

# OKI Semiconductor

1A

## MSM27C1655CZ

524,288-Double Word x 32-Bit or 1,048,576-Word x 16-Bit

4-Double Word x 32-Bit or 8-Word x 16-Bit Page Mode One Time PROM

### DESCRIPTION

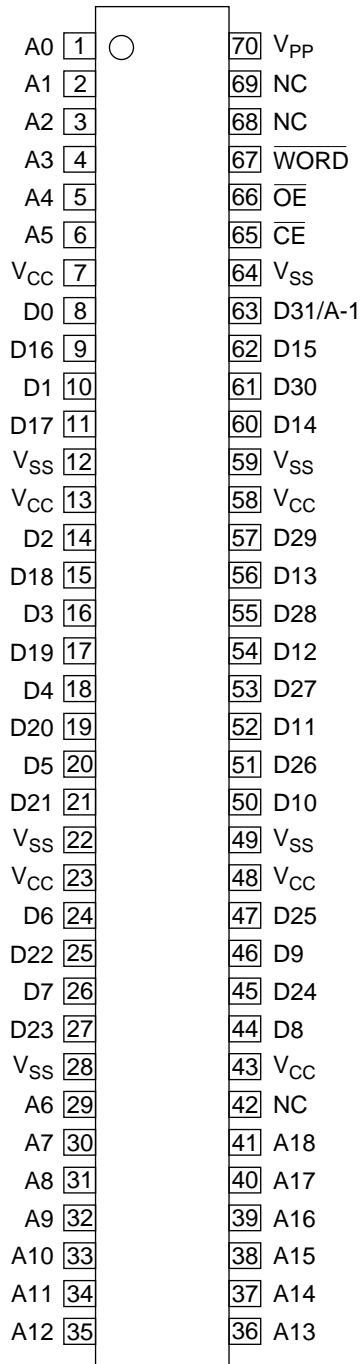
The MSM27C1655CZ is a 16Mbit electrically Programmable Read-Only Memory with page mode. Its configuration can be electrically switched between 524,288 double word x 32bit and 1,048,576 word x 16bit. The MSM27C1655CZ operates on a single +5V power supply and is TTL compatible. The MSM27C1655CZ provides Page mode which can greatly reduce the read access time. Since the MSM27C1655CZ operates asynchronously, external clocks are not required, making this device easy-to-use. The MSM27C1655CZ is suitable as large-capacity fixed memory for microcomputers and data terminals. It is manufactured using a CMOS double silicon gate technology and is offered in 70-pin SSOP, 70-pin TSOP packages.

### FEATURES

- 524,288 double word x 32bit / 1,048,576 word x 16bit electrically switchable configuration
- Single +5V power supply
- Access time 100ns  
Page mode access time 30ns
- Input / Output TTL compatible
- Three-state output
- Packages

70-pin plastic SSOP (SSOP70-P-500-0.80-K)  
70-pin plastic TSOP (TSOP1170-P-400-0.65-K)

