



**PRELIMINARY**  
 Notice: This document is preliminary. Final specifications are subject to change.  
 Some parameters are subject to change.

MITSUBISHI LSIs

# M5M27C128K, -2, -3

**131 072-BIT (16384-WORD BY 8-BIT)  
 CMOS ERASABLE AND ELECTRICALLY REPROGRAMMABLE ROM**

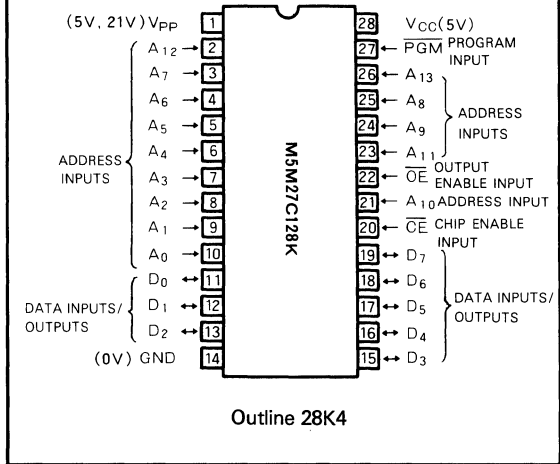
## DESCRIPTION

The Mitsubishi M5M27C128K is a high-speed 131072-bit ultraviolet erasable and electrically reprogrammable read only memory. It is suitable for microprocessor programming applications where rapid turn-around is required. The M5M27C128K is fabricated by N-channel double polysilicon Memory gate and CMOS technology for peripheral circuits, and available in a 28 pin DIL package with a transparent lid.

## FEATURES

- 16384 word x 8 bit organization
- Access time M5M27C128K-2 . . . . . 200ns (max.)  
 M5M27C128K . . . . . 250ns (max.)  
 M5M27C128K-3 . . . . . 300ns (max.)
- Two line control  $\overline{OE}$ ,  $\overline{CE}$
- Low power current ( $I_{CC}$ ): Active . . . . . 30mA (max.)  
 Standby . . . . . 1mA (max.)
- Single 5V power supply
- 3-State output buffer
- Input and output TTL-compatible in read and program mode
- Standard 28-pin DIL package
- Fast programming algorithm
- Interchangeable with M5L27128K

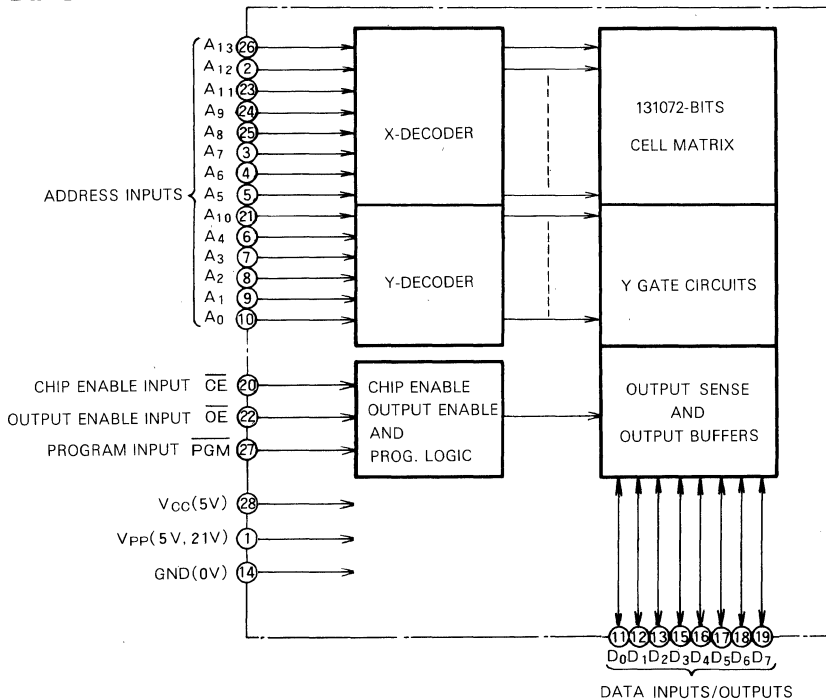
## PIN CONFIGURATION (TOP VIEW)



## APPLICATION

- Microcomputer systems and peripheral equipment

## BLOCK DIAGRAM



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**FUNCTION**

**Read**

Set the  $\overline{CE}$  and  $\overline{OE}$  terminals to the read mode (low level). Low level input to  $\overline{CE}$  and  $\overline{OE}$  and address signals to the address inputs ( $A_0 \sim A_{13}$ ) make the data contents of the designated address location available at the data input/output ( $D_0 \sim D_7$ ). When the  $\overline{CE}$  or  $\overline{OE}$  signal is high, data input/output are in a floating state.

