

# OKI Semiconductor

**FEDR27V1652E-01-02**

Issue Date: Jan. 15, 2004

## MR27V1652E

**1,048,576-Word x 16-Bit or 2,097,152-Word x 8-Bit  
8-Word x 16-Bit or 16-Word x 8-Bit Page Mode One Time PROM**

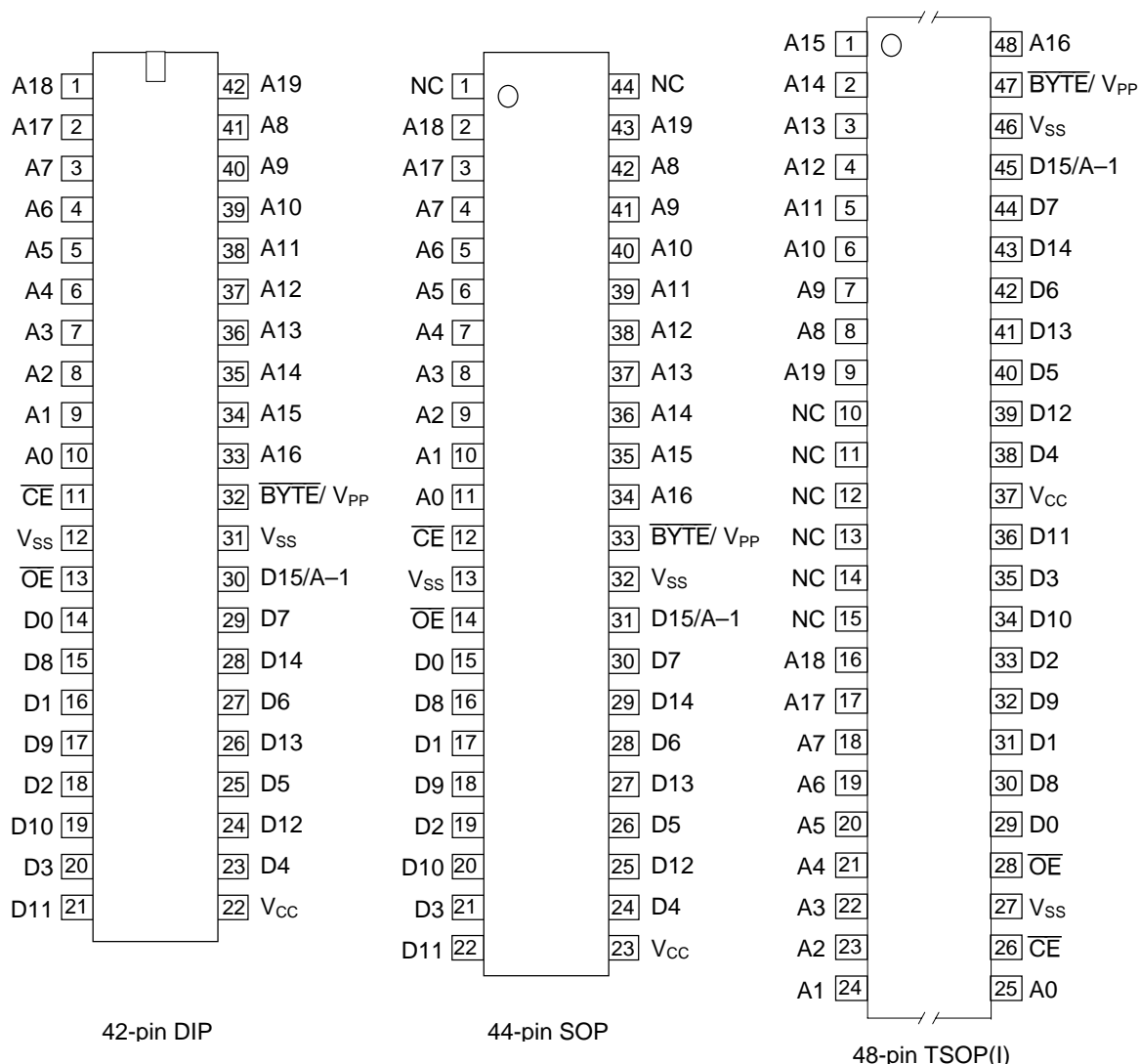
### GENERAL DESCRIPTION

The MR27V1602E is a 16 Mbit electrically One Time Programmable Read-Only Memory with page mode. Its configuration can be electrically switched between 1,048,576-word × 16-bit and 2,097,152-word × 8-bit by the state of the  $\overline{\text{BYTE}}$  pin. The MR27V1652E supports high speed asynchronous read operation using a single 3.3V power supply.