**PIN CONFIGURATION (TOP VIEW)**

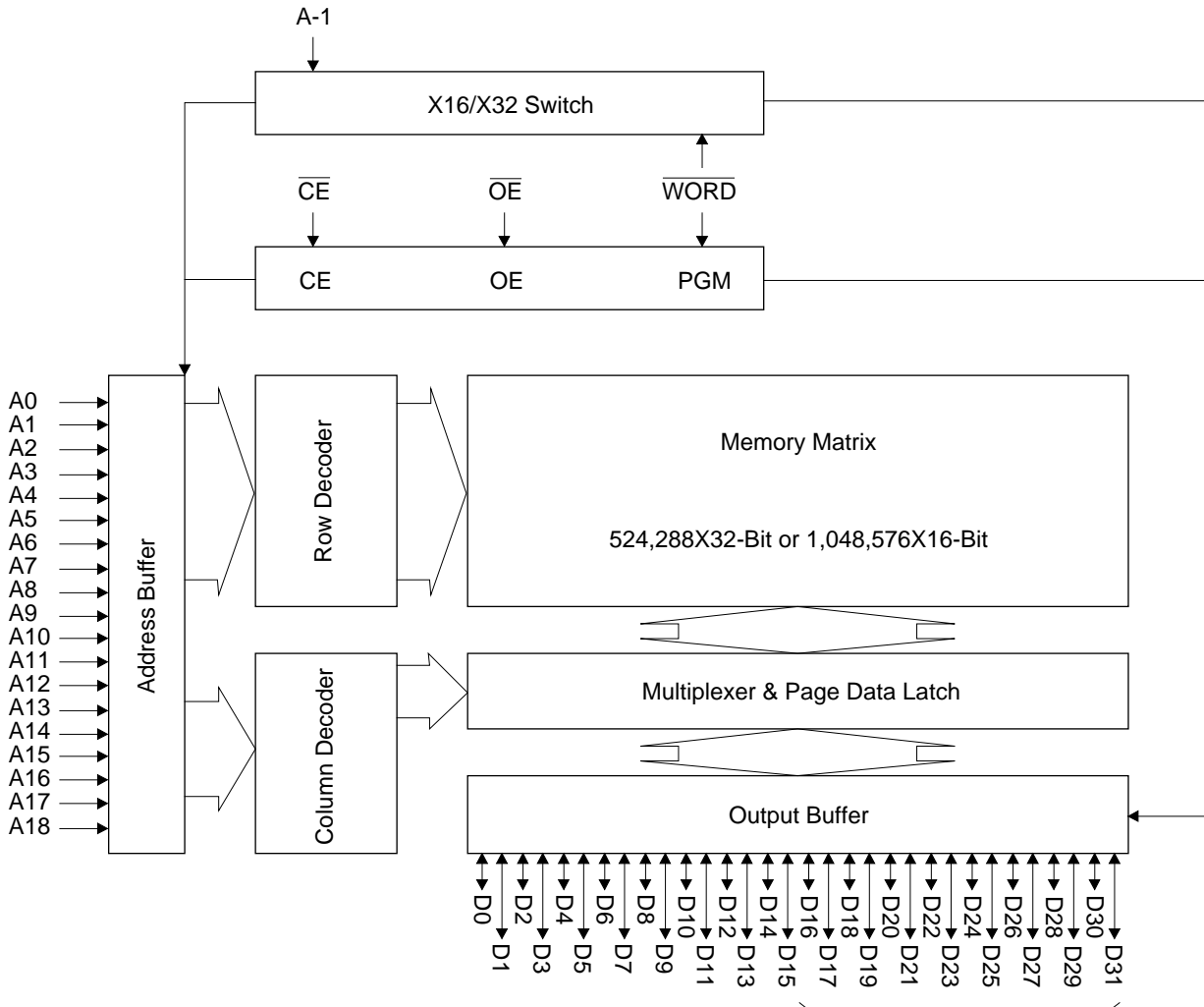


| PIN NAMES       | FUNCTIONS                    |
|-----------------|------------------------------|
| D31/A-1         | Data output / Address input  |
| A0 - A18        | Address input                |
| D0 - D30        | Data output                  |
| CE              | Chip enable                  |
| OE              | Output enable                |
| V <sub>CC</sub> | Power supply voltage         |
| V <sub>SS</sub> | GND                          |
| WORD            | Mode switch                  |
| V <sub>PP</sub> | Program power supply voltage |
| NC              | Non connection               |

70-pin SSOP , TSOP

**MSM27C1655CZ**

**BLOCK DIAGRAM**



In 16-bit output mode, these pins are three-stated and pin D31 functions as the A-1 address pin.

**FUNCTION TABLE**

| MODE            | CE | OE | WORD | V <sub>PP</sub> | V <sub>CC</sub> | D0 - D15         | D16 - D30 | D31/A-1 |
|-----------------|----|----|------|-----------------|-----------------|------------------|-----------|---------|
| READ (32-Bit)   | L  | L  | H    | *               | 4.5V to 5.5V    | D <sub>OUT</sub> |           |         |
| READ (16-Bit)   | L  | L  | L    |                 |                 | D <sub>OUT</sub> | Hi-Z      | L/H     |
| OUTPUT DISABLE  | L  | H  | H    |                 |                 | Hi-Z             |           | *       |
|                 |    |    | L    |                 |                 | Hi-Z             |           | *       |
| STAND-BY        | H  | *  | H    | Hi-Z            |                 | *                |           |         |
|                 |    |    | L    | Hi-Z            |                 | *                |           |         |
| PROGRAM         | L  | H  | L    | 11.5V           | 6.25V           | D <sub>IN</sub>  | Hi-Z      | L/H     |
| PROGRAM INHIBIT | H  | H  |      |                 |                 | Hi-Z             |           |         |
| PROGRAM VERIFY  | H  | L  |      |                 |                 | D <sub>OUT</sub> | Hi-Z      | L/H     |

