



M30LW128D

128 Mbit (two 64Mbit, x8/x16, Uniform Block, Flash Memories)
3V Supply, Multiple Memory Product

PRELIMINARY DATA

FEATURES SUMMARY

- TWO M58LW064D 64Mbit FLASH MEMORIES STACKED IN A SINGLE PACKAGE
- WIDE x8 or x16 DATA BUS for HIGH BANDWIDTH
- SUPPLY VOLTAGE
 - $V_{DD} = 2.7$ to $3.6V$ for Program, Erase and Read operations
 - $V_{DDQ} = 1.8$ to V_{DD} for I/O buffers
- ACCESS TIME
 - Random Read 110ns
 - Page Mode Read 110/25ns
- PROGRAMMING TIME
 - 16 Word Write Buffer
 - $16\mu s$ Word effective programming time
- 128 UNIFORM 64 KWord/128KByte MEMORY BLOCKS
- BLOCK PROTECTION/ UNPROTECTION
- PROGRAM and ERASE SUSPEND
- 128 bit PROTECTION REGISTER
- COMMON FLASH INTERFACE
- 100, 000 PROGRAM/ERASE CYCLES per BLOCK
- ELECTRONIC SIGNATURE
 - Manufacturer Code: 0020h
 - Device Code M30LW128D: 8817h

Figure 1. Packages

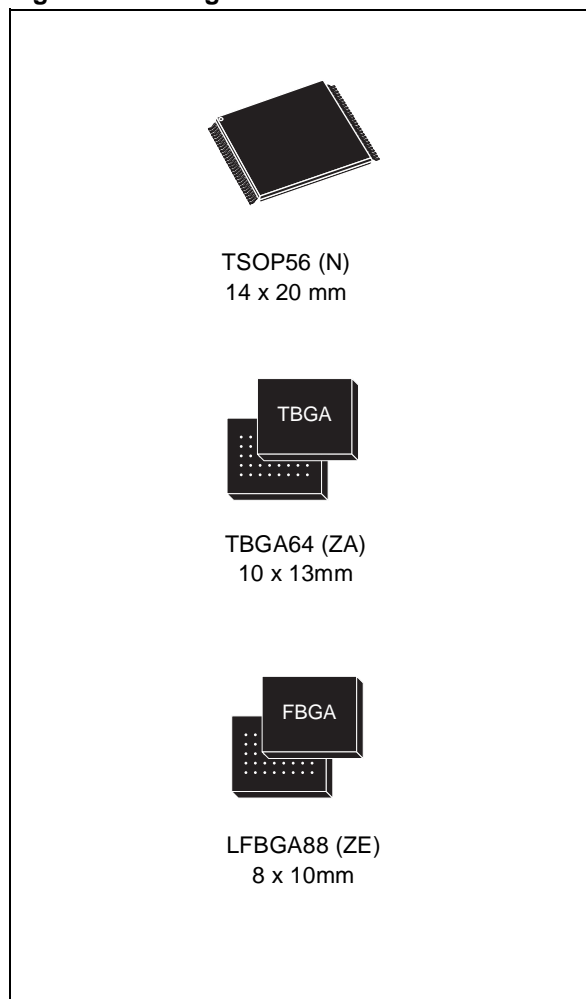


TABLE OF CONTENTS

SUMMARY DESCRIPTION	5
Figure 2. Logic Diagram	6
Table 1. Signal Names	6
Figure 3. TSOP56 Connections	7
Figure 4. TBGA64 Connections (Top view through package)	8
Figure 5. LFBGA Connections (Top view through package)	9
SIGNAL DESCRIPTIONS	10
Address Inputs (A0-A23)	10
Data Inputs/Outputs (DQ0-DQ15)	10
Chip Enable (E)	10
Output Enable (G)	10
Write Enable (W)	10
Reset/Power-Down (RP)	10
Byte/Word Organization Select (BYTE)	10
Status/(Ready/Busy) (STS)	10
Program/Erase Enable (V _{PEN})	11
V _{DD} Supply Voltage	11
V _{DDQ} Supply Voltage	11
V _{SS} Ground	11
V _{SSQ} Ground	11
MEMORY ENABLE	12
Table 2. Single M58LW064D Device Enable, E2, E1 and E0	12
Table 3. M30LW128D Device Enable	12
Figure 6. Stacked Flash Memory	13
Figure 7. Block Addresses	14
BUS OPERATIONS	15
Bus Read	15
Bus Read	15
Page Read	15
Bus Write	15
Output Disable	15
Standby	15
Automatic Low Power	15
Power-Down	15
Table 4. Bus Operations	16
COMMAND INTERFACE	17
Read Memory Array Command	17
Read Electronic Signature Command	17
Read Query Command	17
Read Status Register Command	17

Clear Status Register Command	17
Block Erase Command	17
Word/Byte Program Command	18
Write to Buffer and Program Command	18
Program/Erase Suspend Command	18
Program/Erase Resume Command	19
Block Protect Command	19
Blocks Unprotect Command	19
Protection Register Program Command	19
Configure STS Command	19
Table 5. Commands	21
Table 6. Configuration Codes	22
Table 7. Read Electronic Signature	22
Figure 8. Protection Register Memory Map	23
Table 8. Word-Wide Read Protection Register	23
Table 9. Byte-Wide Read Protection Register	24
Table 10. Program/Erase Times and Program/Erase Endurance Cycles	25
STATUS REGISTER	26
Program/Erase Controller Status (Bit 7)	26
Erase Suspend Status (Bit 6)	26
Erase Status (Bit 5)	26
Program Status (Bit 4)	26
VPEN Status (Bit 3)	27
Program Suspend Status (Bit 2)	27
Block Protection Status (Bit 1)	27
Reserved (Bit 0)	27
Table 11. Status Register Bits	28
MAXIMUM RATING	29
Table 12. Absolute Maximum Ratings	29
DC and AC PARAMETERS	30
Table 13. Operating and AC Measurement Conditions	30
Figure 9. AC Measurement Input Output Waveform	30
Figure 10. AC Measurement Load Circuit	30
Table 14. Capacitance	30
Table 15. DC Characteristics	31
Figure 11. Bus Read AC Waveforms	32
Table 16. Bus Read AC Characteristics	32
Figure 12. Page Read AC Waveforms	33
Table 17. Page Read AC Characteristics	33
Figure 13. Write AC Waveform, Write Enable Controlled	34
Table 18. Write AC Characteristics, Write Enable Controlled	34
Figure 14. Write AC Waveforms, Chip Enable Controlled	35
Table 19. Write AC Characteristics, Chip Enable Controlled	35

Figure 15. Reset, Power-Down and Power-Up AC Waveform	36
Table 20. Reset, Power-Down and Power-Up AC Characteristics	36
PACKAGE MECHANICAL	37
Figure 16. TSOP56 - 56 lead Plastic Thin Small Outline, 14 x 20 mm, Package Outline	37
Table 21. TSOP56 - 56 lead Plastic Thin Small Outline, 14 x 20 mm, Package Mechanical Data	37
Figure 17. TBGA64 - 10x13mm, 8 x 8 ball array 1mm pitch, Package Outline	38
Table 22. TBGA64 - 10x13mm, 8 x 8 ball array, 1 mm pitch, Package Mechanical Data	38
Figure 18. LFBGA88 8x10 mm - 8x10 ball array, 0.8mm pitch, Bottom View Package Outline	39
Table 23. LFBGA88 8x10mm - 8x10 ball array, 0.8mm pitch, Package Mechanical Data	39
PART NUMBERING	40
Table 24. Ordering Information Scheme	40
APPENDIX A. BLOCK ADDRESS TABLE.	41
Table 25. Block Addresses	41
APPENDIX B. COMMON FLASH INTERFACE - CFI.	43
Table 26. Query Structure Overview	43
Table 27. CFI - Query Address and Data Output	44
Table 28. CFI - Device Voltage and Timing Specification	44
Table 29. Device Geometry Definition	45
Table 30. Block Status Register	45
Table 31. Extended Query information	46
APPENDIX C. FLOW CHARTS	47
Figure 19. Write to Buffer and Program Flowchart and Pseudo Code	47
Figure 20. Program Suspend & Resume Flowchart and Pseudo Code	48
Figure 21. Erase Flowchart and Pseudo Code	49
Figure 22. Erase Suspend & Resume Flowchart and Pseudo Code.	50
Figure 23. Block Protect Flowchart and Pseudo Code	51
Figure 24. Blocks Unprotect Flowchart and Pseudo Code	52
Figure 25. Protection Register Program Flowchart and Pseudo Code	53
Figure 26. Command Interface and Program Erase Controller Flowchart (a)	54
Figure 27. Command Interface and Program Erase Controller Flowchart (b)	55
Figure 28. Command Interface and Program Erase Controller Flowchart (c)	56
REVISION HISTORY.	57
Table 32. Document Revision History	57

SUMMARY DESCRIPTION

The M30LW128D is a 128 Mbit device that is composed of two separate 64 Mbit M58LW064D Flash memories. The device can be erased electrically at block level and programmed in-system using a 2.7V to 3.6V (V_{DD}) supply for the circuitry and a 1.8V to V_{DD} (V_{DDQ}) supply for the Input/Output pins.

The bus width can be configured for x8 or x16 for the devices available in the TSOP56 (14 x 20 mm) and TBGA64 (10x13mm, 1mm pitch) packages. The bus width is set to x16 for the devices available in the LFBGA88 (8x10mm, 0.8mm pitch) package.

Each internal M58LW064D has 3 Chip Enable signals to allow up to 4 memories to be connected together without the use of additional glue logic. In this way the address space is contiguous and the microprocessor only requires one Chip Enable, \bar{E} , to control both memories.

The device is divided into 128 blocks of 1Mbit (2 x 64 x 1Mb) that can be erased independently so it is possible to preserve valid data while old data is erased. Program and Erase commands are written to the Command Interface of the device. An on-chip Program/Erase Controller (P/E.C) simplifies the process of programming or erasing the device 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 in the Status Register. The command set required to control the device is consistent with JEDEC standards.

The Write Buffer allows the microprocessor to program from 1 to 16 Words in parallel, both speeding up the programming and freeing up the microprocessor to perform other work. A Word Program command is available to program a single word.

Erase can be suspended in order to perform either Read or Program in any other block and then resumed. Program can be suspended to Read data in any other block and then resumed. Each block can be programmed and erased over 100,000 cycles.

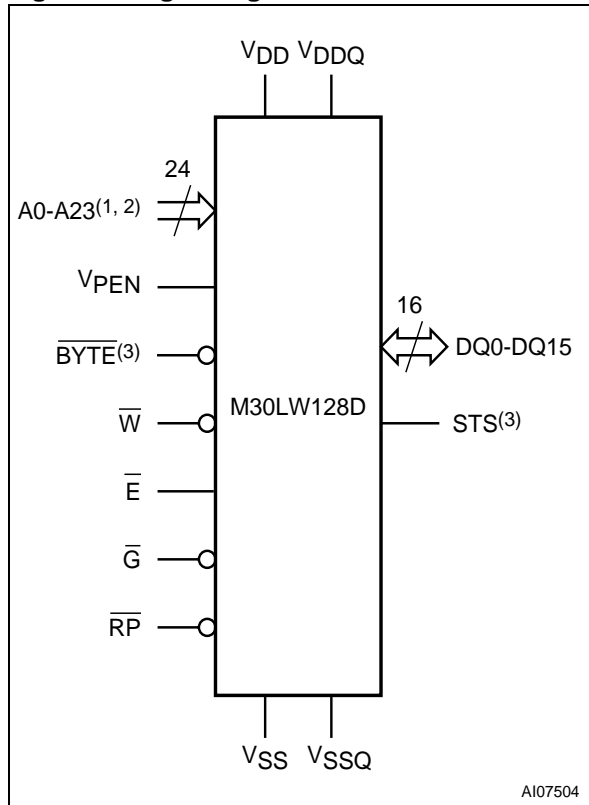
Individual block protection against Program or Erase is provided for data security. All blocks are protected during power-up. The protection of the blocks is non-volatile; after power-up the protection status of each block is restored to the state when power was last removed. Software commands are provided to allow protection of some or all of the blocks and to cancel all block protection bits simultaneously. All Program or Erase operations are blocked when the Program Erase Enable input V_{PEN} is low.

The Reset/Power-Down pin is used to apply a Hardware Reset to the enabled memory and to set the device in power-down mode.

The STS signal is an open drain output that can be used to identify the Program/Erase Controller status. It can be configured in two modes: Ready/Busy mode where a static signal indicates the status of the P/E.C, and Status mode where a pulsing signal indicates the end of a Program or Block Erase operation. In both modes it can be used as a system interrupt signal, useful for saving CPU time. The STS signal is only available with the TSOP56 and TBGA64 packages.

Each memory includes a 128 bit Protection Register. The Protection Register is divided into two 64 bit segments, the first one is written by the manufacturer (contact STMicroelectronics to define the code to be written here), while the second one is programmable by the user. The user programmable segment can be locked.

Figure 2. Logic Diagram



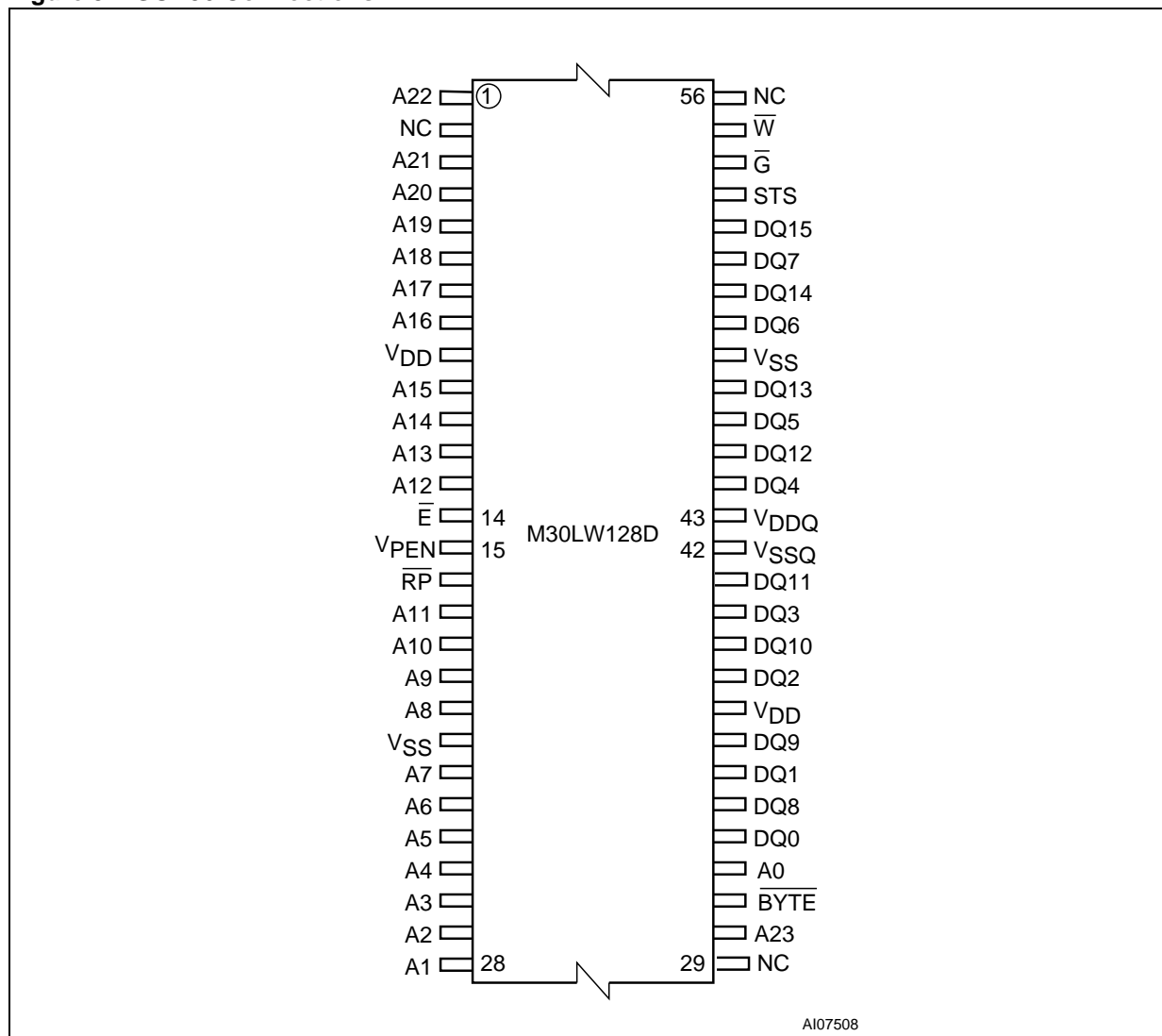
- Note: 1. A0-A22 for LFBGA package (x16 only), A0 is the least significant address.
 2. A0-A23 for TSOP and TFBGA packages, in x8 mode A0 is the least significant address, in x16 mode A1 is the least significant address and A0 is don't care.
 3. Not available with LFBGA package.

Table 1. Signal Names

A0-A23 ^(1, 2)	Address inputs
$\overline{\text{BYTE}}$ ⁽³⁾	Byte/Word Organization Select
DQ0-DQ15	Data Inputs/Outputs
$\overline{\text{E}}$	Chip Enable
$\overline{\text{G}}$	Output Enable
$\overline{\text{RP}}$	Reset/Power-Down
STS ⁽³⁾	Status/(Ready/Busy)
VPEN	Program/Erase Enable
$\overline{\text{W}}$	Write Enable
VDD	Supply Voltage
VDDQ	Input/Output Supply Voltage
VSS	Ground
VSSQ	Input/Output Ground
NC	Not Connected Internally
DU	Do Not Use

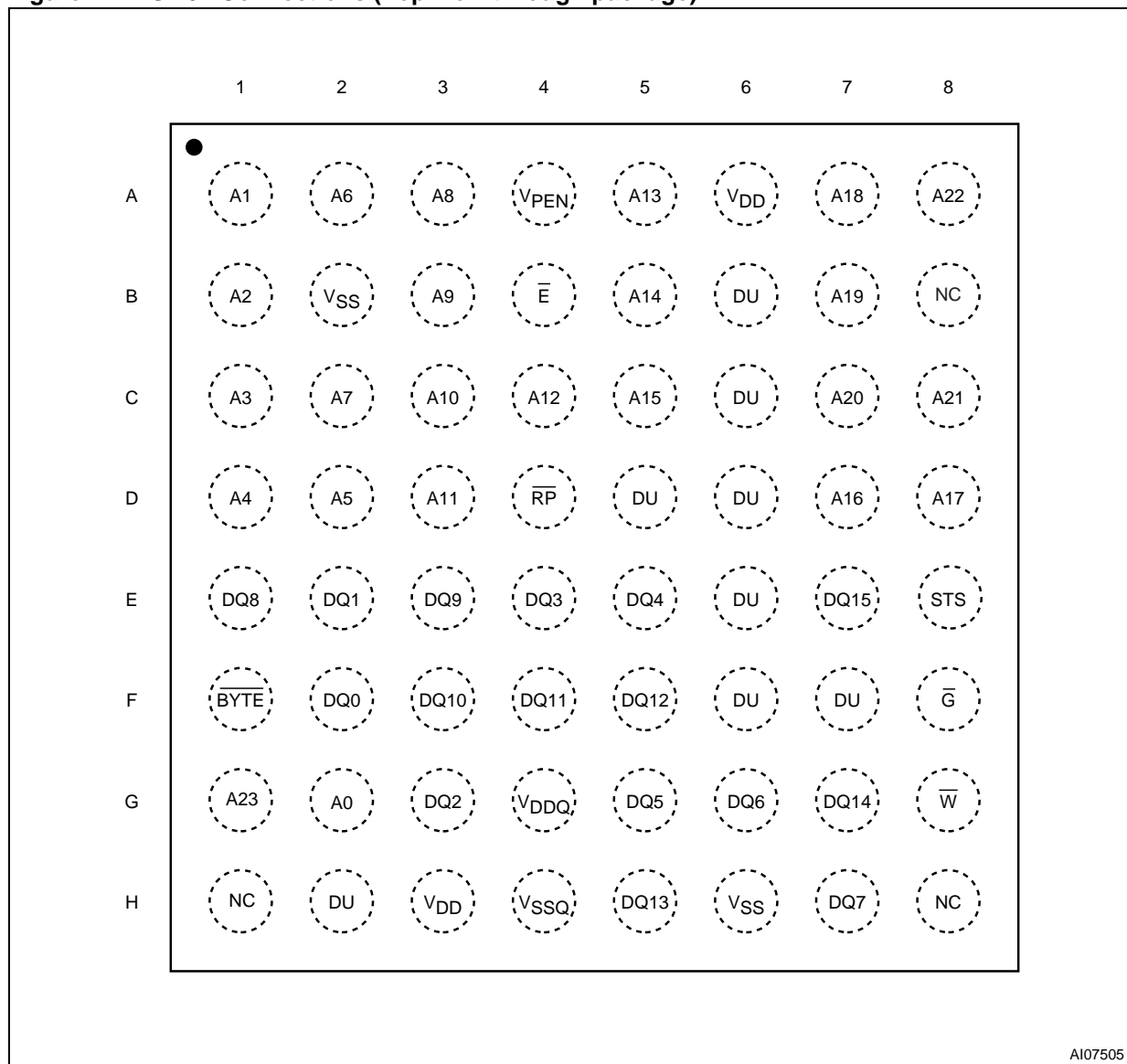
- Note: 1. A0-A22 for LFBGA package (x16 only), A0 is the least significant address.
 2. A0-A23 for TSOP and TFBGA packages, in x8 mode A0 is the least significant address, in x16 mode A1 is the least significant address and A0 is don't care.
 3. Not available with LFBGA package.

