

## 512K (64K x 8) CMOS EPROM

### FEATURES

- High speed performance
- CMOS Technology for low power consumption
  - 25 mA Active current
  - 30  $\mu$ A Standby current
- Factory programming available
- Auto-insertion-compatible plastic packages
- Auto ID aids automated programming
- High speed express programming algorithm
- Organized 64K x 8: JEDEC standard pinouts
  - 28-pin Dual-in-line package
  - 32-pin PLCC Package
  - 28-pin SOIC package
  - 28-pin TSOP package
  - 28-pin VSOP package
  - Tape and reel
- Data Retention > 200 years
- Available for the following temperature ranges
  - Commercial: 0°C to +70°C
  - Industrial: -40°C to +85°C
  - Automotive: -40°C to +125°C

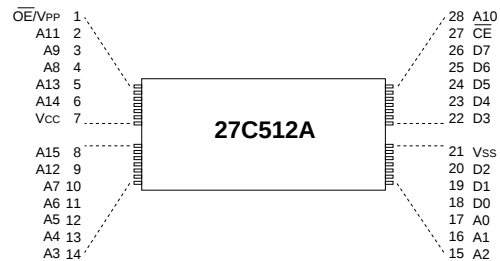
### DESCRIPTION

The Microchip Technology Inc. 27C512A is a CMOS 512K bit electrically Programmable Read Only Memory (EPROM). The device is organized into 64K words by 8 bits (64K bytes). Accessing individual bytes from an address transition or from power-up (chip enable pin going low) is accomplished in less than 90 ns. This very high speed device allows the most sophisticated microprocessors to run at full speed without the need for WAIT states. CMOS design and processing enables this part to be used in systems where reduced power consumption and high reliability are requirements.

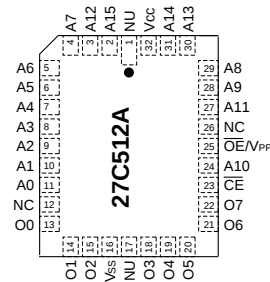
A complete family of packages is offered to provide the most flexibility in applications. For surface mount applications, PLCC, VSOP, TSOP or SOIC packaging is available. Tape or reel packaging is also available for PLCC or SOIC packages.

### PACKAGE TYPES

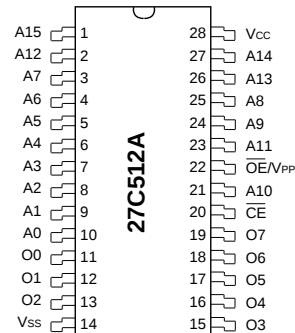
#### TSOP



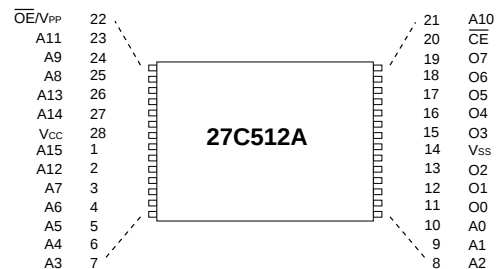
#### PLCC



#### DIP/SOIC



#### VSOP



## 1.0 ELECTRICAL CHARACTERISTICS

### 1.1 Maximum Ratings\*

V<sub>CC</sub> and input voltages w.r.t. V<sub>SS</sub> ..... -0.6V to +7.25V

V<sub>PP</sub> voltage w.r.t. V<sub>SS</sub> during programming ..... -0.6V to +14V

Voltage on A9 w.r.t. V<sub>SS</sub> ..... -0.6V to +13.5V

Output voltage w.r.t. V<sub>SS</sub> ..... -0.6V to V<sub>CC</sub> +1.0V

Storage temperature ..... -65°C to +150°C

Ambient temp. with power applied ..... -65°C to +125°C

\*Notice: Stresses above those listed under "Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