\*: Don't Care

**ABSOLUTE MAXIMUM RATINGS**

| Parameter                        | Symbol    | Condition            | Value                  | Unit |
|----------------------------------|-----------|----------------------|------------------------|------|
| Operating temperature under bias | $T_{opr}$ | -                    | 0 to 70                | °C   |
| Storage temperature              | $T_{stg}$ |                      | -55 to 125             | °C   |
| Input voltage                    | $V_I$     | relative to $V_{SS}$ | -0.5 to $V_{CC} + 0.5$ | V    |
| Output voltage                   | $V_O$     |                      | -0.5 to $V_{CC} + 0.5$ | V    |
| Power supply voltage             | $V_{CC}$  |                      | -0.5 to 7              | V    |
| Program power supply voltage     | $V_{PP}$  |                      | -0.5 to 12.5           | V    |
| Power dissipation per package    | $P_D$     | -                    | 1.0                    | W    |

**RECOMMENDED OPERATING CONDITIONS FOR READ**

(Ta=0 to 70°C)

| Parameter                     | Symbol   | Condition          | Min. | Typ. | Max.         | Unit |
|-------------------------------|----------|--------------------|------|------|--------------|------|
| $V_{CC}$ power supply voltage | $V_{CC}$ | $V_{CC}=4.5V-5.5V$ | 4.5  | -    | 5.5          | V    |
| $V_{PP}$ power supply voltage | $V_{PP}$ |                    | -0.5 | -    | $V_{CC}+0.5$ | V    |
| Input "H" level               | $V_{IH}$ |                    | 2.2  | -    | $V_{CC}+0.5$ | V    |
| Input "L" level               | $V_{IL}$ |                    | -0.5 | -    | 0.8          | V    |

Voltage is relative to  $V_{SS}$

**MSM27C1655CZ**

**ELECTRICAL CHARACTERISTICS (Read operation)**

**DC Characteristics**

( $V_{CC}=5V\pm 0.5V$ ,  $T_a=0$  to  $70^\circ C$ )

| Parameter                               | Symbol    | Condition  | Min. | Typ. | Max.         | Unit    |
|---|-----------|--|------|------|--------------|---------|
| Input leakage current                   | $I_{LI}$  | $V_I=0$ to $V_{CC}$  | -    | -    | 10           | $\mu A$ |
| Output leakage current                  | $I_{LO}$  | $V_O=0$ to $V_{CC}$  | -    | -    | 10           | $\mu A$ |
| $V_{CC}$ power supply current (Standby) | $I_{CS1}$ | $\overline{CE}=V_{CC}$   | -    | -    | 50           | $\mu A$ |
|   | $I_{CS2}$ | $\overline{CE}=V_{IH}$   | -    | -    | 1            | mA      |
| $V_{CC}$ power supply current (Read)    | $I_{CCA}$ | $\overline{CE}=V_{IL}$ , $\overline{OE}=V_{IH}$<br>$t_c=100ns$ | -    | -    | 120          | mA      |
| $V_{PP}$ power supply current           | $I_{PP}$  | $V_{PP}=V_{CC}$  | -    | -    | 10           | $\mu A$ |
| Input "H" level                         | $V_{IH}$  | -  | 2.2  | -    | $V_{CC}+0.5$ | V       |
| Input "L" level                         | $V_{IL}$  | -  | -0.5 | -    | 0.8          | V       |
| Output "H" level                        | $V_{OH}$  | $I_{OH}=-400\mu A$   | 2.4  | -    | -            | V       |
| Output "L" level                        | $V_{OL}$  | $I_{OL}=2.1mA$   | -    | -    | 0.45         | V       |