Figure 3. TSOP56 Connections



Note: Pin 2 (E1 for a single M58LW064D device) and pin 29 (E2 for a single M58LW064D device) are NC (not connected). They should be tied to ground (V_{SS}) to assure compatibility with a single chip 128Mbit device.

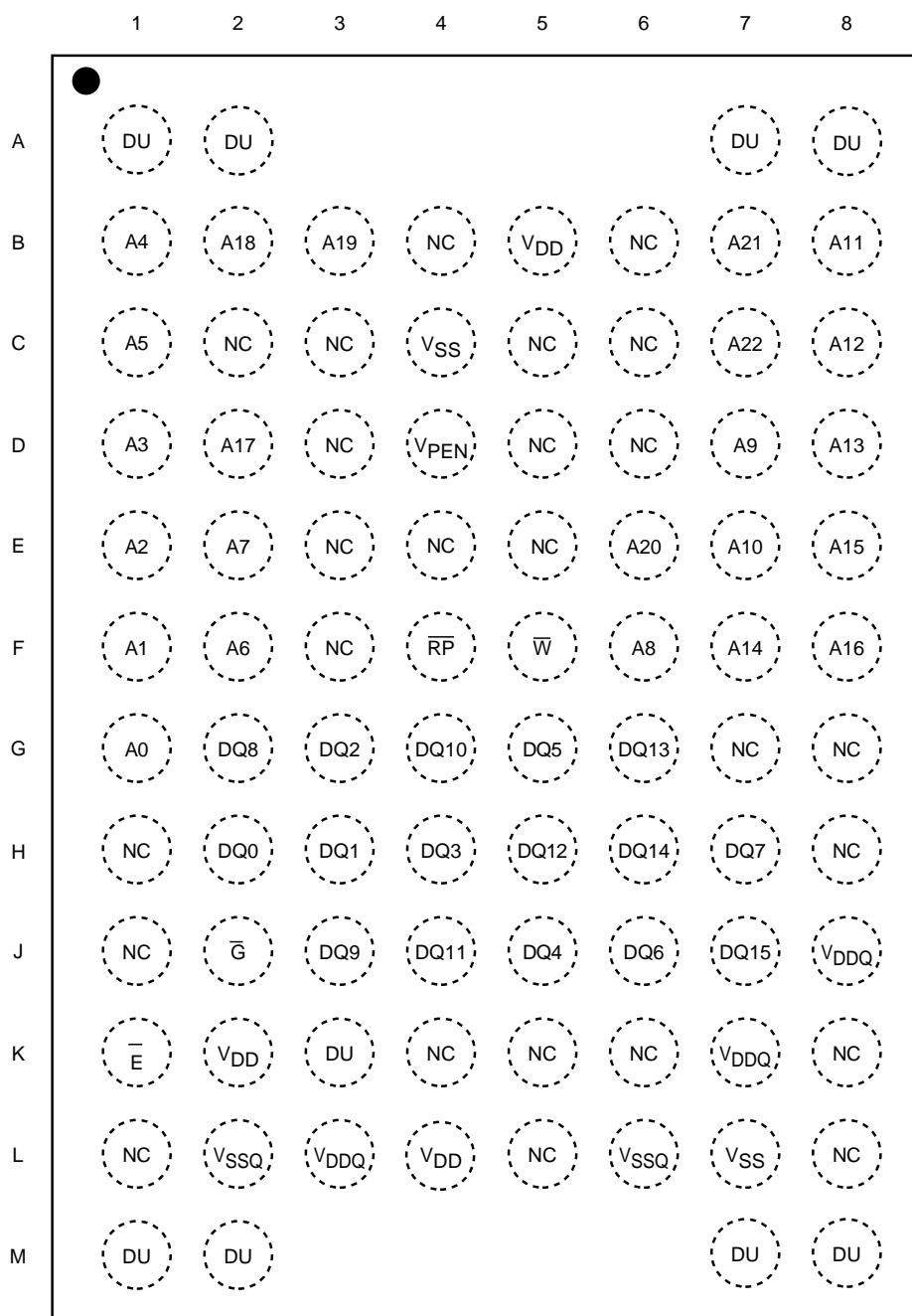
Figure 4. TBGA64 Connections (Top view through package)



AI07505

Note: Ball B8 (E1 for a single M58LW064D device) and ball H1 (E2 for a single M58LW064D device) are NC (not connected). They should be tied to ground (VSS) to assure compatibility with a single chip 128Mbit device.

Figure 5. LFBGA Connections (Top view through package)



AI07555

Note: 1. $\overline{\text{BYTE}}$ and STS connections are not available with the LFBGA88 package.

2. Address Inputs are A0-A22 as only the x16 mode is supported in the LFBGA package. A0 is the least significant while A22 is the most significant address.

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-A23). The Address Inputs are used to select the cells to access in the memory array during Bus Read operations either to read or to program data to. During Bus Write operations they control the commands sent to the Command Interface.

The device must be enabled (refer to Table 3, M30LW128D Device Enable) when selecting the addresses. The address inputs are latched on the rising edge of Write Enable, \overline{W} , or Chip Enable, \overline{E} , whichever occurs first.

For the TSOP and TFBGA packages the address inputs are A0-A23. A0 is used to select the higher or lower byte in x8 mode; it's not used in x16 mode where A1 is the least significant address.

Address input A23 is used to select between the two internal memories. When it is High, V_{IH} , it selects the Upper Memory, when it is Low, V_{IL} , it selects the Lower Memory. Refer to Memory Enable section for more details.

As the LFBGA package only supports x16 mode this package has all the addresses shifted down by one with respect to the TSOP and TFBGA packages. So for the LFBGA package the address inputs are A0-A22 and address input A22 is used to select between the two internal memories. When it is High, V_{IH} , it selects the Upper Memory, when it is Low, V_{IL} , it selects the Lower Memory. Refer to Memory Enable section for more details.

Data Inputs/Outputs (DQ0-DQ15). The Data Inputs/Outputs output the data stored at the selected address during a Bus Read operation, or are used to input the data during a program operation. During Bus Write operations they represent the commands sent to the Command Interface of the internal state machine. When used to input data or Write commands they are latched on the rising edge of Write Enable or Chip Enable, \overline{E} , whichever occurs first.

When the device is enabled and Output Enable is low, V_{IL} , the data bus outputs data from the memory array, the Electronic Signature, the Block Protection status, the CFI Information or the contents of the Status Register. The data bus is high impedance when the device is deselected, Output Enable is high, V_{IH} , or the Reset/Power-Down signal is low, V_{IL} . When the Program/Erase Controller is active the Ready/Busy status is given on DQ7.

Chip Enable (\overline{E}). The Chip Enable input activates the memory control logic, input buffers, decoders and sense amplifiers. The M30LW128D stacked memory uses the A23 (A22 for LFBGA package) address input and the external Chip En-

able, \overline{E} , to select and enable the internal memories. Refer to Memory Enable section and Table 3, for more details.

When the Chip Enable deselects the memory, power consumption is reduced to the Standby level, I_{DD1} .

Output Enable (\overline{G}). The Output Enable, \overline{G} , gates the outputs through the data output buffers during a read operation. When Output Enable, \overline{G} , is at V_{IH} the outputs are high impedance.

Write Enable (\overline{W}). The Write Enable input, \overline{W} , controls writing to the Command Interface, Input Address and Data latches. Both addresses and data can be latched on the rising edge of Write Enable.

Reset/Power-Down (\overline{RP}). The Reset/Power-Down signal can be used to apply a Hardware Reset to the memory.

A Hardware Reset is achieved by holding Reset/Power-Down Low, V_{IL} , for at least t_{PLPH} . When Reset/Power-Down is Low, V_{IL} , the Status Register information is cleared and the power consumption is reduced to power-down level. The device is deselected and outputs are high impedance. If Reset/Power-Down goes low, V_{IL} , during a Block Erase, a Write to Buffer and Program or a Block Protect/Unprotect the operation is aborted and the data may be corrupted. In this case the STS pin stays low, V_{IL} , for a maximum timing of $t_{PLPH} + t_{PHBH}$, until the completion of the Reset/Power-Down pulse.

After Reset/Power-Down goes High, V_{IH} , the device will be ready for Bus Read and Bus Write operations after t_{PHQV} . Note that STS does not fall during a reset, see Ready/Busy Output section.

In an application, it is recommended to associate Reset/Power-Down pin, \overline{RP} , with the reset signal of the microprocessor. Otherwise, if a reset operation occurs while the device is performing an Erase or Program operation, the device may output the Status Register information instead of being initialized to the default Asynchronous Random Read.

Byte/Word Organization Select (\overline{BYTE}). The Byte/Word Organization Select signal is used to switch between the x8 and x16 bus widths 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.

The Byte/Word Organization Select signal is not available with the LFBGA88 package.

Status/(Ready/Busy) (STS). The STS signal is an open drain output that can be used to identify the Program/Erase Controller status. It can be configured in two modes:

- Ready/Busy - the pin is Low, V_{OL} , during Program and Erase operations and high impedance when the memory is ready for any Read, Program or Erase operation.
- Status - the pin gives a pulsing signal to indicate the end of a Program or Block Erase operation.

After power-up or reset the STS pin is configured in Ready/Busy mode. The pin can be configured for Status mode using the Configure STS command.

When the Program/Erase Controller is idle, or suspended, STS can float High through a pull-up resistor. The use of an open-drain output allows the STS pins from several devices to be connected to a single pull-up resistor (a Low will indicate that one, or more, of the memories is busy).

STS is not Low during a reset unless the reset was applied when the Program/Erase controller was active.

The STS signal is not available with the LFBGA88 package.

Program/Erase Enable (V_{PEN}). The Program/Erase Enable input, V_{PEN} , is used to protect all blocks, preventing Program and Erase operations from affecting their data.

Program/Erase Enable must be kept High during all Program/Erase Controller operations, otherwise the operations is not guaranteed to succeed and data may become corrupt.

V_{DD} Supply Voltage. V_{DD} provides the power supply to the internal core of the device. It is the main power supply for all operations (Read, Program and Erase).

V_{DDQ} Supply Voltage. V_{DDQ} provides the power supply to the I/O pins and enables all Outputs to be powered independently from V_{DD} . V_{DDQ} can be tied to V_{DD} or can use a separate supply.

It is recommended to power-up and power-down V_{DD} and V_{DDQ} together to avoid any condition that would result in data corruption.

V_{SS} Ground. Ground, V_{SS} , is the reference for the core power supply. It must be connected to the system ground.

V_{SSQ} Ground. V_{SSQ} ground is the reference for the input/output circuitry driven by V_{DDQ} . V_{SSQ} must be connected to V_{SS} .

Note: Each device in a system should have V_{DD} and V_{DDQ} decoupled with a 0.1 μ F ceramic capacitor close to the pin (high frequency, inherently low inductance capacitors should be as close as possible to the package). See Figure 10, AC Measurement Load Circuit.

MEMORY ENABLE

Each internal M58LW064D memory has 3 Chip Enable signals to allow up to 4 memories to be connected together without the use of additional glue logic, see Table 2, Single M58LW064D Device Enable. In this way the address space is contiguous and the microcontroller only requires one Chip Enable, \bar{E} , to control both memories.

Figure 6 shows how a 128Mbit Stacked Flash memory is created using two M58LW064D memories. One of the memories is located in the Upper Address space and is referred to as the Upper Memory, the other is located in the lower address space and is referred to as the Lower Memory, see Figure 7, Block Addresses.

The E0, E1 and E2 Chip Enables of each M58LW064D memory are connected internally, as shown in Figure 6.

The external signal A23 (A22 for LFBGA package) is used to select between the Upper and Lower

memories. A23 (A22 for LFBGA) is connected to E2 of the Upper Memory and to E1 of the Lower Memory.

E1 of the Upper Memory is always connected to V_{DD} while E2 of the Lower Memory is always connected to V_{SS} .

The external Chip Enable, \bar{E} , is used to enable or disable the memory selected by A23 (A22 for LFBGA), see Table 3, M30LW128D Device Enable. \bar{E} is connected to the E0 signal of both memories.

The M30LW128D (TSOP56 and TBGA64 packages only) supports both x8 and x16 bus widths. It is also possible to have a x32 bus width by connecting two x16 bus width M30LW128D devices together. Note that the two M30LW128D devices must use the same E0 as Chip Enable, as E1 and E2 are not connected internally.

Table 2. Single M58LW064D Device Enable, E2, E1 and E0

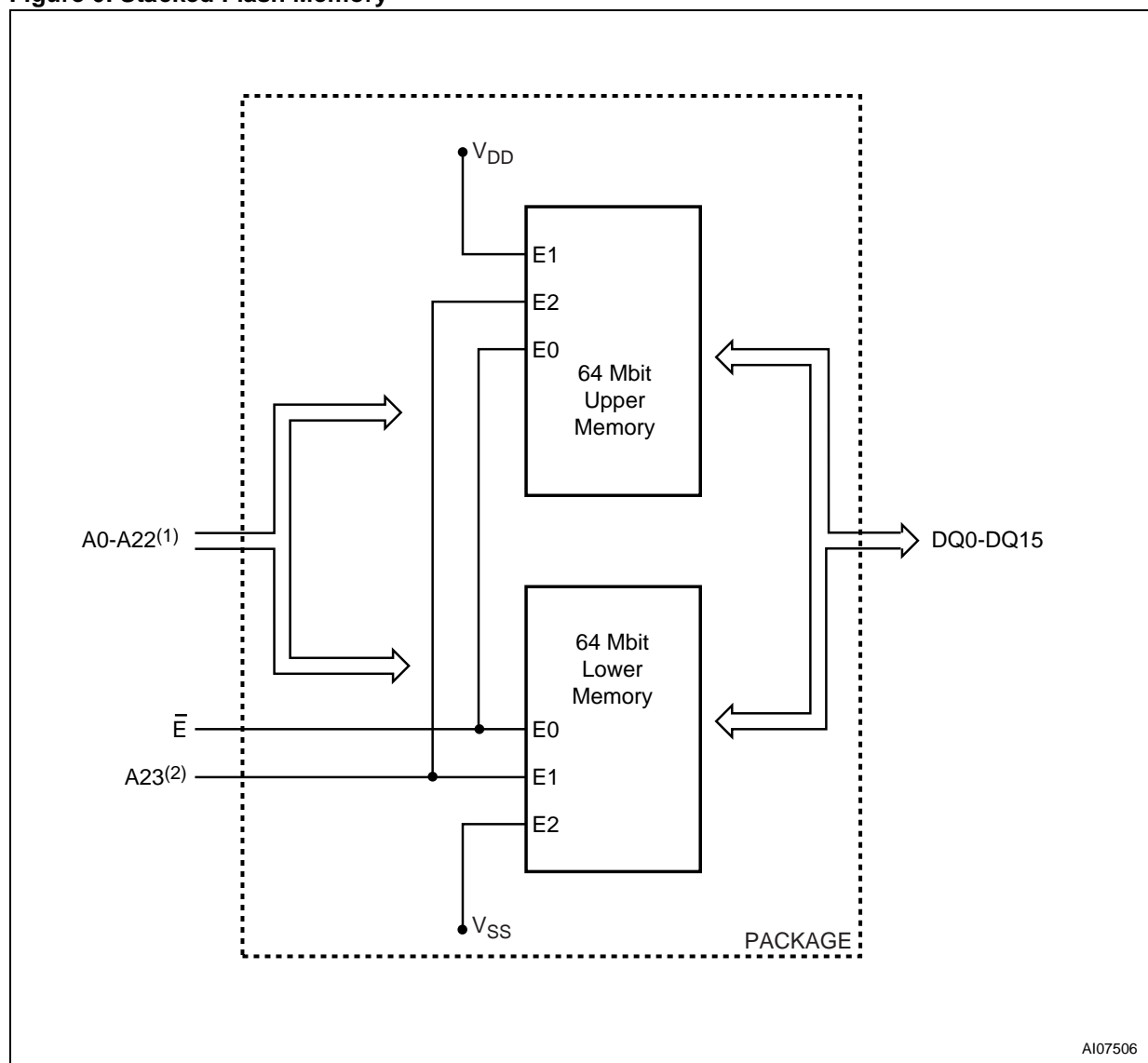
E2	E1	E0	Device
V_{IL}	V_{IL}	V_{IL}	Enabled
V_{IL}	V_{IL}	V_{IH}	Disabled
V_{IL}	V_{IH}	V_{IL}	Disabled
V_{IL}	V_{IH}	V_{IH}	Disabled
V_{IH}	V_{IL}	V_{IL}	Enabled
V_{IH}	V_{IL}	V_{IH}	Enabled
V_{IH}	V_{IH}	V_{IL}	Enabled
V_{IH}	V_{IH}	V_{IH}	Disabled

Table 3. M30LW128D Device Enable

A23 ⁽¹⁾	Internal Signals		Chip Enable, \bar{E}	Upper Memory	Lower Memory
E2 _{UM} = E1 _{LM} ⁽¹⁾	E1 _{UM} ⁽¹⁾	E2 _{LM} ⁽¹⁾	E0 _{UM} = E0 _{LM} ⁽¹⁾		
V_{IL}	$V_{DD} (V_{IH})$	$V_{SS} (V_{IL})$	V_{IL}	Disabled	Enabled
V_{IL}			V_{IH}	Disabled	Disabled
V_{IH}			V_{IL}	Enabled	Disabled
V_{IH}			V_{IH}	Disabled	Disabled

Note: 1. UM = Upper Memory, LM = Lower Memory.
 2. A22 for LFBGA package.

Figure 6. Stacked Flash Memory



AI07506

Note: 1. A0-A21 for LFBGA package.
 2. A22 for LFBGA package.

BUS OPERATIONS

There are 6 bus operations that control each memory. Each of these is described in this section, see Tables 4, Bus Operations, for a summary.

On Power-up or after a Hardware Reset the device defaults to Read Array mode (Page Read).

Typically glitches of less than 5ns on Chip Enable or Write Enable are ignored by the device and do not affect bus operations.

Bus Read. Bus Read operations read from the memory cells, or specific registers (Electronic Signature, Status Register, CFI and Block Protection Status) in the Command Interface.

A valid bus operation involves setting the desired address on the Address inputs, enabling the device (refer to Table 3), applying a Low signal, V_{IL} , to Output Enable and keeping Write Enable High, V_{IH} .

The Data Inputs/Outputs will output the value, see Figure 11, Bus Read AC Waveforms, and Table 16, Bus Read AC Characteristics, for details of when the output becomes valid.

Page Read. Page Read operations are used to read from several addresses within the same memory page.

Each memory page is a 4 Words or 8 Bytes and has the same A3-A23 (A2-A22 for LFBGA package). In x8 mode only A0, A1 and A2 may change, in x16 mode only A1 and A2 (A0 and A1 for LFBGA package) may change.

Valid bus operations are the same as Bus Read operations but with different timings. The first read operation within the page has identical timings, subsequent reads within the same page have much shorter access times. If the page changes then the normal, longer timings apply again. See Figure 12, Page Read AC Waveforms and Table 17, Page Read AC Characteristics for details on when the outputs become valid.

Bus Write. Bus Write operations write to the Command Interface in order to send commands to the device or to latch addresses and input data to program.

A valid Asynchronous Bus Write operation begins by setting the desired address on the Address Inputs and enabling the device (refer to Chip Enable section).

Both the Address Inputs and Data Input/Outputs are latched by the Command Interface on the rising edge of Write Enable or Chip 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 18 and 19, Write and Chip Enable Controlled Write AC Characteristics, for details of the timing requirements.

Output Disable. The Data Inputs/Outputs are in the high impedance state when the Output Enable is High.

Standby. When Chip Enable is High, V_{IH} , the device enters Standby mode and the Data Inputs/Outputs pins are placed in the high impedance state regardless of Output Enable or Write Enable. The Supply Current is reduced to the Standby Supply Current, I_{DD1} .

During Program or Erase operations the device will continue to use the Program/Erase Supply Current, I_{DD3} , for Program or Erase operations until the operation completes.

Automatic Low Power. If there is no change in the state of the bus for a short period of time during Asynchronous Bus Read operations the device enters Auto Low Power mode where the internal Supply Current is reduced to the Auto-Standby Supply Current, I_{DD5} . The Data Inputs/Outputs will still output data if a Bus Read operation is in progress.

Automatic Low Power is only available in Asynchronous Read modes.

Power-Down. The device is in Power-Down mode when Reset/Power-Down, \overline{RP} , is Low. The power consumption is reduced to the Power-Down level, I_{DD2} , and the outputs are high impedance, independent of Chip Enable, Output Enable or Write Enable.

Table 4. Bus Operations

Bus Operation	Memory Enabled	A23 ⁽³⁾	\bar{E}	\bar{G}	\bar{W}	\bar{RP}	Address Inputs	DQ0-DQ15 (x16) DQ0-DQ7 (x8) ⁽¹⁾
Bus Read	Upper	V _{IH}	V _{IL}	V _{IL}	V _{IH}	High	Address	Data Output
	Lower	V _{IL}						
Page Read	Upper	V _{IH}	V _{IL}	V _{IL}	V _{IH}	High	Address	Data Output
	Lower	V _{IL}						
Bus Write	Upper	V _{IH}	V _{IL}	V _{IH}	V _{IL}	High	Address	Data Input
	Lower	V _{IL}						
Output Disable	Output disabled	X	V _{IL}	V _{IH}	V _{IH}	High	X	High Z
Standby	Device disabled	X	V _{IH}	X	X	High	X	High Z
Power-Down	Device disabled	X	X	X	X	V _{IL}	X	High Z

Note: 1. DQ8-DQ15 are High Z in x8 mode.
 2. X = Don't Care V_{IL} or V_{IH}. High = V_{IH} or V_{HH}.
 3. A22 for LFBGA package.

COMMAND INTERFACE

All Bus Write operations to the device are interpreted by the Command Interface. Commands consist of one or more sequential Bus Write operations. As the device contains two internal memories care must be taken to issue the commands to the correct address. Commands issued with A23 (A22 for LFBGA package) High will be addressed to the Upper Memory, commands issued with A23 (A22 for LFBGA) Low will be addressed to the Lower Memory.

