href="#">Table 20., TSOP48 – 48 lead Plastic Thin Small Outline, 12 x 20mm, Package Mechanical Data</a> and <a href="#">Figure 19., TSOP48 – 48 lead Plastic Thin Small Outline, 12 x 20mm, Package Outline</a> , modified.<br>Data modified at addresses 4Ah and 4Fh in <a href="#">Table 28, Primary Algorithm-Specific Extended Query Table</a> and at address 2Ch in <a href="#">Table 27, Device Geometry Definition</a> .                                           |
| 18-Jul-2003 | 2.0     | Note 1 removed from: <a href="#">Figures 5 and 6, Block Address (x8 and x16, respectively)</a> , and from <a href="#">Table 23, Block Addresses</a> . RB bit is High-Z (instead of 1), in <a href="#">Table 8. Auto Select Command</a> description modified. Extended Memory Block size modified in <a href="#">Appendix C</a> .                                                                                                                                                                                                                    |
| 15-Sep-2003 | 2.1     | <a href="#">Figures 15 and 16, Toggle and Alternative Toggle Bits Mechanisms</a> added. <a href="#">Table 16, Toggle and Alternative Toggle Bits AC Characteristics</a> added. Address 38h modified, addresses 39h to 3Ch added in <a href="#">Device Geometry Definition</a> . Address 44h modified in <a href="#">Table 28., Primary Algorithm-Specific Extended Query Table</a> .                                                                                                                                                                |
| 07-Oct-2003 | 2.2     | <a href="#">Figures 15 and 16, Toggle and Alternative Toggle Bits Mechanisms</a> modified; and <a href="#">Notes 1 and 2</a> added. <a href="#">Table 18., Toggle and Alternative Toggle Bits AC Characteristics</a> updated. <a href="#">Figure 8., Toggle Flowchart</a> renamed and modified, Note added.                                                                                                                                                                                                                                         |
| 07-Nov-2003 | 2.3     | Bank Address modified in the Auto Select command, Read CFI Query command and COMMON FLASH INTERFACE (CFI) sections.<br>Addresses for Read CFI Query command modified in the Read CFI command section.                                                                                                                                                                                                                                                                                                                                               |
| 18-Nov-2003 | 2.4     | V <sub>CC</sub> minimum value updated in <a href="#">Table 12., Operating and AC Measurement Conditions</a> . V <sub>PP</sub> and I <sub>PP</sub> test conditions updated in <a href="#">Table 14., DC Characteristics</a> . Customer Lockable Extended Block mechanism modified in <a href="#">APPENDIX C., EXTENDED MEMORY BLOCK</a> .<br><a href="#">APPENDIX D., BLOCK PROTECTION</a> updated: Note 1 added in the In-System Technique section and Note 2 added below <a href="#">Figure 23., In-System Equipment Group Protect Flowchart</a> . |
| 19-Dec-2003 | 2.5     | Architecture Identifier updated in <a href="#">Table 22, Part Numbering Scheme</a> . Customer Lockable Extended Block mechanism modified in <a href="#">APPENDIX C., EXTENDED MEMORY BLOCK</a> .<br><a href="#">APPENDIX D., BLOCK PROTECTION</a> updated: Note 1 updated in the In-System Technique section and Note 2 updated below <a href="#">Figure 23., In-System Equipment Group Protect Flowchart</a> .                                                                                                                                     |
| 12-Aug-2004 | 3.0     | <a href="#">Figure 2., Logic Diagram</a> and <a href="#">Figure 3., TSOP Connections</a> updated.<br><a href="#">Table 9., Dual Operations Allowed In Other Banks</a> and <a href="#">Table 10., Dual Operations Allowed In Same Bank</a> updated in <a href="#">DUAL OPERATIONS AND MULTIPLE BANK ARCHITECTURE</a> section.                                                                                                                                                                                                                        |

| Date        | Version | Revision Details                                                                                                                      |
|-------------|---------|---------------------------------------------------------------------------------------------------------------------------------------|
| 10-Dec-2004 | 4.0     | Status of Ready/Busy signal for Program Error, Chip Erase and Block Erase modified in <a href="#">Table 8., Status Register Bits.</a> |

Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

The ST logo is a registered trademark of STMicroelectronics.

All other names are the property of their respective owners

© 2004 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)