### FEATURES

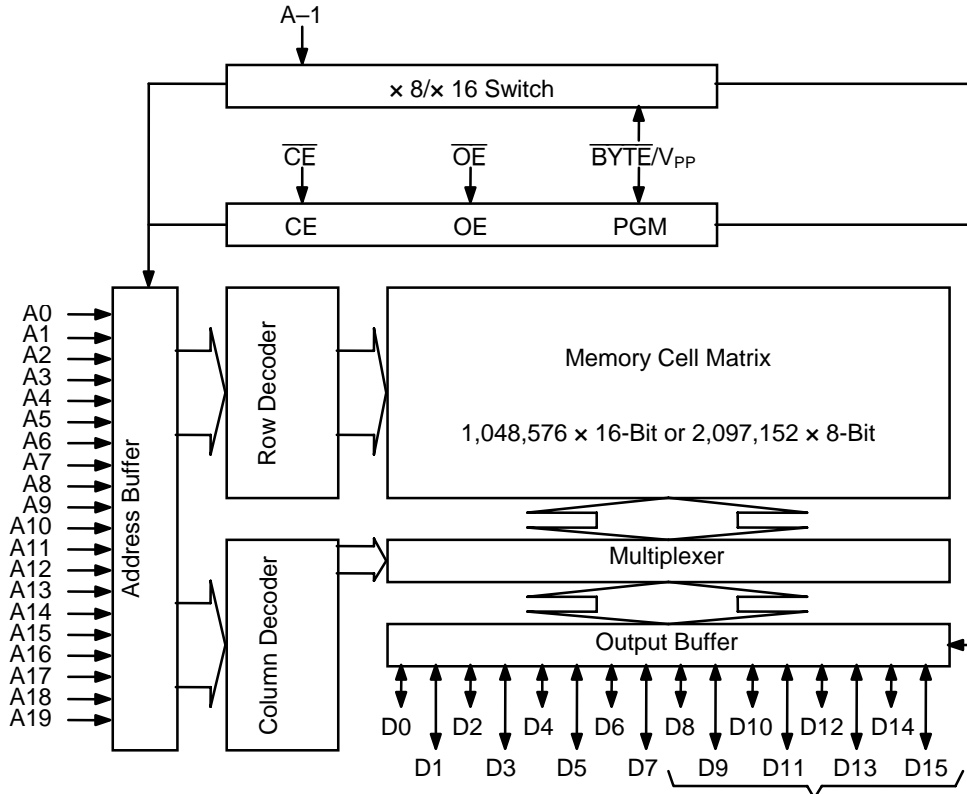
- 1,048,576-word × 16-bit/2,097,152-word × 8-bit electrically switchable configuration
- Page size of 8-word x 16-Bit or 16-word x 8-Bit
- +3.3 V power supply
- Access time
  - Random access mode 100 ns MAX
  - Page access mode 30 ns MAX
- Operating current 100 mA MAX
- Standby current 50  $\mu$ A MAX
- Input/Output TTL compatible
- Tri-state output
- Packages:
  - 42-pin plastic DIP (DIP42-P-600-2.54) (MR27V1652ERA)
  - 44-pin plastic SOP (SOP44-P-600-1.27-K) (MR27V1652EMA)
  - 48-pin plastic TSOP (TSOP I 48-P-1220-0.50-1K) (MR27V1652ETN)

## PIN CONFIGURATION (TOP VIEW)



| Pin name                 | Functions                                |
|--------------------------|--|
| D15/A-1                  | Data output/Address input                |
| A0 to A19                | Address input                            |
| D0 to D14                | Data output                              |
| $\overline{CE}$          | Chip enable                              |
| $\overline{OE}$          | Output enable                            |
| $\overline{BYTE}/V_{PP}$ | Mode switch/Program power supply voltage |
| $V_{CC}$                 | Power supply voltage                     |
| $V_{SS}$                 | GND                                      |
| NC                       | Non connection                           |

**BLOCK DIAGRAM**



In 8-bit output mode, these pins are placed in a high-Z state and pin D15 functions as the A-1 address pin.

**FUNCTION TABLE**

| Mode            | $\overline{CE}$ | $\overline{OE}$ | $\overline{BYTE}/V_{PP}$ | $V_{CC}$ | D0 to D7         | D8 to D14 | D15/A-1 |
|-----------------|-----------------|-----------------|--------------------------|----------|------------------|-----------|---------|
| Read (16-Bit)   | L               | L               | H                        | 3.3 V    | D <sub>OUT</sub> |           |         |
| Read (8-Bit)    | L               | L               | L                        |          | D <sub>OUT</sub> | Hi-Z      | L/H     |
| Output disable  | L               | H               | H                        |          | Hi-Z             |           | *       |
|                 |                 |                 | L                        |          | Hi-Z             |           | *       |
| Standby         | H               | *               | H                        | Hi-Z     |                  | *         |         |
|                 |                 |                 | L                        | Hi-Z     |                  | *         |         |
| Program         | L               | H               | 9.75 V                   | 4.0 V    | D <sub>IN</sub>  |           |         |
| Program inhibit | H               | H               |                          |          | Hi-Z             |           |         |
| Program verify  | H               | L               |                          |          | D <sub>OUT</sub> |           |         |

\*: Don't Care (H or L)