The Commands are summarized in Table 5, Commands. Refer to Table 5 in conjunction with the text descriptions below.

After power-up or a Reset operation the device enters Read mode.

Read Memory Array Command. The Read Memory Array command is used to return the addressed internal memory to Read mode.

One Bus Write cycle is required to issue the Read Memory Array command and return the addressed internal memory to Read mode. Once the command is issued the internal memory remains in Read mode until another command is issued. From Read mode Bus Read operations will access the memory arrays. After power-up or a reset the device (both internal memories) defaults to Read Array mode (Page Read).

While the Program/Erase Controller is executing a Program, Erase, Block Protect, Blocks Unprotect or Protection Register Program operation the device will not accept the Read Memory Array command until the operation completes.

Read Electronic Signature Command. The Read Electronic Signature command is used to read the Manufacturer Code, the Device Code, the Block Protection Status and the Protection Register. One Bus Write cycle is required to issue the Read Electronic Signature command. Once the command is issued subsequent Bus Read operations read the Manufacturer Code, the Device Code, the Block Protection Status or the Protection Register until another command is issued. Refer to Table 7, Read Electronic Signature, Tables 8 and 9, Word and Byte-wide Read Protection Register and Figure 8, Protection Register Memory Map for information on the addresses.

Read Query Command. The Read Query Command is used to read data from the Common Flash Interface (CFI) Memory Area. One Bus Write cycle is required to issue the Read Query Command. Once the command is issued subsequent Bus Read operations read from the Common Flash Interface Memory Area. See Appendix B, Tables 26, 27, 28, 29, 30 and 31 for details on the information contained in the Common Flash Interface (CFI) memory area.

Read Status Register Command. The Read Status Register command is used to read the Status Register. One Bus Write cycle is required to issue the Read Status Register command. As the device contains two Status Registers (one for each internal memory) the command must be issued to the same address as the previous operation (Block Erase, Write to Buffer, Word Program etc.). Once the command is issued subsequent Bus Read operations to the same internal memory (A23 (A22 for LFBGA) Low or A23 (A22 for LFBGA) High depending on where the command was issued to) read the Status Register until another command is issued. If the Bus Read operation is issued to the other internal memory, then the other Status Register will be read, giving the status of the last command issued in the other internal memory.

The Status Register information is present on the output data bus (DQ1-DQ7) when the device is enabled and Output Enable is Low, V_{IL} .

See the section on the Status Register and Table 11 for details on the definitions of the Status Register bits

Clear Status Register Command. The Clear Status Register command can be used to reset bits 1, 3, 4 and 5 in the Status Register to '0'. One Bus Write is required to issue the Clear Status Register command. The command must be issued to the same address as the previous operation (Block Erase, Write to Buffer, Word Program etc.).

The bits in the Status Register are sticky and do not automatically return to '0' when a new Write to Buffer and Program, Erase, Block Protect, Block Unprotect or Protection Register Program command is issued. If any error occurs then it is essential to clear any error bits in the Status Register by issuing the Clear Status Register command before attempting a new Program, Erase or Resume command.

Block Erase Command. The Block Erase command can be used to erase a block. It sets all of the bits in the block to '1'. All previous data in the block is lost. If the block is protected then the Erase operation will abort, the data in the block will not be changed and the Status Register will output the error.

Two Bus Write operations are required to issue the command; the second Bus Write cycle latches the block address in the internal state machine and starts the Program/Erase Controller. Once the command is issued subsequent Bus Read operations read the Status Register. See the section on the Status Register for details on the definitions of the Status Register bits.

During Erase, the device being erased will only accept the Read Status Register and Program/Erase

Suspend commands, ignoring all other commands. The device not being erased will accept any command. Typical Erase times are given in Table 10.

See Appendix C, Figure 21, Block Erase Flowchart and Pseudo Code, for a suggested flowchart on using the Block Erase command.

Word/Byte Program Command. The Word/Byte Program command is used to program a single Word or Byte in the memory array. Two Bus Write operations are required to issue the command; the first write cycle sets up the Word Program command, the second write cycle latches the address and data to be programmed in the internal state machine and starts the Program/Erase Controller.

If the block being programmed is protected an error will be set in the Status Register and the operation will abort without affecting the data in the memory array. The block must be unprotected using the Blocks Unprotect command.

Write to Buffer and Program Command. The Write to Buffer and Program command is used to program the memory array. If the command is issued with A23 (A22 for LFBGA) High the Upper Memory will be programmed, if the command is issued with A23 (A22 for LFBGA) Low the Lower Memory will be programmed.

Up to 16 Words/32 Bytes can be loaded into the Write Buffer and programmed into the memory array. Each Write Buffer has the same A5-A23 (A4-A22 for LFBGA) addresses. In Byte-wide mode only A0-A4 may change, in Word-wide mode only A1-A4 (A0-A3 for LFBGA package) may change.

Four successive steps are required to issue the command.

1. One Bus Write operation is required to set up the Write to Buffer and Program Command. Issue the set up command with the selected memory Block Address where the program operation should occur (any address in the block where the values will be programmed can be used). Any Bus Read operations will start to output the Status Register after the 1st cycle.
2. Use one Bus Write operation to write the same block address along with the value N on the Data Inputs/Output, where N+1 is the number of Words/Bytes to be programmed.
3. Use N+1 Bus Write operations to load the address and data for each Word into the Write Buffer. The addresses must have the same A5-A22.
4. Finally, use one Bus Write operation to issue the final cycle to confirm the command and start the Program operation.

Invalid address combinations or failing to follow the correct sequence of Bus Write cycles will set an error in the Status Register and abort the operation without affecting the data in the memory array. The Status Register should be cleared before re-issuing the command.

If the block being programmed is protected an error will be set in the Status Register and the operation will abort without affecting the data in the memory array. The block must be unprotected using the Blocks Unprotect command.

See Appendix C, Figure 19, Write to Buffer and Program Flowchart and Pseudo Code, for a suggested flowchart on using the Write to Buffer and Program command.

Program/Erase Suspend Command. The Program/Erase Suspend command is used to pause a Write to Buffer and Program or Erase operation. The command will only be accepted during a Program or an Erase operation. It can be issued at any time during an Erase operation but will only be accepted during a Write to Buffer and Program command if the Program/Erase Controller is running.

One Bus Write cycle is required to issue the Program/Erase Suspend command and pause the Program/Erase Controller. The command must be issued to the same address as the current Program or Erase operation. Once the command is issued it is necessary to poll the Program/Erase Controller Status bit (bit 7) to find out when the Program/Erase Controller has paused; no other commands will be accepted until the Program/Erase Controller has paused. After the Program/Erase Controller has paused, the device will continue to output the Status Register until another command is issued.

During the polling period between issuing the Program/Erase Suspend command and the Program/Erase Controller pausing, it is possible for the operation to complete. Once the Program/Erase Controller Status bit (bit 7) indicates that the Program/Erase Controller is no longer active, the Program Suspend Status bit (bit 2) or the Erase Suspend Status bit (bit 6) can be used to determine if the operation has completed or is suspended. For timing on the delay between issuing the Program/Erase Suspend command and the Program/Erase Controller pausing see Table 10.

During Program/Erase Suspend the Read Memory Array, Read Status Register, Read Electronic Signature, Read Query and Program/Erase Resume commands will be accepted by the Command Interface. Additionally, if the suspended operation was Erase then the Word Program, Write to Buffer and Program, and Program Suspend commands will also be accepted.

When one of the devices is being Program or Erase Suspended, any command issued to the other internal Flash memory will be accepted. When a program operation is completed inside a Block Erase Suspend the Read Memory Array command must be issued to reset the device in Read mode, then the Erase Resume command can be issued to complete the whole sequence. Only the blocks not being erased may be read or programmed correctly.

See Appendix C, Figure 20, Program Suspend & Resume Flowchart and Pseudo Code, and Figure 22, Erase Suspend & Resume Flowchart and Pseudo Code, for suggested flowcharts on using the Program/Erase Suspend command.

Program/Erase Resume Command. The Program/Erase Resume command can be used to restart the Program/Erase Controller after a Program/Erase Suspend operation has paused it. One Bus Write cycle is required to issue the Program/Erase Resume command. The command must be issued to the same address as the Program/Erase Suspend command. Once the command is issued subsequent Bus Read operations read the Status Register.

Block Protect Command. The Block Protect command is used to protect a block and prevent Program or Erase operations from changing the data in it. Two Bus Write cycles are required to issue the Block Protect command; the second Bus Write cycle latches the block address in the internal state machine and starts the Program/Erase Controller. Once the command is issued subsequent Bus Read operations read the Status Register. See the section on the Status Register for details on the definitions of the Status Register bits.

During the Block Protect operation the device will only accept the Read Status Register command. All other commands will be ignored. Typical Block Protection times are given in Table 10.

The Block Protection bits are non-volatile, once set they remain set through reset and power-down/power-up. They are cleared by a Blocks Unprotect command.

See Appendix C, Figure 23, Block Protect Flowchart and Pseudo Code, for a suggested flowchart on using the Block Protect command.

Blocks Unprotect Command. The Blocks Unprotect command is used to unprotect all of the blocks. To unprotect all of the blocks in both of the internal memories the command must be issued to both memories, that is first with A23 (A22 for LFBGA) Low and then with A23 (A22 for LFBGA) High. Four Bus Write cycles are required to issue the Blocks Unprotect command; the first two are written with A23 (A22 for LFBGA) Low, the second

two are written with A23 (A22 for LFBGA) High. Once the command is issued subsequent Bus Read operations read the Status Register. See the section on the Status Register for details on the definitions of the Status Register bits.

During the Blocks Unprotect operation the device will only accept the Read Status Register command. All other commands will be ignored. Typical Block Protection times are given in Table 10.

See Appendix C, Figure 24, Blocks Unprotect Flowchart and Pseudo Code, for a suggested flowchart on using the Blocks Unprotect command.

Protection Register Program Command.

The Protection Register Program command is used to Program the 64 bit user segment of the Protection Register. Only the lower address Protection Register is available to the customer (A23 or A22 Low), the other Protection Register is reserved.

Two write cycles are required to issue the Protection Register Program command.

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

Read operations output the Status Register content after the programming has started.

The user-programmable segment can be locked by programming bit 1 of the Protection Register Lock location to '0' (see Table 8 and x for Word-wide and Byte-wide protection addressing). Bit 0 of the Protection Register Lock location locks the factory programmed segment and is programmed to '0' in the factory. The locking of the Protection Register is not reversible, once the lock bits are programmed no further changes can be made to the values stored in the Protection Register, see Figure 8, Protection Register Memory Map. Attempting to program a previously protected Protection Register will result in a Status Register error.

The Protection Register Program cannot be suspended. See Appendix C, Figure 25, Protection Register Program Flowchart and Pseudo Code, for the flowchart for using the Protection Register Program command.

Configure STS Command.

The Configure STS command is used to configure the Status/(Ready/Busy) pin. It has to be configured for both internal memories, that is the command has to be issued first with A23 (A22 for LFBGA) Low and then with A23 (A22 for LFBGA) High. After power-up or reset the STS pin is configured in Ready/Busy mode. The pin can be configured in Status mode using the Configure STS

command (refer to Status/(Ready/Busy) section for more details).

Four Bus Write cycles are required to issue the Configure STS command. The first two cycles must be written with A23 (A22 for LFBGA) Low and the second two with A23 (A22 for LFBGA) High.

- The first bus cycle sets up the Configure STS command. A23 (A22 for LFBGA) must be Low.
- The second Bus Write cycle specifies one of the four possible configurations, A23 (A22 for LFBGA) must be Low, (refer to Table 6, Configuration Codes):
 - Ready/Busy mode
 - Pulse on Erase complete mode

- Pulse on Program complete mode
- Pulse on Erase or Program complete mode
- The third Bus Write cycle re-sets up the Configure STS command. This time A23 (A22 for LFBGA) must be High.
- The fourth re-specifies the configuration code given in the second Bus Write cycle. A23 (A22 for LFBGA) must be High.

The device will not accept the Configure STS command while the Program/Erase controller is busy or during Program/Erase Suspend. When STS pin is pulsing it remains Low for a typical time of 250ns. Any invalid Configuration Code will set an error in the Status Register.

The Configure STS command is not available with the LFBGA88 package.

Table 5. Commands

Command	Cycles	Bus Operations											
		1st Cycle			2nd Cycle			Subsequent			Final		
		Op.	Addr.	Data	Op.	Addr.	Data	Op.	Addr.	Data	Op.	Addr.	Data
Read Memory Array	2	Write	RA	FFh	Read	RA	RD						
Read Electronic Signature ⁽²⁾	≥ 2	Write	PA/BA	90h	Read	IDA	IDD						
Read Status Register	2	Write	PA/BA	70h	Read	PA/BA	SRD						
Read Query ⁽²⁾	≥ 2	Write	PA/BA	98h	Read	QA	QD						
Clear Status Register	1	Write	PA/BA	50h									
Block Erase	2	Write	BA	20h	Write	BA	D0						
Word/Byte Program	2	Write	PA	40h/ 10h	Write	PA	PD						
Write to Buffer and Program	4+N	Write	BA	E8h	Write	BA	N	Write	PA	PD	Write	BA	D0h
Program/Erase Suspend	1	Write	PA/BA	B0h									
Program/Erase Resume	1	Write	PA/BA	D0h									
Block Protect	2	Write	BA	60h	Write	BA	01h						
Blocks Unprotect	4	Write	000000h	60h	Write	000000h	D0h	Write	400000h	60h	Write	400000h	D0h
Protection Register Program	2	Write	PRA	C0h	Write	PRA	PRD						
Configure STS command ⁽³⁾	4	Write	000000h	B8h	Write	000000h	CC	Write	400000h	B8h	Write	400000h	CC

Note: 1. X Don't Care; RA Read Address, RD Read Data, IDA Identifier Address, IDD Identifier Data, SRD Status Register Data, PA Program Address, PD Program Data, QA Query Address, QD Query Data, BA Any address in Block, PRA Protection register address, PRD Protection Register Data, CC Configuration Code.

2. A23 (A22 for LFBGA) selects which internal memory will enter Read Query or Read Electronic signature mode. To verify the block protection in the CFI BA has to be in the internal memory selected by A23 (A22 for LFBGA). To verify the protection of all memory blocks the command has to be issued with A23 (A22 for LFBGA) both High and Low.

3. Not available with LFBGA88 package.

Table 6. Configuration Codes

Configuration Code	DQ1	DQ2	Mode	STS Pin	Description
00h	0	0	Ready/Busy	V_{OL} during P/E operations Hi-Z when the memory is ready	The STS pin is Low during Program and Erase operations and high impedance when the memory is ready for any Read, Program or Erase operation.
01h	0	1	Pulse on Erase complete	Pulse Low then High when operation completed ⁽²⁾	Supplies a system interrupt pulse at the end of a Block Erase operation.
02h	1	0	Pulse on Program complete		Supplies a system interrupt pulse at the end of a Program operation.
03h	1	1	Pulse on Erase or Program complete		Supplies a system interrupt pulse at the end of a Block Erase or Program operation.

Note: 1. DQ2-DQ7 are reserved
2. When STS pin is pulsing it remains Low for a typical time of 250ns.

Table 7. Read Electronic Signature

Code	Bus Width	Address Inputs ⁽³⁾	Data (DQ15-DQ0)
Manufacturer Code	x8	000000h	20h
	x16		0020h
Device Code	x8	000001h	17h
	x16		8817h
Block Protection Status	x8	SBA ⁽¹⁾ +02h	00h (Block Unprotected) 01h (Block Protected)
	x16		0000h (Block Unprotected) 0001h (Block Protected)
Protection Register	x8, x16	000080h ⁽²⁾	PRD ⁽¹⁾

Note: 1. SBA is the Start Base Address of each block, PRD is Protection Register Data.
2. Base Address, refer to Figure 8 and Tables 8 and 9 for more information. A23 (A22 for LFBGA) must be Low to address the customer's Protection Register. The other Protection Register is reserved.
3. A1-A23 for TFBGA and TSOP; A0-A22 for LFBGA.

Figure 8. Protection Register Memory Map

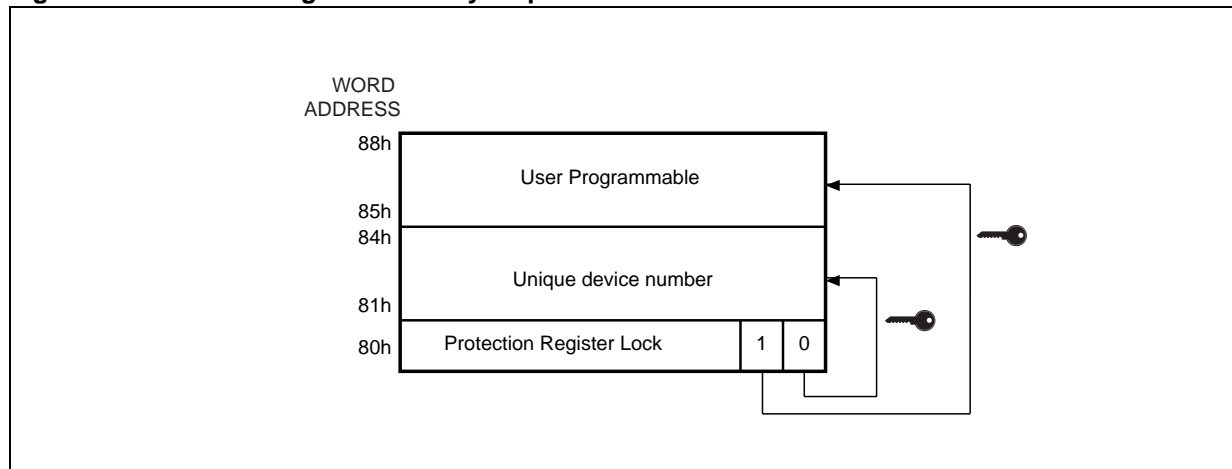


Table 8. Word-Wide Read Protection Register

Word	Use	A8	A7	A6	A5	A4	A3	A2	A1
Lock	Factory, User	1	0	0	0	0	0	0	0
0	Factory (Unique ID)	1	0	0	0	0	0	0	1
1	Factory (Unique ID)	1	0	0	0	0	0	1	0
2	Factory (Unique ID)	1	0	0	0	0	0	1	1
3	Factory (Unique ID)	1	0	0	0	0	1	0	0
4	User	1	0	0	0	0	1	0	1
5	User	1	0	0	0	0	1	1	0
6	User	1	0	0	0	0	1	1	1
7	User	1	0	0	0	1	0	0	0

Note: To read the Protection Register, A23 (A22 for LFBGA) must be V_{IL} .

Table 9. Byte-Wide Read Protection Register

Word	Use	A8	A7	A6	A5	A4	A3	A2	A1
Lock	Factory, User	1	0	0	0	0	0	0	0
Lock	Factory, User	1	0	0	0	0	0	0	0
0	Factory (Unique ID)	1	0	0	0	0	0	0	1
1	Factory (Unique ID)	1	0	0	0	0	0	0	1
2	Factory (Unique ID)	1	0	0	0	0	0	1	0
3	Factory (Unique ID)	1	0	0	0	0	0	1	0
4	Factory (Unique ID)	1	0	0	0	0	0	1	1
5	Factory (Unique ID)	1	0	0	0	0	0	1	1
6	Factory (Unique ID)	1	0	0	0	0	1	0	0
7	Factory (Unique ID)	1	0	0	0	0	1	0	0
8	User	1	0	0	0	0	1	0	1
9	User	1	0	0	0	0	1	0	1
A	User	1	0	0	0	0	1	1	0
B	User	1	0	0	0	0	1	1	0
C	User	1	0	0	0	0	1	1	1
D	User	1	0	0	0	0	1	1	1
E	User	1	0	0	0	1	0	0	0
F	User	1	0	0	0	1	0	0	0

Note: To read the Protection Register, A23 must be V_{IL}.

Table 10. Program/Erase Times and Program/Erase Endurance Cycles

Parameters	M30LW128D			Unit
	Min	Typ ^(1,2)	Max ⁽²⁾	
Block (1Mb) Erase		1.2	4.8 ⁽⁴⁾	s
Chip Program (Write to Buffer)		98	290 ⁽⁴⁾	s
Chip Erase Time		148	440 ⁽⁴⁾	s
Program Write Buffer		192 ⁽³⁾	576 ⁽⁴⁾	μs
Word/Byte Program Time (Word/Byte Program command)		16	48 ⁽⁴⁾	μs
Program Suspend Latency Time		1	20 ⁽⁵⁾	μs
Erase Suspend Latency Time		1	25 ⁽⁵⁾	μs
Block Protect Time		18	30 ⁽⁵⁾	μs
Blocks Unprotect Time		0.75	1.2 ⁽⁵⁾	s
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. Effective byte programming time 6μs, effective word programming time 12μs.

4. Maximum value measured at worst case conditions for both temperature and V_{DD} after 100,000 program/erase cycles.

5. Maximum value measured at worst case conditions for both temperature and V_{DD} .

STATUS REGISTER

The Status Register provides information on the current or previous Program, Erase, Block Protect or Blocks Unprotect operation. The various bits in the Status Register convey information and errors on the operation. They are output on DQ7-DQ0.

To read the Status Register the Read Status Register command can be issued. The Status Register is automatically read after Program, Erase, Block Protect, Blocks Unprotect and Program/Erase Resume commands. As the device contains two Status Registers (one for each internal memory) the Status Register must be read at the same address as the previous operation.

The contents of the Status Register can be updated during an Erase or Program operation by toggling the Output Enable pin or by dis-activating and then reactivating the device (refer to Table 3).

