



## Single Chip 2 Mbit Flash and 64 Kbit Parallel EEPROM Memory

PRELIMINARY DATA

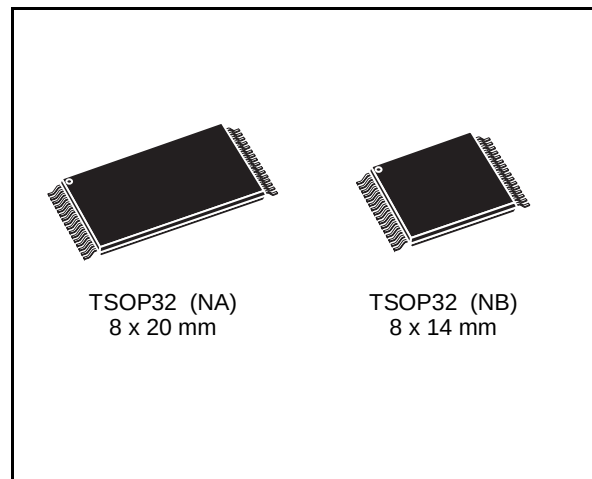
- 2.7V to 3.6V SUPPLY VOLTAGE for PROGRAM, ERASE and READ OPERATIONS
- 100ns ACCESS TIME (Flash and EEPROM blocks)
- WRITE, PROGRAM and ERASE STATUS BITS
- CONCURRENT MODE (Read Flash while writing to EEPROM)
- 100,000 ERASE/WRITE CYCLES
- 10 YEARS DATA RETENTION
- LOW POWER CONSUMPTION
  - Stand-by mode: 60μA
  - Automatic Stand-by mode
  - Deep Power Down mode
- 64 bytes ONE TIME PROGRAMMABLE MEMORY
- STANDARD EPROM/OTP MEMORY PACKAGE
- EXTENDED TEMPERATURE RANGES

### DESCRIPTION

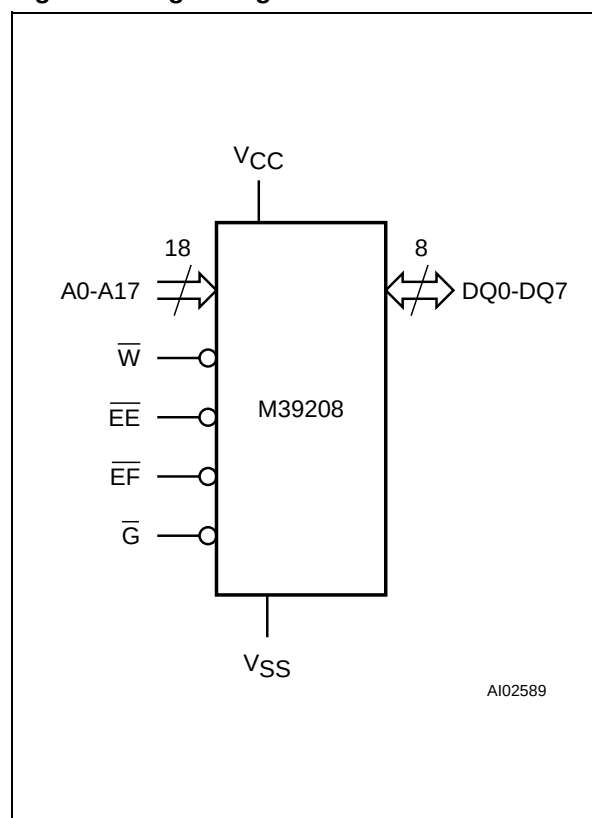
The M39208 is a memory device combining Flash and EEPROM into a single chip and using single supply voltage. The memory is mapped in two blocks: 2 Mbit of Flash memory and 64 Kbit of EEPROM memory. Each space is independant for writing, in concurrent mode the Flash Memory can be read while the EEPROM is being written.

**Table 1. Signal Names**

|                 |                      |
|-----------------|----------------------|
| A0-A17          | Address Inputs       |
| DQ0-DQ7         | Data Input / Outputs |
| $\overline{EE}$ | EEPROM Block Enable  |
| $\overline{EF}$ | Flash Block Enable   |
| $\overline{G}$  | Output Enable        |
| $\overline{W}$  | Write Enable         |
| V <sub>CC</sub> | Supply Voltage       |
| V <sub>SS</sub> | Ground               |



**Figure 1. Logic Diagram**

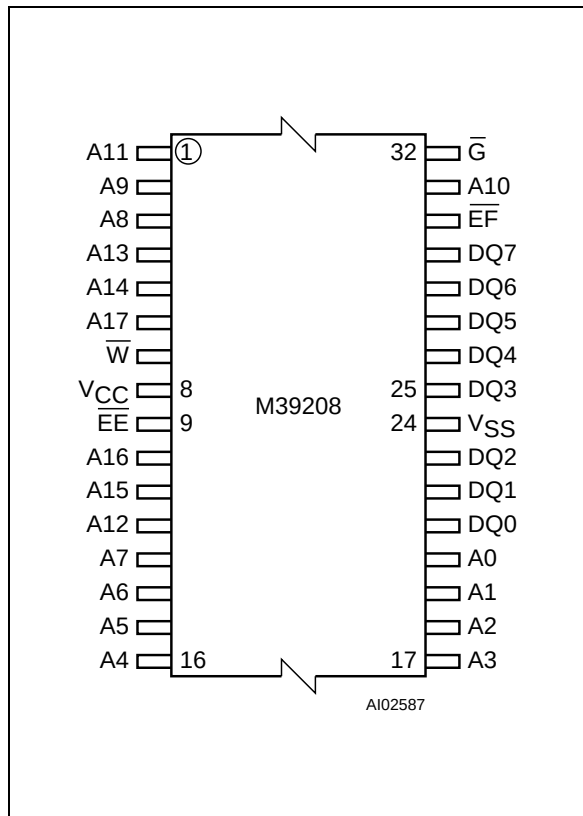


**Table 2. Absolute Maximum Ratings** <sup>(1)</sup>

| Symbol                                                            | Parameter                                    | Value        | Unit |
|-------------------------------------------------------------------|----------------------------------------------|--------------|------|
| T <sub>A</sub>                                                    | Ambient Operating Temperature                | –40 to 85    | °C   |
| T <sub>BIAS</sub>                                                 | Temperature Under Bias                       | –50 to 125   | °C   |
| T <sub>STG</sub>                                                  | Storage Temperature                          | –65 to 150   | °C   |
| V <sub>IO</sub> <sup>(2)</sup>                                    | Input or Output Voltages                     | –0.6 to 5    | V    |
| V <sub>CC</sub>                                                   | Supply Voltage                               | –0.6 to 5    | V    |
| V <sub>A9</sub> , V <sub>G</sub> , V <sub>EF</sub> <sup>(2)</sup> | A9, $\overline{G}$ , $\overline{EF}$ Voltage | –0.6 to 13.5 | V    |

**Notes:** 1. Except for the rating "Operating Temperature Range", stresses above those listed in the Table "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.

2. Minimum Voltage may undershoot to –2V during transition and for less than 20ns.

**Figure 2. TSOP Pin Connections****DESCRIPTION (Cont'd)**

An additional 64 bytes of EPROM are One Time Programmable.

The M39208 EEPROM memory block may be written by byte or by page of 64 bytes and the integrity

of the data can be secured with the help of the Software Data Protection (SDP).

The M39208 Flash Memory block offers 4 sectors of 64 Kbytes, each sector may be erased individually, and programmed Byte-by-Byte. Each sector can be separately protected and unprotected against program and erase. Sector erasure may be suspended, while data is read from other sectors of the Flash memory block (or EEPROM memory block), and then resumed.

During a Program or Erase cycle in the Flash memory block or during a Write in the EEPROM memory block, the status of the M39208 internal logic can be read on the Data Outputs DQ7, DQ6, DQ5 and DQ3.

**PIN DESCRIPTION**

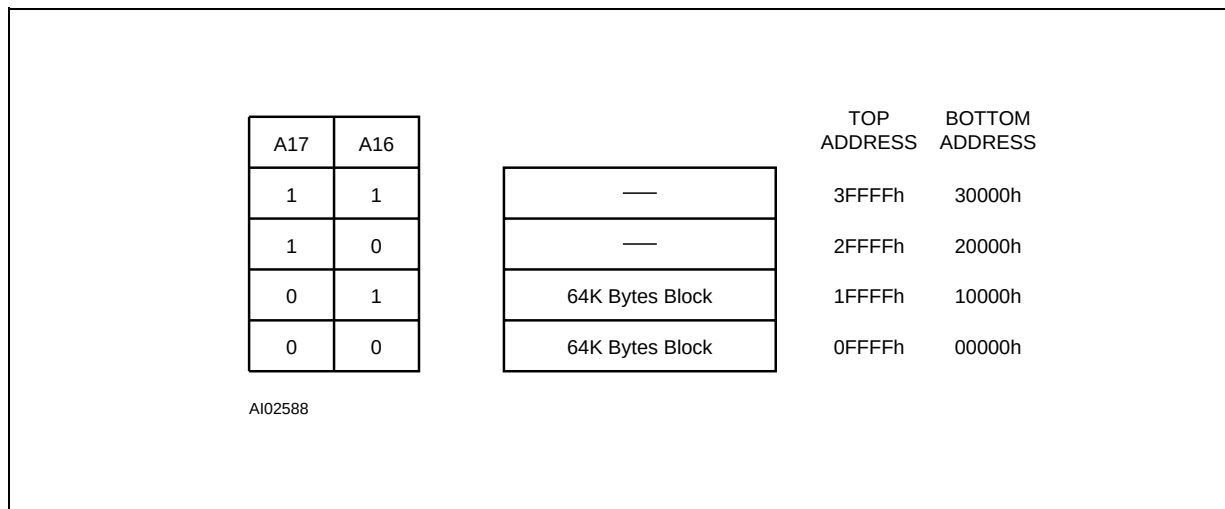
**Address Inputs (A0-A17).** The address inputs for the memory array are latched during a write operation. A0-A12 access locations in the EEPROM memory block A0-A17 access locations in the Flash memory block. The memory block selected is given by the state on the EE and EF inputs respectively.

When a specific voltage (V<sub>ID</sub>) is applied on the A9 address input, additional specific areas can be accessed: Read the Manufacturer identifier, Read the Flash block identifier, Read/Write the EEPROM block identifier, Verify the Flash Sector Protection Status.

**Data Input/Output (DQ0-DQ7).** A write operation inputs one byte which is latched when EE (or EF) and Write Enable  $\overline{W}$  are driven active.

Data read is valid when one Chip Enable (Chip Enable Flash or Chip Enable EEPROM) and Output Enable are driven active. The output is high

Figure 3. Flash Block Sectors



impedance when the chip is deselected (both  $\overline{EE}$  and  $\overline{EF}$  driven high) or the outputs are disabled ( $\overline{G}$  driven high).

Read operations are used to output the contents from the memory, the Manufacturer identifier, the Flash Sector protection Status, the Flash block Identifier, the EEPROM identifier or the OTP row content.

**Memory Block Enable ( $\overline{EE}$  and  $\overline{EF}$ ).** The Memory Block Enable ( $\overline{EE}$  or  $\overline{EF}$ ) activates the memory control logic, input buffers, decoders and sense amplifiers. When the  $\overline{EE}$  input is driven high, the EEPROM memory block is not selected; when the  $\overline{EF}$  input is driven high, the Flash memory block is not selected. Attempts to access both EEPROM and Flash blocks ( $\overline{EE}$  low and  $\overline{EF}$  low) are forbidden. Switching between the two memory block enables ( $\overline{EE}$  and  $\overline{EF}$ ) must not be made on the same clock cycle, a delay of greater than  $t_{EHFL}$  must be inserted.

The M39208 is in standby when both  $\overline{EF}$  and  $\overline{EE}$  are High (when no internal Erase or programming is running). The power consumption is reduced to the standby level and the outputs are in the high impedance state, independent of the Output Enable  $\overline{G}$  or Write Enable  $\overline{W}$  inputs.

After 150ns of inactivity and when the addresses are driven at CMOS levels, the chip automatically enters a pseudo standby mode where consumption is reduced to the CMOS standby value, while the outputs continue to drive the bus.

**Output Enable ( $\overline{G}$ ).** The Output Enable gates the outputs through the data buffers during a read operation. The data outputs are in the high impedance state when the Output Enable  $\overline{G}$  is High.

During Sector Protect and Sector Unprotect operations, the  $\overline{G}$  input must be forced to  $V_{ID}$  level (12V + 0.5V) (for Flash memory block only).

**Write Enable ( $\overline{W}$ ).** Addresses are latched on the falling edge of  $\overline{W}$ , and Data Inputs are latched on the rising edge of  $\overline{W}$ .

## OPERATIONS

The M39208 memory is addressed through 18 inputs A0-A17 and provides data on eight Data Inputs/Outputs DQ0-DQ7 with the help of four control lines: Chip Enable EEPROM ( $\overline{EE}$ ), Chip Enable Flash ( $\overline{EF}$ ), Output Enable ( $\overline{G}$ ) and Write Enable ( $\overline{W}$ ) inputs.

An operation is defined as the basic decoding of the logic level applied to the control input pins ( $\overline{EF}$ ,  $\overline{EE}$ ,  $\overline{G}$ ,  $\overline{W}$ ) and the specified voltages applied on the relevant address pins. These operations are detailed in Table 3.

**Read.** Both Chip Enable and Output Enable (that is  $\overline{EF}$  and  $\overline{G}$  or  $\overline{EE}$  and  $\overline{G}$ ) must be low in order to read the output of the memory.

Read operations are used to output the contents from the Flash or EEPROM block, the Manufacturer identifier, the Flash Sector protection Status, the Flash block Identifier, the EEPROM identifier or the OTP row content.

Notes:

- The Chip Enable input mainly provides power control and should be used for device selection. The Output Enable input should be used to gate data onto the output in combination with active  $\overline{EF}$  or  $\overline{EE}$  input signals.
- The data read depends on the previous instruction entered into the memory (see Table 4).