TABLE 1-1: PIN FUNCTION TABLE

| Name                   | Function                                    |
|------------------------|---------------------------------------------|
| A0-A15                 | Address Inputs                              |
| $\overline{CE}$        | Chip Enable                                 |
| $\overline{OE}/V_{PP}$ | Output Enable/Programming Voltage           |
| O0 - O7                | Data Output                                 |
| V <sub>CC</sub>        | +5V Power Supply                            |
| V <sub>SS</sub>        | Ground                                      |
| NC                     | No Connection; No Internal Connection       |
| NU                     | Not Used; No External Connection is Allowed |

TABLE 1-2: READ OPERATION DC CHARACTERISTICS

| V <sub>CC</sub> = +5V ±10%<br>Commercial: Tamb = 0°C to +70°C<br>Industrial: Tamb = -40°C to +85°C<br>Extended (Automotive): Tamb = -40°C to +125°C |                  |                                      |                                                                          |             |                           |                |                                                                                                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--------------------------------------|--------------------------------------------------------------------------|-------------|---------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Parameter                                                                                                                                           | Part*            | Status                               | Symbol                                                                   | Min         | Max                       | Units          | Conditions                                                                                                                                                                                                       |
| Input Voltages                                                                                                                                      | all              | Logic "1"<br>Logic "0"               | V <sub>IH</sub><br>V <sub>IL</sub>                                       | 2.0<br>-0.5 | V <sub>CC</sub> +1<br>0.8 | V<br>V         |                                                                                                                                                                                                                  |
| Input Leakage                                                                                                                                       | all              |                                      | I <sub>LI</sub>                                                          | -10         | 10                        | μA             | V <sub>IN</sub> = 0 to V <sub>CC</sub>                                                                                                                                                                           |
| Output Voltages                                                                                                                                     | all              | Logic "1"<br>Logic "0"               | V <sub>OH</sub><br>V <sub>OL</sub>                                       | 2.4         | 0.45                      | V<br>V         | I <sub>OH</sub> = - 400 μA<br>I <sub>OL</sub> = 2.1 mA                                                                                                                                                           |
| Output Leakage                                                                                                                                      | all              | —                                    | I <sub>LO</sub>                                                          | -10         | 10                        | μA             | V <sub>OUT</sub> = 0V to V <sub>CC</sub>                                                                                                                                                                         |
| Input Capacitance                                                                                                                                   | all              | —                                    | C <sub>IN</sub>                                                          | —           | 6                         | pF             | V <sub>IN</sub> = 0V; Tamb = 25°C;<br>f = 1 MHz                                                                                                                                                                  |
| Output Capacitance                                                                                                                                  | all              | —                                    | C <sub>OUT</sub>                                                         | —           | 12                        | pF             | V <sub>OUT</sub> = 0V; Tamb = 25°C;<br>f = 1 MHz                                                                                                                                                                 |
| Power Supply Current, Active                                                                                                                        | C<br>I, E        | TTL input<br>TTL input               | I <sub>CC</sub><br>I <sub>CC</sub>                                       | —<br>—      | 25<br>35                  | mA<br>mA       | V <sub>CC</sub> = 5.5V<br>f = 1 MHz;<br>$\overline{OE}/V_{PP} = \overline{CE} = V_{IL}$ ;<br>I <sub>OUT</sub> = 0 mA;<br>V <sub>IL</sub> = -0.1 to 0.8V;<br>V <sub>IH</sub> = 2.0 to V <sub>CC</sub> ;<br>Note 1 |
| Power Supply Current, Standby                                                                                                                       | C<br>I, E<br>all | TTL input<br>TTL input<br>CMOS input | I <sub>CC(S)TLL</sub><br>I <sub>CC(S)TLL</sub><br>I <sub>CC(S)CMOS</sub> | —<br>—<br>— | 1<br>2<br>30              | mA<br>mA<br>μA | $\overline{CE} = V_{CC} \pm 0.2V$                                                                                                                                                                                |

\* Parts: C=Commercial Temperature Range; I, E=Industrial and Extended Temperature Ranges