Status Register bits 5, 4, 3 and 1 are associated with various error conditions and can only be reset with the Clear Status Register command. The Status Register bits are summarized in Table 11, Status Register Bits. Refer to Table 11 in conjunction with the following text descriptions.

Program/Erase Controller Status (Bit 7). The Program/Erase Controller Status bit indicates whether the Program/Erase Controller is active or inactive. When the Program/Erase Controller Status bit is Low, V_{OL} , the Program/Erase Controller is active and all other Status Register bits are High Impedance; when the bit is High, V_{OH} , the Program/Erase Controller is inactive.

The Program/Erase Controller Status is Low immediately after a Program/Erase Suspend command is issued until the Program/Erase Controller pauses. After the Program/Erase Controller pauses the bit is High.

During Program, Erase, Block Protect and Blocks Unprotect operations the Program/Erase Controller Status bit can be polled to find the end of the operation. The other bits in the Status Register should not be tested until the Program/Erase Controller completes the operation and the bit is High.

After the Program/Erase Controller completes its operation the Erase Status, Program Status and Block Protection Status bits should be tested for errors.

Erase Suspend Status (Bit 6). The Erase Suspend Status bit indicates that an Erase operation has been suspended and is waiting to be resumed. The Erase Suspend Status should only be considered valid when the Program/Erase Controller Status bit is High (Program/Erase Controller inactive); after a Program/Erase Suspend command is issued the memory may still complete the operation rather than entering the Suspend mode.

When the Erase Suspend Status bit is Low, V_{OL} , the Program/Erase Controller is active or has completed its operation; when the bit is High, V_{OH} , a Program/Erase Suspend command has been issued and the memory is waiting for a Program/Erase Resume command.

When a Program/Erase Resume command is issued the Erase Suspend Status bit returns Low.

Erase Status (Bit 5). The Erase Status bit can be used to identify if the device has failed to verify that the block has erased correctly or that all blocks have been unprotected successfully. The Erase Status bit should be read once the Program/Erase Controller Status bit is High (Program/Erase Controller inactive).

When the Erase Status bit is Low, V_{OL} , the device has successfully verified that the block has erased correctly or all blocks have been unprotected successfully. When the Erase Status bit is High, V_{OH} , the erase operation has failed. Depending on the cause of the failure other Status Register bits may also be set to High, V_{OH} .

- If only the Erase Status bit (bit 5) is set High, V_{OH} , then the Program/Erase Controller has applied the maximum number of pulses to the block and still failed to verify that the block has erased correctly or that all the blocks have been unprotected successfully.
- If the failure is due to an erase or blocks unprotect with V_{PEN} low, V_{OL} , then V_{PEN} Status bit (bit 3) is also set High, V_{OH} .
- If the failure is due to an erase on a protected block then Block Protection Status bit (bit 1) is also set High, V_{OH} .
- If the failure is due to a program or erase incorrect command sequence then Program Status bit (bit 4) is also set High, V_{OH} .

Once set High, the Erase Status bit can only be reset Low by a Clear Status Register command or a hardware reset. If set High it should be reset before a new Program or Erase command is issued, otherwise the new command will appear to fail.

Program Status (Bit 4). The Program Status bit is used to identify a Program or Block Protect failure. The Program Status bit should be read once the Program/Erase Controller Status bit is High (Program/Erase Controller inactive).

When the Program Status bit is Low, V_{OL} , the device has successfully verified that the Write Buffer has programmed correctly or the block is protected. When the Program Status bit is High, V_{OH} , the program or block protect operation has failed. Depending on the cause of the failure other Status Register bits may also be set to High, V_{OH} .

- If only the Program Status bit (bit 4) is set High, V_{OH} , then the Program/Erase Controller has applied the maximum number of pulses to the byte and still failed to verify that the Write Buffer has programmed correctly or that the Block is protected.
- If the failure is due to a program or block protect with V_{PEN} low, V_{OL} , then V_{PEN} Status bit (bit 3) is also set High, V_{OH} .
- If the failure is due to a program on a protected block then Block Protection Status bit (bit 1) is also set High, V_{OH} .
- If the failure is due to a program or erase incorrect command sequence then Erase Status bit (bit 5) is also set High, V_{OH} .

Once set High, the Program Status bit can only be reset Low by a Clear Status Register command or a hardware reset. If set High it should be reset before a new Program or Erase command is issued, otherwise the new command will appear to fail.

V_{PEN} Status (Bit 3). The V_{PEN} Status bit can be used to identify if a Program, Erase, Block Protection or Block Unprotection operation has been attempted when V_{PEN} is Low, V_{IL} .

When the V_{PEN} Status bit is Low, V_{OL} , no Program, Erase, Block Protection or Block Unprotection operations have been attempted with V_{PEN} Low, V_{IL} , since the last Clear Status Register command, or hardware reset. When the V_{PEN} Status bit is High, V_{OH} , a Program, Erase, Block Protection or Block Unprotection operation has been attempted with V_{PEN} Low, V_{IL} .

Once set High, the V_{PEN} Status bit can only be reset by a Clear Status Register command or a hardware reset. If set High it should be reset before a new Program, Erase, Block Protection or Block Unprotection command is issued, otherwise the new command will appear to fail.

Program Suspend Status (Bit 2). The Program Suspend Status bit indicates that a Program operation has been suspended and is waiting to be resumed. The Program Suspend Status should only be considered valid when the Program/Erase Controller Status bit is High (Program/Erase Controller inactive); after a Program/Erase Suspend command is issued the device may still complete the operation rather than entering the Suspend mode.

When the Program Suspend Status bit is Low, V_{OL} , the Program/Erase Controller is active or has completed its operation; when the bit is High, V_{OH} , a Program/Erase Suspend command has been issued and the device is waiting for a Program/Erase Resume command.

When a Program/Erase Resume command is issued the Program Suspend Status bit returns Low.

Block Protection Status (Bit 1). The Block Protection Status bit can be used to identify if a Program or Erase operation has tried to modify the contents of a protected block.

When the Block Protection Status bit is Low, V_{OL} , no Program or Erase operations have been attempted to protected blocks since the last Clear Status Register command or hardware reset; when the Block Protection Status bit is High, V_{OH} , a Program (Program Status bit 4 set High) or Erase (Erase Status bit 5 set High) operation has been attempted on a protected block.

Once set High, the Block Protection Status bit can only be reset Low by a Clear Status Register command or a hardware reset. If set High it should be reset before a new Program or Erase command is issued, otherwise the new command will appear to fail.

Reserved (Bit 0). Bit 0 of the Status Register is reserved. Its value should be masked.

Table 11. Status Register Bits

OPERATION	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Result (Hex)
Program/Erase Controller active	0	Hi-Z						N/A
Write Buffer not ready	0	Hi-Z						N/A
Write Buffer ready	1	0	0	0	0	0	0	80h
Write Buffer ready in Erase Suspend	1	1	0	0	0	0	0	C0h
Program suspended	1	0	0	0	0	1	0	84h
Program suspended in Erase Suspend	1	1	0	0	0	1	0	C4h
Program/Block Protect completed successfully	1	0	0	0	0	0	0	80h
Program completed successfully in Erase Suspend	1	1	0	0	0	0	0	C0h
Program/Block protect failure due to incorrect command sequence	1	0	1	1	0	0	0	B0h
Program failure due to incorrect command sequence in Erase Suspend	1	1	1	1	0	0	0	F0h
Program/Block Protect failure due to V _{PEN} error	1	0	0	1	1	0	0	98h
Program failure due to V _{PEN} error in Erase Suspend	1	1	0	1	1	0	0	D8h
Program failure due to Block Protection	1	0	0	1	0	0	1	92h
Program failure due to Block Protection in Erase Suspend	1	1	0	1	0	0	1	D2h
Program/Block Protect failure due to cell failure	1	0	0	1	0	0	0	90h
Program failure due to cell failure in Erase Suspend	1	1	0	1	0	0	0	D0h
Erase Suspended	1	1	0	0	0	0	0	C0h
Erase/Blocks Unprotect completed successfully	1	0	0	0	0	0	0	80h
Erase/Blocks Unprotect failure due to incorrect command sequence	1	0	1	1	0	0	0	B0h
Erase/Blocks Unprotect failure due to V _{PEN} error	1	0	1	0	1	0	0	A8h
Erase failure due to Block Protection	1	0	1	0	0	0	1	A2h
Erase/Blocks Unprotect failure due to failed cells in Block	1	0	1	0	0	0	0	A0h
Configure STS error due to invalid configuration code	1	0	1	1	0	0	0	B0h

MAXIMUM RATING

Stressing the device above the ratings listed in Table 12, Absolute Maximum Ratings, may cause permanent damage to the device. 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. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability. Refer also to the STMicroelectronics SURE Program and other relevant quality documents.

Table 12. Absolute Maximum Ratings

Symbol	Parameter	Value		Unit
		Min	Max	
T _{BIAS}	Temperature Under Bias	-40	125	°C
T _{STG}	Storage Temperature	-55	150	°C
V _{IO}	Input or Output Voltage	-0.6	V _{DDQ} +0.6	V
V _{DD} , V _{DDQ}	Supply Voltage	-0.6	5.0	V
I _{OSC}	Output Short-circuit Current		100 ⁽¹⁾	mA

Note: 1. Maximum one output short-circuited at a time and for no longer than 1 second.

DC AND AC PARAMETERS

This section summarizes the operating and 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 Measure-

ment Conditions summarized in Table 13, Operating and AC Measurement Conditions. Designers should check that the operating conditions in their circuit match the measurement conditions when relying on the quoted parameters.

Table 13. Operating and AC Measurement Conditions

Parameter	M30LW128D		Units	
	Min	Max		
Supply Voltage (V_{DD})	2.7	3.6	V	
Input/Output Supply Voltage (V_{DDQ})	2.7	3.6	V	
Ambient Temperature (T_A)	Grade 1	0	70	°C
	Grade 6	-40	85	°C
Load Capacitance (C_L)	30		pF	
Input Pulses Voltages	0 to V_{DDQ}		V	
Input and Output Timing Ref. Voltages	0.5 V_{DDQ}		V	

Figure 9. AC Measurement Input Output Waveform

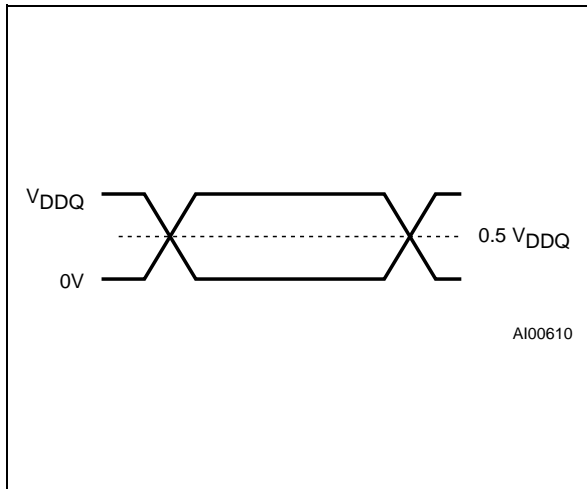


Figure 10. AC Measurement Load Circuit

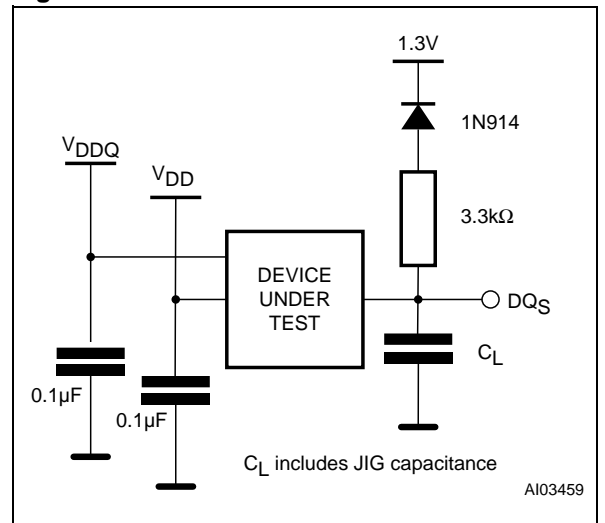


Table 14. Capacitance

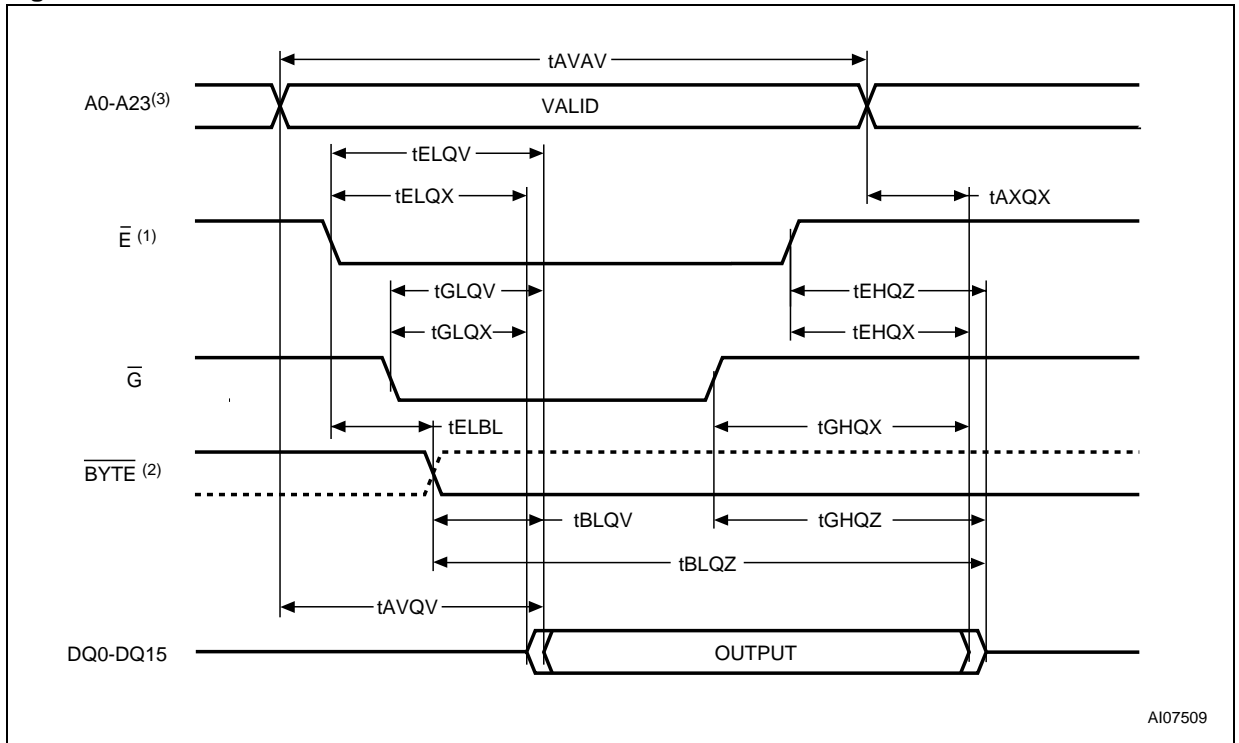
Symbol	Parameter	Test Condition	Typ	Max	Unit
C_{IN}	Input Capacitance	$V_{IN} = 0V$	6	8	pF
C_{OUT}	Output Capacitance	$V_{OUT} = 0V$	8	12	pF

Note: 1. $T_A = 25^\circ C$, $f = 1$ MHz
 2. Sampled only, not 100% tested.

Table 15. DC Characteristics

Symbol	Parameter	Test Condition	Min	Max	Unit
I_{LI}	Input Leakage Current	$0V \leq V_{IN} \leq V_{DDQ}$		± 1	μA
I_{LO}	Output Leakage Current	$0V \leq V_{OUT} \leq V_{DDQ}$		± 5	μA
I_{DD}	Supply Current (Random Read)	$\bar{E} = V_{IL}, f=5MHz$		20	mA
I_{DD0}	Supply Current (Page Read)	$\bar{E} = V_{IL}, f=33MHz$		29	mA
I_{DD1}	Supply Current (Standby)	$E = V_{IH}, \overline{RP} = V_{IH}$		80	μA
I_{DD5}	Supply Current (Auto Low-Power)	$E = V_{IL}, \overline{RP} = V_{IH}$		80	μA
I_{DD2}	Supply Current (Reset/Power-Down)	$\overline{RP} = V_{IL}$		80	μA
I_{DD3}	Supply Current (Program or Erase, Block Protect, Block Unprotect)	Program or Erase operation in progress		30	mA
I_{DD4}	Supply Current (Erase/Program Suspend)	$E = V_{IH}$		80	μA
V_{IL}	Input Low Voltage		-0.5	$0.3V_{DDQ}$	V
V_{IH}	Input High Voltage		$0.7V_{DDQ}$	$V_{DDQ} + 0.5$	V
V_{OL}	Output Low Voltage	$I_{OL} = 100\mu A$		0.2	V
V_{OH}	Output High Voltage	$I_{OH} = -100\mu A$	$V_{DDQ} - 0.2$		V
V_{LKO}	V_{DD} Supply Voltage (Erase and Program lockout)			2	V
V_{PENH}	V_{PEN} Supply Voltage (block erase, program and block protect)		2.7	3.6	V

Figure 11. Bus Read AC Waveforms



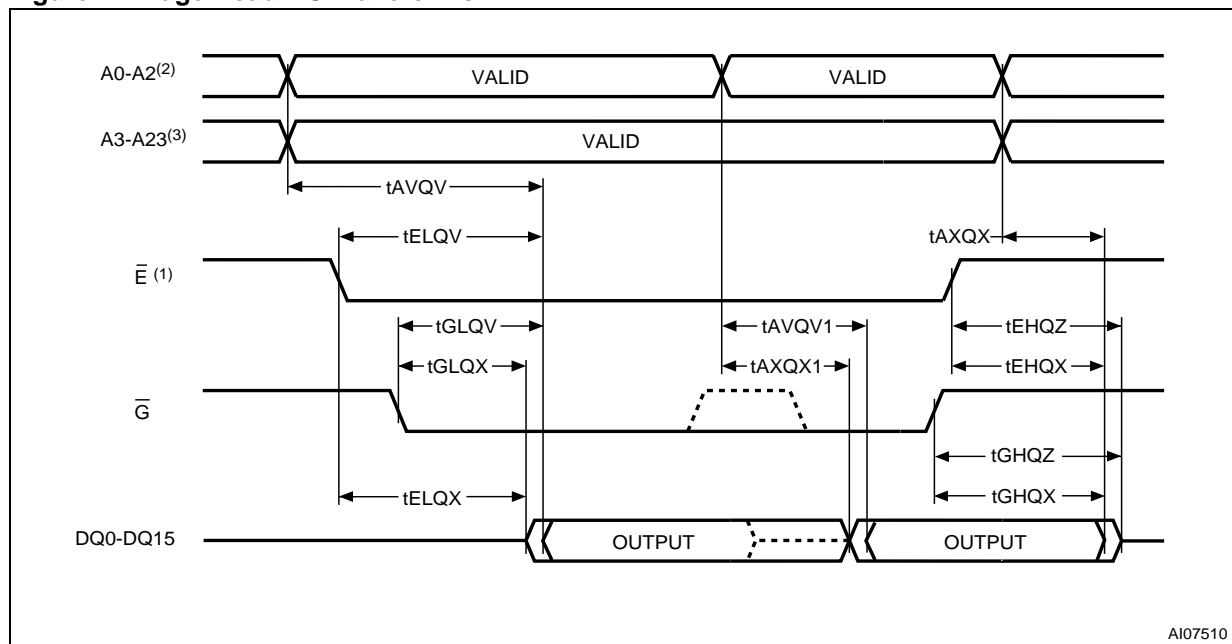
AI07509

- Note: 1. Refer to Table 3 for details of how the device is enabled.
 2. BYTE can be Low or High. The BYTE signal is not available with the LFBGA package.
 3. A0-A22 for LFBGA package.