Table 3. Basic Operations

| Operation      | $\overline{EF}$ | $\overline{EE}$ | $\overline{G}$ | $\overline{W}$ | DQ0 - DQ7             |
|----------------|-----------------|-----------------|----------------|----------------|-----------------------|
| Read           | $V_{IL}$        | $V_{IH}$        | $V_{IL}$       | $V_{IH}$       | Read in Flash Block   |
|                | $V_{IH}$        | $V_{IL}$        | $V_{IL}$       | $V_{IH}$       | Read in EEPROM Block  |
| Write          | $V_{IL}$        | $V_{IH}$        | $V_{IH}$       | $V_{IL}$       | Write in Flash Block  |
|                | $V_{IH}$        | $V_{IL}$        | $V_{IH}$       | $V_{IL}$       | Write in EEPROM Block |
| Output Disable | $V_{IL}$        | $V_{IH}$        | $V_{IH}$       | X              | Hi-Z                  |
|                | $V_{IH}$        | $V_{IL}$        | $V_{IH}$       | X              | Hi-Z                  |
| Standby        | $V_{IH}$        | $V_{IH}$        | X              | X              | Hi-Z                  |

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

**Write.** A Write operation can be used for two goals:

- either write data in the EEPROM memory block
- or enter a sequence of bytes composing an instruction.

The reader should note that Programming a Flash byte is an instruction (see Instructions paragraph).

Writing data requires:

- the Chip Enable (either  $\overline{EE}$  or  $\overline{EF}$ ) to be Low
- the Write Enable ( $\overline{W}$ ) to be Low with Output Enable ( $\overline{G}$ ) High.

Addresses in Flash block (or EEPROM block) are latched on the falling edge of  $\overline{W}$  or  $\overline{EF}$  ( $\overline{EE}$ ) whichever occurs last; the data to be written in Flash block (EEPROM block) is latched on the rising edge of  $\overline{W}$  or  $\overline{EF}$  ( $\overline{EE}$ ) whichever occurs first.

**Specific Read and Write Operations.** Device specific data is accessed through operations decoding the  $V_{ID}$  level applied on A9 ( $V_{ID} = 12V + 0.5V$ ) and the logic levels applied on address inputs (A0, A1, A6). These specific operations are:

- Read the Manufacturer identifier
- Read the Device identifier
- Define the Flash Sector protection
- Read the EEPROM identifier
- Write the EEPROM identifier

Note: The OTP row (64 bytes) is accessed with a specific software sequence detailed in the paragraph "Write in OTP row".

### Instructions

An instruction is defined as a sequence of specific Write operations. Each received byte is sequentially decoded (and not executed as standard Write operations) and the instruction is executed when

the correct number of bytes are properly received and the time between two consecutive bytes is shorter than the time-out value.

The sequencing of any instruction must be followed exactly, any invalid combination of instruction bytes or time-out between two consecutive bytes will reset the device logic into a Read memory state (when addressing the Flash block) or directly decoded as a single operation when addressing the EEPROM block.

The M39208 set of instructions includes:

- Program a byte in the Flash block
- Read a Flash sector protection status
- Erase instructions: Flash Sector Erase, Flash Block Erase, Flash Sector Erase Suspend, Flash Sector Erase Resume
- EEPROM power down
- Deep power down
- Set/Reset the EEPROM software write protection (SDP)
- OTP row access
- Reset and Return
- Read identifiers: read the manufacturer identifier, Read the Flash block identifier

These instructions are detailed in Table 4.

For efficient decoding of the instruction, the two first bytes of an instruction are the coded cycles and are followed by a command byte or a confirmation byte. The coded cycles consist of writing the data AAh at address 5555h during the first cycle and data 55h at address 2AAAh during the second cycle.

In the specific case of the Erase instruction, the instruction expects confirmation by two additional coded cycles.

Table 4. Instructions <sup>(1)</sup>

| Instruction                                 | $\overline{EE}$ | $\overline{EF}$ | Cycle 1          | Cycle 2    | Cycle 3          | Cycle 4                                    | Cycle 5      | Cycle 6             | Cycle 7                            |
|---------------------------------------------|-----------------|-----------------|------------------|------------|------------------|--------------------------------------------|--------------|---------------------|------------------------------------|
| Read Manufacturer Identifier <sup>(2)</sup> | 1               | 0               | AAh @5555h       | 55h @2AAAh | 90h @5555h       | Read Identifier with (A0,A1,A6) at (0,0,0) |              |                     |                                    |
| Read Flash Identifier <sup>(2)</sup>        | 1               | 0               | AAh @5555h       | 55h @2AAAh | 90h @5555h       | Read identifier with (A0,A1,A6) at (1,0,0) |              |                     |                                    |
| Read OTP Row                                | 0               | 1               | AAh @5555h       | 55h @2AAAh | 90h @5555h       | Read byte 1                                | Read byte 2  |                     | Read byte N                        |
| Read Block Protection Status <sup>(2)</sup> | 1               | 0               | AAh @5555h       | 55h @2AAAh | 90h @5555h       | Read Identifier with (A0,A1,A6) at (0,1,0) |              |                     |                                    |
| Program a Flash Byte                        | 1               | 0               | AAh @5555h       | 55h @2AAAh | A0h @5555h       | Data @address                              |              |                     |                                    |
| Erase one Flash Block                       | 1               | 0               | AAh @5555h       | 55h @2AAAh | 80h @5555h       | AAh @5555h                                 | 55h @2AAAh   | 30h @Sector address | 30h @Sector address <sup>(3)</sup> |
| Erase the Whole Flash                       | 1               | 0               | AAh @5555h       | 55h @2AAAh | 80h @5555h       | AAh @5555h                                 | 55h @2AAAh   | 10h @5555h          |                                    |
| Suspend Block Erase                         | 1               | 0               | B0h @any address |            |                  |                                            |              |                     |                                    |
| Resume Block Erase                          | 1               | 0               | 30h @any address |            |                  |                                            |              |                     |                                    |
| EEPROM Power Down                           | 0               | 1               | AAh @5555h       | 55h @2AAAh | 30h @5555h       |                                            |              |                     |                                    |
| Deep Power Down                             | 1               | 0               | 20h @5555h       |            |                  |                                            |              |                     |                                    |
| SDP Enable (EEPROM)                         | 0               | 1               | AAh @5555h       | 55h @2AAAh | A0h @5555h       | Write byte 1                               | Write byte 2 |                     | Write byte N                       |
| SDP Disable (EEPROM)                        | 0               | 1               | AAh @5555h       | 55h @2AAAh | 80h @5555h       | AAh @5555h                                 | 55h @2AAAh   | 20h @5555h          |                                    |
| Write in OTP Row                            | 0               | 1               | AAh @5555h       | 55h @2AAAh | B0h @5555h       | Write byte 1                               | Write byte 2 |                     | Write byte N                       |
| Return (from OTP Read or EEPROM Power Down) | 0               | 1               | F0h @any address |            |                  |                                            |              |                     |                                    |
| Reset                                       | 1               | 0               | AAh @5555h       | 55h @2AAAh | F0h @any Address |                                            |              |                     |                                    |
| Reset (short instruction)                   | 1               | 0               | F0h @any address |            |                  |                                            |              |                     |                                    |

Notes: 1. AAh @5555h means Write byte AAh at address 5555h.

2. This instruction can also be performed as a simple Read operation with A9=V<sub>ID</sub> (refer to READ chapter).

3. Additional blocks to be erased must be entered within 80μs.

Table 5. Device Identifiers

| Identifier                       | $\overline{EF}$ | $\overline{EE}$ | $\overline{G}$  | $\overline{W}$  | A0              | A1              | A6              | A9              | Other Addresses | DQ0 - DQ7             |
|----------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------------|
| Read the Manufacturer Identifier | V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IL</sub> | V <sub>IL</sub> | V <sub>IL</sub> | V <sub>ID</sub> | Don't Care      | 20h                   |
| Read the Flash Block Identifier  | V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IH</sub> | V <sub>IL</sub> | V <sub>IL</sub> | V <sub>ID</sub> | Don't Care      | t.b.d.                |
| Read the EEPROM Block Identifier | V <sub>IH</sub> | V <sub>IL</sub> | V <sub>IL</sub> | V <sub>IH</sub> | X               | X               | V <sub>IL</sub> | V <sub>ID</sub> | Don't Care      | 64 bytes user defined |

Note: X = Don't Care.

## POWER SUPPLY and CURRENT CONSUMPTION

**EEPROM Power Down.** The M39208 can be set with the EEPROM in power down with the help of the EEPROM power down instruction (see Table 4). Once the EEPROM power down instruction is decoded, the EEPROM block cannot be accessed unless a further Return instruction is decoded.

**Deep Power Down.** The M39208 can be set in the lowest I<sub>CC</sub> consumption mode with the help of the Deep Power Down instruction (see Table 4). Once the instruction is decoded, the device is set in a sleep mode until a Reset instruction is decoded.

**Power Up.** The M39208 internal logic is reset upon a power-up condition to Read memory status. Any Write operation in EEPROM is inhibited during the first 5 ms following the power-up.

Either  $\overline{EF}$ ,  $\overline{EE}$  or  $\overline{W}$  must be tied to V<sub>IH</sub> during Power-up for the maximum security of the data contents and to remove the possibility of a byte being written on the first rising edge of  $\overline{EF}$ ,  $\overline{EE}$  or  $\overline{W}$ . Any write cycle initiation is locked when V<sub>CC</sub> is below V<sub>LKO</sub>.

## READ

Read operations and instructions can be used to:

- read the contents of the Memory Array (Flash block and EEPROM block)
- read the Memory Array (Flash block and EEPROM block) status and identifiers.

## Read data (Flash and EEPROM blocks)

Both Chip Enable  $\overline{EF}$  (or  $\overline{EE}$ ) and Output Enable ( $\overline{G}$ ) must be low in order to read the data from the memory.

### Read the Manufacturer Identifier

The manufacturer's identifier can be read with two methods: a Read operation or a Read instruction.

**Read Operation.** The manufacturer's identifier can be read with a Read operation with specific logic levels applied on A0, A1, A6 and the V<sub>ID</sub> level (V<sub>ID</sub> = 12V + 0.5V) on A9 (see Table 5).

**Read Instruction.** The manufacturer's identifier can also be read with a single instruction composed of 4 operations: 3 specific Write operations (see Table 4) and a Read which outputs the Manufacturer identifier, the Flash block identifier or the Flash sector protection status.

### Read the Flash Block Identifier

The Flash block identifier can be read with two methods: a Read operation or a Read instruction.

**Read Operation.** The Flash block identifier (t.b.d.) can be read with a single Read operation with specific logic levels applied on A0, A1, A6 and the V<sub>ID</sub> level on A9 (see Table 5).

**Read Instruction.** The Flash block identifier can also be read with an instruction composed of 4 operations: 3 specific Write operations and a Read (see Table 4).

Table 6. Status Bit

|        | $\overline{EF}$ | $\overline{EE}$ | DQ7          | DQ6         | DQ5        | DQ4 | DQ3            | DQ2 | DQ1 | DQ0 |
|--------|-----------------|-----------------|--------------|-------------|------------|-----|----------------|-----|-----|-----|
| Flash  | V <sub>IL</sub> | V <sub>IH</sub> | Data Polling | Toggle Flag | Error Flag | X   | Erase Time-out | X   | X   | X   |
| EEPROM | V <sub>IH</sub> | V <sub>IL</sub> | Data Polling | Toggle Flag | X          | X   | X              | X   | X   | X   |

Note: X = Not guaranteed value, can be read either '1' or '0'.

### Read the EEPROM Block Identifier

The EEPROM block identifier (64 bytes, user defined) can be read with a single Read operation with A6 = '0' and A9 = V<sub>ID</sub> (see Table 5).

### Read the OTP Row

The OTP row is mapped in the EEPROM block ( $\overline{EE}$  = '0',  $\overline{EF}$  = '1'). Read of the OTP row (64 bytes) is by an instruction (see Table 4) composed of three specific Write operations of data bytes at three specific memory locations (each location in a different page) before reading the OTP row content.

When accessing the OTP row, only the LSB addresses (A6 to A0) are decoded where A6 must be '0'.

Each Read of the OTP row has to be followed by the Return instruction (see Table 4).

### Read the Flash Sector Protection Status

Reading the Flash sector protection status is by an instruction similar to the Read Manufacturer identifier instruction, the only difference being the value of the logic levels applied on A0, A1, A6, while A16 and A17 define the Flash sector whose protection has to be verified. Such a read instruction will output a 01h if the Flash sector is protected and a 00h if the Flash sector is not protected.

The Flash sector protection status can also be verified with a Read operation (see chapter: Flash block specific features), with V<sub>ID</sub> on A9.

### Read the Status Bits

The M39208 provides several Write operation status flags which may be used to minimize the application write (or erase or program) time. These signals are available on the I/O port bits when programming (or erasing) are in progress.

**Data Polling flag, DQ7.** When Erasing or Programming into the Flash block (or when Writing into the EEPROM block), bit DQ7 outputs the complement of the bit being entered for Programming/Writing on DQ7. Once the Program instruction or the Write operation is performed, the

true logic value is read on DQ7 (in a Read operation).

Flash memory block specific features:

- Data Polling is effective after the fourth W pulse (for programming) or after the sixth W pulse (for Erase). It must be performed at the address being programmed or at an address within the Flash sector being erased.
- During an Erase instruction, DQ7 outputs a '0'. After completion of the instruction, DQ7 will output the last bit programmed (that is a '1' after erasing).
- if the byte to be programmed is in a protected Flash sector, the instruction is ignored.
- If all the Flash sectors to be erased are protected, DQ7 will be set to '0' for about 100μs, and then return to the previous addressed byte. No erasure will be performed.
- if all sectors are protected, a Bulk Erase instruction is ignored.