When the  $\overline{CE}$  signal is high, the device is in the standby mode or power-down mode.

**Programming**

**(Fast programming algorithm)**

First set  $V_{CC}=6V$ ,  $V_{PP}=21V$  and then set an address to first address to be programmed. After applying 1 ms program pulse ( $\overline{PGM}$ ) to the address, verify is performed. If the output data of that address is not verified correctly, apply one more 1 ms program pulse. The programmer continues 1 ms pulse-then-verify routines until the device verify correctly or fifteen of these pulse-then-verify routines have been completed. The programmer also maintains its total number of 1 ms pulses applied to that address in register X. And then applied a program pulse 4 times of register X value long as an overprogram pulse. When the programming procedure above is finished, step to the next address and repeat this procedure till last address to be programmed. (See P.6-24)

**(Conventional programming algorithm)**

The device enters the programming mode when 21V is supplied to the  $V_{PP}$  power supply input and  $\overline{CE}$  is at low level. A location is designated by address signals ( $A_0 \sim A_{13}$ ), and the data to be programmed must be applied at 8-bits in parallel to the data inputs ( $D_0 \sim D_7$ ). A program pulse to the  $\overline{PGM}$  at this state will effect programming. Only one programming pulse is required, but its width must satisfy the condition  $45 \text{ ms} \leq t_{PW} \leq 55 \text{ ms}$ .

**Erase**

Erase is effected by exposure to ultraviolet light with a wavelength of 2537Å at an intensity of approximately 15WS/cm<sup>2</sup>. Sunlight and fluorescent light may contain ultraviolet light sufficient to erase the programmed information. For any operation in the read mode, the transparent lid should be covered with opaque tape.

**MODE SELECTION**

| Mode \ Pins     | $\overline{CE}$ (20) | $\overline{OE}$ (22) | $\overline{PGM}$ (27) | $V_{PP}$ (1) | $V_{CC}$ (28) | Outputs (11~13, 15~19) |
|-----------------|----------------------|----------------------|-----------------------|--------------|---------------|------------------------|
| Read            | $V_{IL}$             | $V_{IL}$             | $V_{IH}$              | $V_{CC}$     | $V_{CC}$      | Data out               |
| Standby         | $V_{IH}$             | X*                   | X*                    | $V_{CC}$     | $V_{CC}$      | Floating               |
| Program         | $V_{IL}$             | $V_{IH}$             | $V_{IL}$              | $V_{PP}$     | $V_{CC}$      | Data in                |
| Program verify  | $V_{IL}$             | $V_{IL}$             | $V_{IH}$              | $V_{PP}$     | $V_{CC}$      | Data out               |
| Program inhibit | $V_{IH}$             | X*                   | X*                    | $V_{PP}$     | $V_{CC}$      | Floating               |

\* : X can be either  $V_{IL}$  or  $V_{IH}$ .

**ABSOLUTE MAXIMUM RATINGS (Note 1)**

| Symbol    | Parameter   | Limits      | Unit |
|-----------|---|-------------|------|
| $T_{opr}$ | Temperature under bias                              | -10 ~ 80    | °C   |
| $T_{stg}$ | Storage temperature                                 | -65 ~ 125   | °C   |
| $V_{I1}$  | All input or output voltage (Note 2)                | -0.6 ~ 7    | V    |
| $V_{I2}$  | $V_{PP}$ supply voltage during programming (Note 2) | -0.6 ~ 22.0 | V    |

Note 1: Stresses above those listed may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or at any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods affects device reliability.

2: With respect to Ground.