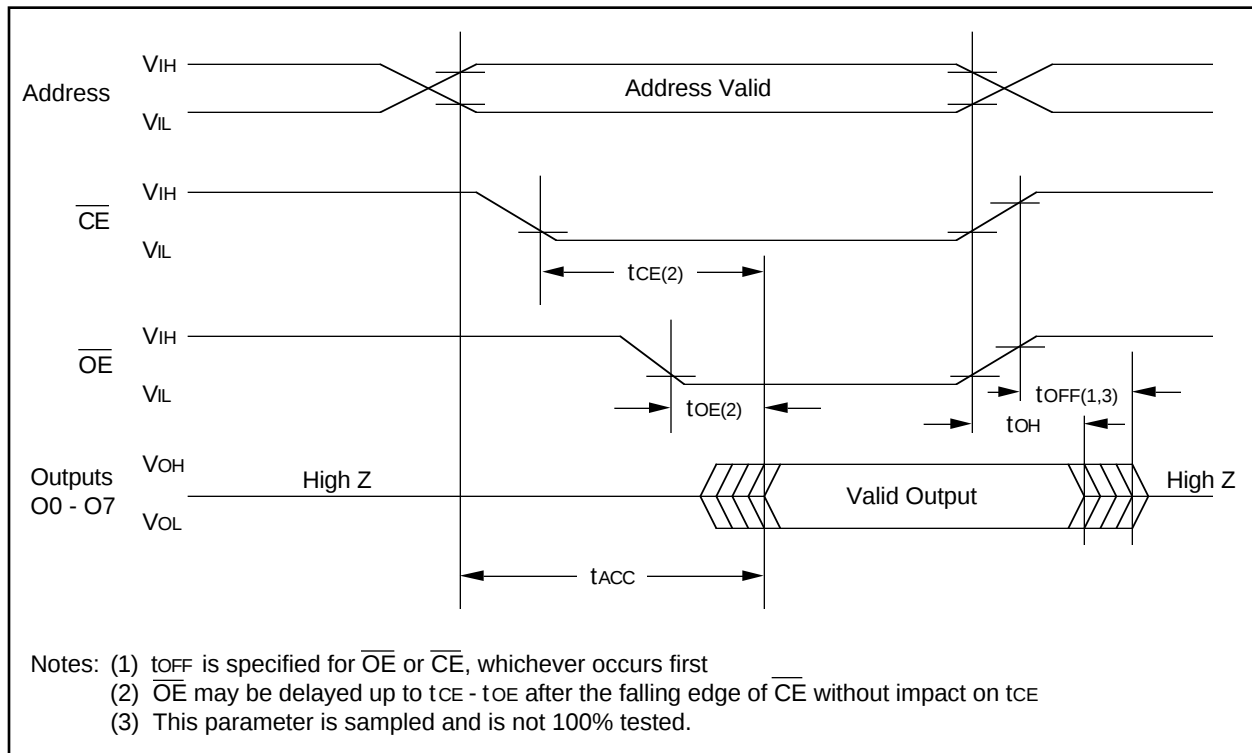
Note 1: Typical active current increases .75 mA per MHz up to operating frequency for all temperature ranges.