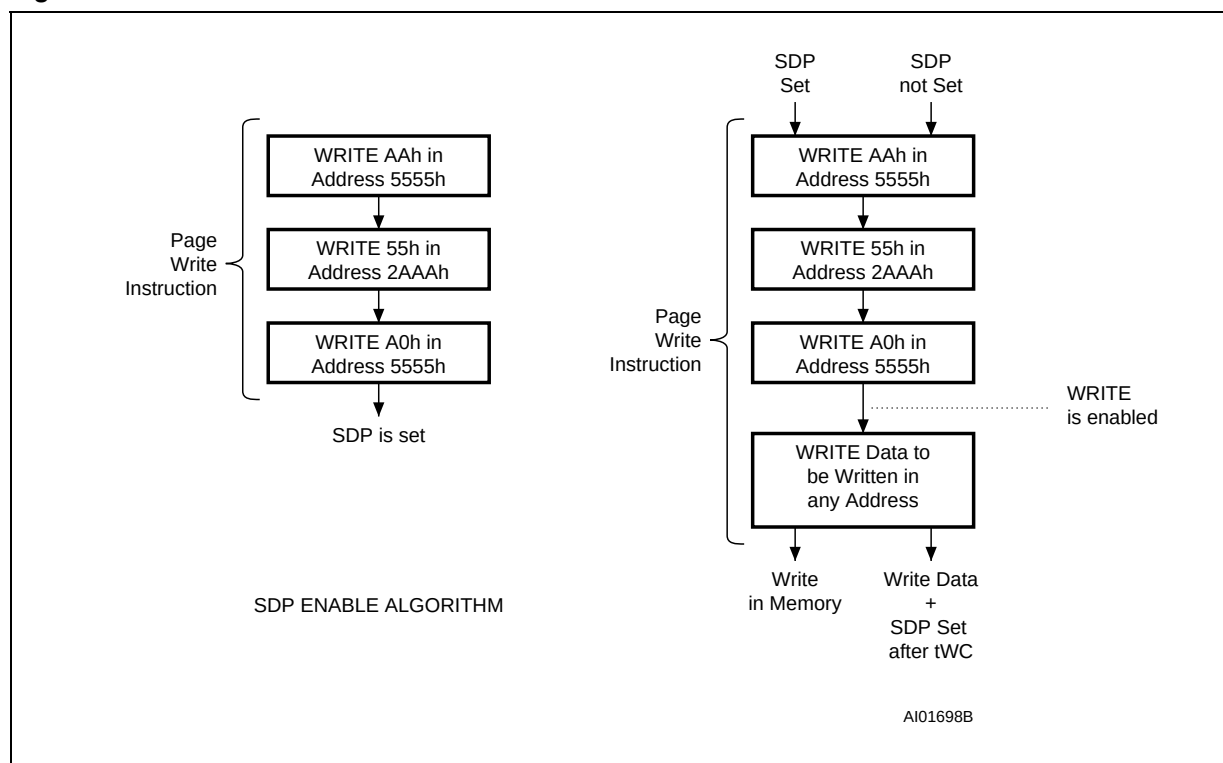
**Toggle flag, DQ6.** The M39208 also offers another way for determining when the EEPROM write or the Flash memory Program instruction is completed. During the internal Write operation, the DQ6 will toggle from '0' to '1' and '1' to '0' on subsequent attempts to read any byte of the memory, when either  $\overline{G}$ ,  $\overline{EE}$  or  $\overline{EF}$  is low.

When the internal cycle is completed the toggling will stop and the data read on DQ0-DQ7 is the addressed memory byte. The device is now accessible for a new Read or Write operation. The operation is completed when two successive reads yield the same output data.

Flash memory block specific features:

- a. the Toggle bit is effective after the fourth  $\overline{W}$  pulse (for programming) or after the sixth  $\overline{W}$  pulse (for Erase).
- b. If the byte to be programmed belongs to a protected Flash sector, the instruction is ignored and:

Figure 4. EEPROM SDP Enable Flowcharts



- if all the Flash sectors selected for erasure are protected, DQ6 will toggle to '0' for about 100µs, and then return to the previous addressed byte.
- if all sectors are protected, the Bulk Erase instruction is ignored.

**Error flag, DQ5 (Flash block only).** This bit is set to '1' when there is a failure during either a Flash byte programming or a Sector erase or the Bulk Erase.

In case of error in Flash sector erase or byte program, the Flash sector in which the error occurred or to which the programmed byte belongs, must not be used any longer (other Flash sectors may still be used). The Error bit resets after Reset instruction.

During a correct Program or Erase, the Error bit will set to '0'.

**Erase Time-out flag, DQ3 (Flash block only).** The Erase Timer bit reflects the time-out period allowed between two consecutive Sector Erase instructions. The Erase timer bit is set to '0' after a Sector Erase instruction for a time period of 100µs

±20% unless an additional Sector Erase instruction is decoded. After this time period or when the additional Sector Erase instruction is decoded, DQ3 is set to '1'.

#### WRITE a BYTE (or a PAGE) in EEPROM

It should be noticed that writing in the EEPROM block is an operation, it is not an instruction (as for Programming a byte in the Flash block).

#### Write a Byte in EEPROM Block

A write operation is initiated when Chip Enable  $\overline{EE}$  is Low and Write Enable  $\overline{W}$  is Low with Output Enable  $\overline{G}$  High. Addresses are latched on the falling edge of  $\overline{W}$ ,  $\overline{EE}$  whichever occurs last.

Once initiated, the write operation is internally timed until completion, that is during a time  $t_{w}$ .

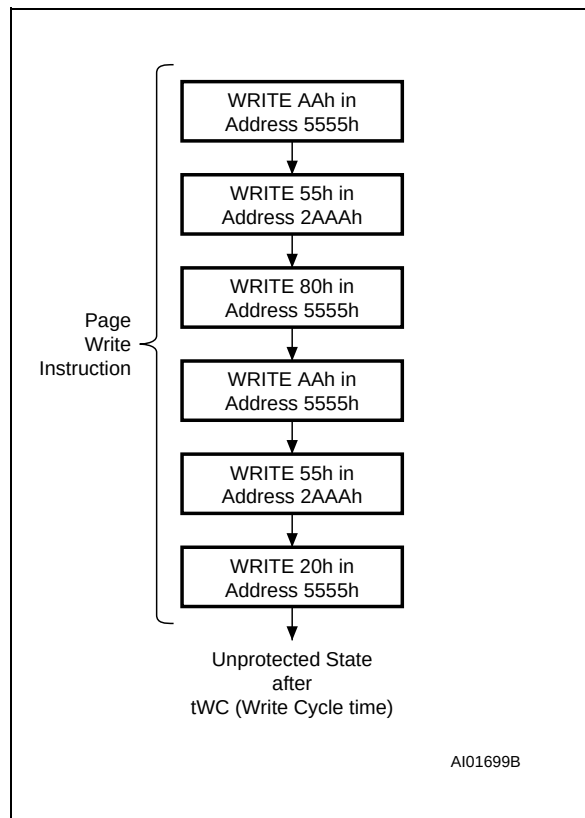
The status of the write operation can be found by reading the Data Polling and Toggle bits (as detailed in the READ chapter) or the Ready/Busy output. This Ready/Busy output is driven low from the write of the byte being written until the completion of the internal Write sequence.



Table 7. Write the EEPROM Block Identifier

| $\overline{EF}$ | $\overline{EE}$ | $\overline{G}$ | $\overline{W}$ | A6       | A9       | Other Addresses | DQ0 - DQ7             |
|-----------------|-----------------|----------------|----------------|----------|----------|-----------------|-----------------------|
| $V_{IH}$        | $V_{IL}$        | $V_{IH}$       | $V_{IL}$       | $V_{IL}$ | $V_{ID}$ | Don't Care      | 64 bytes User Defined |

Figure 5. SDP disable Flowchart



### Write a Page in EEPROM Block

The Page write allows up to 64 bytes within the same EEPROM page to be consecutively latched into the memory prior to initiating a programming cycle. All bytes must be located in a single page address, that is A6-A12 must be the same for all bytes. Once initiated, the Page write operation is internally timed until completion, that is during a time  $t_{WC}$ .

The status of the write operation can be seen by reading the Data Polling and Toggle bits (as detailed in the READ chapter).

A Page write is composed of successive Write instructions which must be sequenced within a time

period (between two consecutive Write operations) that is smaller than the  $t_{WLWL}$  value. If this period of time exceeds the  $t_{WLWL}$  value, the internal programming cycle will start.

### EEPROM Block Software Data Protection

A protection instruction allows the user to inhibit all write modes to the EEPROM block: the Software Data Protection (referenced as SDP in the following). The SDP feature is useful for protecting the EEPROM memory from inadvertent write cycles that may occur during uncontrolled bus conditions.

The M39208 is shipped as standard in the unprotected state meaning that the EEPROM memory contents can be changed by the user. After the SDP enable instruction, the device enters the Protect Mode where no further write operations have any effect on the EEPROM memory contents.

The device remains in this mode until a valid SDP disable instruction is received whereby the device reverts to the unprotected state.

To enable the Software Data Protection, the device has to be written (with a Page Write) with three specific data bytes at three specific memory locations (each location in a different page) as shown in Figure 4. This sequence provides an unlock key to enable the write action, and, at the same time, SDP continues to be set. Any further Write in EEPROM when the SDP is set will use this same sequence of three specific data bytes at three specific memory locations followed by the bytes to write. The first SDP enable sequence can be directly followed by the bytes to written.

Similarly, to disable the Software Data Protection the user has to write specific data bytes into six different locations with a Page Write addressing different bytes in different pages, as shown in Figure 5.

The Software Data Protection state is non-volatile and is not changed by power on/off sequences. The SDP enable/disable instructions set/reset an internal non-volatile bit and therefore will require a write time  $t_{WC}$ . This Write operation can be monitored only on the Toggle bit (status bit DQ6).

Figure 6. Data Polling Flowchart

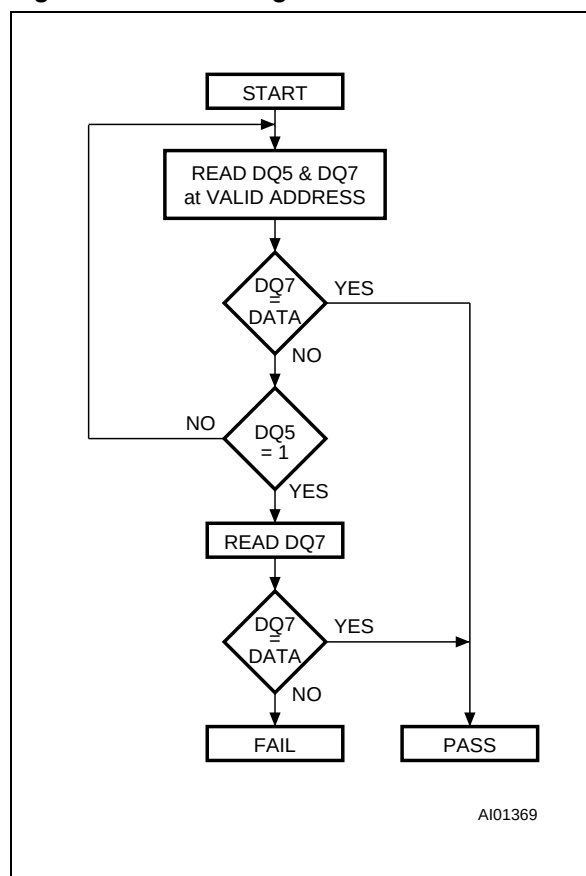
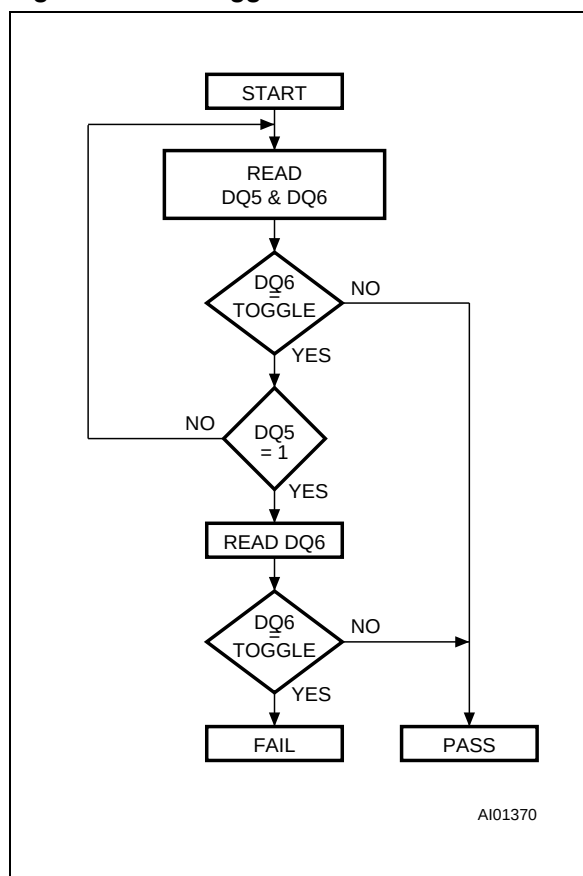


Figure 7. Data Toggle Flowchart



### Write OTP Row

Writing (only one time) in the OTP row (64 bytes) is enabled by an instruction. This instruction is composed of three specific Write operations of data bytes at three specific memory locations (each location in a different page) followed by the the data to store in the OTP row (refer to Table 4).

When accessing the OTP row, the only LSB addresses (A6 to A0) are decoded, with A6 = '0'.

### Write the EEPROM Block Identifier

The EEPROM block identifier can be written with a single Write operation with specific logic levels applied on A6 and the V<sub>ID</sub> level on A9 (see Table 7).

### PROGRAM in the Flash BLOCK

It should be noted that writing data into the EEPROM block and the Flash block is not per-

formed in a similar way: the Flash memory requires an instruction (see Instruction chapter) for Erasing and another instruction for Programming one (or more) byte(s), the EEPROM memory is directly written with a simple operation (see Operation chapter).

**Program Instruction.** During the execution of the Program instruction, the Flash block memory will not accept any further instructions.

The Flash block memory can be programmed byte-by-byte. The program instruction is a sequence of three specific Write operations followed by writing the address and data byte to be programmed into the Flash block memory (see Table 4). The M39208 automatically starts and performs the programming after the fourth write operation.

During programming, the memory status may be checked by reading the status bits DQ5, DQ6 and DQ7, as detailed in the following sections.

**Data Polling.** Polling on DQ7 is a method of checking whether a Program or an Erase instruction is in progress or completed (see Figure 6). When a Program instruction is in progress, data bit DQ7 is the complement of the original data bit 7; when DQ7 is identical to the old data and the Error bit DQ5 is still '0', the instruction is complete. To determine if DQ7 is valid, each poll must store the original data for comparison, and if they are the same, it can be considered that the operation was successful. The Error bit DQ5 is checked to ensure timing limits have not exceeded.