Table 16. Bus Read AC Characteristics

Symbol	Parameter		M30LW128D		Unit
			110		
tAVAV	Address Valid to Address Valid	Min	110	ns	
tAVQV	Address Valid to Output Valid	Max	110	ns	
tAXQX	Address Transition to Output Transition	Min	0	ns	
tBLQV	Byte Low (or High) to Output Valid	Max	1	µs	
tBLQZ	Byte Low (or High) to Output Hi-Z	Max	1	µs	
tEHQX	Chip Enable High to Output Transition	Min	0	ns	
tEHQZ	Chip Enable High to Output Hi-Z	Max	25	ns	
tELBL	Chip Enable Low to Byte Low (or High)	Max	10	ns	
tELQX	Chip Enable Low to Output Transition	Min	0	ns	
tELQV	Chip Enable Low to Output Valid	Max	110	ns	
tGHQX	Output Enable High to Output Transition	Min	0	ns	
tGHQZ	Output Enable High to Output Hi-Z	Max	15	ns	
tGLQX	Output Enable Low to Output Transition	Min	0	ns	
tGLQV	Output Enable Low to Output Valid	Max	25	ns	

Figure 12. Page Read AC Waveforms



AI07510

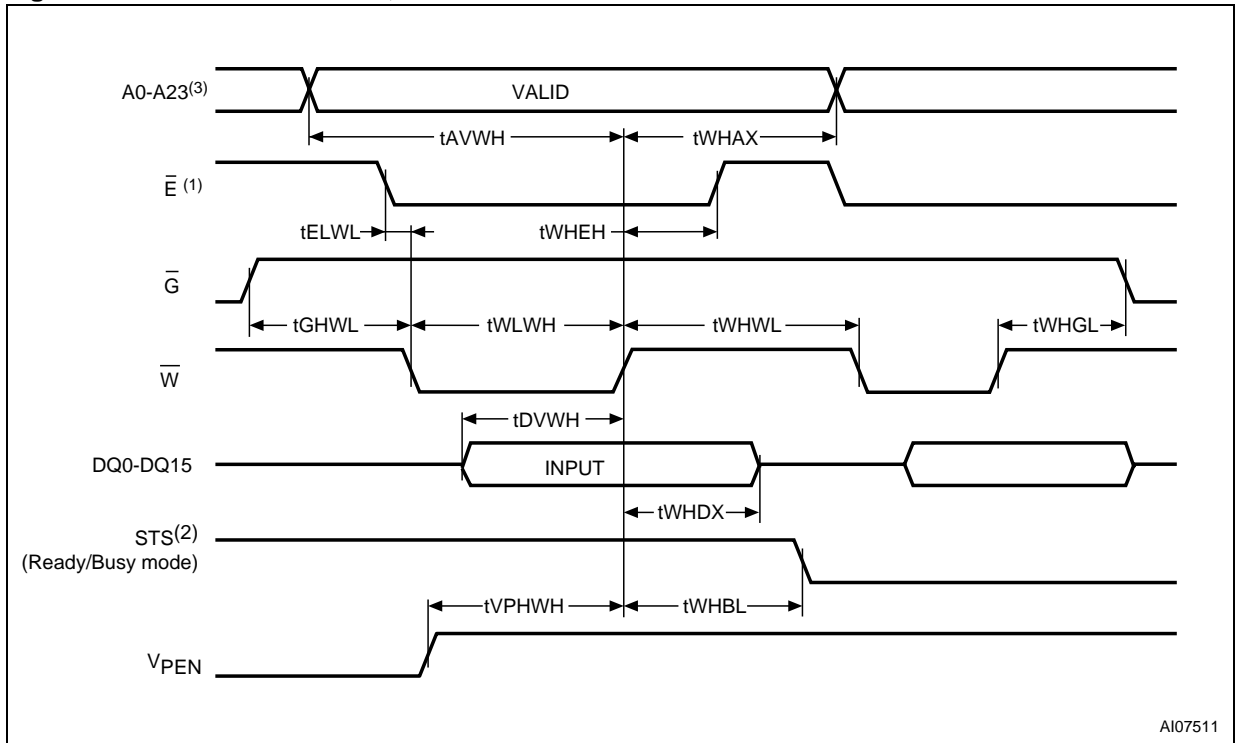
Note: 1. Refer to Table 3 for details of how the device is enabled.
 2. A0-A1 for LFBGA package.
 3. A2-A22 for LFBGA package.

Table 17. Page Read AC Characteristics

Symbol	Parameter		M30LW128D	
			110	Unit
t_{AXQX1}	Address Transition to Output Transition	Min	6	ns
t_{AVQV1}	Address Valid to Output Valid	Max	25	ns

Note: For other timings see Table 16, Bus Read AC Characteristics.

Figure 13. Write AC Waveform, Write Enable Controlled



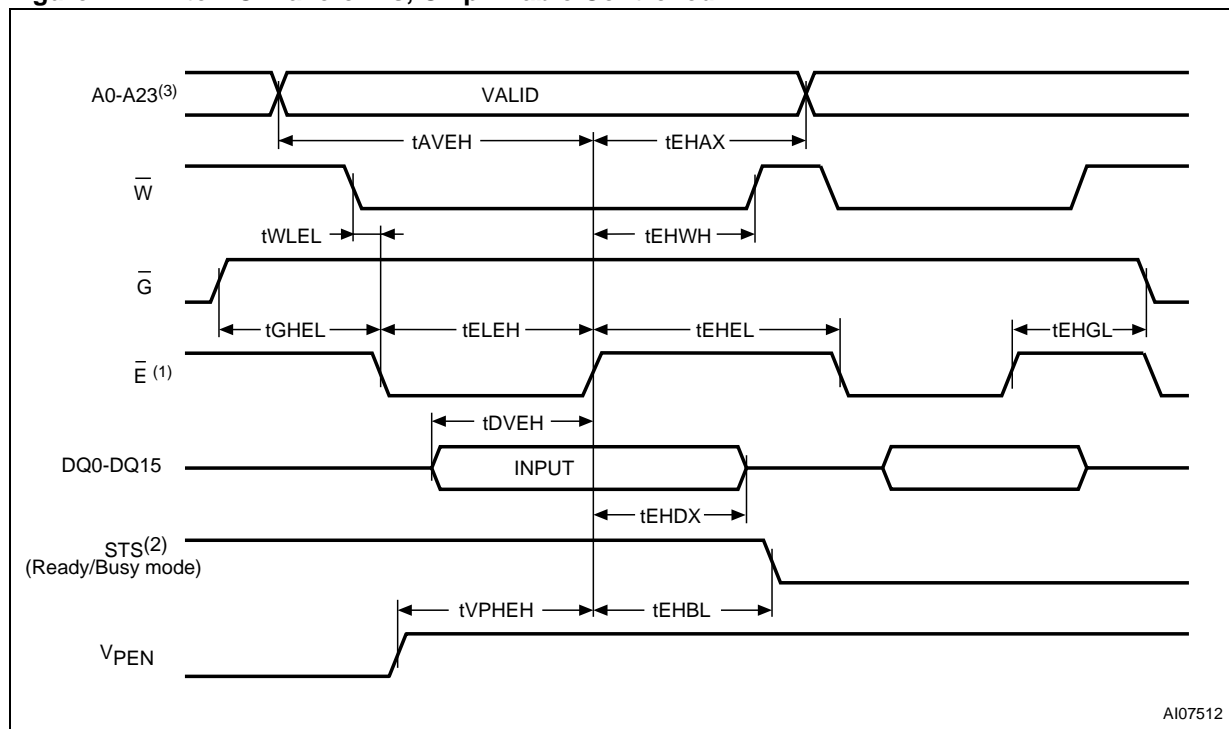
AI07511

- Note: 1. Refer to Table 3 for details of how the device is enabled.
 2. Not available with the LFBGA package.
 3. A0-A22 for LFBGA package.

Table 18. Write AC Characteristics, Write Enable Controlled

Symbol	Parameter		M30LW128D	
			110	Unit
t_{AVWH}	Address Valid to Write Enable High	Min	50	ns
t_{DVWH}	Data Input Valid to Write Enable High	Min	50	ns
t_{ELWL}	Chip Enable Low to Write Enable Low	Min	0	ns
t_{VPHWH}	Program/Erase Enable High to Write Enable High	Min	0	ns
t_{WHAX}	Write Enable High to Address Transition	Min	0	ns
t_{WHBL}	Write Enable High to Status/(Ready/Busy) low	Max	500	ns
t_{WHDX}	Write Enable High to Input Transition	Min	0	ns
t_{WHEH}	Write Enable High to Chip Enable High	Min	0	ns
t_{GHWL}	Output Enable High to Write Enable Low	Min	20	ns
t_{WHGL}	Write Enable High to Output Enable Low	Min	35	ns
t_{WHWL}	Write Enable High to Write Enable Low	Min	30	ns
t_{WLWH}	Write Enable Low to Write Enable High	Min	70	ns

Figure 14. Write AC Waveforms, Chip Enable Controlled



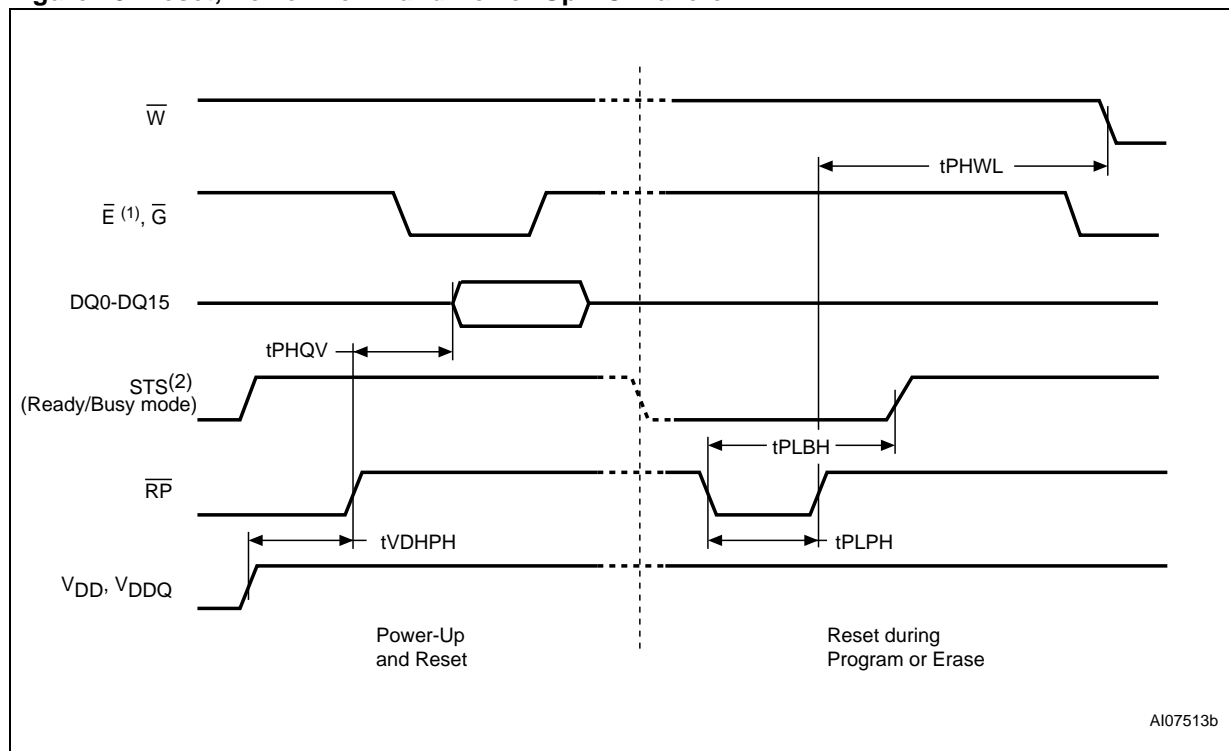
AI07512

- Note: 1. Refer to Table 3 for details of how the device is enabled.
 2. Not available with the LFBGA package.
 3. A0-A22 for LFBGA package.

Table 19. Write AC Characteristics, Chip Enable Controlled.

Symbol	Parameter		M30LW128D	
			110	Unit
t_{AVEH}	Address Valid to Chip Enable High	Min	50	ns
t_{DVEH}	Data Input Valid to Chip Enable High	Min	50	ns
t_{WLEL}	Write Enable Low to Chip Enable Low	Min	0	ns
t_{VPHEH}	Program/Erase Enable High to Chip Enable High	Min	0	ns
t_{EHAX}	Chip Enable High to Address Transition	Min	5	ns
t_{EHBL}	Chip Enable High to Status/(Ready/Busy) low	Max	500	ns
t_{EHDX}	Chip Enable High to Input Transition	Min	5	ns
t_{EHWH}	Chip Enable High to Write Enable High	Min	0	ns
t_{GHLEL}	Output Enable High to Chip Enable Low	Min	20	ns
t_{EHGL}	Chip Enable High to Output Enable Low	Min	35	ns
t_{EHEL}	Chip Enable High to Chip Enable Low	Min	30	ns
t_{ELEH}	Chip Enable Low to Chip Enable High	Min	70	ns

Figure 15. Reset, Power-Down and Power-Up AC Waveform



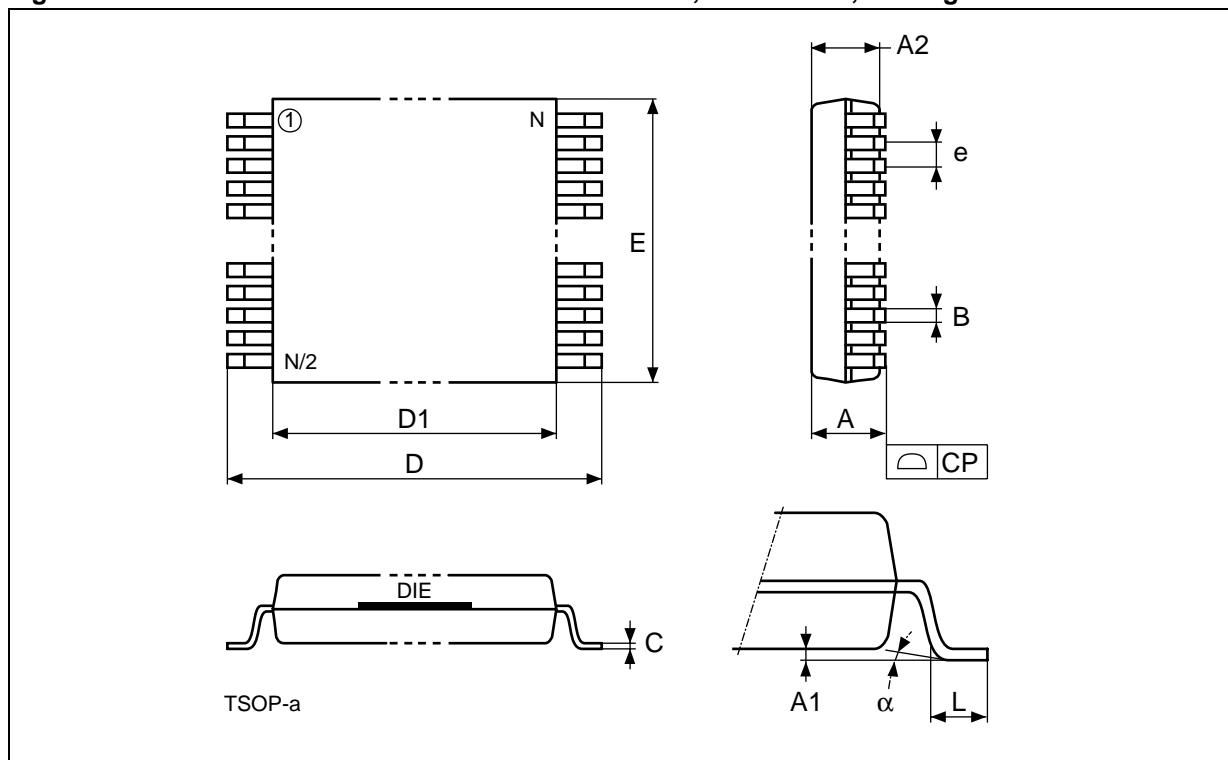
Note: 1. Refer to Table 3 for details of how the device is enabled.
 2. Not available with the LFBGA88 package.

Table 20. Reset, Power-Down and Power-Up AC Characteristics

Symbol	Parameter		M30LW128D	
			110	Unit
t_{PHQV}	Reset/Power-Down High to Data Valid	Max	150	ns
t_{PHWL}	Reset/Power-Down High to Write Enable Low	Max	1	μ s
t_{PLPH}	Reset/Power-Down Low to Reset/Power-Down High	Min	100	ns
t_{PLBH}	Reset/Power-Down Low to Status/(Ready/Busy) High	Max	30	μ s
t_{VDHPH}	Supply Voltages High to Reset/Power-Down High	Min	0	μ s

PACKAGE MECHANICAL

Figure 16. TSOP56 - 56 lead Plastic Thin Small Outline, 14 x 20 mm, Package Outline

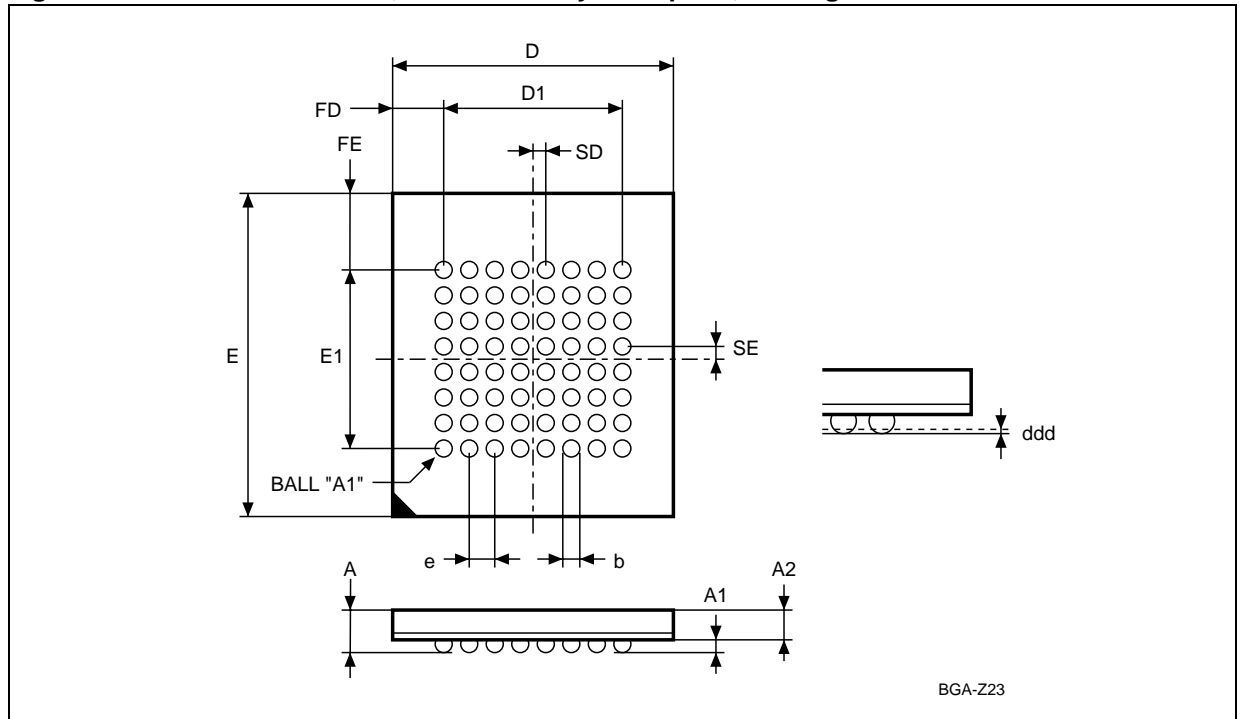


Note: Drawing is not to scale.

Table 21. TSOP56 - 56 lead Plastic Thin Small Outline, 14 x 20 mm, Package Mechanical Data

Symbol	mm			inches		
	Typ	Min	Max	Typ	Min	Max
A			1.20			0.0472
A1		0.05	0.15		0.0020	0.0059
A2		0.95	1.05		0.0374	0.0413
B		0.17	0.27		0.0067	0.0106
C		0.10	0.21		0.0039	0.0083
D		19.80	20.20		0.7795	0.7953
D1		18.30	18.50		0.7205	0.7283
E		13.90	14.10		0.5472	0.5551
e	0.50	–	–	0.0197	–	–
L		0.50	0.70		0.0197	0.0276
α		0°	5°		0°	5°
N	56			56		
CP			0.10			0.0039

Figure 17. TBGA64 - 10x13mm, 8 x 8 ball array 1mm pitch, Package Outline

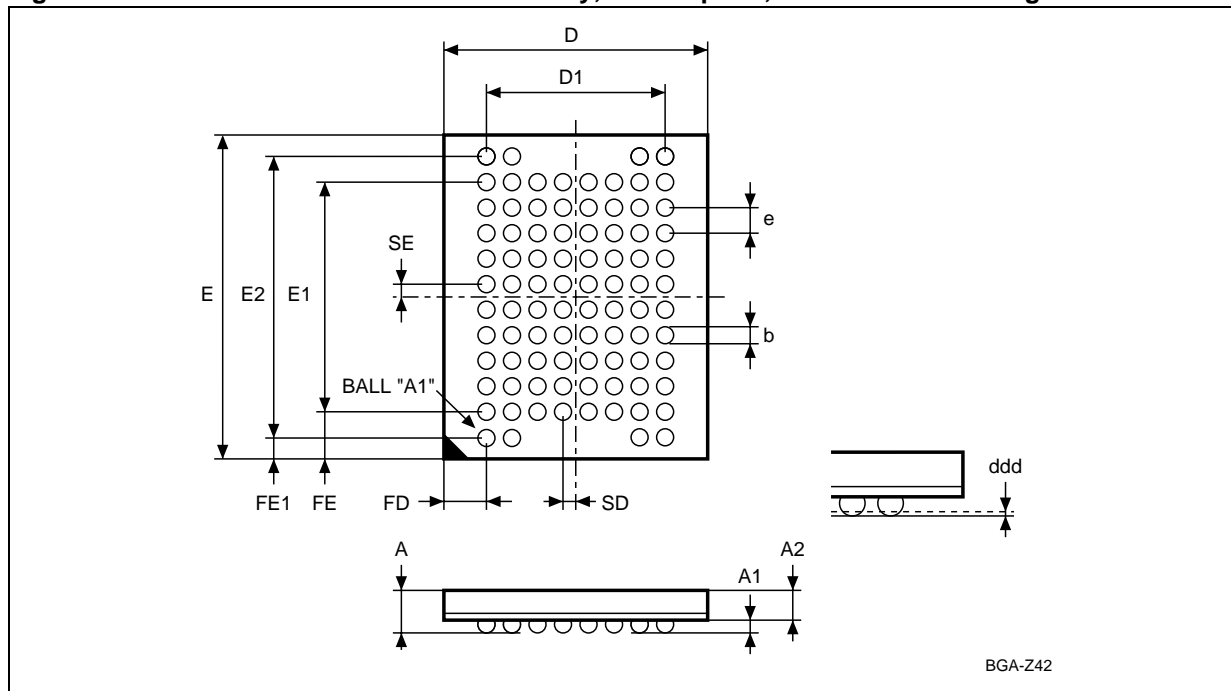


Note: Drawing is not to scale.