**ABSOLUTE MAXIMUM RATINGS**

| Parameter                        | Symbol           | Condition                   | Value                        | Unit |
|----------------------------------|------------------|-----------------------------|------------------------------|------|
| Operating temperature under bias | T <sub>a</sub>   | —                           | 0 to 70                      | °C   |
| Storage temperature              | T <sub>stg</sub> |                             | -55 to 125                   | °C   |
| Input voltage                    | V <sub>I</sub>   | relative to V <sub>SS</sub> | -0.5 to V <sub>CC</sub> +0.5 | V    |
| Output voltage                   | V <sub>O</sub>   |                             | -0.5 to V <sub>CC</sub> +0.5 | V    |
| Power supply voltage             | V <sub>CC</sub>  |                             | -0.5 to 5                    | V    |
| Program power supply voltage     | V <sub>PP</sub>  |                             | -0.5 to 11.5                 | V    |
| Power dissipation per package    | P <sub>D</sub>   | —                           | 1.0                          | W    |

**RECOMMENDED OPERATING CONDITIONS**(T<sub>a</sub> = 0 to 70°C)

| Parameter                            | Symbol          | Condition                      | Min.   | Typ. | Max.                  | Unit |
|--------------------------------------|-----------------|--------------------------------|--------|------|-----------------------|------|
| V <sub>CC</sub> power supply voltage | V <sub>CC</sub> | V <sub>CC</sub> = 3.0 to 3.6 V | 3.0    | —    | 3.6                   | V    |
| V <sub>PP</sub> power supply voltage | V <sub>PP</sub> |                                | -0.5   | —    | V <sub>CC</sub> +0.5  | V    |
| 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** | —    | 0.6                   | V    |

Voltage is relative to V<sub>SS</sub>.\* : V<sub>CC</sub>+1.5V(Max.) when pulse width of overshoot is less than 10ns.

\*\* : -1.5V(Min.) when pulse width of undershoot is less than 10ns.

**ELECTRICAL CHARACTERISTICS****DC Characteristics**(V<sub>CC</sub> = 3.3 V ± 0.3 V, T<sub>a</sub> = 0 to 70°C)

| parameter   | Symbol            | Condition   | Min.   | Typ. | Max.                  | Unit |
|---|-------------------|---|--------|------|-----------------------|------|
| Input leakage current                             | I <sub>LI</sub>   | V <sub>I</sub> = 0 to V <sub>CC</sub>                                       | —      | —    | 10                    | μA   |
| Output leakage current                            | I <sub>LO</sub>   | V <sub>O</sub> = 0 to V <sub>CC</sub>                                       | —      | —    | 10                    | μA   |
| V <sub>CC</sub> power supply current<br>(Standby) | I <sub>CCSC</sub> | $\overline{CE} = V_{CC}$  | —      | —    | 50                    | μA   |
|   | I <sub>CCST</sub> | $\overline{CE} = V_{IH}$  | —      | —    | 1                     | mA   |
| V <sub>CC</sub> power supply current<br>(Read)    | I <sub>CCA</sub>  | $\overline{CE} = V_{IL}, \overline{OE} = V_{IH}$<br>t <sub>c</sub> = 100 ns | —      | —    | 100                   | mA   |
| V <sub>PP</sub> power supply current              | I <sub>PP</sub>   | V <sub>PP</sub> = V <sub>CC</sub>   | —      | —    | 10                    | μA   |
| 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** | —    | 0.6                   | V    |
| Output "H" level                                  | V <sub>OH</sub>   | I <sub>OH</sub> = -400 μA   | 2.4    | —    | —                     | V    |
| Output "L" level                                  | V <sub>OL</sub>   | I <sub>OL</sub> = 2.1 mA  | —      | —    | 0.4                   | V    |

Voltage is relative to V<sub>SS</sub>.\* : V<sub>CC</sub>+1.5V(Max.) when pulse width of overshoot is less than 10ns.

\*\* : -1.5V(Min.) when pulse width of undershoot is less than 10ns.

**AC Characteristics**(V<sub>CC</sub> = 3.3 V ± 0.3 V, T<sub>a</sub> = 0 to 70°C)

| Parameter                   | Symbol           | Condition                                | Min. | Max. | Unit |
|-----------------------------|------------------|--|------|------|------|
| Address cycle time          | t <sub>c</sub>   | —  | 100  | —    | ns   |
| Address access time         | t <sub>ACC</sub> | $\overline{CE} = \overline{OE} = V_{IL}$ | —    | 100  | ns   |
| Page cycle time             | t <sub>PC</sub>  | —  | 30   | —    | ns   |
| Page access time            | t <sub>PAC</sub> | —  | —    | 30   | ns   |
| $\overline{CE}$ access time | t <sub>CE</sub>  | $\overline{OE} = V_{IL}$                 | —    | 100  | ns   |
| $\overline{OE}$ access time | t <sub>OE</sub>  | $\overline{CE} = V_{IL}$                 | —    | 30   | ns   |
| Output disable time         | t <sub>CHZ</sub> | $\overline{OE} = V_{IL}$                 | 0    | 30   | ns   |
|                             | t <sub>OHZ</sub> | $\overline{CE} = V_{IL}$                 | 0    | 25   | ns   |
| Output hold time            | t <sub>OH</sub>  | $\overline{CE} = \overline{OE} = V_{IL}$ | 0    | —    | ns   |