**TABLE 1-3: READ OPERATION AC CHARACTERISTICS**

|                                                                                                |                  | AC Testing Waveform:       |     | $V_{IH} = 2.4V$ and $V_{IL} = .45V$ ; $V_{OH} = 2.0V$ and $V_{OL} = 0.8V$ |     |                                             |     |             |     |                                            |                                                 |
|------------------------------------------------------------------------------------------------|------------------|----------------------------|-----|---------------------------------------------------------------------------|-----|---------------------------------------------|-----|-------------|-----|--------------------------------------------|-------------------------------------------------|
|                                                                                                |                  | Output Load:               |     | 1 TTL Load + 100 pF                                                       |     |                                             |     |             |     |                                            |                                                 |
|                                                                                                |                  | Input Rise and Fall Times: |     | 10 ns                                                                     |     |                                             |     |             |     |                                            |                                                 |
|                                                                                                |                  | Ambient Temperature:       |     | Commercial:                                                               |     | $T_{amb} = 0^{\circ}C$ to $+70^{\circ}C$    |     | Industrial: |     | $T_{amb} = -40^{\circ}C$ to $+85^{\circ}C$ |                                                 |
|                                                                                                |                  |                            |     | Extended (Automotive):                                                    |     | $T_{amb} = -40^{\circ}C$ to $+125^{\circ}C$ |     |             |     |                                            |                                                 |
| Parameter                                                                                      | Sym              | 27C512-90*                 |     | 27C512-10*                                                                |     | 27C512-12                                   |     | 27C512-15   |     | Units                                      | Conditions                                      |
|                                                                                                |                  | Min                        | Max | Min                                                                       | Max | Min                                         | Max | Min         | Max |                                            |                                                 |
| Address to Output Delay                                                                        | t <sub>ACC</sub> | —                          | 90  | —                                                                         | 100 | —                                           | 120 | —           | 150 | ns                                         | $\overline{CE} = \overline{OE}/V_{PP} = V_{IL}$ |
| $\overline{CE}$ to Output Delay                                                                | t <sub>CE</sub>  | —                          | 90  | —                                                                         | 100 | —                                           | 120 | —           | 150 | ns                                         | $\overline{OE}/V_{PP} = V_{IL}$                 |
| $\overline{OE}$ to Output Delay                                                                | t <sub>OE</sub>  | —                          | 40  | —                                                                         | 40  | —                                           | 50  | —           | 60  | ns                                         | $\overline{CE} = V_{IL}$                        |
| $\overline{OE}$ to Output High Impedance                                                       | t <sub>OFF</sub> | 0                          | 35  | 0                                                                         | 35  | 0                                           | 40  | 0           | 45  | ns                                         |                                                 |
| Output Hold from Address, $\overline{CE}$ or $\overline{OE}/V_{PP}$ , whichever occurred first | t <sub>OH</sub>  | 0                          | —   | 0                                                                         | —   | 0                                           | —   | 0           | —   | ns                                         |                                                 |

\*90/10 AC Testing Waveforms:  $V_{IH} = 3.0V$  and  $V_{IL} = 0V$ ;  $V_{OH} = 1.5V$  and  $V_{OL} = 1.5V$   
Output Load: 1 TTL Load + 30 pF

**FIGURE 1-1: READ WAVEFORMS**



**TABLE 1-4: PROGRAMMING DC CHARACTERISTICS**

| Ambient Temperature: $T_{amb} = 25^{\circ}\text{C} \pm 5^{\circ}\text{C}$<br>$V_{CC} = 6.5\text{V} \pm 0.25\text{V}$ , $\overline{OE}/V_{PP} = V_H = 13.0\text{V} \pm 0.25\text{V}$ |           |           |      |            |               |                                                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|------|------------|---------------|----------------------------------------------------------------|
| Parameter                                                                                                                                                                           | Status    | Symbol    | Min. | Max.       | Units         | Conditions (See Note 1)                                        |
| Input Voltages                                                                                                                                                                      | Logic "1" | $V_{IH}$  | 2.0  | $V_{CC}+1$ | V             |                                                                |
|                                                                                                                                                                                     | Logic "0" | $V_{IL}$  | -0.1 | 0.8        | V             |                                                                |
| Input Leakage                                                                                                                                                                       | —         | $I_{LI}$  | -10  | 10         | $\mu\text{A}$ | $V_{IN} = 0\text{V to } V_{CC}$                                |
| Output Voltages                                                                                                                                                                     | Logic "1" | $V_{OH}$  | 2.4  | 0.45       | V             | $I_{OH} = -400\text{ }\mu\text{A}$<br>$I_{OL} = 2.1\text{ mA}$ |
|                                                                                                                                                                                     | Logic "0" | $V_{OL}$  | —    |            | V             |                                                                |
| VCC Current, program & verify                                                                                                                                                       | —         | $I_{CC2}$ | —    | 35         | mA            | $\overline{CE} = V_{IL}$                                       |
| $\overline{OE}/V_{PP}$ Current, program                                                                                                                                             | —         | $I_{PP2}$ | —    | 25         | mA            |                                                                |
| A9 Product Identification                                                                                                                                                           | —         | $V_{ID}$  | 11.5 | 12.5       | V             |                                                                |

Note 1:  $V_{CC}$  must be applied simultaneously or before  $V_{PP}$  voltage on  $\overline{OE}/V_{PP}$  and removed simultaneously or after the  $V_{PP}$  voltage on  $\overline{OE}/V_{PP}$ .