Table 22. TBGA64 - 10x13mm, 8 x 8 ball array, 1 mm pitch, Package Mechanical Data

Symbol	millimeters			inches		
	Typ	Min	Max	Typ	Min	Max
A			1.200			0.0472
A1	0.300	0.200	0.350	0.0118	0.0079	0.0138
A2			0.850			0.0335
b		0.400	0.500		0.0157	0.0197
D	10.000	9.900	10.100	0.3937	0.3898	0.3976
D1	7.000	-	-	0.2756	-	-
ddd			0.100			0.0039
e	1.000	-	-	0.0394	-	-
E	13.000	12.900	13.100	0.5118	0.5079	0.5157
E1	7.000	-	-	0.2756	-	-
FD	1.500	-	-	0.0591	-	-
FE	3.000	-	-	0.1181	-	-
SD	0.500	-	-	0.0197	-	-
SE	0.500	-	-	0.0197	-	-

Figure 18. LFBGA88 8x10 mm - 8x10 ball array, 0.8mm pitch, Bottom View Package Outline



Note: Drawing is not to scale.

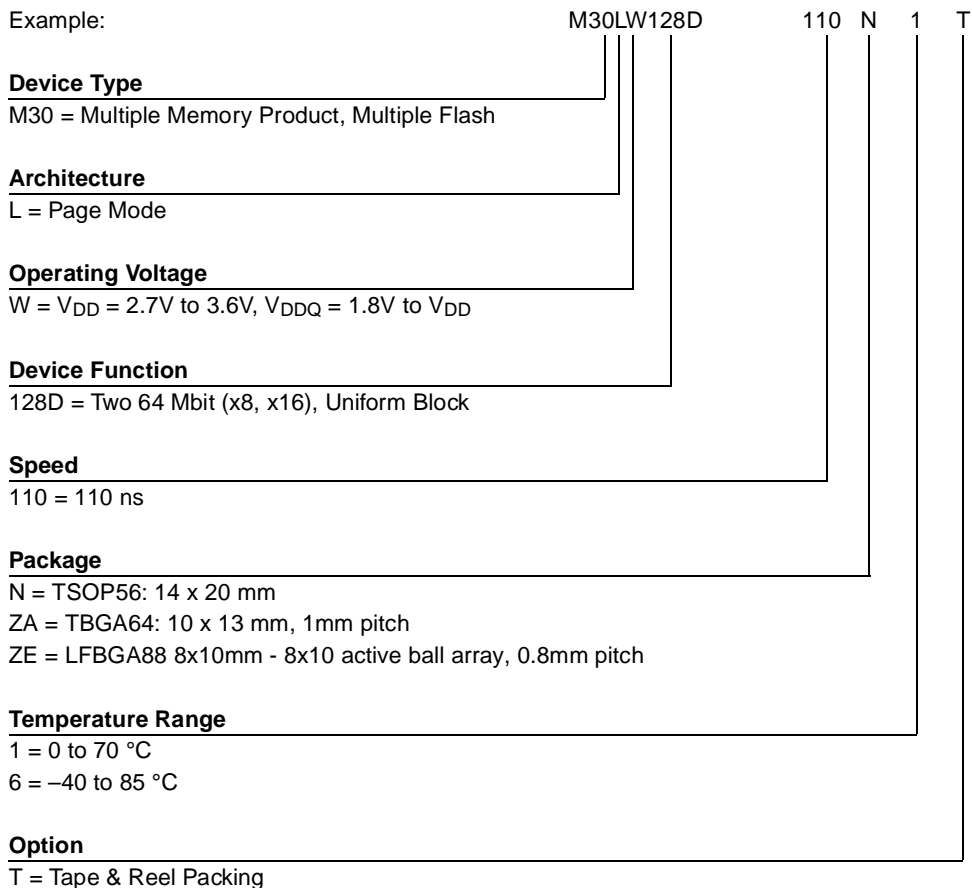
Table 23. LFBGA88 8x10mm - 8x10 ball array, 0.8mm pitch, Package Mechanical Data

Symbol	millimeters			inches		
	Typ	Min	Max	Typ	Min	Max
A			1.400			0.0551
A1		0.300			0.0118	
A2	0.960			0.0378		
b	0.400	0.350	0.450	0.0157	0.0138	0.0177
D	8.000	7.900	8.100	0.3150	0.3110	0.3189
D1	5.600	–	–	0.2205	–	–
ddd			0.100			0.0039
E	10.000	9.900	10.100	0.3937	0.3898	0.3976
E1	7.200	–	–	0.2835	–	–
E2	8.800	–	–	0.3465	–	–
e	0.800	–	–	0.0315	–	–
FD	1.200	–	–	0.0472	–	–
FE	1.400	–	–	0.0551	–	–
FE1	0.600	–	–	0.0236	–	–
SD	0.400	–	–	0.0157	–	–
SE	0.400	–	–	0.0157	–	–

Note: All of the values in the table are preliminary and are subject to change.

PART NUMBERING

Table 24. Ordering Information Scheme



Note: 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 the ST Sales Office nearest to you.

APPENDIX A. BLOCK ADDRESS TABLE

Table 25. Block Addresses

Block No.	Address Range (x8 Bus Width)	Address Range (x16 Bus Width)
128	FE0000h-FFFFFFh	7F0000h-7FFFFFFh
127	FC0000h-FDFFFFFFh	7E0000h-7EFFFFFFh
126	FA0000h-FBFFFFFFh	7D0000h-7DFFFFFFh
125	F80000h-F9FFFFFFh	7C0000h-7CFFFFFFh
124	F60000h-F7FFFFFFh	7B0000h-7BFFFFFFh
123	F40000h-F5FFFFFFh	7A0000h-7AFFFFFFh
122	F20000h-F3FFFFFFh	790000h-79FFFFFFh
121	F00000h-F1FFFFFFh	780000h-78FFFFFFh
120	EE0000h-EFFFFFFFh	770000h-77FFFFFFh
119	EC0000h-EDFFFFFFh	760000h-76FFFFFFh
118	EA0000h-EBFFFFFFh	750000h-75FFFFFFh
117	E80000h-E9FFFFFFh	740000h-74FFFFFFh
116	E60000h-E7FFFFFFh	730000h-73FFFFFFh
115	E40000h-E5FFFFFFh	720000h-72FFFFFFh
114	E20000h-E3FFFFFFh	710000h-71FFFFFFh
113	E00000h-E1FFFFFFh	700000h-70FFFFFFh
112	DE0000h-DFFFFFFFh	6F0000h-6FFFFFFFh
111	DC0000h-DDFFFFFFh	6E0000h-6EFFFFFFh
110	DA0000h-DBFFFFFFh	6D0000h-6DFFFFFFh
109	D80000h-D9FFFFFFh	6C0000h-6CFFFFFFh
108	D60000h-D7FFFFFFh	6B0000h-6BFFFFFFh
107	D40000h-D5FFFFFFh	6A0000h-6AFFFFFFh
106	D20000h-D3FFFFFFh	690000h-69FFFFFFh
105	D00000h-D1FFFFFFh	680000h-68FFFFFFh
104	CE0000h-CFFFFFFFh	670000h-67FFFFFFh
103	CC0000h-CDFFFFFFh	660000h-66FFFFFFh
102	CA0000h-CBFFFFFFh	650000h-65FFFFFFh
101	C80000h-C9FFFFFFh	640000h-64FFFFFFh
100	C60000h-C7FFFFFFh	630000h-63FFFFFFh
99	C40000h-C5FFFFFFh	620000h-62FFFFFFh
98	C20000h-C3FFFFFFh	610000h-61FFFFFFh
97	C00000h-C1FFFFFFh	600000h-60FFFFFFh
96	BE0000h-BFFFFFFFh	5F0000h-5FFFFFFFh

Upper Memory

Block No.	Address Range (x8 Bus Width)	Address Range (x16 Bus Width)
95	BC0000h-BDFFFFFFh	5E0000h-5EFFFFFFh
94	BA0000h-BBFFFFFFh	5D0000h-5DFFFFFFh
93	B80000h-B9FFFFFFh	5C0000h-5CFFFFFFh
92	B60000h-B7FFFFFFh	5B0000h-5BFFFFFFh
91	B40000h-B5FFFFFFh	5A0000h-5AFFFFFFh
90	B20000h-B3FFFFFFh	590000h-59FFFFFFh
89	B00000h-B1FFFFFFh	580000h-58FFFFFFh
88	AE0000h-AFFFFFFFh	570000h-57FFFFFFh
87	AC0000h-ADFFFFFFh	560000h-56FFFFFFh
86	AA0000h-ABFFFFFFh	550000h-55FFFFFFh
85	A80000h-A9FFFFFFh	540000h-54FFFFFFh
84	A60000h-A7FFFFFFh	530000h-53FFFFFFh
83	A40000h-A5FFFFFFh	520000h-52FFFFFFh
82	A20000h-A3FFFFFFh	510000h-51FFFFFFh
81	A00000h-A1FFFFFFh	500000h-50FFFFFFh
80	9E0000h-9FFFFFFFh	4F0000h-4FFFFFFFh
79	9C0000h-9DFFFFFFh	4E0000h-4EFFFFFFh
78	9A0000h-9BFFFFFFh	4D0000h-4DFFFFFFh
77	980000h-99FFFFFFh	4C0000h-4CFFFFFFh
76	960000h-97FFFFFFh	4B0000h-4BFFFFFFh
75	940000h-95FFFFFFh	4A0000h-4AFFFFFFh
74	920000h-93FFFFFFh	490000h-49FFFFFFh
73	900000h-91FFFFFFh	480000h-48FFFFFFh
72	8E0000h-8FFFFFFFh	470000h-47FFFFFFh
71	8C0000h-8DFFFFFFh	460000h-46FFFFFFh
70	8A0000h-8BFFFFFFh	450000h-45FFFFFFh
69	880000h-89FFFFFFh	440000h-44FFFFFFh
68	860000h-87FFFFFFh	430000h-43FFFFFFh
67	840000h-85FFFFFFh	420000h-42FFFFFFh
66	820000h-83FFFFFFh	410000h-41FFFFFFh
65	800000h-81FFFFFFh	400000h-40FFFFFFh

Upper Memory

Block No.	Address Range (x8 Bus Width)	Address Range (x16 Bus Width)
64	7E0000h-7FFFFFFh	3F0000h-3FFFFFFh
63	7C0000h-7DFFFFFFh	3E0000h-3EFFFFFFh
62	7A0000h-7BFFFFFFh	3D0000h-3DFFFFFFh
61	780000h-79FFFFFFh	3C0000h-3CFFFFFFh
60	760000h-77FFFFFFh	3B0000h-3BFFFFFFh
59	740000h-75FFFFFFh	3A0000h-3AFFFFFFh
58	720000h-73FFFFFFh	390000h-39FFFFFFh
57	700000h-71FFFFFFh	380000h-38FFFFFFh
56	6E0000h-6FFFFFFh	370000h-37FFFFFFh
55	6C0000h-6DFFFFFFh	360000h-36FFFFFFh
54	6A0000h-6BFFFFFFh	350000h-35FFFFFFh
53	680000h-69FFFFFFh	340000h-34FFFFFFh
52	660000h-67FFFFFFh	330000h-33FFFFFFh
51	640000h-65FFFFFFh	320000h-32FFFFFFh
50	620000h-63FFFFFFh	310000h-31FFFFFFh
49	600000h-61FFFFFFh	300000h-30FFFFFFh
48	5E0000h-5FFFFFFh	2F0000h-2FFFFFFFh
47	5C0000h-5DFFFFFFh	2E0000h-2EFFFFFFh
46	5A0000h-5BFFFFFFh	2D0000h-2DFFFFFFh
45	580000h-59FFFFFFh	2C0000h-2CFFFFFFh
44	560000h-57FFFFFFh	2B0000h-2BFFFFFFh
43	540000h-55FFFFFFh	2A0000h-2AFFFFFFh
42	520000h-53FFFFFFh	290000h-29FFFFFFh
41	500000h-51FFFFFFh	280000h-28FFFFFFh
40	4E0000h-4FFFFFFh	270000h-27FFFFFFh
39	4C0000h-4DFFFFFFh	260000h-26FFFFFFh
38	4A0000h-4BFFFFFFh	250000h-25FFFFFFh
37	480000h-49FFFFFFh	240000h-24FFFFFFh
36	460000h-47FFFFFFh	230000h-23FFFFFFh
35	440000h-45FFFFFFh	220000h-22FFFFFFh
34	420000h-43FFFFFFh	210000h-21FFFFFFh
33	400000h-41FFFFFFh	200000h-20FFFFFFh
32	3E0000h-3FFFFFFh	1F0000h-1FFFFFFh
31	3C0000h-3DFFFFFFh	1E0000h-1EFFFFFFh
30	3A0000h-3BFFFFFFh	1D0000h-1DFFFFFFh

Lower Memory

Block No.	Address Range (x8 Bus Width)	Address Range (x16 Bus Width)
29	380000h-39FFFFFFh	1C0000h-1CFFFFFFh
28	360000h-37FFFFFFh	1B0000h-1BFFFFFFh
27	340000h-35FFFFFFh	1A0000h-1AFFFFFFh
26	320000h-33FFFFFFh	190000h-19FFFFFFh
25	300000h-31FFFFFFh	180000h-18FFFFFFh
24	2E0000h-2FFFFFFFh	170000h-17FFFFFFh
23	2C0000h-2DFFFFFFh	160000h-16FFFFFFh
22	2A0000h-2BFFFFFFh	150000h-15FFFFFFh
21	280000h-29FFFFFFh	140000h-14FFFFFFh
20	260000h-27FFFFFFh	130000h-13FFFFFFh
19	240000h-25FFFFFFh	120000h-12FFFFFFh
18	220000h-23FFFFFFh	110000h-11FFFFFFh
17	200000h-21FFFFFFh	100000h-10FFFFFFh
16	1E0000h-1FFFFFFh	0F0000h-0FFFFFFh
15	1C0000h-1DFFFFFFh	0E0000h-0EFFFFFFh
14	1A0000h-1BFFFFFFh	0D0000h-0DFFFFFFh
13	180000h-19FFFFFFh	0C0000h-0CFFFFFFh
12	160000h-17FFFFFFh	0B0000h-0BFFFFFFh
11	140000h-15FFFFFFh	0A0000h-0AFFFFFFh
10	120000h-13FFFFFFh	090000h-09FFFFFFh
9	100000h-11FFFFFFh	080000h-08FFFFFFh
8	0E0000h-0FFFFFFh	070000h-07FFFFFFh
7	0C0000h-0DFFFFFFh	060000h-06FFFFFFh
6	0A0000h-0BFFFFFFh	050000h-05FFFFFFh
5	080000h-09FFFFFFh	040000h-04FFFFFFh
4	060000h-07FFFFFFh	030000h-03FFFFFFh
3	040000h-05FFFFFFh	020000h-02FFFFFFh
2	020000h-03FFFFFFh	010000h-01FFFFFFh
1	000000h-01FFFFFFh	000000h-00FFFFFFh

Lower Memory

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 de-

vice, enabling the software to upgrade itself when necessary.

When the CFI Query Command (RCFI) is issued the device enters CFI Query mode and the data structure is read from the memory. Tables 26, 27, 28, 29, 30 and 31 show the addresses used to retrieve the data.

Table 26. Query Structure Overview

Address ⁽⁵⁾		Sub-section Name	Description
x16	x8 ⁽⁴⁾		
0000h	00h		Manufacturer Code
0001h	02h		Device Code
0010h	20h	CFI Query Identification String	Command set ID and algorithm data offset
001Bh	36h	System Interface Information	Device timing and voltage information
0027h	4Eh	Device Geometry Definition	Flash memory layout
P(h) ⁽¹⁾		Primary Algorithm-specific Extended Query Table	Additional information specific to the Primary Algorithm (optional)
A(h) ⁽²⁾		Alternate Algorithm-specific Extended Query Table	Additional information specific to the Alternate Algorithm (optional)
(SBA+02)h ⁽⁶⁾		Block Status Register	Block-related Information

- Note:
1. Offset 15h defines P which points to the Primary Algorithm Extended Query Address Table.
 2. Offset 19h defines A which points to the Alternate Algorithm Extended Query Address Table.
 3. SBA is the Start Base Address for each block.
 4. In x8 mode A0 must be set to V_{IL}. Otherwise, 00h will be output.
 5. A23 (A22 for LFBGA) must be set to V_{IL} to access the CFI (to issue the command and to read the CFI data).
 6. To read the block protection status in the CFI A23 (A22 for LFBGA) must be set to V_{IH} when issuing the command. Then to address blocks in the Lower 64Mbit set A23 (A22 for LFBGA) to V_{IL}; to address blocks in the Upper 64Mbit set A23 (A22 for LFBGA) to V_{IH}.

Table 27. CFI - Query Address and Data Output

Address ⁽³⁾		Data		Description
x16	x8 ⁽²⁾			
0010h	20h	51h	"Q"	Query ASCII String 51h; "Q" 52h; "R" 59h; "Y"
0011h	22h	52h	"R"	
0012h	24h	59h	"Y"	
0013h	26h	01h		Primary Vendor: Command Set and Control Interface ID Code
0014h	28h	00h		
0015h	2Ah	31h		Primary algorithm extended Query Address Table: P(h)
0016h	2Ch	00h		
0017h	2Eh	00h		Alternate Vendor: Command Set and Control Interface ID Code
0018h	30h	00h		
0019h	32h	00h		Alternate Algorithm Extended Query address Table
001Ah	34h	00h		

Note: 1. Query Data are always presented on DQ7-DQ0. DQ15-DQ8 are set to '0'.
 2. In x8 mode A0 must be set to V_{IL}. Otherwise, 00h will be output.
 3. A23 (A22 for LFBGA) must be set to V_{IL} to access the CFI (to issue the command and to read the CFI data).

Table 28. CFI - Device Voltage and Timing Specification

Address ⁽⁵⁾		Data	Description
x16	x8 ⁽⁴⁾		
001Bh	36h	27h ⁽¹⁾	V _{DD} Min, 2.7V
001Ch	38h	36h ⁽¹⁾	V _{DD} max, 3.6V
001Dh	3Ah	00h ⁽²⁾	V _{PP} min – Not Available
001Eh	3Ch	00h ⁽²⁾	V _{PP} max – Not Available
001Fh	3Eh	04h	2 ⁿ μs typical time-out for Word, DWord prog – Not Available
0020h	40h	08h	2 ⁿ μs, typical time-out for max buffer write
0021h	42h	0Ah	2 ⁿ ms, typical time-out for Erase Block
0022h	44h	00h ⁽³⁾	2 ⁿ ms, typical time-out for chip erase – Not Available
0023h	46h	04h	2 ⁿ x typical for Word Dword time-out max – Not Available
0024h	48h	04h	2 ⁿ x typical for buffer write time-out max
0025h	4Ah	04h	2 ⁿ x typical for individual block erase time-out maximum
0026h	4Ch	00h ⁽³⁾	2 ⁿ x typical for chip erase max time-out – Not Available

Note: 1. Bits are coded in Binary Code Decimal, bit7 to bit4 are scaled in Volts and bit3 to bit0 in mV.
 2. Bit7 to bit4 are coded in Hexadecimal and scaled in Volts while bit3 to bit0 are in Binary Code Decimal and scaled in 100mV.
 3. Not supported.
 4. In x8 mode A0 must be set to V_{IL}. Otherwise, 00h will be output.
 5. A23 (A22 for LFBGA) must be set to V_{IL} to access the CFI (to issue the command and to read the CFI data).

Table 29. Device Geometry Definition

Address ⁽³⁾		Data	Description
x16	x8 ⁽¹⁾		
0027h	4Eh	18h	n where 2 ⁿ is number of bytes memory Size
0028h	50h	02h	Device Interface 02h is the interface for M30LW128D devices delivered in TSOP56 and TBGA64 packages (x8 and x16 modes available)
	N/A ⁽²⁾	01h	
0029h	52h	00h	
002Ah	54h	05h	Maximum number of bytes in Write Buffer, 2 ⁿ
002Bh	56h	00h	
002Ch	58h	01h	Bit7-0 = number of Erase Block Regions in device
002Dh	5Ah	7Fh	Number (n-1) of Erase Blocks of identical size; n=128
002Eh	5Ch	00h	
002Fh	5Eh	00h	Erase Block Region Information x 256 bytes per Erase block (128K bytes)
0030h	60h	02h	

- Note: 1. In x8 mode A0 must be set to V_{IL}. Otherwise, 00h will be output.
2. N/A = Not Applicable. Only the x16 mode is available with the LFBGA package.
3. A23 (A22 for LFBGA) must be set to V_{IL} to access the CFI (to issue the command and to read the CFI data).

Table 30. Block Status Register

Address ⁽³⁾	Data		Selected Block Information
(BA+2)h ⁽¹⁾	bit0	0	Block Unprotected
		1	Block Protected
	bit1	0	Last erase operation ended successfully ⁽²⁾
		1	Last erase operation not ended successfully ⁽²⁾
	bit7-2	0	Reserved for future features

- Note: 1. BA specifies the block address location, A23-A17.
2. Not Supported.
3. To read the block protection status in the CFI A23 (A22 for LFBGA) must be set to V_{IH} when issuing the command. Then to address blocks in the Lower 64Mbit; set A23 (A22 for LFBGA) to V_{IL}; to address blocks in the Upper 64Mbit set A23 (A22 for LFBGA) to V_{IH}.