**Measurement conditions**

Input signal level----- 0 V/3 V

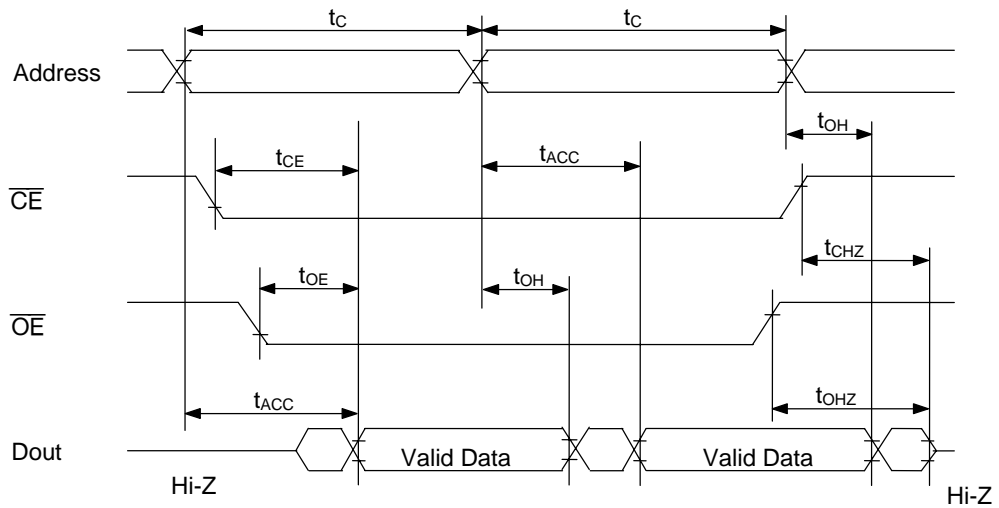
Input timing reference level ----- 0.8 V/2.0 V

Output load ----- 100 pF

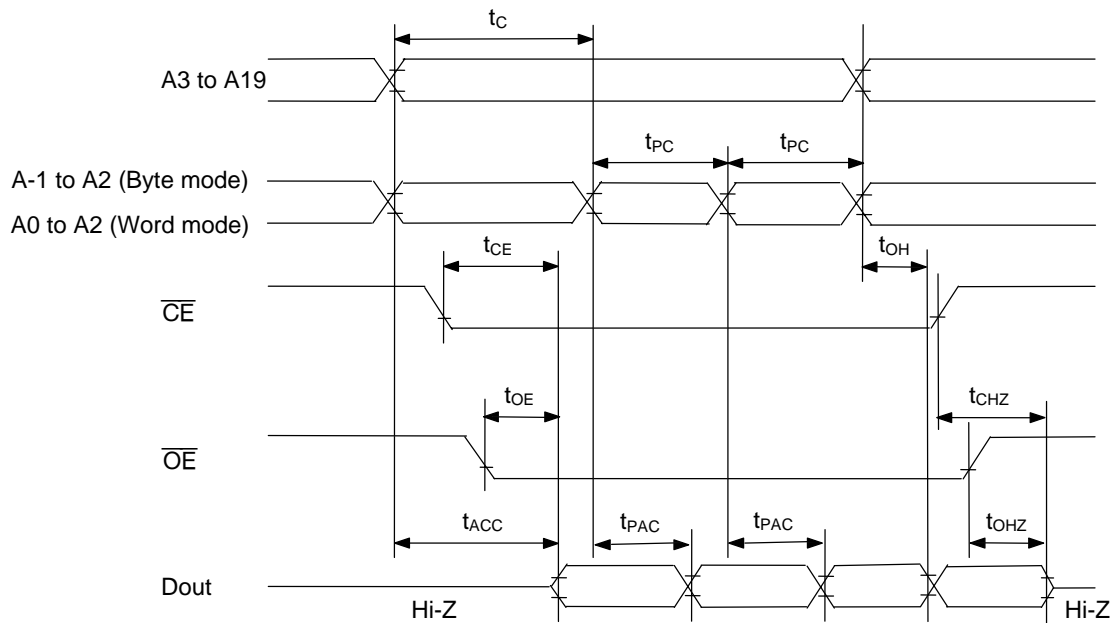
Output timing reference level----- 0.8 V/2.0 V

**TIMING CHART (READ CYCLE)**

**Random Access Mode Read Cycle**



**Page Access Mode Read Cycle**



**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> +0.5 V | —    | —    | 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>  | —                                       | —    | —    | 80                   | mA   |
| Input "H" level                                | V <sub>IH</sub>  | —                                       | 3.0  | —    | 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> = -400 μA               | 2.4  | —    | —                    | V    |
| Output "L" level                               | V <sub>OL</sub>  | I <sub>OL</sub> = 2.1 mA                | —    | —    | 0.45                 | V    |
| Program voltage                                | V <sub>PP</sub>  | —                                       | 9.5  | 9.75 | 10.0                 | V    |
| V <sub>CC</sub> power supply voltage           | V <sub>CC</sub>  | —                                       | 3.9  | 4.0  | 4.1                  | V    |