Voltage is relative to  $V_{SS}$

**AC Characteristics**

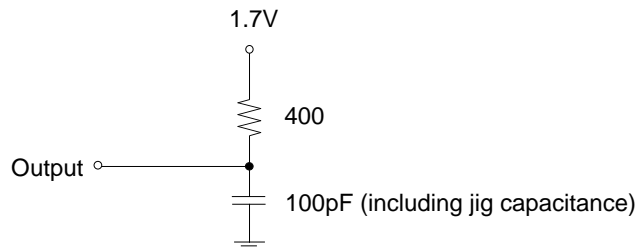
( $V_{CC}=5V\pm 0.5V$ ,  $T_a=0$  to  $70^\circ C$ )

| Parameter                   | Symbol     | Condition                            | Min. | Max. | Unit |
|-----------------------------|------------|--------------------------------------|------|------|------|
| Address access cycle time   | $T_C$      | -                                    | 100  | -    | ns   |
| Address access time         | $T_{ACC}$  | $\overline{CE}=\overline{OE}=V_{IL}$ | -    | 100  | ns   |
| Page set up time            | $T_{PSET}$ | NOTE(1)                              | 120  | -    | ns   |
| Page access cycle time      | $T_{PC}$   | -                                    | 30   | -    | ns   |
| Page access time            | $T_{PAC}$  | -                                    | -    | 30   | ns   |
| $\overline{CE}$ access time | $T_{CE}$   | $\overline{OE}=V_{IL}$               | -    | 100  | ns   |
| $\overline{OE}$ access time | $T_{OE}$   | $\overline{CE}=V_{IL}$               | -    | 30   | ns   |
| Output disable time         | $T_{CHZ}$  | $\overline{OE}=V_{IL}$               | 0    | 30   | ns   |
|                             | $T_{OHZ}$  | $\overline{CE}=V_{IL}$               | 0    | 25   | ns   |
| Output hold time            | $T_{OH}$   | $\overline{CE}=\overline{OE}=V_{IL}$ | 0    | -    | ns   |

NOTE(1)  $T_{PSET}$  is defined as the end of either  $\overline{CE}$  trailing edge or address transition in random access term until the first page address transition.

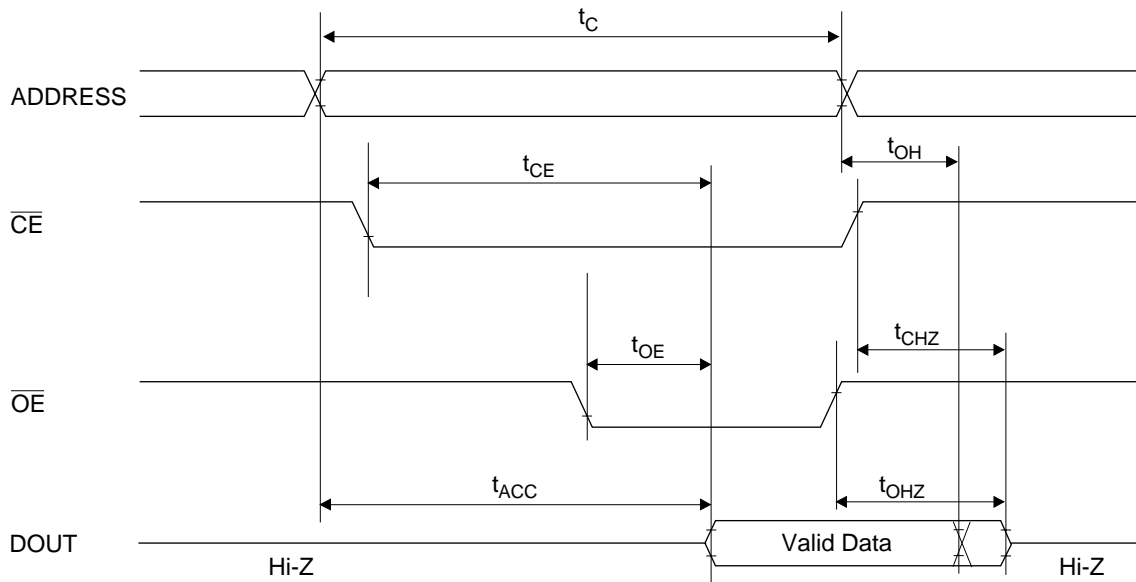
Measurement conditions

- Input signal level ----- 0V/3V
- Input timing reference level ----- 0.8V/2.0V
- Output load ----- 1TTL gate + 100pF
- Output timing reference level ----- 0.8V/2.0V