When an Erase operation is in progress, DQ7 is always '0', and will be '1' when finished, so long as DQ5= '0'.

In all cases, when DQ5 is '1', DQ7 should be checked again, in case DQ7 changed simultaneously with DQ5. If DQ7 = true data (Program) or DQ7 = '1' (Erase), the operation is successful and execution should return to the caller. A suggested second read will provide all true data (Program) or all FFh (Erase). Otherwise, this should be flagged as an error, and the device should be Reset.

**Data Toggle.** Checking the Toggle bit DQ6 is an alternative method of checking if Program or Erase operations are in progress or completed (see Figure 7). When an operation is in progress, data bit DQ6 constantly toggles for successive read operations. When DQ6 no longer toggles and the Error bit DQ5 is '0', the operation is completed. To determine if DQ6 has toggled, each polling action requires 2 consecutive read operations of the data, and if the data read is the same, it can be considered that the operation was successful. The Error bit DQ5 is checked to ensure timing limits have not been exceeded. In all cases, when DQ5 is '1', DQ6 should be checked again, in case DQ6 has changed simultaneously with DQ5. If DQ6 has stopped toggling, the operation is successful and execution should return to the caller. A suggested second read will provide all true data (Program) or all FFh (Erase). Otherwise, this event should be flagged as an error, and the device should be Reset.

## ERASE in the Flash BLOCK

It should be noted that:

a. Programming any byte of one Flash sector (or bulk) requires that the Flash sector (or bulk) has been previously erased (once for all bytes within the sector or bulk) with the correct instruction (see Instructions chapter).

b. Writing in the EEPROM memory is an operation triggering an automatic sequencing of byte erase followed by a byte write. Writing in EEPROM does not require a specific erase operation before writing.

**Bulk Erase Instruction.** The Bulk Erase instruction uses six write operations followed by Read operations of the status register bits, as described in Table 4. If any byte of the Bulk Erase instruction is wrong, the Bulk Erase instruction aborts and the device is reset to the Read Flash memory status.

During a Bulk Erase, the memory status may be checked by reading the status bits DQ5, DQ6 and DQ7, as detailed in the "PROGRAM in the Flash BLOCK" chapter. The Error bit (DQ5) returns a '1' if there has been an Erase Failure (maximum number of erase cycles have been executed).

It is not necessary to program the array with 00h, the M39208 will automatically do this before erasing to FFh.

During the execution of the Bulk Erase instruction, the Flash block logic does not accept any instruction.

**Sector Erase in Flash Block.** The Sector Erase instruction uses six write operations, as described in Table 4. Additional Flash Sector Erase confirm commands and Flash sector addresses can be written subsequently to erase other Flash sectors in parallel, without further coded cycles, if the additional instruction is transmitted in a shorter time than the timeout period to end of period. The input of a new Sector Erase instruction will restart the time-out period.

The status of the internal timer can be monitored through the level of DQ3 (Erase time-out bit), if DQ3 is '0' the Sector Erase instruction has been received and the timeout is counting; if DQ3 is '1', the timeout has expired and the M39208 is erasing the Flash sector(s). Before and during Erase timeout, any instruction different than Erase suspend and Erase Resume will abort the instruction and reset the device to read array mode.

It is not necessary to program the Flash sector with 00h as the M39208 will do this automatically before erasing (byte = FFh).

During a Sector Erase, the memory status may be checked by reading the status bits DQ5, DQ6 and DQ7, as detailed in the "Program instruction" chapter. During the execution of the erase instruction, the Flash block logic accepts only the Reset and Erase Suspend instructions (erasure of one Flash sector may be suspended, in order to read data from another Flash sector, and then resumed).

**Table 8. Flash Sector Protection**

| $\overline{EF}$ | $\overline{EE}$ | $\overline{G}$  | $\overline{W}$  | A0              | A1              | A6              | A9              | A12 | A16 | A17 | DQ0 - DQ7                                                                |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----|-----|-----|--------------------------------------------------------------------------|
| V <sub>IL</sub> | V <sub>IH</sub> | V <sub>ID</sub> | V <sub>IL</sub> | X               | X               | X               | V <sub>ID</sub> | X   | SA  | SA  | Protection Activation                                                    |
| V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IL</sub> | V <sub>ID</sub> | X   | SA  | SA  | Verify the protection status:<br>when DQ0= 1, the sector is<br>protected |

**Notes:** X = Don't care.  
SA = Software Address.

**Table 9. Flash Unprotection**

| $\overline{EF}$ | $\overline{EE}$ | $\overline{G}$  | $\overline{W}$  | A0              | A1              | A6              | A9              | A12             | A15             | A16 | A17 | DQ0 - DQ7                                                               |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----|-----|-------------------------------------------------------------------------|
| V <sub>ID</sub> | V <sub>IH</sub> | V <sub>ID</sub> | V <sub>IL</sub> | X               | X               | X               | V <sub>ID</sub> | V <sub>IH</sub> | V <sub>IH</sub> | X   | X   | Activation of Unprotected<br>Mode                                       |
| V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IL</sub> | V <sub>IH</sub> | V <sub>IH</sub> | V <sub>ID</sub> | X               | X               | SA  | SA  | Verify the protection status:<br>when 00h, the sector is<br>unprotected |

**Notes:** X = Don't care.  
SA = Software Address.

**Erase Suspend Instruction.** When a Flash Sector Erase operation is in progress, the Erase Suspend instruction may suspend the operation by writing B0h at any address (see Table 4). This allows reading of data from another Flash sector while erase is in progress. Erase suspend is accepted only during the Flash Sector Erase instruction execution and defaults to read array mode. An Erase Suspend instruction entered during an Erase timeout will, in addition to suspending the erase, terminates the timeout.

The Toggle bit DQ6 stops toggling when the M39208 internal logic is suspended. The Toggle bit status must be monitored at an address out of the Flash sector being erased. Toggle bit will stop toggling between 0.1μs and 15μs after the Erase Suspend instruction has been written. The M39208 will then automatically be set into Read Flash Block Memory Array mode.

When erase is suspended, Reading from Flash sectors being erased will output invalid data, a Read from Flash sector not being erased is valid. During an Erase Suspend, the Flash memory will respond only to Erase Resume and Reset instructions.

A Reset instruction will definitively abort erasure and can leave invalid data in the Flash sectors being erased.

**Erase Resume Instruction.** If an Erase Suspend instruction was previously executed, the erase op-

eration may be resumed by this instruction. The Erase Resume instruction consists of writing 30h at any address (see Table 4).

## FLASH BLOCK SPECIFIC FEATURES

**Flash Sector Protection.** Each Flash sector can be separately protected against Program or Erase. Flash Sector Protection provides additional data security, as it disables all program or erase operations. This mode is activated when both A9 and  $\overline{G}$  are set to V<sub>ID</sub> (12V + 0.5V) and the Flash sector address is applied on A16 and A17, as shown in Figure 8 and Table 8.

Flash sector protection is programmed with the help of a specific sequence of levels applied on  $\overline{EF}$ ,  $\overline{EE}$ ,  $\overline{G}$ , A0, A1, A6, A9, A16 and A17; this sequence includes a verification of the Protection status on DQ0 as shown in Table 8.

Any attempt to program or erase a protected Flash sector will be ignored by the device.

Remarks:

- The Verify operation is a read with a simulated worst case conditions. This allows a guarantee of the retention of the Protection status
- During the application life, the Sector protection status can be accessed with a regular Read instruction without applying a "high voltage" V<sub>ID</sub> on A9. This instruction is detailed in Table 4.

Figure 8. Sector Protection Flowchart

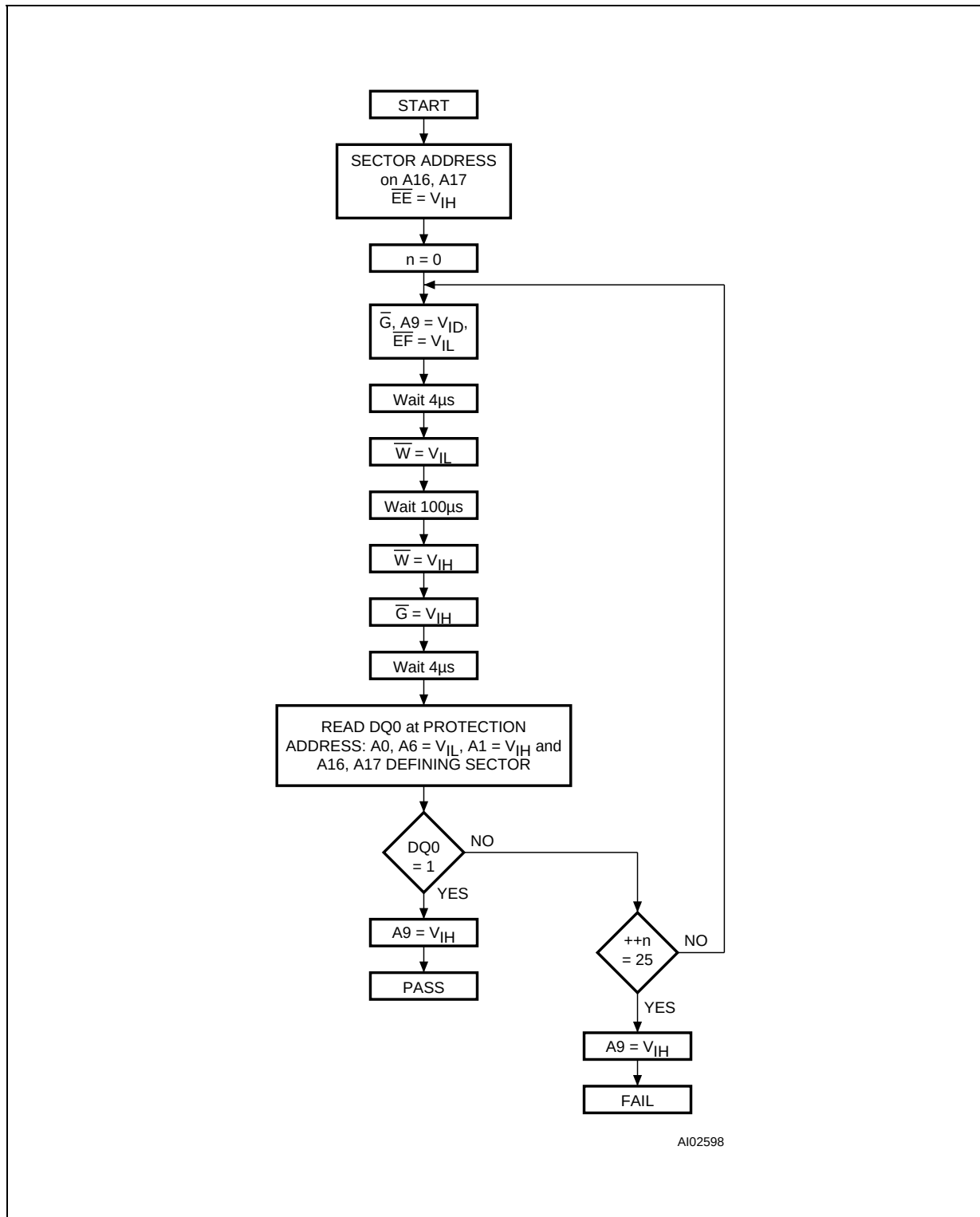
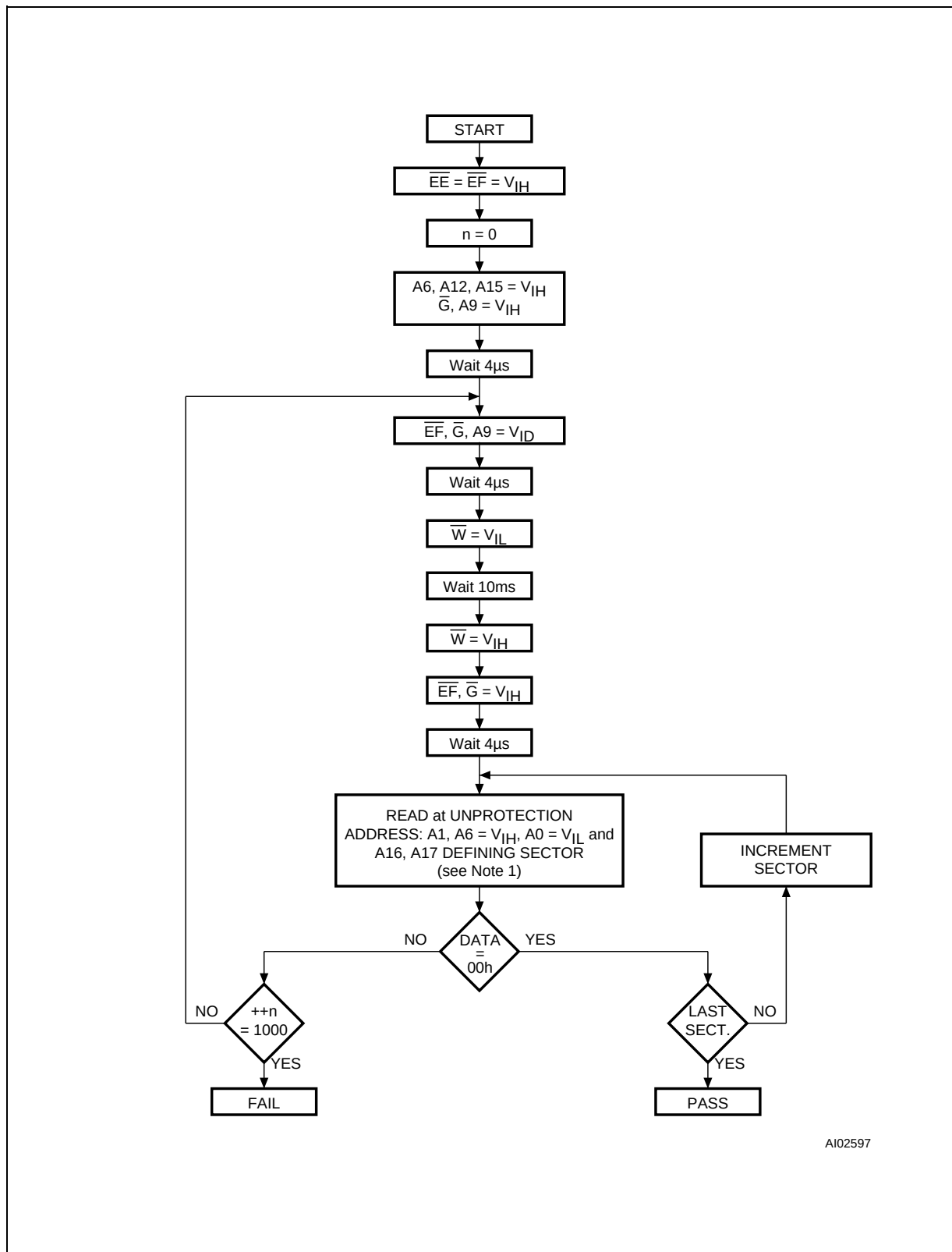