Voltage is relative to V<sub>SS</sub>.**AC Characteristics**(V<sub>CC</sub> = 4.0 V ± 0.1 V,  $\overline{BYTE}/V_{PP}$  = 9.75 V ± 0.25 V, Ta = 25°C ± 5°C)

| Parameter                                    | Symbol           | Condition | Min. | Typ. | Max. | Unit |
|--|------------------|-----------|------|------|------|------|
| Address set-up time                          | t <sub>AS</sub>  | —         | 100  | —    | —    | ns   |
| $\overline{OE}$ set-up time                  | t <sub>oES</sub> | —         | 2    | —    | —    | μs   |
| Data set-up time                             | t <sub>DS</sub>  | —         | 100  | —    | —    | ns   |
| Address hold time                            | t <sub>AH</sub>  | —         | 2    | —    | —    | μs   |
| Data hold time                               | t <sub>DH</sub>  | —         | 100  | —    | —    | ns   |
| Output float delay time from $\overline{OE}$ | t <sub>OHZ</sub> | —         | 0    | —    | 100  | ns   |
| V <sub>PP</sub> voltage set-up time          | t <sub>VS</sub>  | —         | 2    | —    | —    | μs   |
| Program pulse width                          | t <sub>PW</sub>  | —         | 9    | 10   | 11   | μs   |
| Data valid from $\overline{OE}$              | t <sub>OE</sub>  | —         | —    | —    | 100  | ns   |
| Address hold from $\overline{OE}$ high       | t <sub>AOH</sub> | —         | 0    | —    | —    | ns   |

**Pin Check Function**

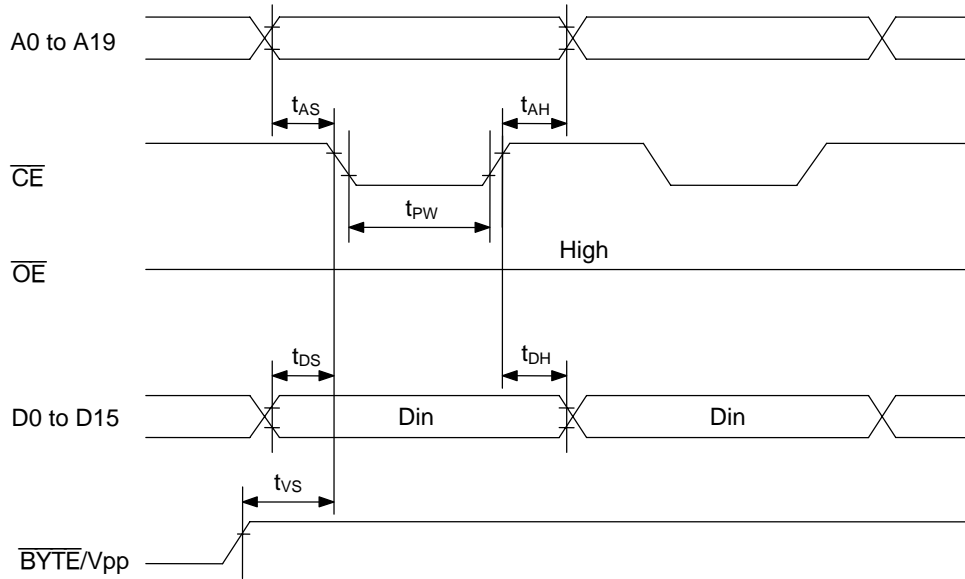
Pin Check Function is to check contact between each device-pin and each socket-lead with EPROM programmer. Setting up address as following condition call the preprogrammed codes on device outputs.

(V<sub>CC</sub> = 3.3 V ± 0.3 V,  $\overline{CE} = V_{IL}$ ,  $\overline{OE} = V_{IL}$ ,  $\overline{BYTE}/V_{PP} = V_{IH}$ , Ta = 25°C ± 5°C)

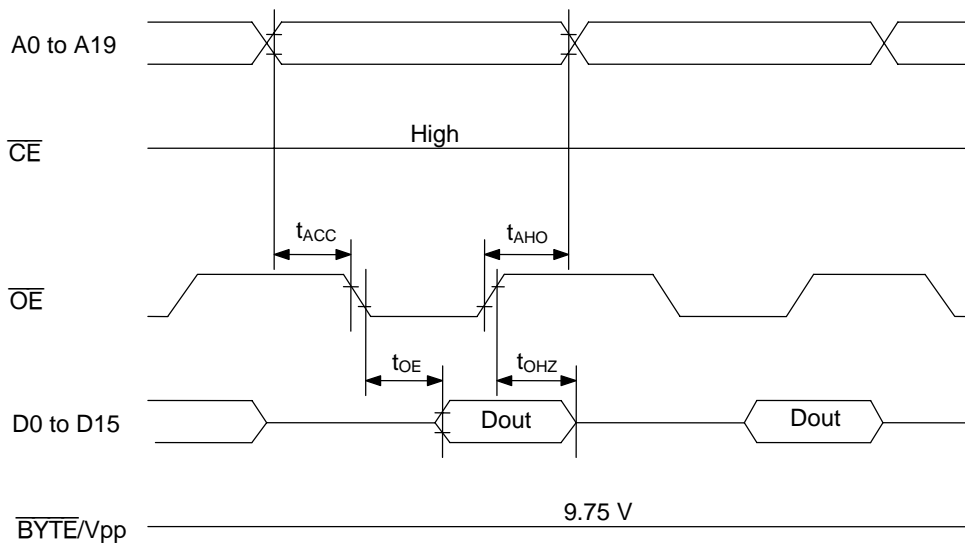
| A0               | A1 | A2 | A3 | A4 | A5 | A6 | A7 | A8 | A9  | A10 | A11 | A12 | A13 | A14 | A15 | A16 | A17 | A18 | A19  | DATA |
|------------------|----|----|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| 0                | 1  | 0  | 1  | 0  | 1  | 0  | 1  | 0  | VH* | 0   | 1   | 0   | 1   | 0   | 1   | 0   | 0   | 1   | 1    | FF00 |
| 1                | 0  | 1  | 0  | 1  | 0  | 1  | 0  | 1  | VH* | 1   | 0   | 1   | 0   | 1   | 0   | 1   | 1   | 0   | 0    | 00FF |
| Other conditions |    |    |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     | FFFF |      |