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**READ OPERATION**

**DC ELECTRICAL CHARACTERISTICS** ( $T_a=0\sim 70^\circ\text{C}$ ,  $V_{CC}=5\text{V}\pm 5\%$ ,  $V_{PP}=V_{CC}$ , unless otherwise noted)

| Symbol    | Parameter                | Test conditions                      | Limits |     |            | Unit          |
|-----------|--------------------------|--------------------------------------|--------|-----|------------|---------------|
|           |                          |                                      | Min    | Typ | Max        |               |
| $I_{L1}$  | Input load current       | $V_{IN}=5.25\text{V}$                |        |     | 10         | $\mu\text{A}$ |
| $I_{L0}$  | Output leakage current   | $V_{OUT}=5.25\text{V}$               |        |     | 10         | $\mu\text{A}$ |
| $I_{PP1}$ | $V_{PP}$ current read    | $V_{PP}=5.25\text{V}$                |        | 1   | 100        | $\mu\text{A}$ |
| $I_{CC1}$ | $V_{CC}$ current standby | $\overline{OE}=V_{IH}$               |        |     | 1          | $\text{mA}$   |
|           |                          | $\overline{OE}=V_{CC}$               |        | 1   | 100        | $\mu\text{A}$ |
| $I_{CC2}$ | $V_{CC}$ current Active  | $\overline{OE}=\overline{OE}=V_{IL}$ |        |     | 30         | $\text{mA}$   |
|           |                          | $f=4\text{MHz}$                      |        |     | 30         | $\text{mA}$   |
| $V_{IL}$  | Input low voltage        |                                      | -0.1   |     | 0.8        | V             |
| $V_{IH}$  | Input high voltage       |                                      | 2.0    |     | $V_{CC}+1$ | V             |
| $V_{OL}$  | Output low voltage       | $I_{OL}=2.1\text{mA}$                |        |     | 0.45       | V             |
| $V_{OH}$  | Output high voltage      | $I_{OH}=-400\mu\text{A}$             | 2.4    |     |            | V             |

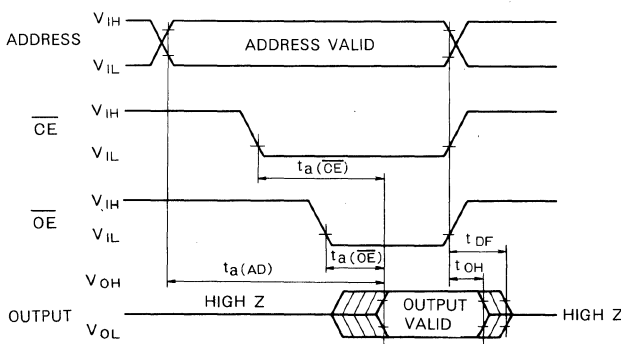
Note 3: Typical values are at  $T_a=25^\circ\text{C}$  and nominal supply voltages.

**AC ELECTRICAL CHARACTERISTICS** ( $T_a=0\sim 70^\circ\text{C}$ ,  $V_{CC}=5\text{V}\pm 5\%$ ,  $V_{PP}=V_{CC}$ , unless otherwise noted)

| Symbol               | Parameter   | Test conditions                      | Limits       |     |            |     |              |     | Unit |
|----------------------|---|--------------------------------------|--------------|-----|------------|-----|--------------|-----|------|
|                      |   |                                      | M5M27C128K-2 |     | M5M27C128K |     | M5M27C128K-3 |     |      |
|                      |   |                                      | Min          | Max | Min        | Max | Min          | Max |      |
| $t_a(\text{AD})$     | Address to output delay                             | $\overline{CE}=\overline{OE}=V_{IL}$ |              | 200 |            | 250 |              | 300 | ns   |
| $t_a(\overline{CE})$ | $\overline{CE}$ to output delay                     | $\overline{OE}=V_{IL}$               |              | 200 |            | 250 |              | 300 | ns   |
| $t_a(\overline{OE})$ | Output enable to output delay                       | $\overline{CE}=V_{IL}$               |              | 75  |            | 100 |              | 120 | ns   |
| $t_{DF}$             | Output enable high to output float                  | $\overline{CE}=V_{IL}$               | 0            | 60  | 0          | 85  | 0            | 105 | ns   |
| $t_{OH}$             | Output hold from $\overline{CE}$ or $\overline{OE}$ | $\overline{CE}=\overline{OE}=V_{IL}$ | 0            |     | 0          |     | 0            |     | ns   |

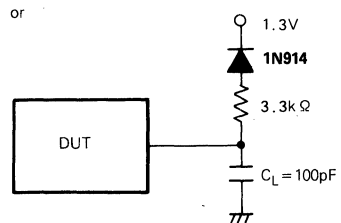
Note 4:  $V_{CC}$  must be applied simultaneously  $V_{PP}$  and removed simultaneously  $V_{PP}$ .