Figure 9. Sector Unprotecting Flowchart

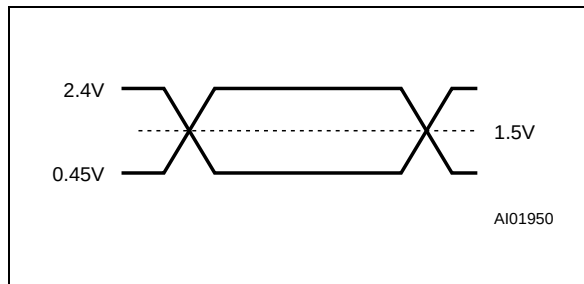
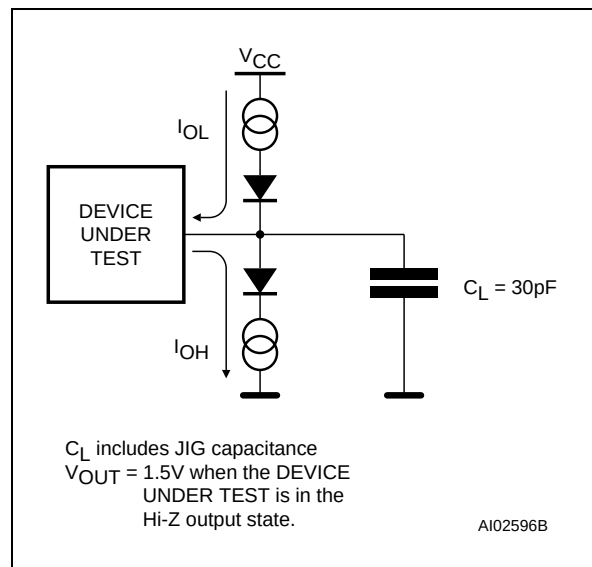


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**Note:** 1. A6 is kept at  $V_{IH}$  during unprotection algorithm in order to secure best unprotection verification. During all other protection status reads, A6 must be kept at  $V_{IL}$ .

**Table 10. AC Measurement Conditions**

|                             |                    |
|-----------------------------|--------------------|
| Input Rise and Fall Times   | $\leq 10\text{ns}$ |
| Input Pulse Voltages        | 0.45V to 2.4V      |
| Input Timing Ref. Voltages  | 0.8V and 2V        |
| Output Timing Ref. Voltages | 1.5V               |

**Figure 10. AC Testing Input Output Waveform****Figure 11. Output AC Testing Load Circuit****Table 11. Capacitance<sup>(1)</sup>** ( $T_A = 25\text{ }^{\circ}\text{C}$ ,  $f = 1\text{ MHz}$ )

| Symbol    | Parameter          | Test Condition        | Min | Max | Unit |
|-----------|--------------------|-----------------------|-----|-----|------|
| $C_{IN}$  | Input Capacitance  | $V_{IN} = 0\text{V}$  |     | 6   | pF   |
| $C_{OUT}$ | Output Capacitance | $V_{OUT} = 0\text{V}$ |     | 12  | pF   |

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

**Flash Sector Unprotection.** Flash sectors can be unprotected to allow updating of their contents. Note that the Sector Unprotection unprotects all sectors (sector 0 up to sector 7).

Flash Sector Unprotection is activated with a specific sequence of levels applied on  $\overline{EF}$ ,  $\overline{EE}$ ,  $\overline{G}$ , A0, A1, A6, A9, A12 and A15; this sequence includes a verification of the Protection status on DQ0-DQ7 as shown in Figure 9 and Table 9.

This allows a guarantee of the retention of the Protection status.

Remarks:

- The Verify operation is a read with a simulated worst case conditions. This allows a guarantee of the retention of the Protection status

- During the application life, the Sector protection status can be accessed with a regular Read instruction without "high voltage"  $V_{ID}$  on A9. This instruction is detailed in Table 4.

**Reset Instruction.** The Reset instruction resets the device internal logic in a few  $\mu\text{s}$ . Reset is an instruction of either one write operation or three write operations (refer to Table 4).

**Supply Rails.** Normal precautions must be taken for supply voltage decoupling, each device in a system should have the  $V_{CC}$  rail decoupled with a  $0.1\mu\text{F}$  capacitor close to the  $V_{CC}$  and  $V_{SS}$  pins. The printed circuit board trace width should be sufficient to carry the  $V_{CC}$  program and erase currents required.

**Table 12. DC Characteristics**(T<sub>A</sub> = 0 to 70°C or –20 to 85°C or –40 to 85°C; V<sub>CC</sub> = 2.7 V to 3.6V)

| Symbol                          | Parameter                                            | Test Condition                                                                           | Min                   | Max                   | Unit |
|---------------------------------|------------------------------------------------------|------------------------------------------------------------------------------------------|-----------------------|-----------------------|------|
| I <sub>LI</sub>                 | Input Leakage Current                                | 0V ≤ V <sub>IN</sub> ≤ V <sub>CC</sub>                                                   |                       | ±1                    | μA   |
| I <sub>LO</sub>                 | Output Leakage Current                               | 0V ≤ V <sub>OUT</sub> ≤ V <sub>CC</sub>                                                  |                       | ±1                    | μA   |
| I <sub>CC1</sub> <sup>(1)</sup> | Supply Current (Read Flash) TTL                      | $\overline{EE} = V_{IH}, \overline{EF} = V_{IL}, \overline{G} = V_{IH}, f = 6\text{MHz}$ |                       | 15                    | mA   |
| I <sub>CC2</sub>                | Supply Current (Read EEPROM) TTL                     | $\overline{EE} = V_{IL}, \overline{EF} = V_{IH}, \overline{G} = V_{IH}, f = 6\text{MHz}$ |                       | 15                    | mA   |
| I <sub>CC3</sub>                | Supply Current (Standby) CMOS                        | $\overline{EF} = \overline{EE} = V_{CC} \pm 0.2\text{V}$                                 |                       | 60                    | μA   |
| I <sub>CC4</sub>                | Supply Current (Flash Block Program or Erase)        | Byte program, Sector or Chip Erase in progress                                           |                       | 20                    | mA   |
| I <sub>CC5</sub>                | Supply Current (EEPROM Write)                        | During t <sub>wc</sub>                                                                   |                       | 20                    | mA   |
| I <sub>CC6</sub>                | Supply Current in Deep Power Down Mode               | After a Deep Power Down instruction (see Table 4)                                        |                       | 2                     | μA   |
| V <sub>IL</sub>                 | Input Low Voltage                                    |                                                                                          | –0.5                  | 0.8                   | V    |
| V <sub>IH</sub>                 | Input High Voltage                                   |                                                                                          | 0.7 V <sub>CC</sub>   | V <sub>CC</sub> + 0.3 | V    |
| V <sub>OL</sub>                 | Output Low Voltage                                   | I <sub>OL</sub> = 1.8mA                                                                  |                       | 0.45                  | V    |
| V <sub>OH</sub>                 | Output High Voltage                                  | I <sub>OH</sub> = –100μA                                                                 | V <sub>CC</sub> – 0.4 |                       | V    |
| V <sub>ID</sub>                 | A9 High Voltage                                      |                                                                                          | 11.5                  | 12.5                  | V    |
| I <sub>ID</sub>                 | V <sub>ID</sub> Current                              | A9 = V <sub>ID</sub>                                                                     |                       | 100                   | μA   |
| V <sub>LKO</sub>                | V <sub>CC</sub> Minimum for Write, Erase and Program |                                                                                          | 2                     | 2.3                   | V    |

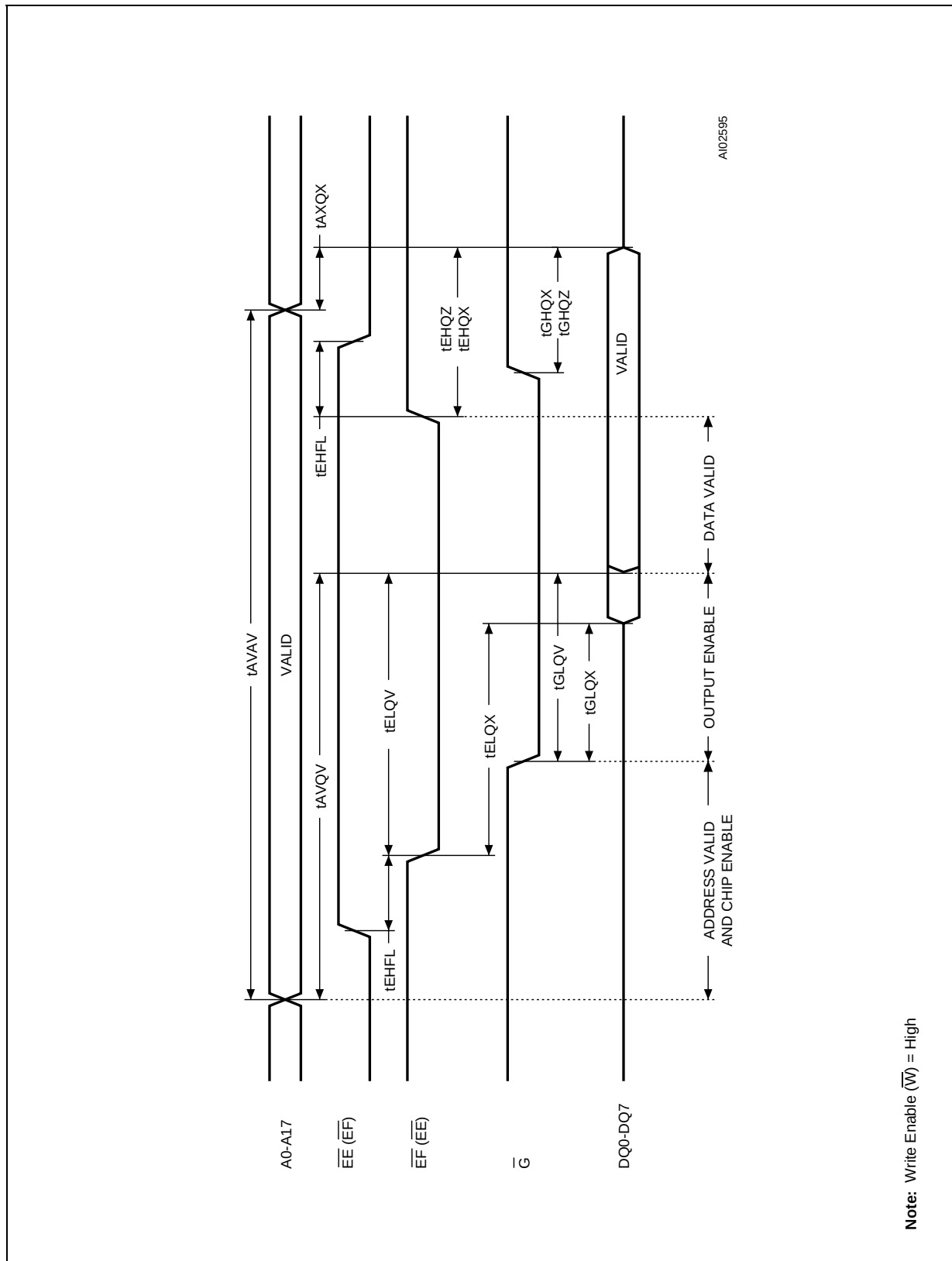
**Note:** 1. When reading the Flash block when an EEPROM byte(s) is under a write cycle, the supply current is I<sub>CC1</sub> + I<sub>CC5</sub>.**GLOSSARY****Block:** EEPROM block (64 Kbit) or Flash block (2 Mbit)**Bulk:** the whole Flash block (2 Mbit)**Sector:** 64 Kbyte of Flash memory**Page:** 64 bytes of EEPROM**Write and Program:** Writing (into the EEPROM block) and programming (the Flash block) is not performed in a similar way:

- the Flash memory requires an instruction (see Instruction chapter) for Erasing and another instruction for Programming one (or more) byte(s)
- the EEPROM memory is directly written with a simple operation (see Operation chapter).

**SDP:** Software Data Protection. Used for protecting the EEPROM block against false Write operations (as in noisy environments).