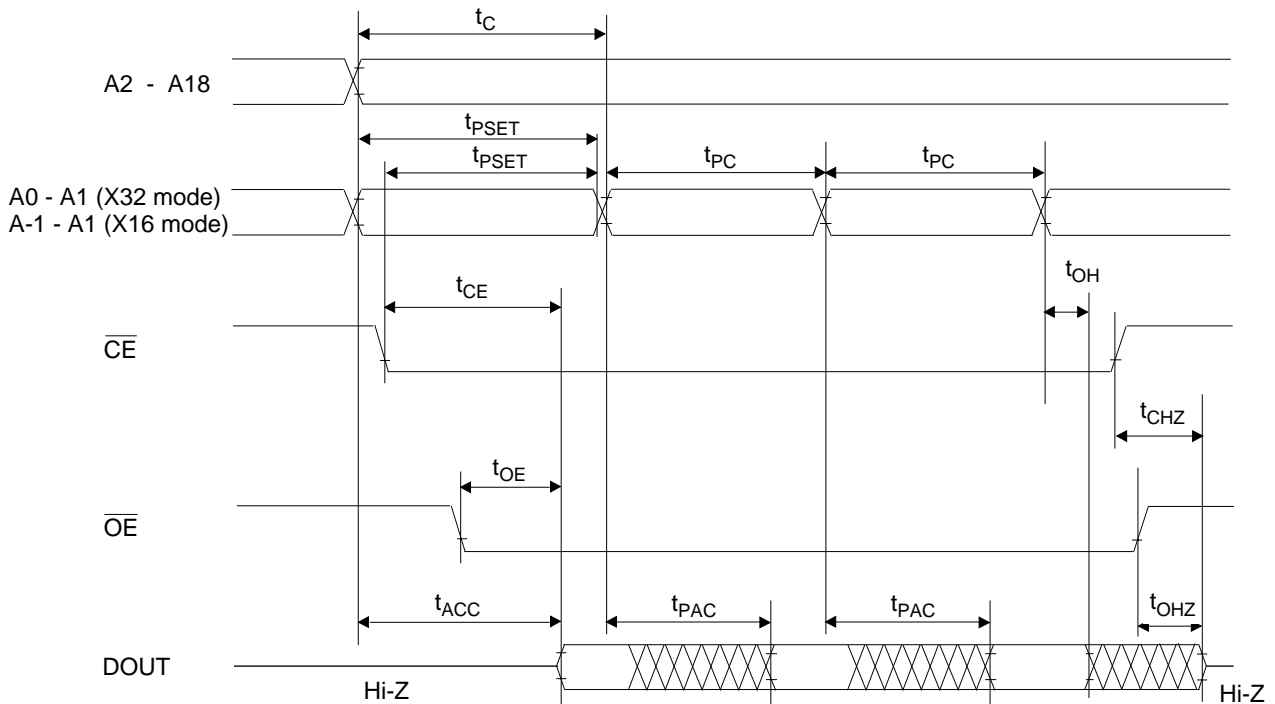


**TIMING CHART**

**NORMAL MODE READ CYCLE**



**PAGE MODE READ CYCLE**



## MSM27C1655CZ

**ELECTRICAL CHARACTERISTICS (Programming operation)****DC Characteristics**

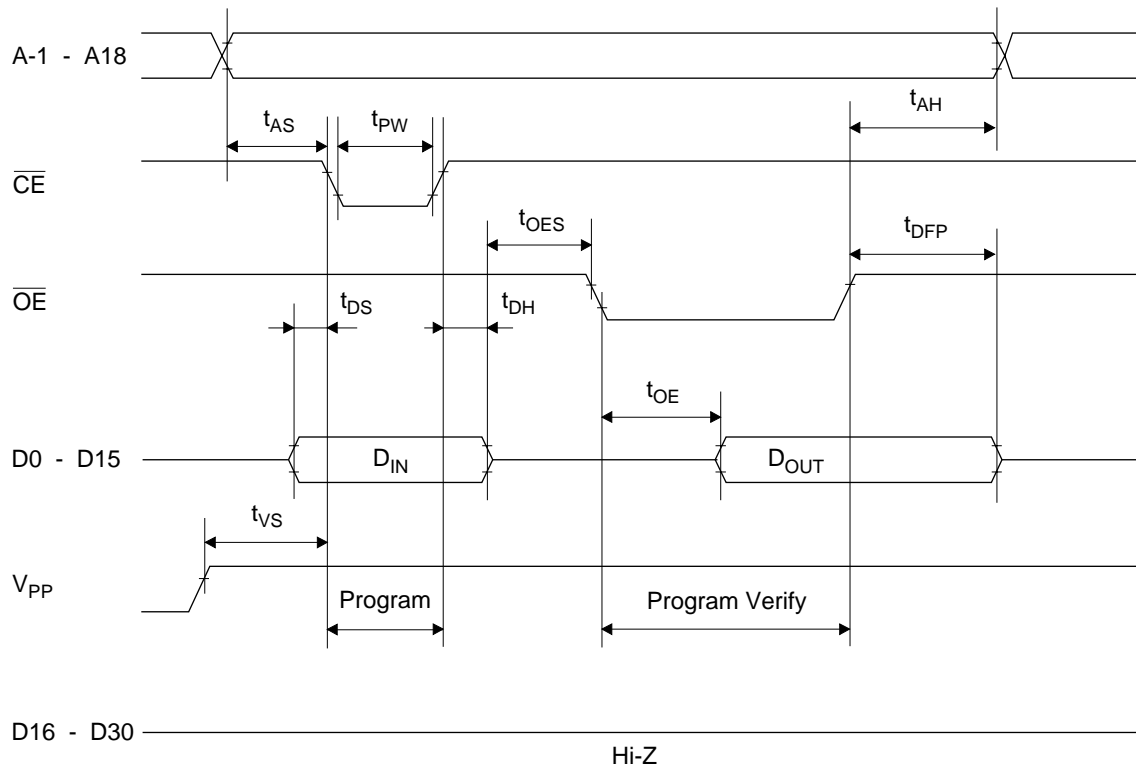
(Ta=25°C±5°C)

| Parameter                                      | Symbol           | Condition                             | Min.  | Typ. | Max.                 | Unit |
|--|------------------|---------------------------------------|-------|------|----------------------|------|
| Input leakage current                          | I <sub>LI</sub>  | V <sub>I</sub> =V <sub>CC</sub> +0.5V | -     | -    | 10                   | μA   |
| V <sub>PP</sub> power supply current (Program) | I <sub>PP2</sub> | $\overline{CE}=V_{IL}$                | -     | -    | 50                   | mA   |
| V <sub>CC</sub> power supply current           | I <sub>CC</sub>  | -                                     | -     | -    | 100                  | mA   |
| Input "H" level                                | V <sub>IH</sub>  | -                                     | 2.2   | -    | V <sub>CC</sub> +0.5 | V    |
| Input "L" level                                | V <sub>IL</sub>  | -                                     | -0.5  | -    | 0.8                  | V    |
| Output "H" level                               | V <sub>OH</sub>  | I <sub>OH</sub> =-400μA               | 2.4   | -    | -                    | V    |
| Output "L" level                               | V <sub>OL</sub>  | I <sub>OL</sub> =2.1mA                | -     | -    | 0.45                 | V    |