Table 31. Extended Query information

Address ⁽³⁾			Data (Hex)		Description
offset	x16	x8 ⁽²⁾			
(P)h	0031h	62h	50h	"P"	Query ASCII string - Extended Table
(P+1)h	0032h	64h	52h	"R"	
(P+2)h	0033h	66h	49h	"I"	
(P+3)h	0034h	68h	31h		Major version number
(P+4)h	0035h	6Ah	31h		Minor version number
(P+5)h	0036h	6Ch	CEh		Optional Feature: (1=yes, 0=no) bit0, Chip Erase Supported (0=no) bit1, Suspend Erase Supported (1=yes) bit2, Suspend Program Supported (1=yes) bit3, Protect/Unprotect Supported (1=yes) bit4, Queue Erase Supported (0=no) bit5, Instant Individual Block locking (0=no) bit6, Protection bits supported (1=yes) bit7, Page Read supported (1=yes) bit8, Synchronous Read supported (0=no) bit9, Multi chip device (1=yes) bit10, Simultaneous operations supported (1=yes) Bits 11 to 31 reserved for future use
(P+6)h	0037h	6Eh	06h		
(P+7)h	0038h	70h	00h		
(P+8)h	0039h	72h	00h		
(P+9)h	003Ah	74h	01h		Function allowed after Suspend: Program allowed after Erase Suspend (1=yes) Bits 1 to 7 reserved for future use
(P+A)h	003Bh	76h	01h		Block Status Register bit0, Block Protect-Bit status active (1=yes) bit1, Block Lock-Down Bit status (not available) bits 2 to 15 reserved for future use
(P+B)h	003Ch	78h	00h		
(P+C)h	003Dh	7Ah	33h		V _{DD} OPTIMUM Program/Erase voltage conditions
(P+D)h	003Eh	7Ch	00h		V _{PP} OPTIMUM Program/Erase voltage conditions
(P+E)h	003Fh	7Eh	01h		OTP protection: No. of protection register fields
(P+F)h	0040h	80h	80h		Protection Register's start address, least significant bits
(P+10)h	0041h	82h	00h		Protection Register's start address, most significant bits
(P+11)h	0042h	84h	03h		n where 2 ⁿ is number of factory reprogrammed bytes
(P+12)h	0043h	86h	03h		n where 2 ⁿ is number of user programmable bytes
(P+13)h	0044h	88h	03h		Page Read: 2 ⁿ Bytes (n = bits 0-7)
(P+14)h	0045h	8Ah	00h		Synchronous mode configuration fields
(P+15)h	0046h	8Ch	Reserved for future use		

Note: 1. Bit7 to bit4 are coded in Hexadecimal and scaled in Volt while bit3 to bit0 are in Binary Code Decimal and scaled in mV.

2. In x8 mode, A0 must be set to V_{IL}, otherwise 00h will be output.

3. A23 (A22 for LFBGA) must be set to V_{IL} to access the CFI (to issue the command and to read the CFI data).

APPENDIX C. FLOW CHARTS

Figure 19. Write to Buffer and Program Flowchart and Pseudo Code

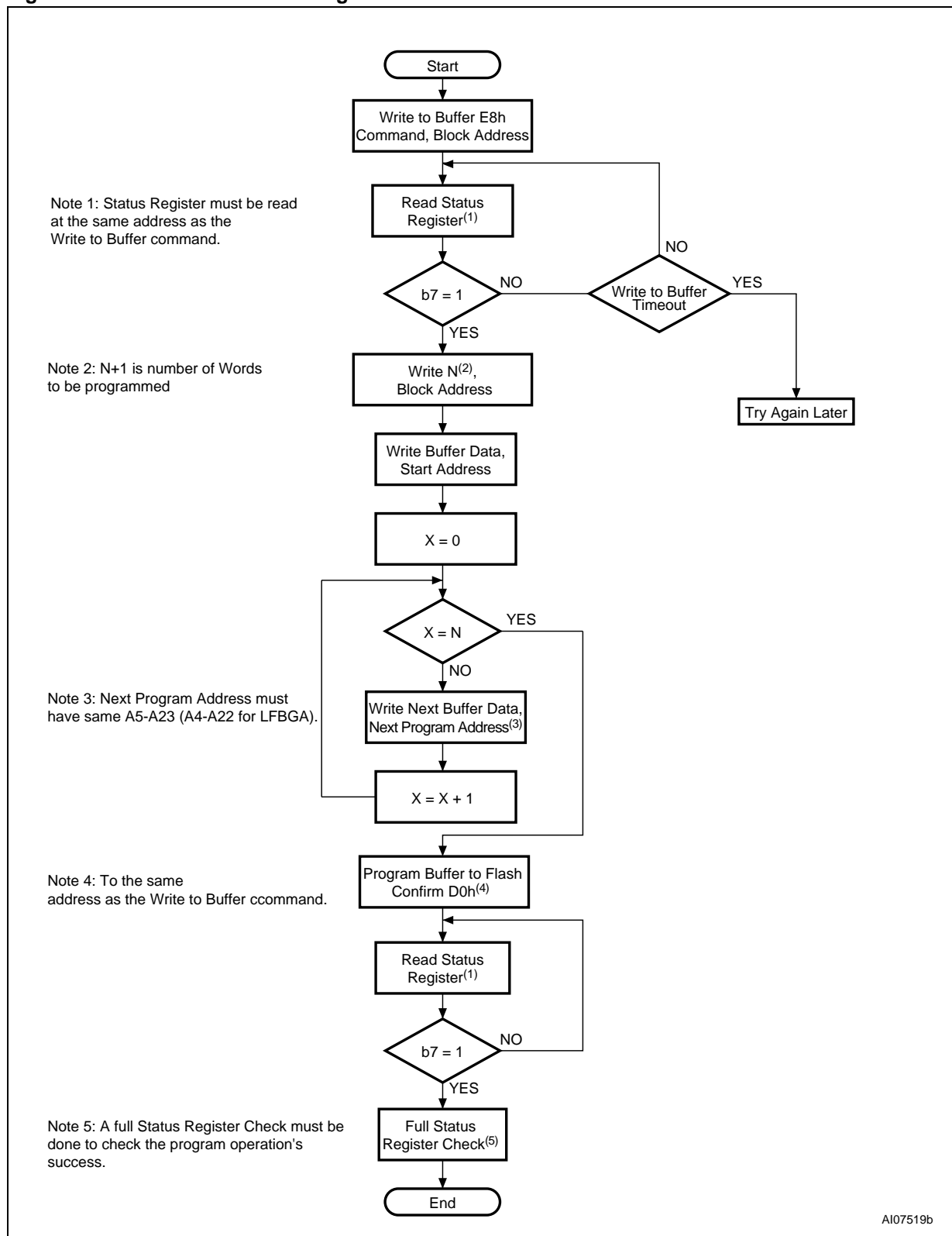
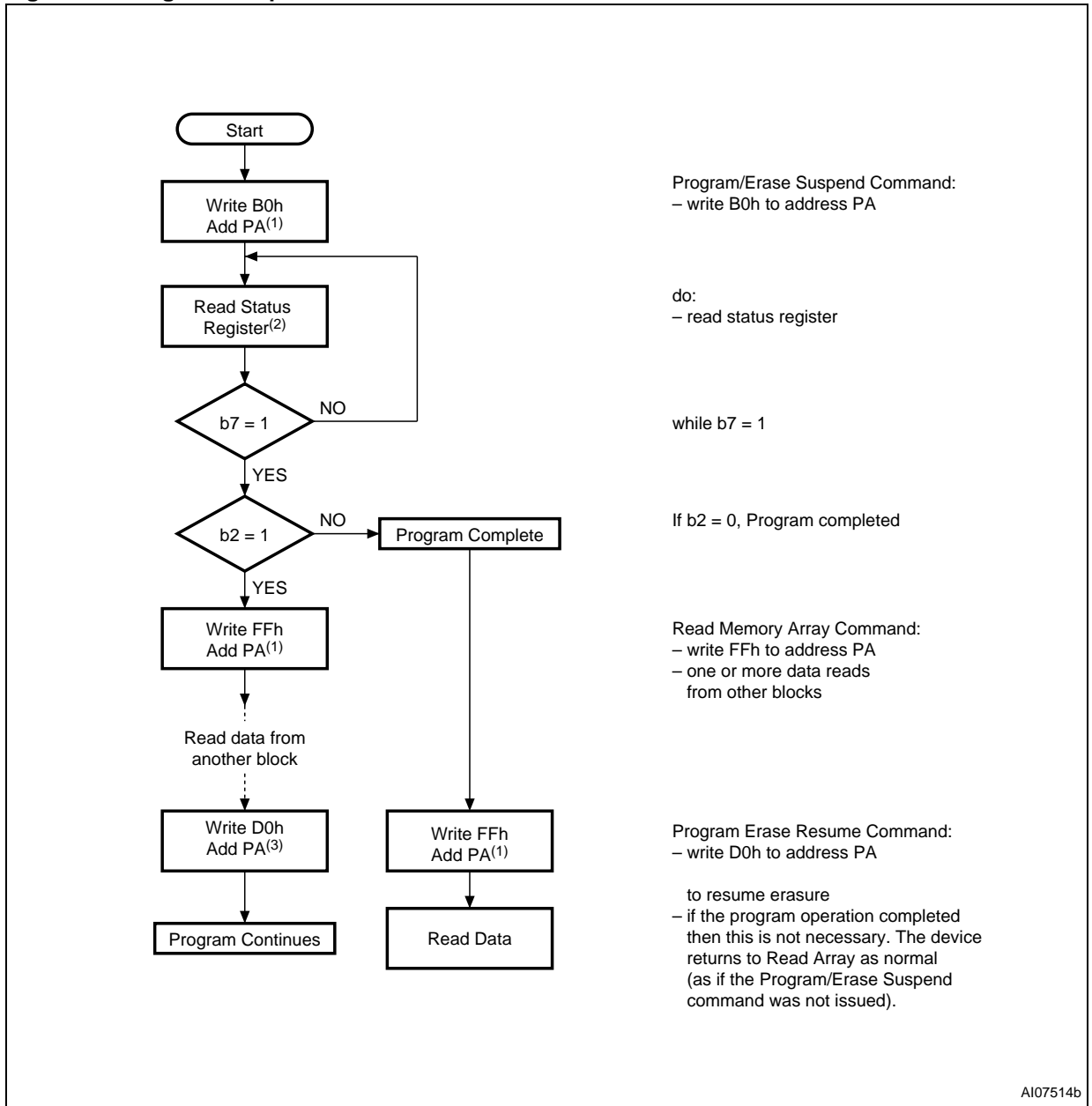
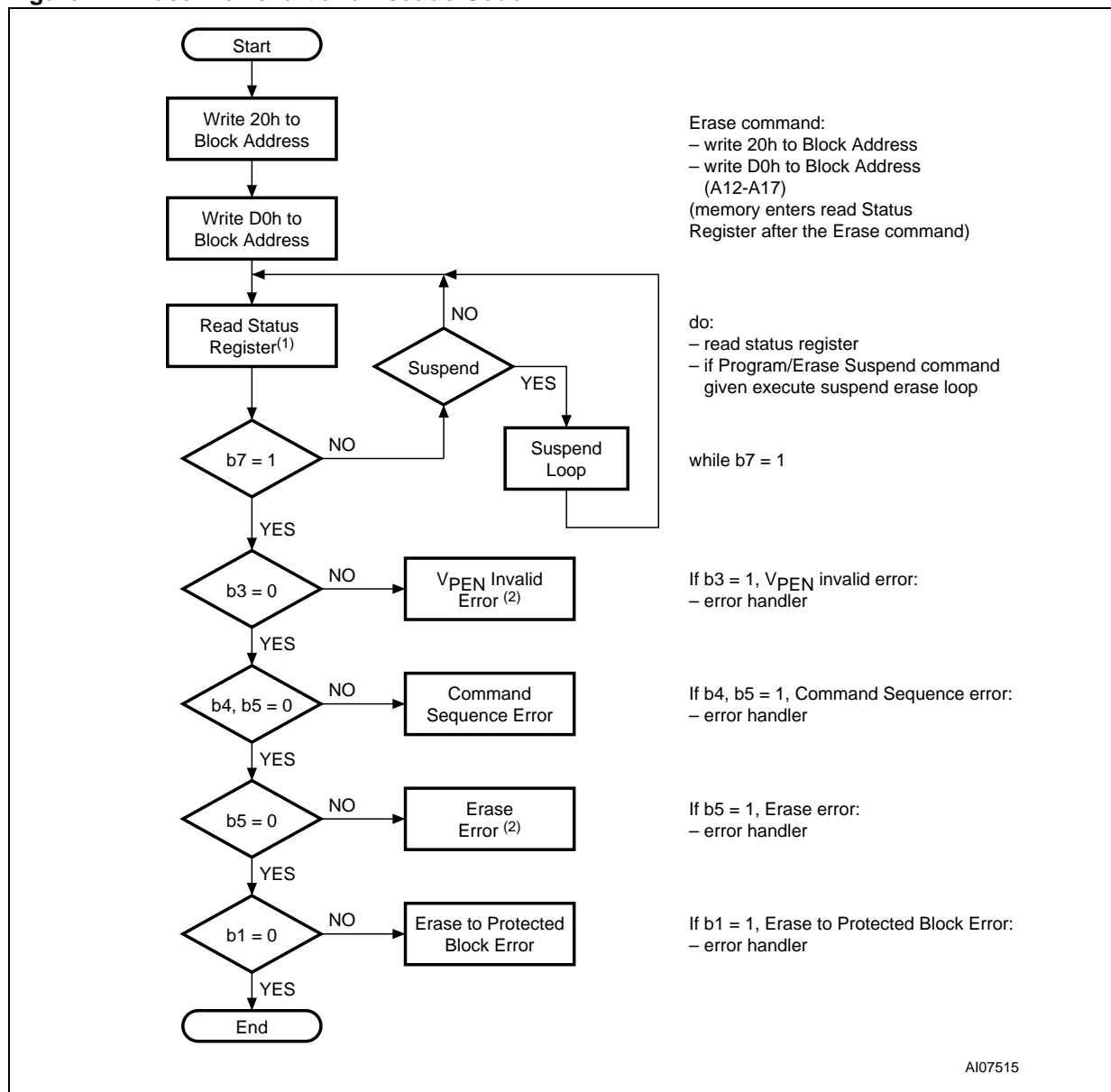


Figure 20. Program Suspend & Resume Flowchart and Pseudo Code



- Note: 1. PA = Program Address. The Program/ Erase Suspend command must be issued to the same address as the current Program command. The Read Memory Array command must also be issued to the same address.
2. The Read Status Register command must be issued to the same address as the Program/ Erase Suspend command.
3. PA = Program Address. The Program/ Erase Resume command must be issued to the same address as the Program/ Erase Suspend command.

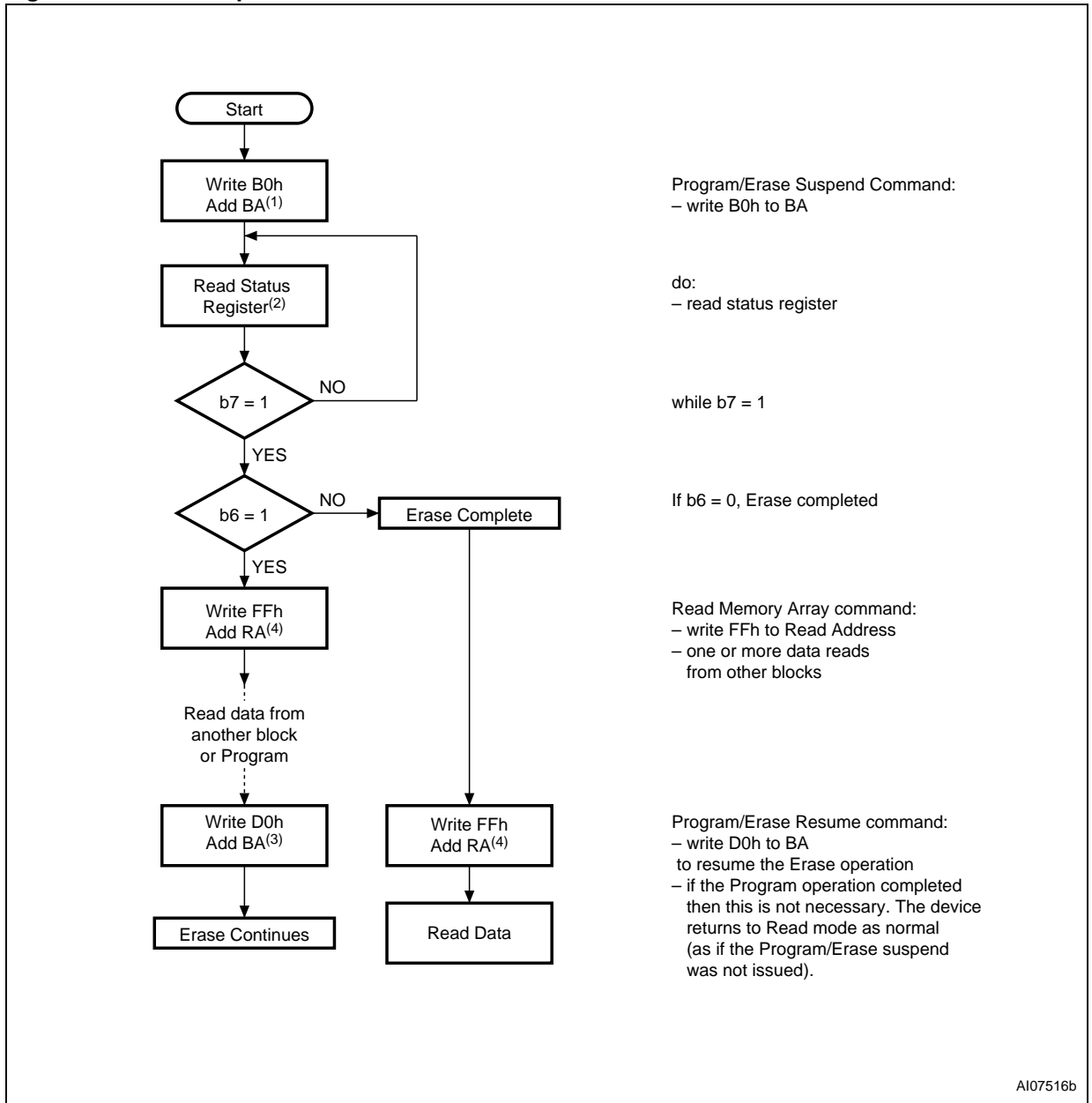
Figure 21. Erase Flowchart and Pseudo Code



Note: 1. The Read Status Register command must be issued to the same address as the Block Erase command.

2. If an error is found, the Status Register must be cleared (Clear Status Register Command) before further Program or Erase operations.

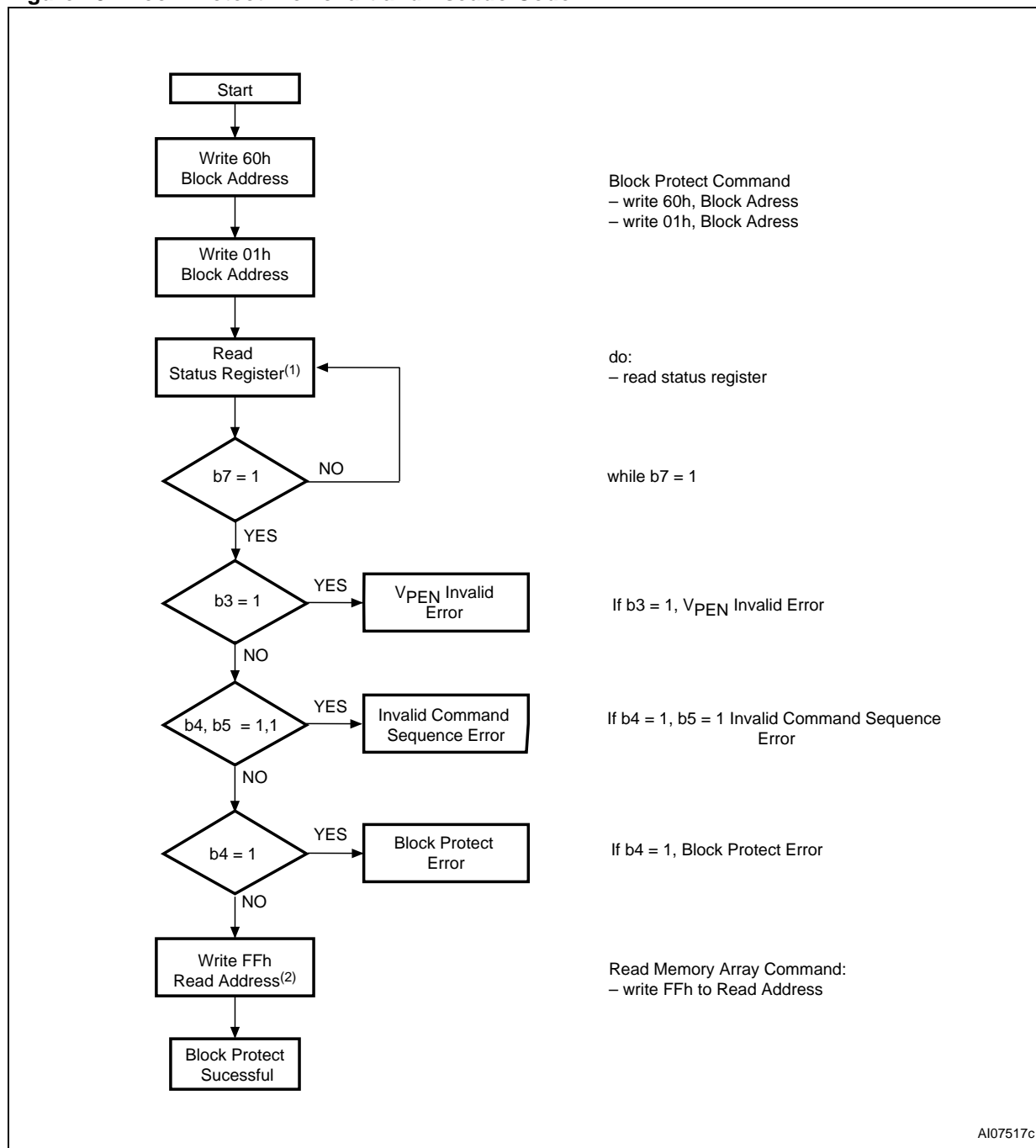
Figure 22. Erase Suspend & Resume Flowchart and Pseudo Code



AI07516b

- Note:
1. The Program/ Erase Suspend command must be issued to the same address as the current Erase command.
 2. The Read Status Register command must be issued to the same address as the Program/ Erase Suspend command.
 3. The Program/ Erase Resume command must be issued to the same address as the Program/ Erase Suspend command.
 4. RA is the address of the data to be read.