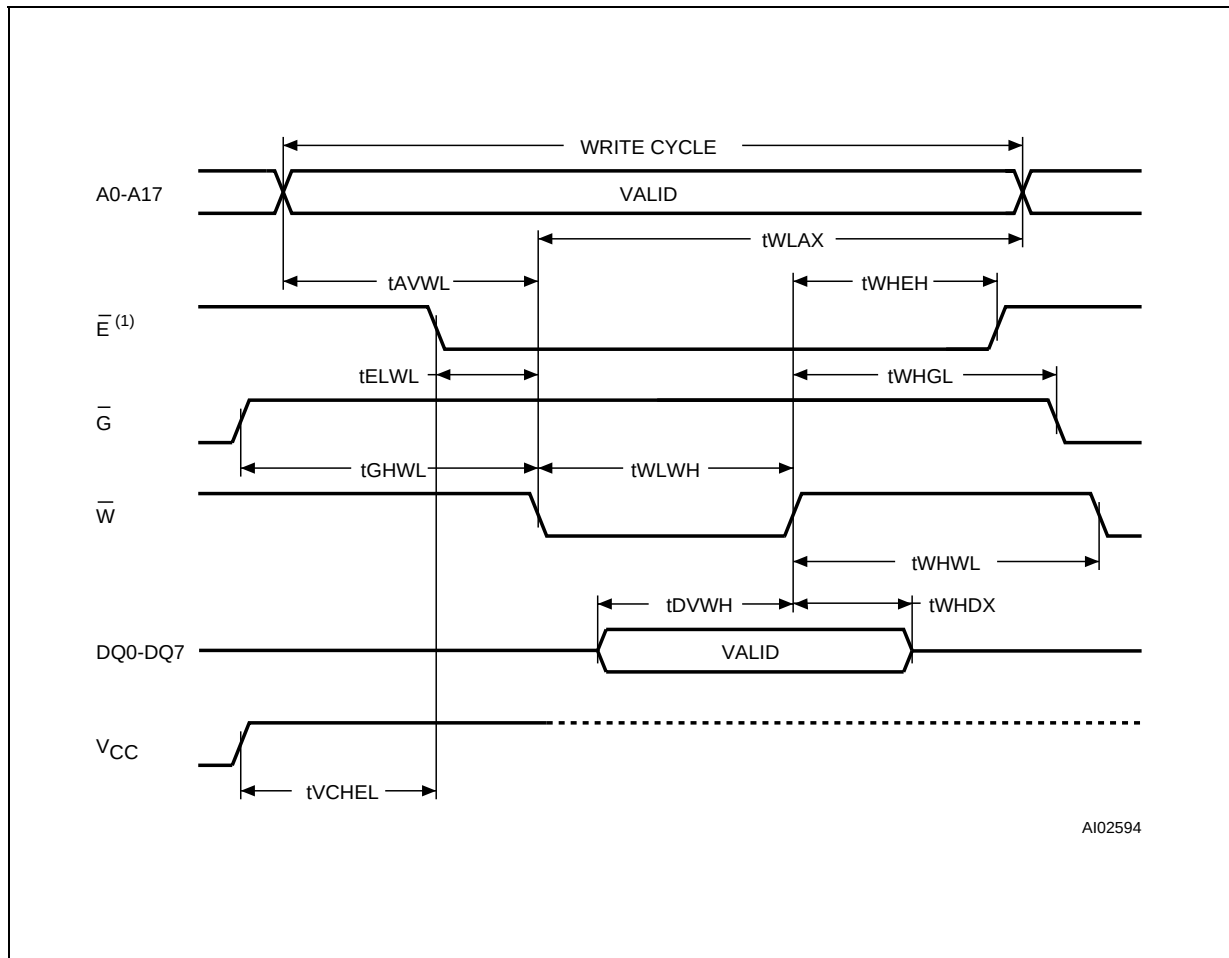
Figure 12. Read Mode AC Waveforms



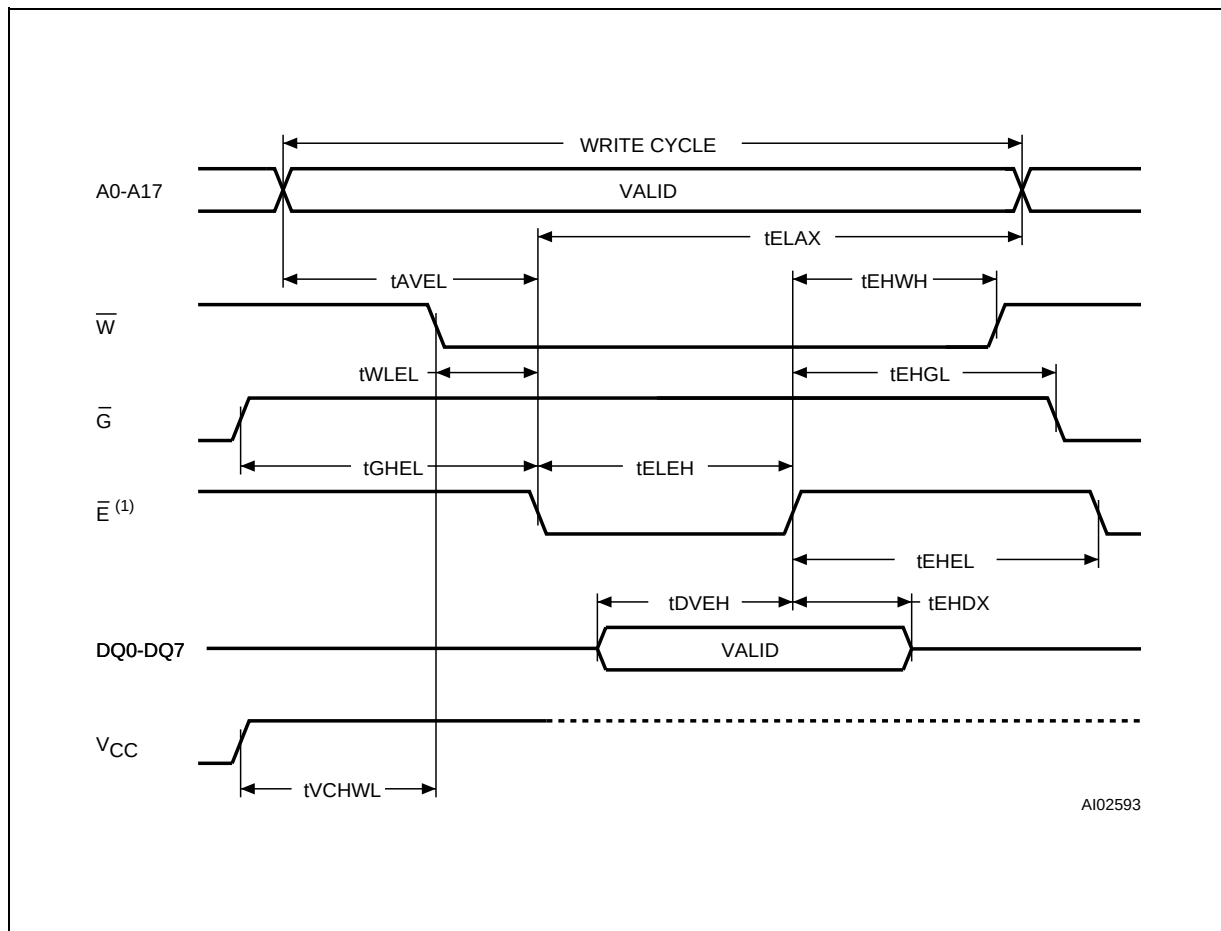
**Table 13. Read AC Characteristics**(T<sub>A</sub> = 0 to 70°C or –20 to 85°C or –40 to 85°C; V<sub>CC</sub> = 2.7 V to 3.6V)

| Symbol                           | Alt              | Parameter                                                               | Test Condition                                                                                                                                 | M39208 |     |      |     |      |     | Unit |
|----------------------------------|------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----|------|-----|------|-----|------|
|                                  |                  |                                                                         |                                                                                                                                                | -100   |     | -120 |     | -150 |     |      |
|                                  |                  |                                                                         |                                                                                                                                                | Min    | Max | Min  | Max | Min  | Max |      |
| t <sub>AVAV</sub>                | t <sub>RC</sub>  | Address Valid to Next Address Valid                                     | $\overline{(\overline{EE}, \overline{EF})} = (V_{IL}, V_{IH})$ or $(\overline{EE}, \overline{EF}) = (V_{IH}, V_{IL})$ ,<br>G = V <sub>IL</sub> | 100    |     | 120  |     | 150  |     | ns   |
| t <sub>AVQV</sub>                | t <sub>ACC</sub> | Address Valid to Output Valid                                           | $\overline{(\overline{EE}, \overline{EF})} = (V_{IL}, V_{IH})$ or $(\overline{EE}, \overline{EF}) = (V_{IH}, V_{IL})$ ,<br>G = V <sub>IL</sub> |        | 100 |      | 120 |      | 150 | ns   |
| t <sub>ELQX</sub> <sup>(1)</sup> | t <sub>LZ</sub>  | Chip Enable Low to Output Transition                                    | $\overline{G} = V_{IL}$                                                                                                                        | 0      |     | 0    |     | 0    |     | ns   |
| t <sub>ELQV</sub> <sup>(2)</sup> | t <sub>CE</sub>  | Chip Enable Low to Output Valid                                         | $\overline{G} = V_{IL}$                                                                                                                        |        | 100 |      | 120 |      | 150 | ns   |
| t <sub>GLQX</sub> <sup>(1)</sup> | t <sub>OLZ</sub> | Output Enable Low to Output Transition                                  | $\overline{(\overline{EE}, \overline{EF})} = (V_{IL}, V_{IH})$ or $(\overline{EE}, \overline{EF}) = (V_{IH}, V_{IL})$                          | 0      |     | 0    |     | 0    |     | ns   |
| t <sub>GLQV</sub> <sup>(2)</sup> | t <sub>OE</sub>  | Output Enable Low to Output Valid                                       | $\overline{(\overline{EE}, \overline{EF})} = (V_{IL}, V_{IH})$ or $(\overline{EE}, \overline{EF}) = (V_{IH}, V_{IL})$                          |        | 40  |      | 55  |      | 55  | ns   |
| t <sub>EHQX</sub>                | t <sub>OH</sub>  | Chip Enable High to Output Transition                                   | $\overline{G} = V_{IL}$                                                                                                                        | 0      |     | 0    |     | 0    |     | ns   |
| t <sub>EHQZ</sub> <sup>(1)</sup> | t <sub>HZ</sub>  | Chip Enable High to Output Hi-Z                                         | $\overline{G} = V_{IL}$                                                                                                                        |        | 30  |      | 40  |      | 40  | ns   |
| t <sub>GHQX</sub>                | t <sub>OH</sub>  | Output Enable High to Output Transition                                 | $\overline{(\overline{EE}, \overline{EF})} = (V_{IL}, V_{IH})$ or $(\overline{EE}, \overline{EF}) = (V_{IH}, V_{IL})$                          | 0      |     | 0    |     | 0    |     | ns   |
| t <sub>GHQZ</sub> <sup>(1)</sup> | t <sub>DF</sub>  | Output Enable High to Output Hi-Z                                       | $\overline{(\overline{EE}, \overline{EF})} = (V_{IL}, V_{IH})$ or $(\overline{EE}, \overline{EF}) = (V_{IH}, V_{IL})$                          |        | 30  |      | 40  |      | 40  | ns   |
| t <sub>AXQX</sub>                | t <sub>OH</sub>  | Address Transition to Output Transition                                 | $\overline{(\overline{EE}, \overline{EF})} = (V_{IL}, V_{IH})$ or $(\overline{EE}, \overline{EF}) = (V_{IH}, V_{IL})$ ,<br>G = V <sub>IL</sub> | 0      |     | 0    |     | 0    |     | ns   |
| t <sub>EHFL</sub>                | t <sub>CED</sub> | $\overline{EE}(\overline{EF})$ Active to $\overline{EF}(\overline{EE})$ |                                                                                                                                                | 100    |     | 100  |     | 100  |     | ns   |

**Notes:** 1. Sampled only, not 100% tested.2.  $\overline{G}$  may be delayed by up to t<sub>ELQV</sub> - t<sub>GLQV</sub> after the falling edge of  $\overline{EE}$  (or  $\overline{EF}$ ) without increasing t<sub>ELQV</sub>.

Figure 13. Write AC Waveforms,  $\overline{W}$  Controlled

**Notes:** Address are latched on the falling edge of  $\overline{W}$ . Data is latched on the rising edge of  $\overline{W}$ .  
 $\overline{E}$  is either  $\overline{EF}$  when  $\overline{EE} = V_{IH}$  or  $\overline{EE}$  when  $\overline{EF} = V_{IH}$ .

Figure 14. Write AC Waveforms,  $\overline{E}$  Controlled

**Notes:** Address are latched on the falling edge of  $\overline{E}$ , Data is latched on the rising edge of  $\overline{E}$ .  
 $\overline{E}$  is either  $\overline{EF}$  when  $\overline{EE} = V_{IH}$  or  $\overline{EE}$  when  $\overline{EF} = V_{IH}$ .

**Table 14. Write AC Characteristics, Write Enable Controlled**(T<sub>A</sub> = 0 to 70°C or –20 to 85°C or –40 to 85°C; V<sub>CC</sub> = 2.7 V to 3.6V)

| Symbol                            | Alt               | Parameter                                        | M39208 |     |      |     |      |     | Unit |
|-----------------------------------|-------------------|--------------------------------------------------|--------|-----|------|-----|------|-----|------|
|                                   |                   |                                                  | -100   |     | -120 |     | -150 |     |      |
|                                   |                   |                                                  | Min    | Max | Min  | Max | Min  | Max |      |
| t <sub>AVAV</sub>                 | t <sub>WC</sub>   | Address Valid to Next Address Valid              | 100    |     | 120  |     | 150  |     | ns   |
| t <sub>ELWL</sub> <sup>(2)</sup>  | t <sub>CS</sub>   | Chip Enable Low to Write Enable Low              | 0      |     | 0    |     | 0    |     | ns   |
| t <sub>WLWH</sub>                 | t <sub>WP</sub>   | Write Enable Low to Write Enable High            | 50     |     | 50   |     | 65   |     | ns   |
| t <sub>DVWH</sub>                 | t <sub>DS</sub>   | Input Valid to Write Enable High                 | 50     |     | 50   |     | 65   |     | ns   |
| t <sub>WHDX</sub>                 | t <sub>DH</sub>   | Write Enable High to Input Transition            | 0      |     | 0    |     | 0    |     | ns   |
| t <sub>WHEH</sub> <sup>(2)</sup>  | t <sub>CH</sub>   | Write Enable High to Chip Enable High            | 0      |     | 0    |     | 0    |     | ns   |
| t <sub>WHWL</sub>                 | t <sub>WPH</sub>  | Write Enable High to Write Enable Low            | 30     |     | 30   |     | 35   |     | ns   |
| t <sub>AVWL</sub>                 | t <sub>AS</sub>   | Address Valid to Write Enable Low                | 0      |     | 0    |     | 0    |     | ns   |
| t <sub>WLAX</sub>                 | t <sub>AH</sub>   | Write Enable Low to Address Transition           | 50     |     | 50   |     | 65   |     | ns   |
| t <sub>GHWL</sub>                 |                   | Output Enable High to Write Enable Low           | 0      |     | 0    |     | 0    |     | ns   |
| t <sub>VCHL</sub>                 | t <sub>VCS</sub>  | V <sub>CC</sub> High to Chip Enable Low          | 50     |     | 50   |     | 50   |     | μs   |
| t <sub>WHQV1</sub> <sup>(1)</sup> |                   | Write Enable High to Output Valid (Program)      | 8      |     | 8    |     | 8    |     | μs   |
| t <sub>WHQV2</sub> <sup>(1)</sup> |                   | Write Enable High to Output Valid (Sector Erase) | 0.5    | 30  | 0.5  | 30  | 0.5  | 30  | sec  |
| t <sub>WHWL0</sub>                |                   | Time Out between 2 consecutive Section Erase     |        | 80  |      | 80  |      | 80  | μs   |
| t <sub>WHGL</sub>                 | t <sub>OEHL</sub> | Write Enable High to Output Enable Low           | 0      |     | 0    |     | 0    |     | ns   |