**TABLE 1-5: PROGRAMMING AC CHARACTERISTICS**

| for Program, Program Verify<br>and Program Inhibit Modes | AC Testing Waveform: $V_{IH}=2.4V$ and $V_{IL}=0.45V$ ; $V_{OH}=2.0V$ ; $V_{OL}=0.8V$<br>Ambient Temperature: $25^{\circ}C \pm 5^{\circ}C$<br>$V_{CC} = 6.5V \pm 0.25V$ , $\overline{OE}/V_{PP} = V_H = 13.0V \pm 0.25 V$ |      |      |         |                     |
|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|---------|---------------------|
| Parameter                                                | Symbol                                                                                                                                                                                                                    | Min. | Max. | Units   | Remarks             |
| Address Set-Up Time                                      | $t_{AS}$                                                                                                                                                                                                                  | 2    | —    | $\mu s$ |                     |
| Data Set-Up Time                                         | $t_{DS}$                                                                                                                                                                                                                  | 2    | —    | $\mu s$ |                     |
| Data Hold Time                                           | $t_{DH}$                                                                                                                                                                                                                  | 2    | —    | $\mu s$ |                     |
| Address Hold Time                                        | $t_{AH}$                                                                                                                                                                                                                  | 0    | —    | $\mu s$ |                     |
| Float Delay (2)                                          | $t_{DF}$                                                                                                                                                                                                                  | 0    | 130  | ns      |                     |
| Vcc Set-Up Time                                          | $t_{VCS}$                                                                                                                                                                                                                 | 2    | —    | $\mu s$ |                     |
| Program Pulse Width (1)                                  | $t_{PW}$                                                                                                                                                                                                                  | 95   | 105  | $\mu s$ | 100 $\mu s$ typical |
| $\overline{CE}$ Set-Up Time                              | $t_{CES}$                                                                                                                                                                                                                 | 2    | —    | $\mu s$ |                     |
| $\overline{OE}$ Set-Up Time                              | $t_{OES}$                                                                                                                                                                                                                 | 2    | —    | $\mu s$ |                     |
| $\overline{OE}$ Hold Time                                | $t_{OEH}$                                                                                                                                                                                                                 | 2    | —    | $\mu s$ |                     |
| $\overline{OE}$ Recovery Time                            | $t_{OR}$                                                                                                                                                                                                                  | 2    | —    | $\mu s$ |                     |
| $\overline{OE}/V_{PP}$ Rise Time During Programming      | $t_{PRT}$                                                                                                                                                                                                                 | 50   | —    | ns      |                     |

Note 1: For express algorithm, initial programming width tolerance is 100  $\mu\text{s} \pm 5\%$ .

2: This parameter is only sampled and not 100% tested. Output float is defined as the point where data is no longer driven (see timing diagram).



## 1.3 Standby Mode

The standby mode is entered when the  $\overline{CE}$  pin is high, and the program mode is not identified.

When this conditions are met, the supply current will drop from 25 mA to 30  $\mu$ A.

## 1.4 Output Enable $\overline{OE}/V_{PP}$

This multifunction pin eliminates bus connection in multiple bus microprocessor systems and the outputs go to high impedance when:

- the  $\overline{OE}/V_{PP}$  pin is high ( $V_{IH}$ ).

When a  $V_H$  input is applied to this pin, it supplies the programming voltage ( $V_{PP}$ ) to the device.

## 1.5 Erase Mode (UV Windowed Versions)

Windowed products offer the ability to erase the memory array. The memory matrix is erased to the all "1's" state as a result of being exposed to ultraviolet light. To ensure complete erasure, a dose of 15 watt-second/cm<sup>2</sup> is required. This means that the device window must be placed within one inch and directly underneath an ultraviolet lamp with a wavelength of 2537 Angstroms, intensity of 12,000 mW/cm<sup>2</sup> for approximately 40 minutes.