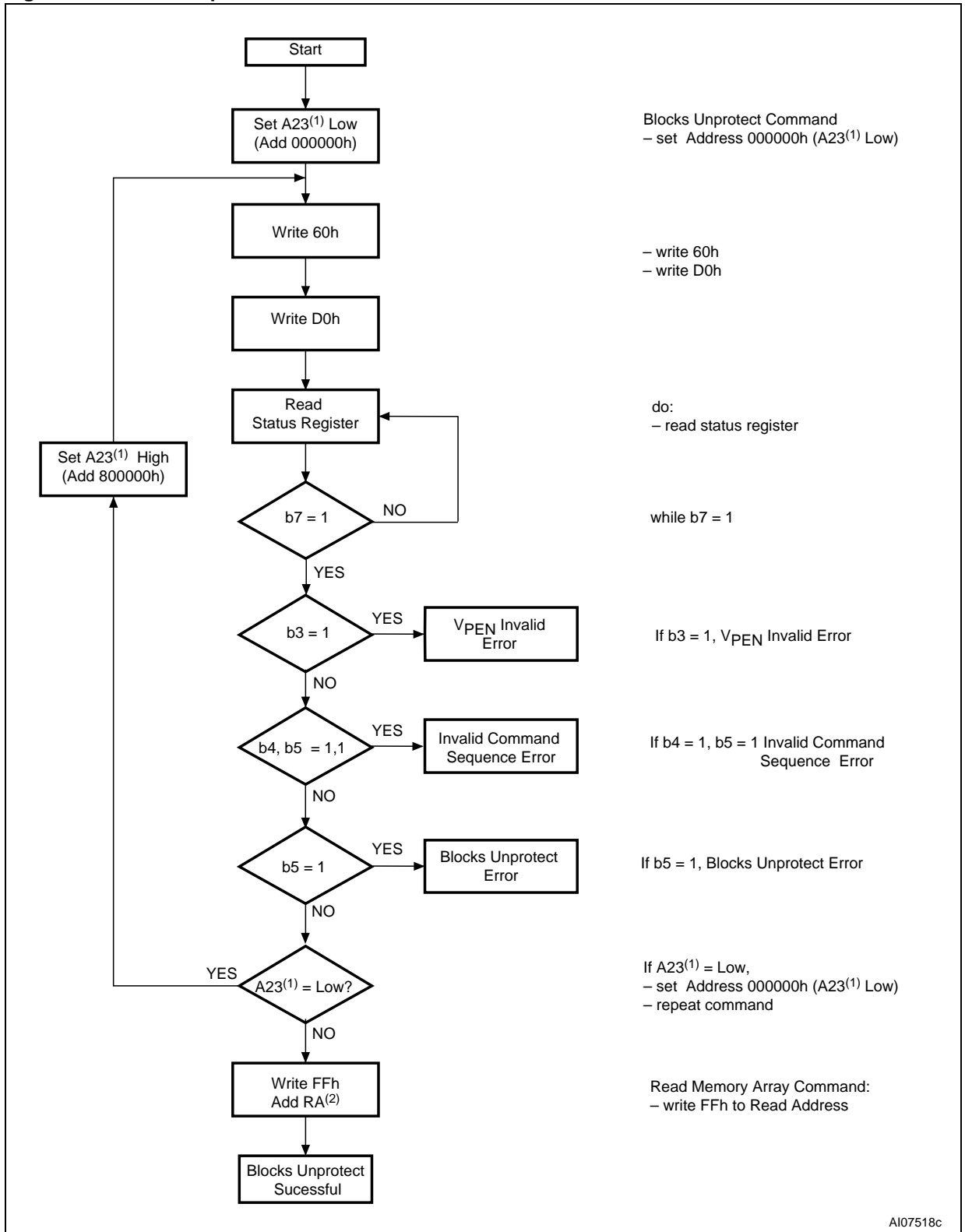
Figure 23. Block Protect Flowchart and Pseudo Code



Note: 1. The Read Status Register command must be issued to the same address as the Block Protect command.

2. As the device contains two internal memories, the Read Memory Array command must be issued to an address in the internal memory that has to return to Read mode.

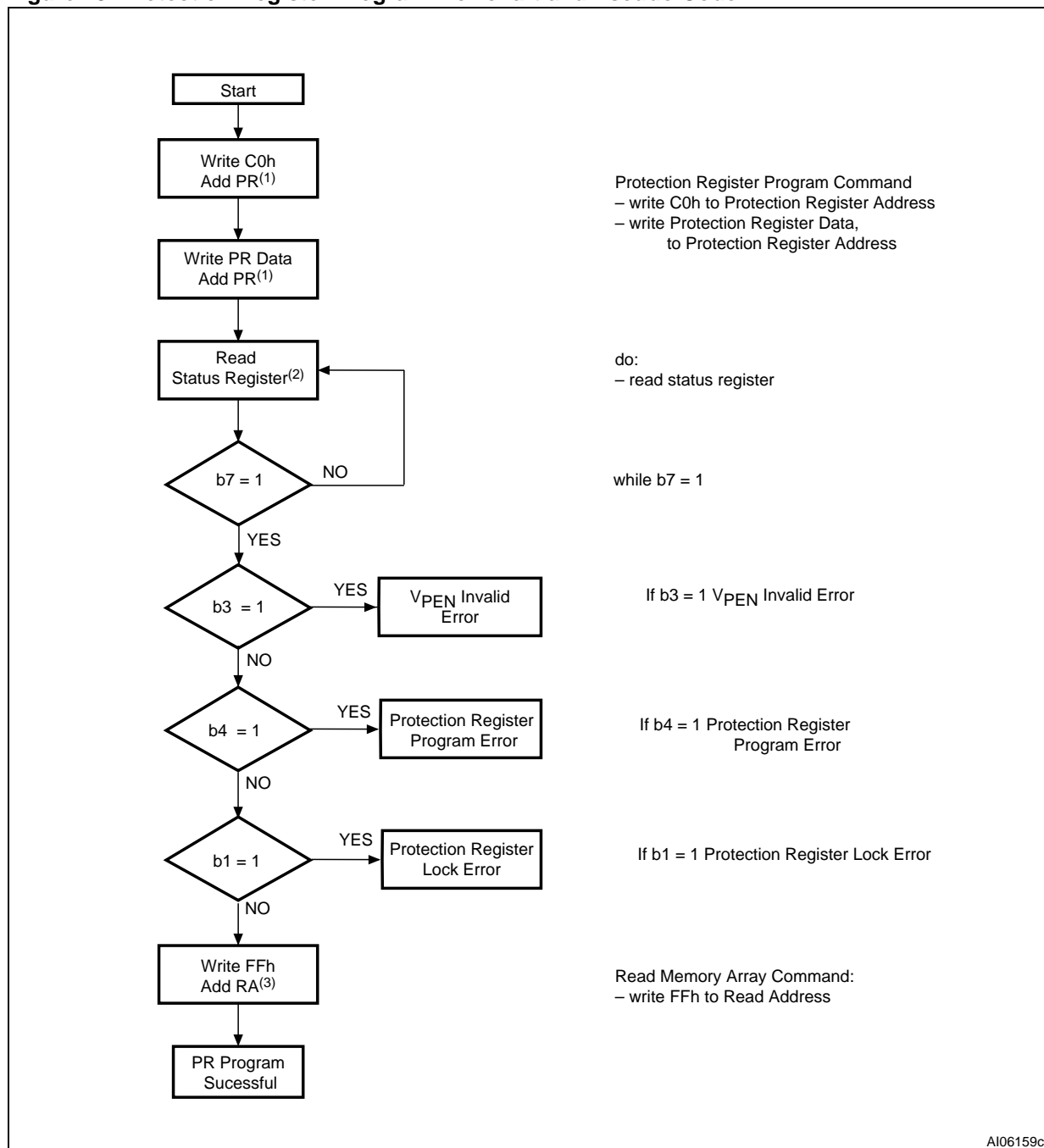
Figure 24. Blocks Unprotect Flowchart and Pseudo Code



Note: 1. A22 for LFPGA package.

2. RA = Read Address. As the device contains two internal memories, the Read Memory Array command must be issued to an address in the internal memory that has to return to Read mode.

Figure 25. Protection Register Program Flowchart and Pseudo Code

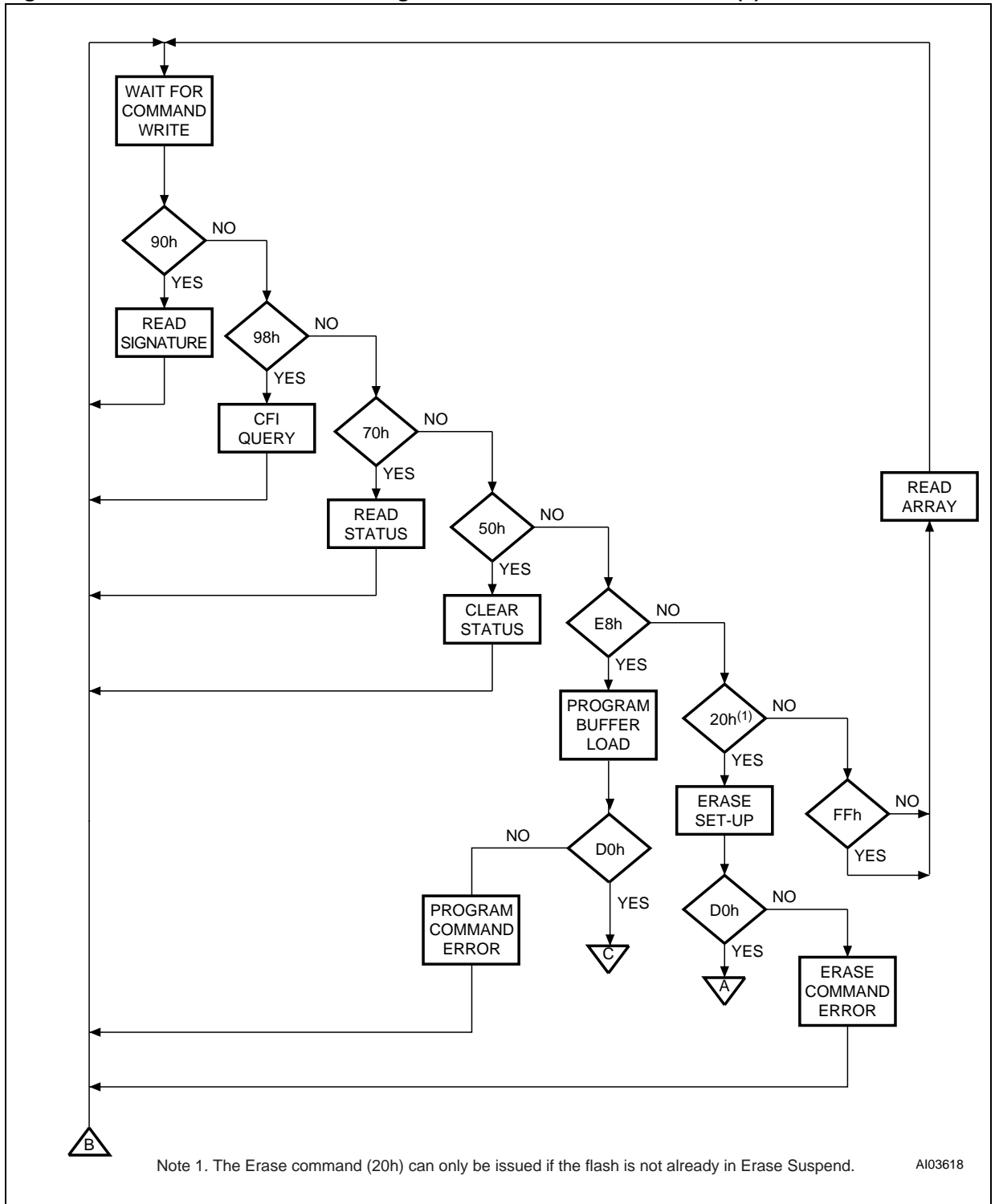


Note: 1. PR = Protection Register

2. The Read Status Register command must be issued to the same address as the Protection Register Program command.

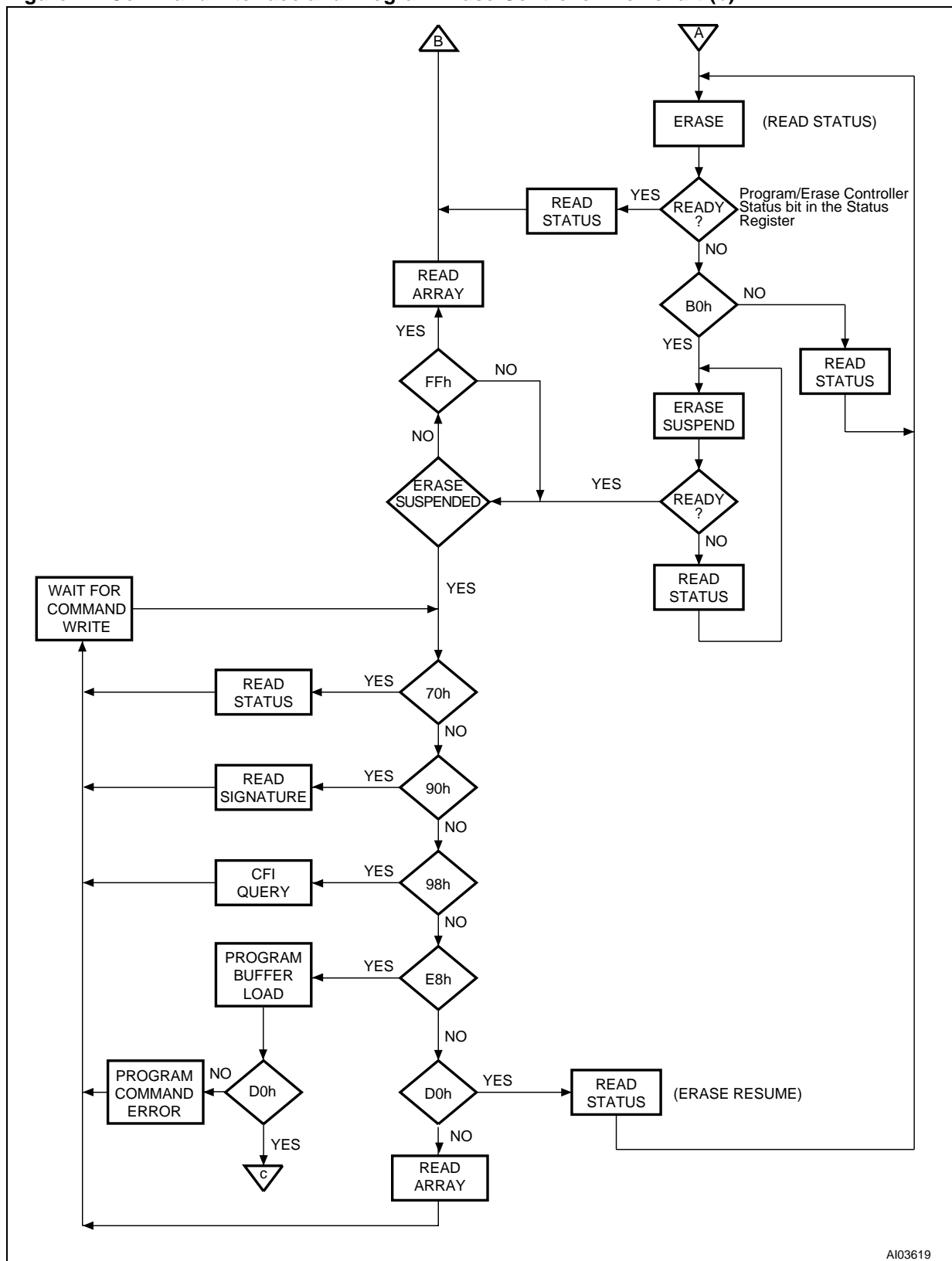
3. RA = Read Address. As the device contains two internal memories, the Read Memory Array command must be issued to an address in the internal memory that has to return to Read mode.

Figure 26. Command Interface and Program Erase Controller Flowchart (a)



Note: The commands must be issued to the addresses detailed in the Command Interface section, Table 5.

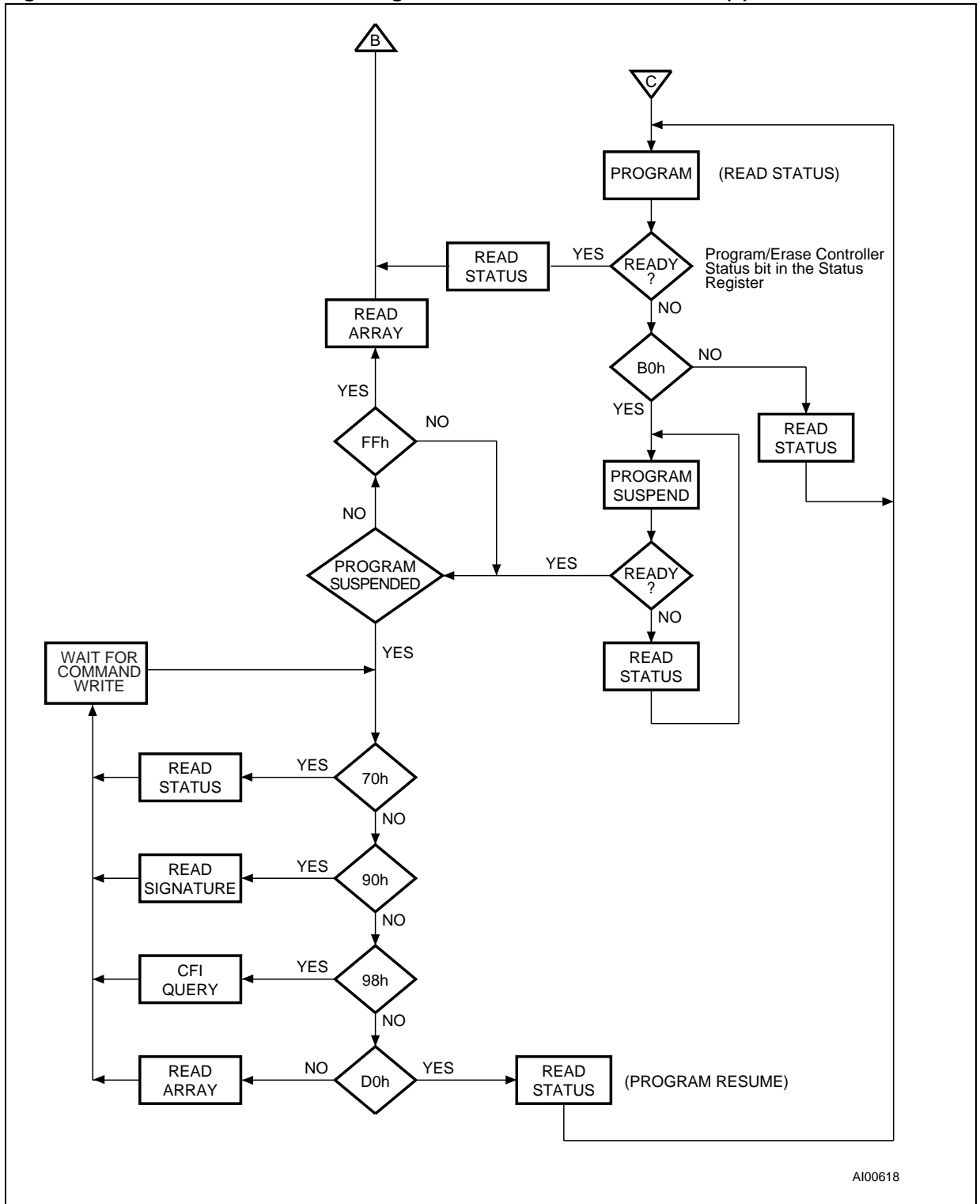
Figure 27. Command Interface and Program Erase Controller Flowchart (b)



A103619

Note: The commands must be issued to the addresses detailed in the Command Interface section, Table 5.

Figure 28. Command Interface and Program Erase Controller Flowchart (c).



AI00618

Note: The commands must be issued to the addresses detailed in the Command Interface section, Table 5.

REVISION HISTORY

Table 32. Document Revision History

Date	Version	Revision Details
10-Oct-2002	1.0	First Issue
11-Feb-2003	2.0	<p>Device code changed, LFBGA88 package added, Program /Erase Times and Program/Erase Endurance cycles table modified, Read Electronic Signature table modified, CFI Tables clarified in particular Table 31 and 29 (Extended Query Information and Device Geometry Definition). I_{OSC} parameter added to Absolute Maximum Ratings table. I_{DD} and V_{LKO} clarified and I_{DD0} and V_{PENH} parameters added to DC Characteristics table. t_{PHWL} parameter added to Reset, Power-Down and Power-Up AC Waveforms figure and Characteristics table. I_{DD1}, I_{DD5}, I_{DD2}, I_{DD4}, V_{IL}, V_{IH} and V_{LKO} values refined in DC Characteristics table.</p> <p>Chip Enable state corrected for Power-Down in Table 4, Bus Operations. Addresses modified for Blocks Unprotect and Configure STS commands in Table 5, Commands. Addresses modified in Figure 24, Blocks Unprotect Flowchart and Pseudo Code. Figure 23, Block Protect Flowchart and Pseudo Code, clarified.</p> <p>Blocks Temporary Unprotect feature of Reset/Power Down pin no longer available. Program/Erase Suspend, Write to Buffer and Program, and Block Erase Commands clarified.</p>
20-Mar-2003	2.1	Description of address inputs clarified throughout the document.

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 registered trademark of STMicroelectronics
All other names are the property of their respective owners

© 2003 STMicroelectronics - All Rights Reserved

STMicroelectronics GROUP OF COMPANIES
Australia - Brazil - Canada - China - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta -
Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States
www.st.com