| Program voltage                                | V <sub>PP</sub>  | -                                     | 11.25 | 11.5 | 11.75                | V    |
| V <sub>CC</sub> power supply voltage           | V <sub>CC</sub>  | -                                     | 6.0   | 6.25 | 6.5                  | V    |

Voltage is relative to V<sub>SS</sub>**AC Characteristics**(V<sub>CC</sub>=6.25V±0.25V, V<sub>pp</sub>=11.5V±0.25V, Ta=25°C±5°C)

| Parameter                               | Symbol           | Condition | Min. | Typ. | Max. | Unit |
|---|------------------|-----------|------|------|------|------|
| Address set-up time                     | T <sub>AS</sub>  | -         | 2    | -    | -    | μs   |
| $\overline{OE}$ set-up time             | T <sub>OES</sub> | -         | 2    | -    | -    | μs   |
| Data set-up time                        | T <sub>DS</sub>  | -         | 2    | -    | -    | μs   |
| Address hold time                       | T <sub>AH</sub>  | -         | 0    | -    | -    | μs   |
| Data hold time                          | T <sub>DH</sub>  | -         | 2    | -    | -    | μs   |
| Output float delay from $\overline{OE}$ | T <sub>DFP</sub> | -         | 0    | -    | 130  | ns   |
| V <sub>PP</sub> voltage set-up time     | T <sub>VS</sub>  | -         | 2    | -    | -    | μs   |
| Program pulse width                     | T <sub>PW</sub>  | -         | 23   | 25   | 27   | μs   |
| Data valid from $\overline{OE}$         | T <sub>OE</sub>  | -         | -    | -    | 150  | ns   |