**AC WAVEFORMS**



Test conditions for A.C. characteristics  
 Input voltage:  $V_{IL}=0.45\text{V}$ ,  $V_{IH}=2.4\text{V}$   
 Input rise and fall times:  $\leq 20\text{ns}$   
 Reference voltage at timing measurement: Inputs 1V and 2V Output 0.8V, and 2V

Output load: 1TTL gate +  $C_L(100\text{pF})$



**CAPACITANCE**

| Symbol    | Parameter  | Test conditions  | Limits |     |     | Unit        |
|-----------|--|--|--------|-----|-----|-------------|
|           |  |  | Min    | Typ | Max |             |
| $C_{IN}$  | Input capacitance (Address, $\overline{CE}$ , $\overline{OE}$ , PGM) | $T_a=25^\circ\text{C}$ , $f=1\text{MHz}$ , $V_1=V_0=0\text{V}$ |        | 4   | 6   | $\text{pF}$ |
| $C_{OUT}$ | Output capacitance   |  |        | 8   | 12  | $\text{pF}$ |

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**PROGRAM OPERATION**

**FAST PROGRAMMING ALGORITHM**  
**DC ELECTRICAL CHARACTERISTICS**

( $T_a = 25 \pm 5^\circ\text{C}$ ,  $V_{CC} = 6V \pm 0.25V$ ,  $V_{PP} = 21V \pm 0.5V$ , unless otherwise noted)

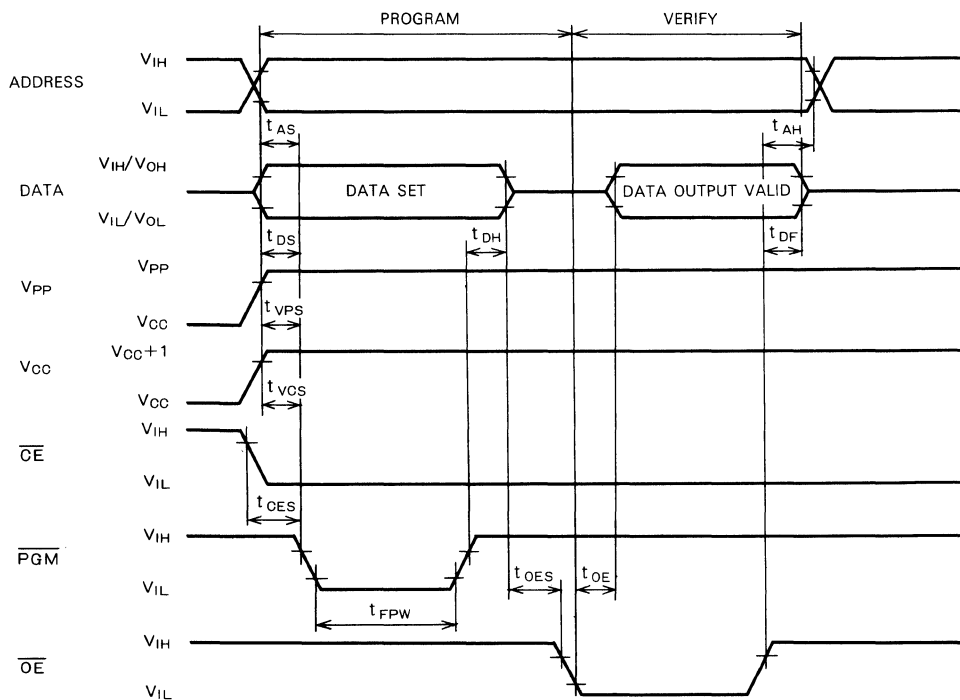
| Symbol    | Parameter               | Test conditions                           | Limits |     |          | Unit          |
|-----------|-------------------------|---|--------|-----|----------|---------------|
|           |                         |   | Min    | Typ | Max      |               |
| $I_{LI}$  | Input current           | $V_{IN} = V_{IL}$ or $V_{IH}$             |        |     | 10       | $\mu\text{A}$ |
| $V_{OL}$  | Output low voltage      | $I_{OL} = 2.1\text{mA}$                   |        |     | 0.45     | V             |
| $V_{OH}$  | Output high voltage     | $I_{OH} = -400\mu\text{A}$                | 2.4    |     |          | V             |
| $V_{IL}$  | Input low voltage       |   | -0.1   |     | 0.8      | V             |
| $V_{IH}$  | Input high voltage      |   | 2.0    |     | $V_{CC}$ | V             |
| $I_{CC2}$ | $V_{CC}$ supply current |   |        |     | 30       | mA            |
| $I_{PP2}$ | $V_{PP}$ supply current | $\overline{CE} = V_{IL} = \overline{PGM}$ |        |     | 30       | mA            |