\*: VH = 8 V ± 0.25 V

**Consecutive Programming Waveforms**

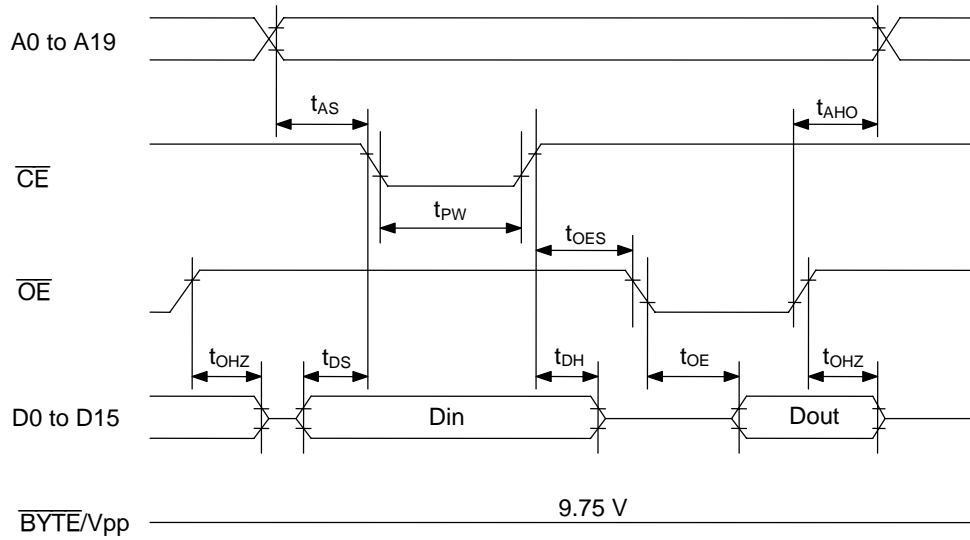


**Consecutive Program Verify Waveforms**





**Program and Program Verify Cycle Waveforms**



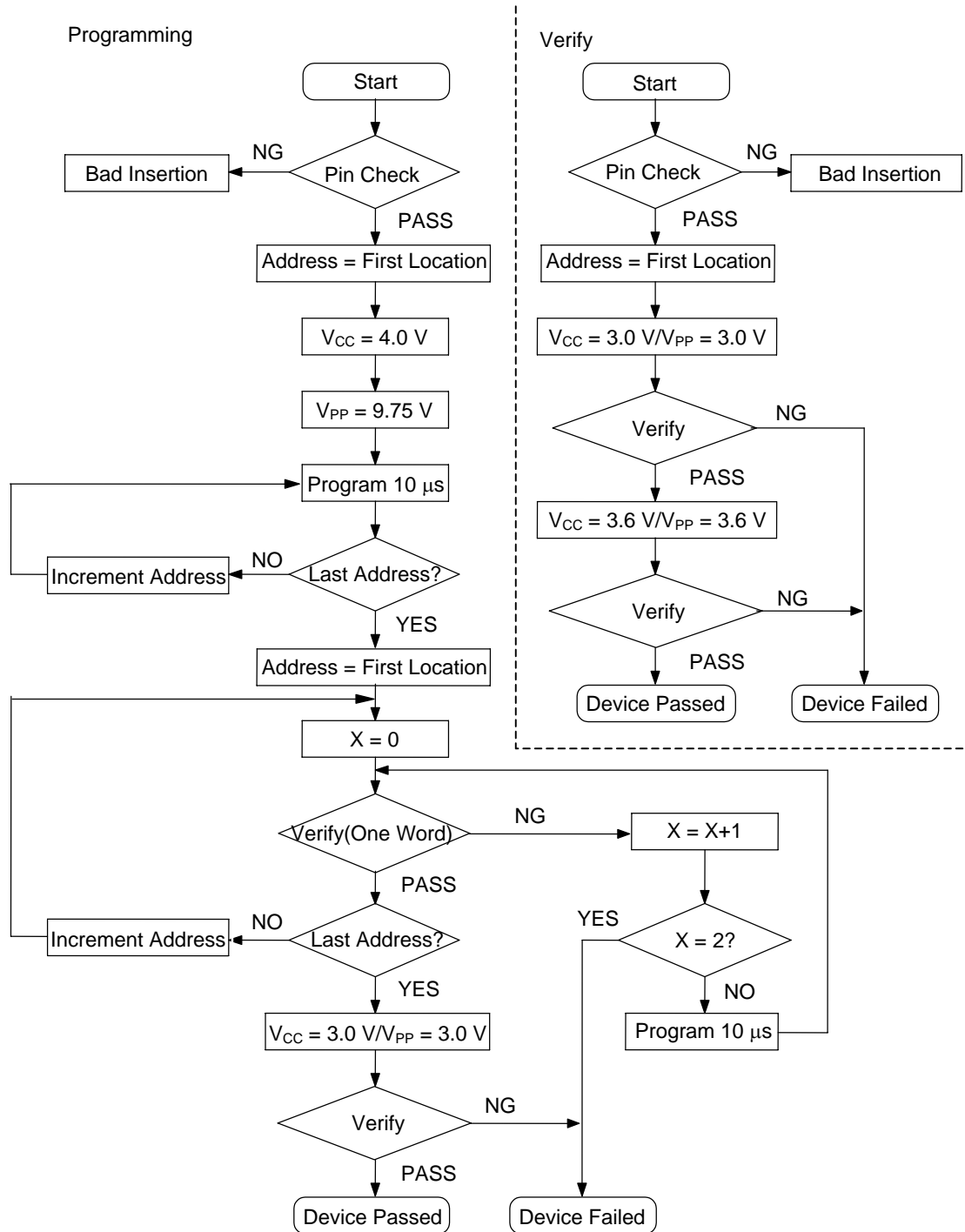
**Pin Capacitance**

( $V_{CC} = 3.3\text{ V}$ ,  $T_a = 25^\circ\text{C}$ ,  $f = 1\text{ MHz}$ )

| Parameter                       | Symbol    | Condition          | Min. | Typ. | Max.   | Unit |
|---------------------------------|-----------|--------------------|------|------|--------|------|
| Input                           | $C_{IN1}$ | $V_I = 0\text{ V}$ | —    | —    | 10     | pF   |
| $\overline{\text{BYTE}}/V_{PP}$ | $C_{IN2}$ |                    | —    | —    | 120    |      |
| Output                          | $C_{OUT}$ | $V_O = 0\text{ V}$ | —    | —    | 10(12) |      |