## 1.6 Programming Mode

The Express algorithm must be used for best results. It has been developed to improve programming yields and throughput times in a production environment. Up to 10 100-microsecond pulses are applied until the byte is verified. A flowchart of the Express algorithm is shown in Figure 1-3.

Programming takes place when:

- $V_{CC}$  is brought to the proper voltage,
- $\overline{OE}/V_{PP}$  is brought to the proper  $V_H$  level, and
- $\overline{CE}$  line is low.

Since the erased state is "1" in the array, programming of "0" is required. The address to be programmed is set via pins A0 - A15 and the data to be programmed is presented to pins O0 - O7. When data and address are stable, a low going pulse on the  $\overline{CE}$  line programs that location.

## 1.7 Verify

After the array has been programmed it must be verified to ensure all the bits have been correctly programmed. This mode is entered when all the following conditions are met:

- $V_{CC}$  is at the proper level,
- the  $\overline{OE}/V_{PP}$  pin is low, and
- the  $\overline{CE}$  line is low.

## 1.8 Inhibit

When programming multiple devices in parallel with different data, only  $\overline{CE}$  needs to be under separate control to each device. By pulsing the  $\overline{CE}$  line low on a particular device, that device will be programmed; all other devices with  $\overline{CE}$  held high will not be programmed with the data (although address and data will be available on their input pins).