### Programming Waveform



### PIN Capacitance

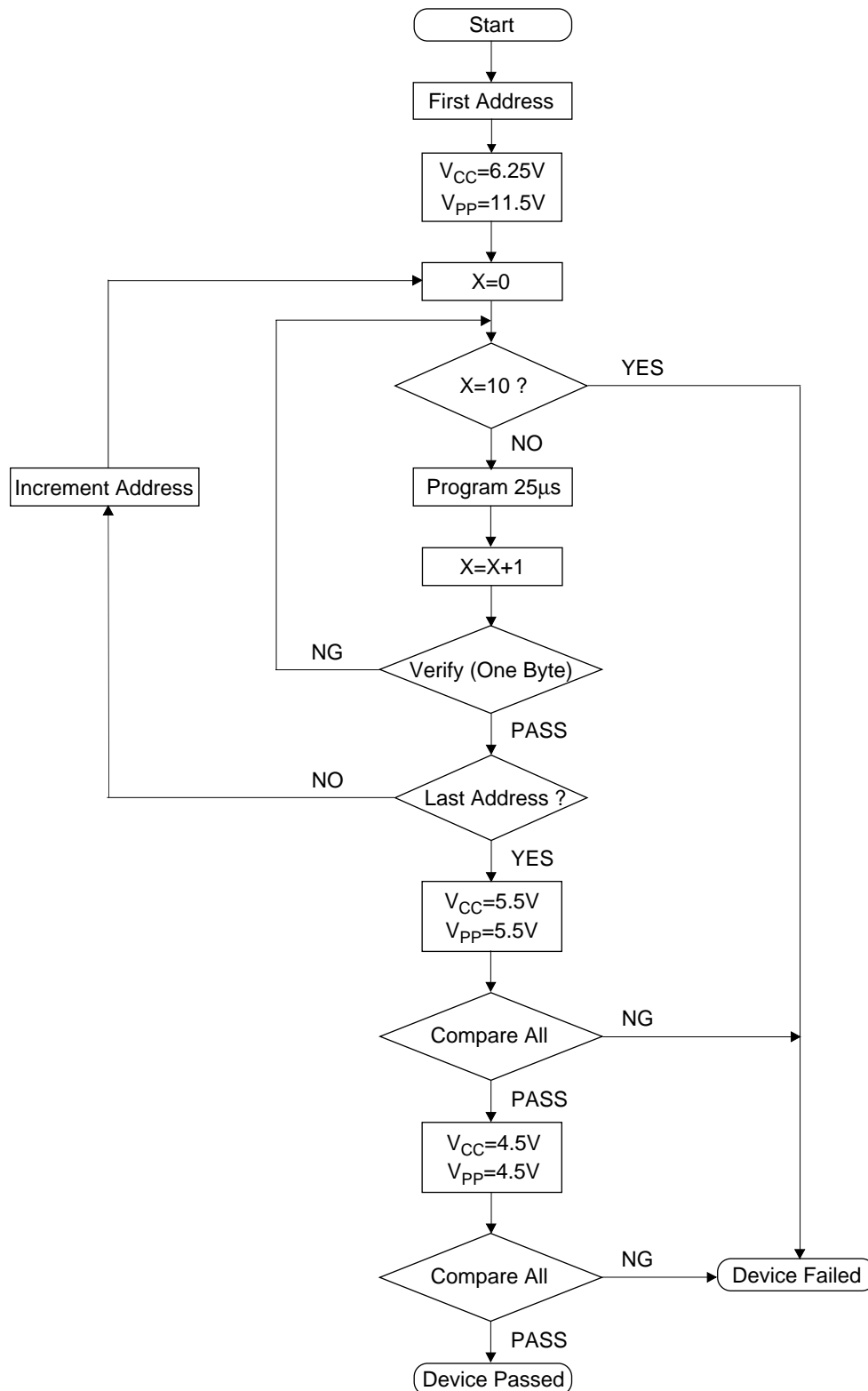
( $V_{CC}=5V, T_a=25^\circ C, f=1MHz$ )

| Parameter | Symbol    | Condition | Min. | Typ. | Max. | Unit |
|-----------|-----------|-----------|------|------|------|------|
| Input     | $C_{IN1}$ | $V_I=0V$  | -    | -    | 12   | pF   |
| $V_{PP}$  | $C_{IN2}$ |           | -    | -    | 60   |      |
| Output    | $C_{OUT}$ | $V_O=0V$  | -    | -    | 15   |      |