**AC ELECTRICAL CHARACTERISTICS** ( $T_a = 25 \pm 5^\circ\text{C}$ ,  $V_{CC} = 6V \pm 0.25V$ ,  $V_{PP} = 21V \pm 0.5V$ , unless otherwise noted)

| Symbol    | Parameter                                    | Test conditions | Limits |     |      | Unit          |
|-----------|--|-----------------|--------|-----|------|---------------|
|           |  |                 | Min    | Typ | Max  |               |
| $t_{AS}$  | Address setup time                           |                 | 2      |     |      | $\mu\text{s}$ |
| $t_{OES}$ | $\overline{OE}$ set up time                  |                 | 2      |     |      | $\mu\text{s}$ |
| $t_{DS}$  | Data setup time                              |                 | 2      |     |      | $\mu\text{s}$ |
| $t_{AH}$  | Address hold time                            |                 | 0      |     |      | $\mu\text{s}$ |
| $t_{DH}$  | Data hold time                               |                 | 2      |     |      | $\mu\text{s}$ |
| $t_{DF}$  | Chip enable to output float delay            |                 | 0      |     | 130  | ns            |
| $t_{VCS}$ | $V_{CC}$ setup time                          |                 | 2      |     |      | $\mu\text{s}$ |
| $t_{VPS}$ | $V_{PP}$ setup time                          |                 | 2      |     |      | $\mu\text{s}$ |
| $t_{FPW}$ | $\overline{PGM}$ initial program pulse width |                 | 0.95   | 1   | 1.05 | ms            |
| $t_{OPW}$ | $\overline{PGM}$ over program pulse width    |                 | 3.8    |     | 63   | ms            |
| $t_{CES}$ | $\overline{CE}$ setup time                   |                 | 2      |     |      | $\mu\text{s}$ |
| $t_{OE}$  | Data valid from $\overline{OE}$              |                 |        |     | 150  | ns            |