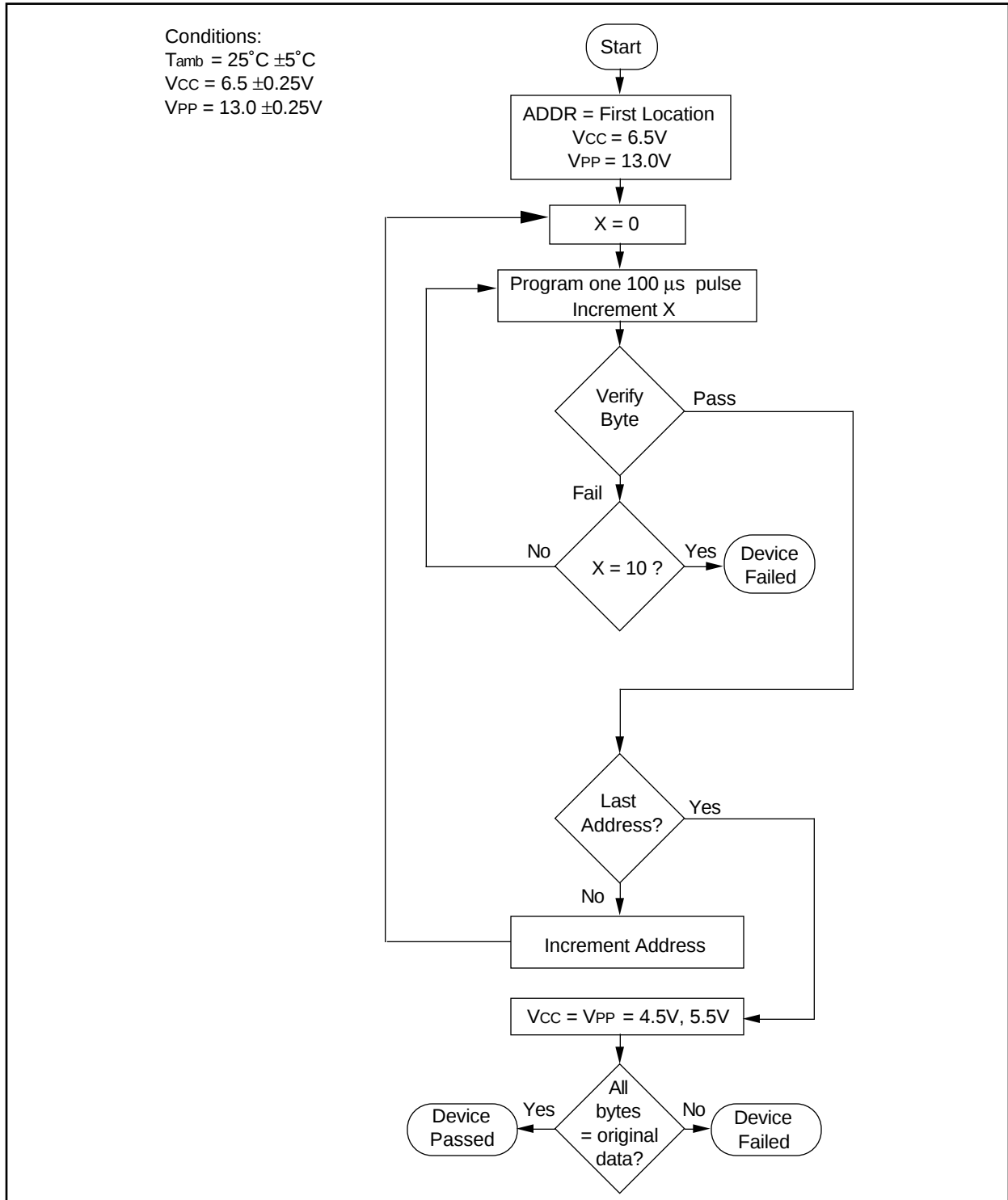
## 1.9 Identity Mode

In this mode specific data is output which identifies the manufacturer as Microchip Technology Inc. and the device type. This mode is entered when Pin A9 is taken to  $V_H$  (11.5V to 12.5V). The  $\overline{CE}$  and  $\overline{OE}/V_{PP}$  lines must be at  $V_{IL}$ . A0 is used to access any of the two non-erasable bytes whose data appears on O0 through O7.

| Pin $\rightarrow$            | Input    | Output |   |   |   |   |   |   |   |    |
|------------------------------|----------|--------|---|---|---|---|---|---|---|----|
| Identity<br>$\downarrow$     | A0       | 0      | 0 | 0 | 0 | 0 | 0 | 0 | 0 | H  |
|                              |          | 7      | 6 | 5 | 4 | 3 | 2 | 1 | 0 | e  |
| Manufacturer<br>Device Type* | $V_{IL}$ | 0      | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 29 |
|                              | $V_{IH}$ | 1      | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0D |

\* Code subject to change

FIGURE 1-3: PROGRAMMING EXPRESS ALGORITHM



# 27C512A

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NOTES:

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# 27C512A

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NOTES:

# 27C512A

## 27C512A Product Identification System

To order or to obtain information (e.g., on pricing or delivery),, please use listed part numbers, and refer to factory or listed sales offices.

|                |   |           |          |           |                                                |
|----------------|---|-----------|----------|-----------|------------------------------------------------|
| <b>27C512A</b> | - | <b>70</b> | <b>I</b> | <b>/P</b> |                                                |
|                |   |           |          |           | <b>Package:</b>                                |
|                |   |           |          |           | L = Plastic Leaded Chip Carrier                |
|                |   |           |          |           | P = Plastic DIP (600 Mil)                      |
|                |   |           |          |           | SO = Plastic SOIC (300 Mil)                    |
|                |   |           |          |           | TS = Thin Small Outline Package(TSOP) 8x20mm   |
|                |   |           |          |           | VS = Very Small Outline Package(VSOP) 8x13.4mm |
|                |   |           |          |           | <b>Temperature Range:</b>                      |
|                |   |           |          |           | Blank = 0°C to +70°C                           |
|                |   |           |          |           | I = -40°C to +85°C                             |
|                |   |           |          |           | E = -40°C to +125°C                            |
|                |   |           |          |           | <b>Access Time:</b>                            |
|                |   |           |          |           | 90 = 90 ns                                     |
|                |   |           |          |           | 10 = 100 ns                                    |
|                |   |           |          |           | 12 = 120 ns                                    |
|                |   |           |          |           | 15 = 150 ns                                    |
|                |   |           |          |           | <b>Device:</b>                                 |
|                |   |           |          |           | 27C512A 512K (64K x 8) CMOS EPROM              |

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