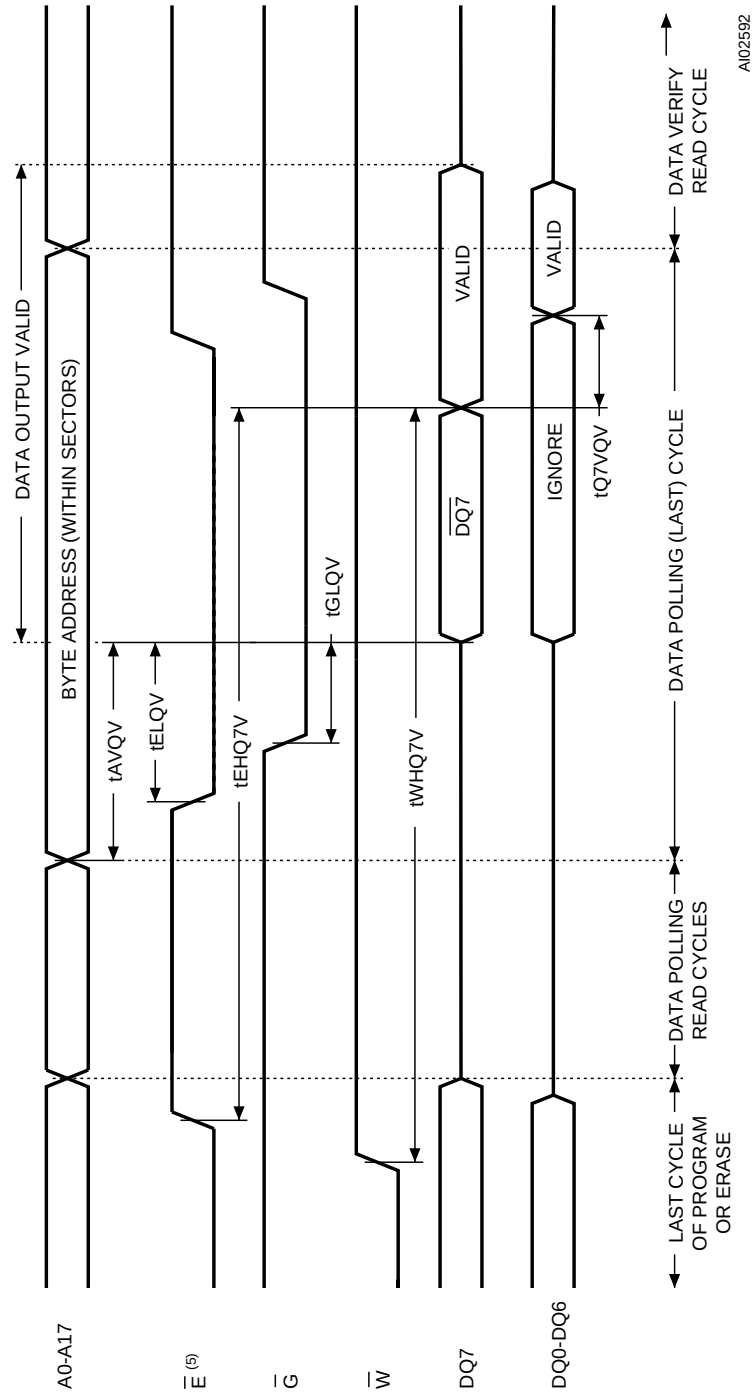
**Notes:** 1. Time is measured to Data Polling or Toggle Bit, t<sub>WHQV</sub> = t<sub>WHQ7V</sub> + t<sub>Q7VQV</sub>2. Chip Enable means (EE, EF) = (V<sub>IL</sub>, V<sub>IH</sub>) or (EE, EF) = (V<sub>IH</sub>, V<sub>IL</sub>).

**Table 15. Write AC Characteristics,  $\overline{EE}$  or  $\overline{EF}$  Controlled**(T<sub>A</sub> = 0 to 70°C or –20 to 85°C or –40 to 85°C; V<sub>CC</sub> = 2.7 V to 3.6V)

| Symbol                            | Alt               | Parameter                                               | M39208 |     |      |     |      |     | Unit |
|-----------------------------------|-------------------|---------------------------------------------------------|--------|-----|------|-----|------|-----|------|
|                                   |                   |                                                         | -100   |     | -120 |     | -150 |     |      |
|                                   |                   |                                                         | Min    | Max | Min  | Max | Min  | Max |      |
| t <sub>WLWL</sub>                 | t <sub>BLC</sub>  | Time-out after the Last Byte Write                      | 150    |     | 150  |     | 150  |     | μs   |
| t <sub>WC</sub>                   |                   | Write Cycle Time (EEPROM)                               |        | 10  |      | 10  |      | 10  | ms   |
| t <sub>AVAV</sub>                 |                   | Address Valid to Next Address Valid                     | 100    |     | 120  |     | 150  |     | ns   |
| t <sub>WLEL</sub>                 | t <sub>WS</sub>   | Write Enable Low to Memory Block Enable Low             | 0      |     | 0    |     | 0    |     | ns   |
| t <sub>ELEH</sub>                 | t <sub>CP</sub>   | Memory Block Enable Low to Memory Block Enable High     | 50     |     | 50   |     | 65   |     | ns   |
| t <sub>DVEH</sub>                 | t <sub>DS</sub>   | Input Valid to Memory Block Enable High                 | 50     |     | 50   |     | 65   |     | ns   |
| t <sub>EHDX</sub>                 | t <sub>DH</sub>   | Memory Block Enable High to Input Transition            | 0      |     | 0    |     | 0    |     | ns   |
| t <sub>EHWH</sub>                 | t <sub>WH</sub>   | Memory Block Enable High to Write Enable High           | 0      |     | 0    |     | 0    |     | ns   |
| t <sub>EHCL</sub>                 | t <sub>CPH</sub>  | Memory Block Enable High to Memory Block Enable Low     | 30     |     | 30   |     | 35   |     | ns   |
| t <sub>AVEL</sub>                 | t <sub>AS</sub>   | Address Valid to Memory Block Enable Low                | 0      |     | 0    |     | 0    |     | ns   |
| t <sub>ELAX</sub>                 | t <sub>AH</sub>   | Memory Block Enable Low to Address Transition           | 50     |     | 50   |     | 65   |     | ns   |
| t <sub>GHEL</sub>                 |                   | Output Enable High to Memory Block Enable Low           | 0      |     | 0    |     | 0    |     | ns   |
| t <sub>VCHWL</sub>                | t <sub>VCS</sub>  | V <sub>CC</sub> High to Write Enable Low                | 50     |     | 50   |     | 50   |     | μs   |
| t <sub>EHQV1</sub> <sup>(1)</sup> |                   | Memory Block Enable High to Output Valid (Program)      | 8      |     | 8    |     | 8    |     | μs   |
| t <sub>EHQV2</sub> <sup>(1)</sup> |                   | Memory Block Enable High to Output Valid (Sector Erase) | 0.5    | 30  | 0.5  | 30  | 0.5  | 30  | sec  |
| t <sub>EHGL</sub>                 | t <sub>OEHL</sub> | Memory Block Enable High to Output Enable Low           | 0      |     | 0    |     | 0    |     | ns   |

**Notes:** 1. Time is measured to Data Polling or Toggle Bit, t<sub>WHQV</sub> = t<sub>WHQ7V</sub> + t<sub>Q7VQV</sub>.

Figure 15. Data Polling DQ7 AC Waveforms



- Notes:**
1. All other timings are as a normal Read cycle.
  2. DQ7 and DQ0-DQ6 can transmit to valid at any point during the data output valid period.
  3.  $t_{WHQ7V}$  is the Program or Erase time.
  4. During erasing operation Byte address must be within Sector being erased.
  5.  $\overline{E}$  is either  $\overline{EF}$  when  $\overline{EE} = V_{IH}$  or  $\overline{EE}$  when  $\overline{EF} = V_{IH}$ .

**Table 16. Data Polling and Toggle Bit AC Characteristics <sup>(1)</sup>**(T<sub>A</sub> = 0 to 70°C or –20 to 85°C or –40 to 85°C; V<sub>CC</sub> = 2.7 V to 3.6V)

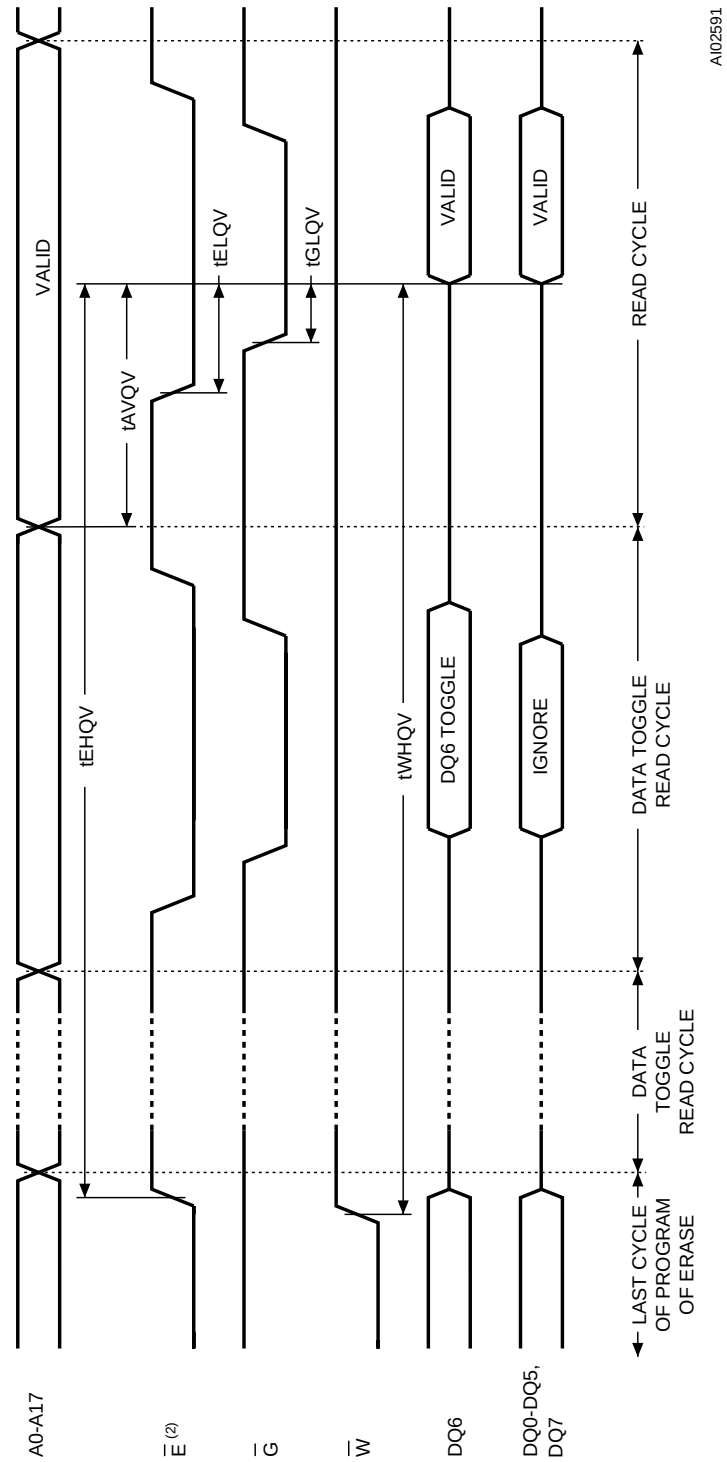
| Symbol              | Test Conditions               | Parameter                                                                               | M39208 |     |      |     |      |     | Unit |
|---------------------|-------------------------------|-----------------------------------------------------------------------------------------|--------|-----|------|-----|------|-----|------|
|                     |                               |                                                                                         | -100   |     | -120 |     | -150 |     |      |
|                     |                               |                                                                                         | Min    | Max | Min  | Max | Min  | Max |      |
| t <sub>WHQ7V1</sub> | $\overline{EF} = 0$<br>EE = 1 | Write Enable <u>H</u> igh to DQ7 Valid (Program, W Controlled)                          | 10     |     | 10   |     | 10   |     | μs   |
| t <sub>WHQ7V2</sub> | $\overline{EF} = 0$<br>EE = 1 | Write Enable <u>H</u> igh to DQ7 Valid (Sector Erase, W Controlled)                     | 1.5    | 30  | 1.5  | 30  | 1.5  | 30  | sec  |
| t <sub>EHQ7V1</sub> | $\overline{EF} = 0$<br>EE = 1 | Flash Block Enable <u>H</u> igh to DQ7 Valid (Program, $\overline{EF}$ Controlled)      | 10     |     | 10   |     | 10   |     | μs   |
| t <sub>EHQ7V2</sub> | $\overline{EF} = 0$<br>EE = 1 | Flash Block Enable <u>H</u> igh to DQ7 Valid (Sector Erase, $\overline{EF}$ Controlled) | 1.5    | 30  | 1.5  | 30  | 1.5  | 30  | sec  |
| t <sub>Q7VQV</sub>  | $\overline{EF} = 0$<br>EE = 1 | Q7 Valid to Output Valid (Data Polling)                                                 |        | 40  |      | 50  |      | 55  | ns   |