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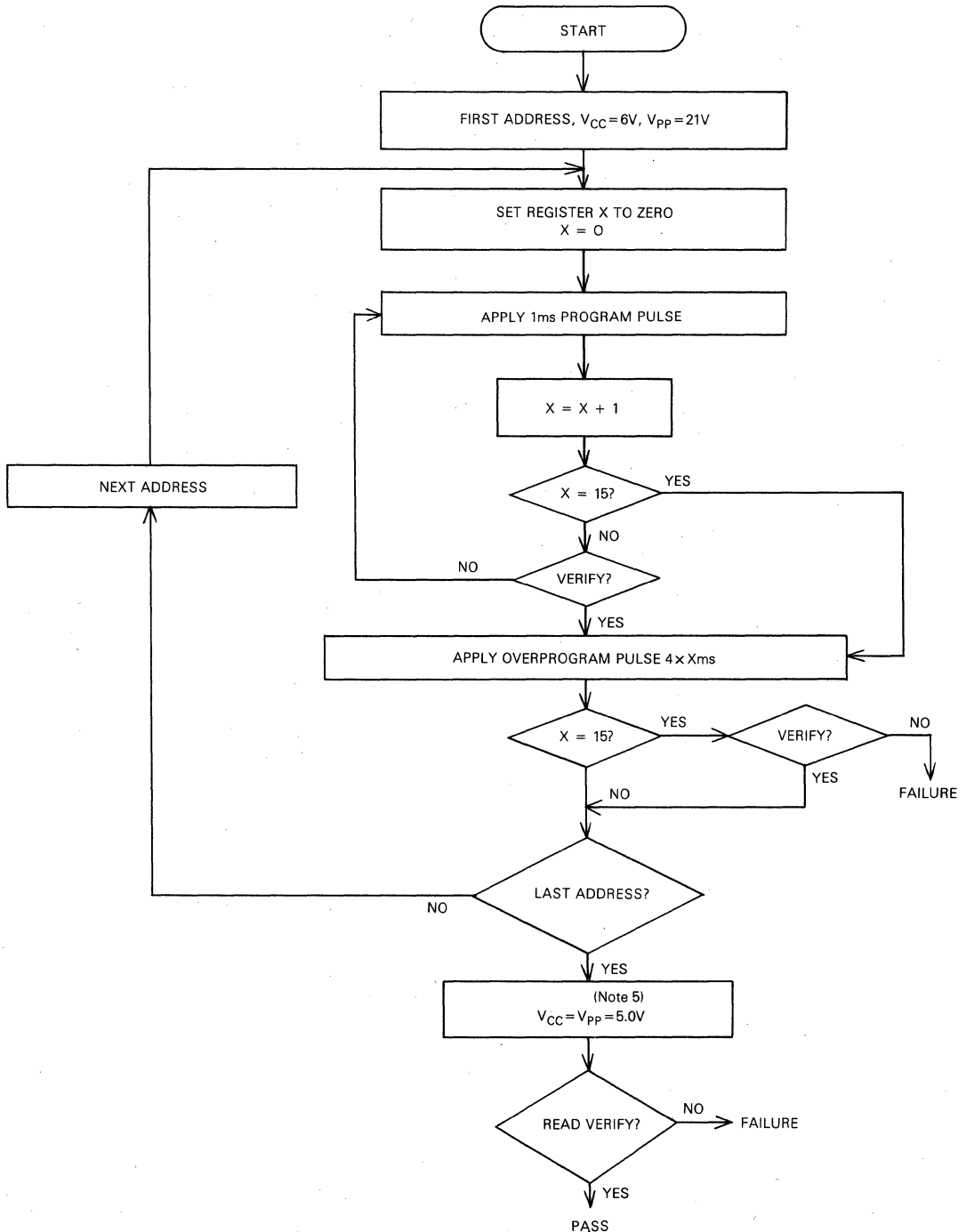
**AC WAVEFORMS**



Test conditions for A.C. characteristics  
 Input voltage:  $V_{IL} = 0.45V$ ,  $V_{IH} = 2.4V$   
 Input rise and fall times:  $\leq 20ns$   
 Reference voltage at timing measurement: Input 1V and 2V Output 0.8V, and 2V

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**FAST PROGRAMMING ALGORITHM  
 FLOW CHART**



Note 5:  $4.75 \leq V_{CC} = V_{PP} \leq 5.25V$

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**M5M27C128K, -2, -3**

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**CONVENTIONAL PROGRAMMING ALGORITHM**

**DC ELECTRICAL CHARACTERISTICS** ( $T_a = 25 \pm 5^\circ\text{C}$ ,  $V_{CC} = 5V \pm 5\%$ ,  $V_{PP} = 21V \pm 0.5V$ , unless otherwise noted)