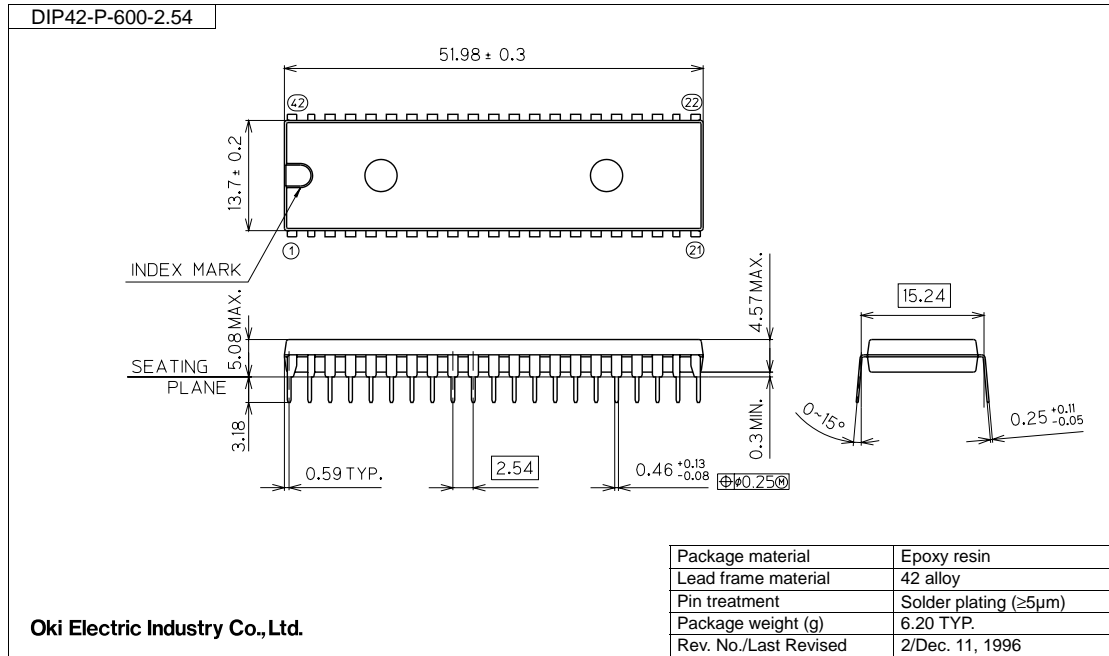
( ):DIP only

Programming/Verify Flow Chart

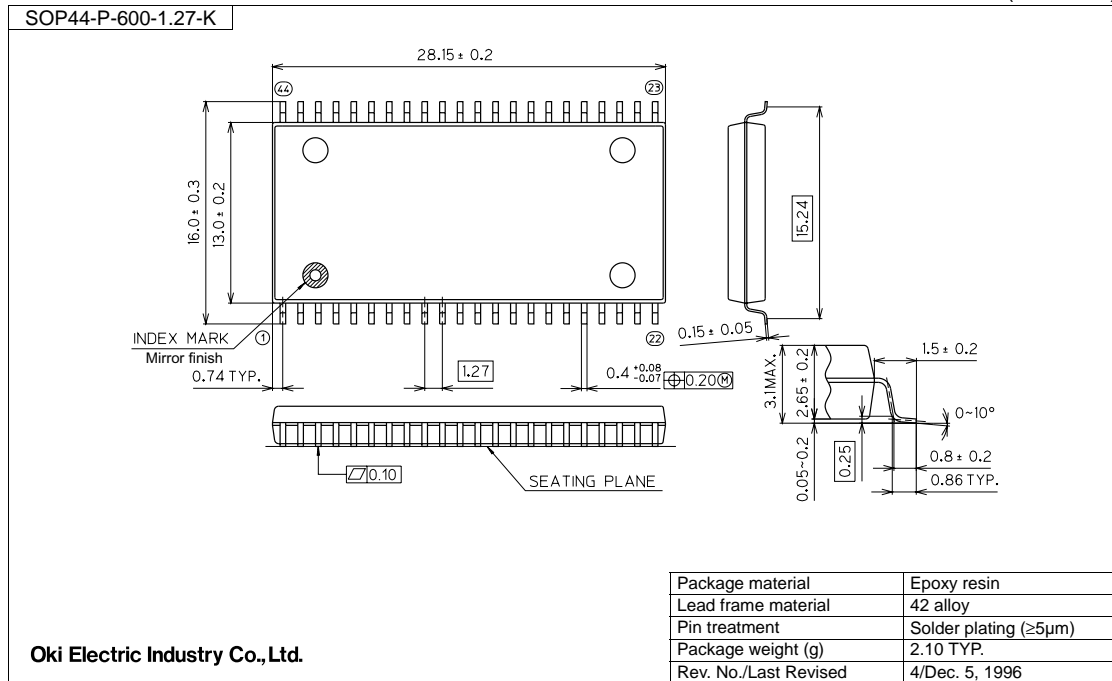


**PACKAGE DIMENSIONS**

(Unit: mm)



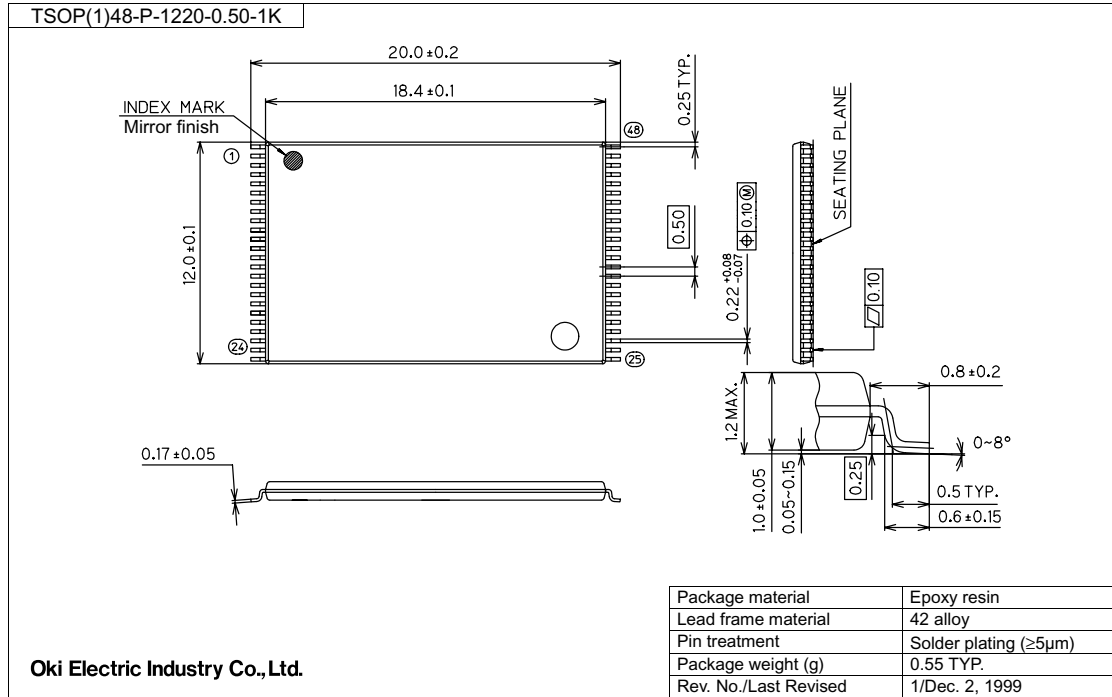
(Unit: mm)



Notes for Mounting the Surface Mount Type Package

The surface mount type packages are very susceptible to heat in reflow mounting and humidity absorbed in storage. Therefore, before you perform reflow mounting, contact Oki's responsible sales person for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times).

(Unit: mm)



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**REVISION HISTORY**

| Document No.       | Date          | Page             |                 | Description                   |
|--------------------|---------------|------------------|-----------------|-------------------------------|
|                    |               | Previous Edition | Current Edition |                               |
| FEDR27V1652E-01-01 | Oct. 2000     | –                | –               | Final edition 1               |
| FEDR27V1652E-01-02 | Jan. 15, 2004 | 1, 2             | 1, 2, 13        | Added 48-pin TSOP(I) package. |

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