**Notes:** 1. All other timings are defined in Read AC Characteristics table.**Table 17. Program, Erase Times and Program, Erase Endurance Cycles (Flash Block)**(T<sub>A</sub> = 0 to 70°C or –20 to 85°C or –40 to 85°C; V<sub>CC</sub> = 2.7 V to 3.6V)

| Parameter                         | M39208  |     |     | Unit   |
|-----------------------------------|---------|-----|-----|--------|
|                                   | Min     | Typ | Max |        |
| Chip Program (Byte)               |         | 8   |     | sec    |
| Chip Erase (Preprogrammed)        |         | 3   | 30  | sec    |
| Chip Erase                        |         | 10  |     | sec    |
| Sector Erase (Preprogrammed)      |         | 1   | 30  | sec    |
| Sector Erase                      |         | 2   |     | sec    |
| Byte Program                      |         | 10  |     | μs     |
| Program/Erase Cycles (per Sector) | 100,000 |     |     | cycles |

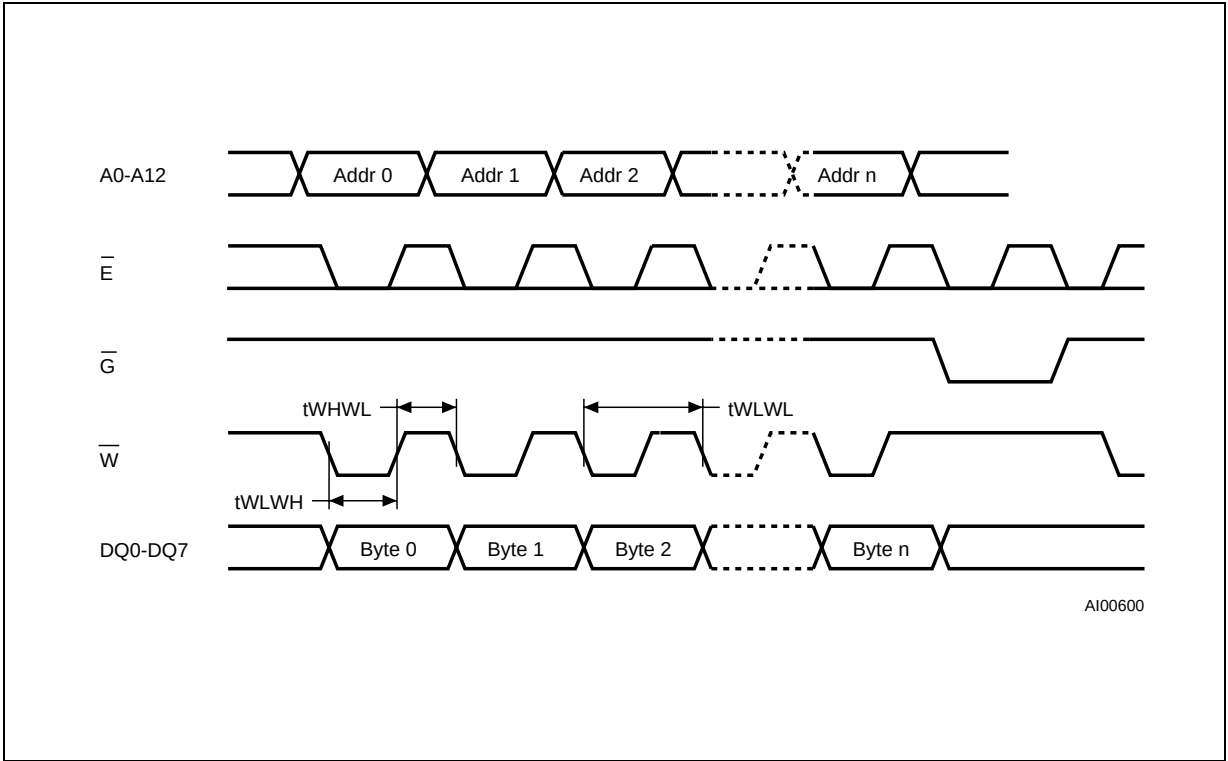


Figure 16. Data Toggle DQ6 AC Waveforms

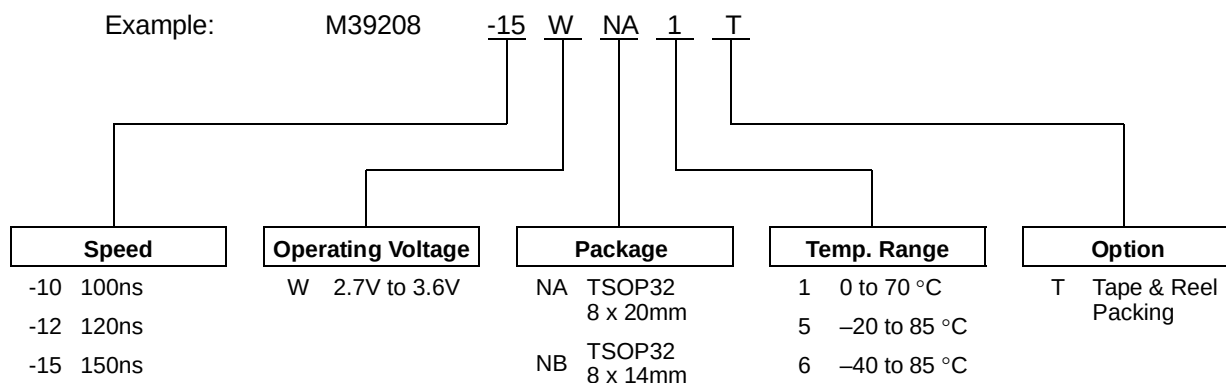


**Notes:** 1. All other timings are as a normal Read cycle.  
 2.  $\overline{E}$  is either  $\overline{EF}$  when  $\overline{EE} = V_{IH}$  or  $\overline{EE}$  when  $\overline{EF} = V_{IH}$ .

Figure 17. EEPROM Page Write Mode AC Waveforms,  $\overline{W}$  Controlled



## ORDERING INFORMATION SCHEME

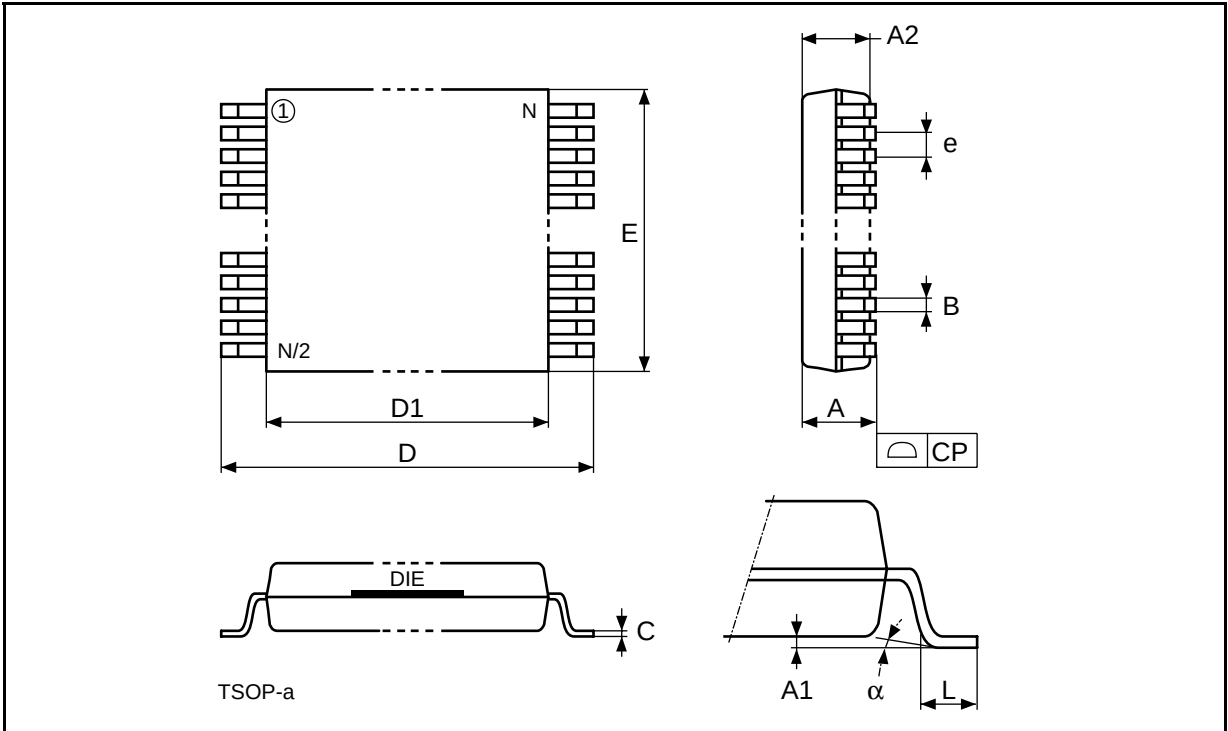


Devices are shipped from the factory with the memory content set at all "1's" (FFh).

For a list of available options (Speed, Package, etc...) or for further information on any aspect of this device, please contact the STMicroelectronics Sales Office nearest to you.

TSOP32 - 32 lead Plastic Thin Small Outline, 8 x 14mm

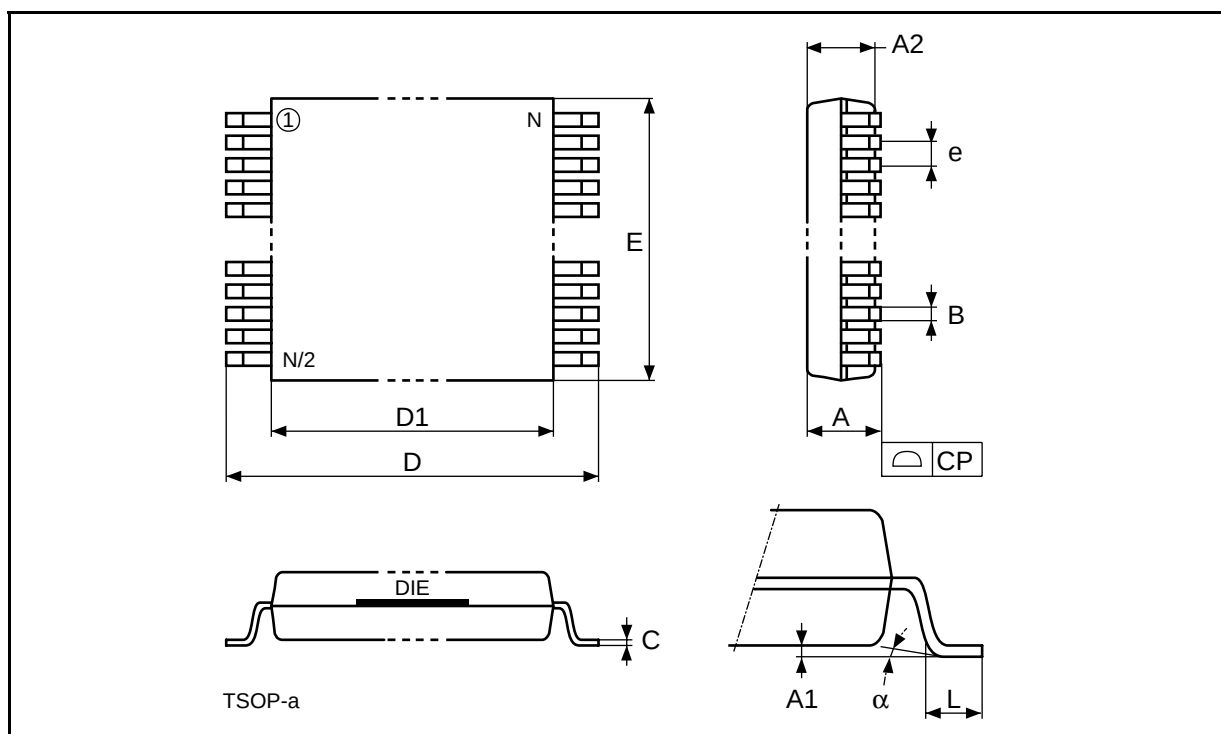
| Symb | mm   |       |       | inches |       |       |
|------|------|-------|-------|--------|-------|-------|
|      | Typ  | Min   | Max   | Typ    | Min   | Max   |
| A    |      |       | 1.20  |        |       | 0.047 |
| A1   |      | 0.05  | 0.15  |        | 0.002 | 0.006 |
| A2   |      | 0.95  | 1.05  |        | 0.037 | 0.041 |
| B    |      | 0.17  | 0.27  |        | 0.007 | 0.011 |
| C    |      | 0.10  | 0.21  |        | 0.004 | 0.008 |
| D    |      | 13.80 | 14.20 |        | 0.543 | 0.559 |
| D1   |      | 12.30 | 12.50 |        | 0.484 | 0.492 |
| E    |      | 7.90  | 8.10  |        | 0.311 | 0.319 |
| e    | 0.50 | -     | -     | 0.020  | -     | -     |
| L    |      | 0.50  | 0.70  |        | 0.020 | 0.028 |
| α    |      | 0°    | 5°    |        | 0°    | 5°    |
| N    | 32   |       |       | 32     |       |       |
| CP   |      |       | 0.10  |        |       | 0.004 |



Drawing is not to scale.

**TSOP32 - 32 lead Plastic Thin Small Outline, 8 x 20mm**

| Symb     | mm   |       |       | inches |       |       |
|----------|------|-------|-------|--------|-------|-------|
|          | Typ  | Min   | Max   | Typ    | Min   | Max   |
| A        |      |       | 1.20  |        |       | 0.047 |
| A1       |      | 0.05  | 0.15  |        | 0.002 | 0.007 |
| A2       |      | 0.95  | 1.05  |        | 0.037 | 0.041 |
| B        |      | 0.15  | 0.27  |        | 0.006 | 0.011 |
| C        |      | 0.10  | 0.21  |        | 0.004 | 0.008 |
| D        |      | 19.80 | 20.20 |        | 0.780 | 0.795 |
| D1       |      | 18.30 | 18.50 |        | 0.720 | 0.728 |
| E        |      | 7.90  | 8.10  |        | 0.311 | 0.319 |
| e        | 0.50 | -     | -     | 0.020  | -     | -     |
| L        |      | 0.50  | 0.70  |        | 0.020 | 0.028 |
| $\alpha$ |      | 0°    | 5°    |        | 0°    | 5°    |
| N        | 32   |       |       | 32     |       |       |
| CP       |      |       | 0.10  |        |       | 0.004 |



Drawing is not to scale.

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