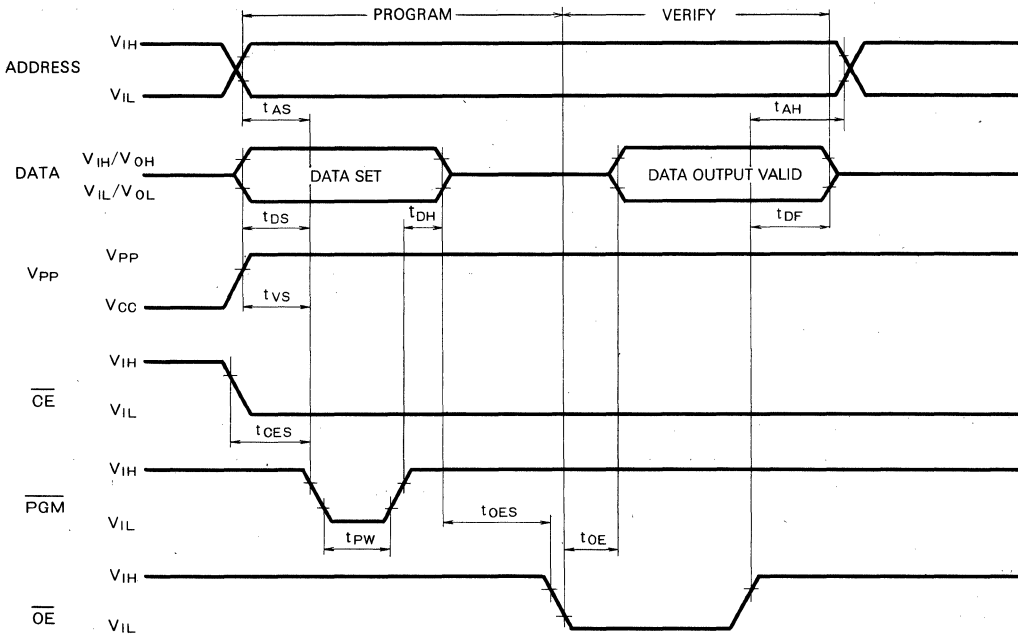
| Symbol    | Parameter               | Test conditions               | Limits |     |              | Unit          |
|-----------|-------------------------|-------------------------------|--------|-----|--------------|---------------|
|           |                         |                               | Min    | Typ | Max          |               |
| $I_{LI}$  | Input current           | $V_{IN} = V_{IL}$ or $V_{IH}$ |        |     | 10           | $\mu\text{A}$ |
| $V_{OL}$  | Output low voltage      | $I_{OL} = 2.1\text{mA}$       |        |     | 0.45         | V             |
| $V_{OH}$  | Output high voltage     | $I_{OH} = -400\mu\text{A}$    | 2.4    |     |              | V             |
| $V_{IL}$  | Input low voltage       |                               | -0.1   |     | 0.8          | V             |
| $V_{IH}$  | Input high voltage      |                               | 2.0    |     | $V_{CC} + 1$ | V             |
| $I_{CC2}$ | $V_{CC}$ Supply current |                               |        |     | 30           | mA            |
| $I_{PP}$  | $V_{PP}$ Supply current | $CE = V_{IL} = \text{PGM}$    |        |     | 30           | mA            |

**AC ELECTRICAL CHARACTERISTICS** ( $T_a = 25 \pm 5^\circ\text{C}$ ,  $V_{CC} = 5V \pm 5\%$ ,  $V_{PP} = 21V \pm 0.5V$ , unless otherwise noted)

| Symbol    | Parameter                        | Test conditions | Limits |     |     | Unit          |
|-----------|----------------------------------|-----------------|--------|-----|-----|---------------|
|           |                                  |                 | Min    | Typ | Max |               |
| $t_{AS}$  | Address set up time              |                 | 2      |     |     | $\mu\text{s}$ |
| $t_{OES}$ | OE setup time                    |                 | 2      |     |     | $\mu\text{s}$ |
| $t_{DS}$  | Data setup time                  |                 | 2      |     |     | $\mu\text{s}$ |
| $t_{AH}$  | Address hold time                |                 | 0      |     |     | $\mu\text{s}$ |
| $t_{DH}$  | Data hold time                   |                 | 2      |     |     | $\mu\text{s}$ |
| $t_{DF}$  | Chip enable to output delay      |                 | 0      |     | 130 | ns            |
| $t_{VS}$  | $V_{PP}$ setup time              |                 | 2      |     |     | $\mu\text{s}$ |
| $t_{PW}$  | PGM Pulse width (during program) |                 | 45     | 50  | 55  | ms            |
| $t_{CES}$ | CE setup time                    |                 | 2      |     |     | $\mu\text{s}$ |
| $t_{OE}$  | Data valid from OE               |                 |        |     | 150 | ns            |

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Test conditions for A.C. characteristics  
 Input rise and fall time:  $\leq 20\text{ns}$   
 Input voltage:  $V_{IL} = 0.45\text{V}$ ,  $V_{IH} = 2.4\text{V}$   
 Reference voltage at timing measurement: Input 1V and 2V  
 Outputs 0.8V and 2V