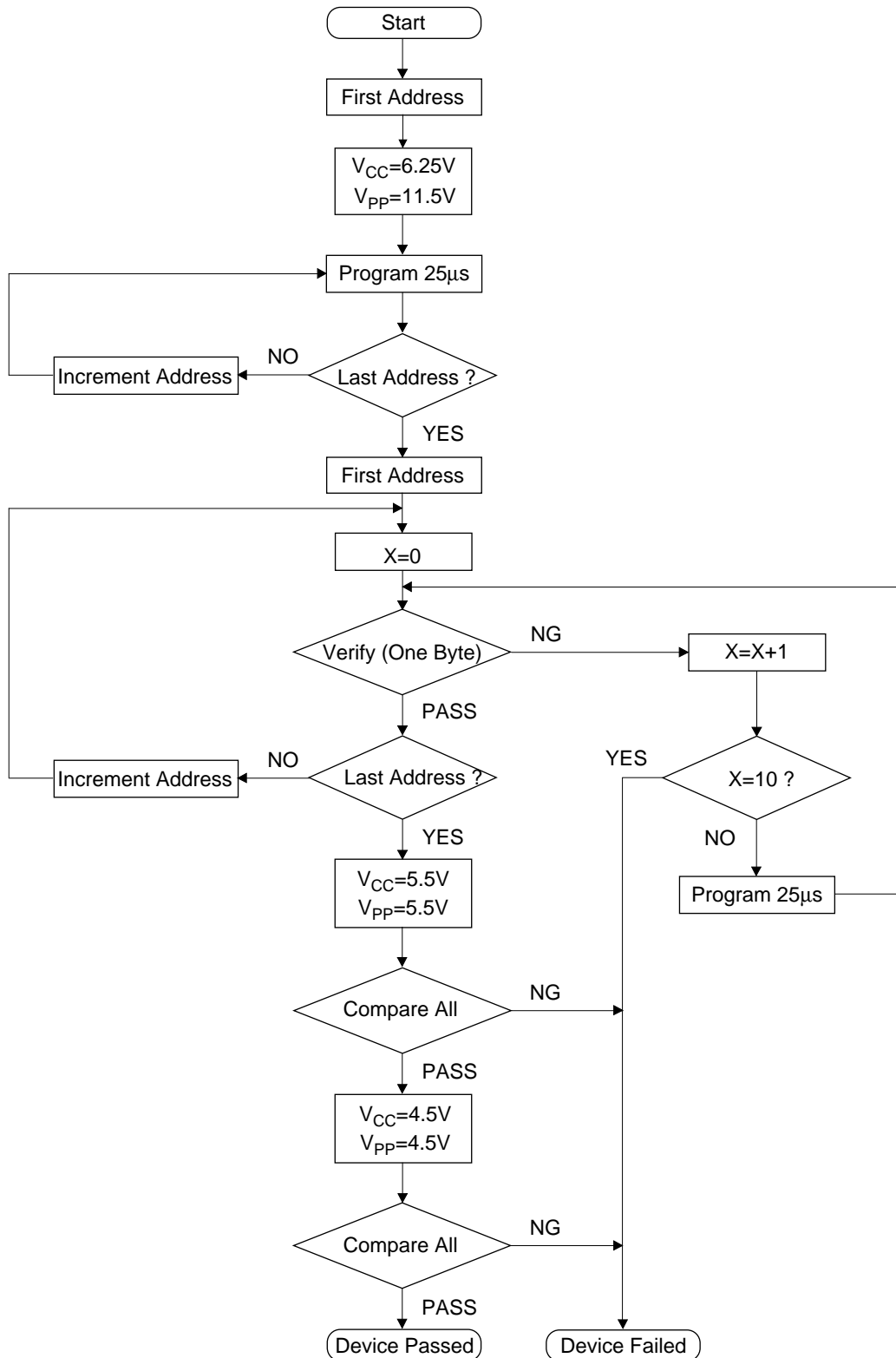


MSM27C1655CZ

High Speed Programming Algorithm ( I )



High Speed Programming Algorithm ( II )



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