

CMOS 4-BIT MICROCONTROLLER

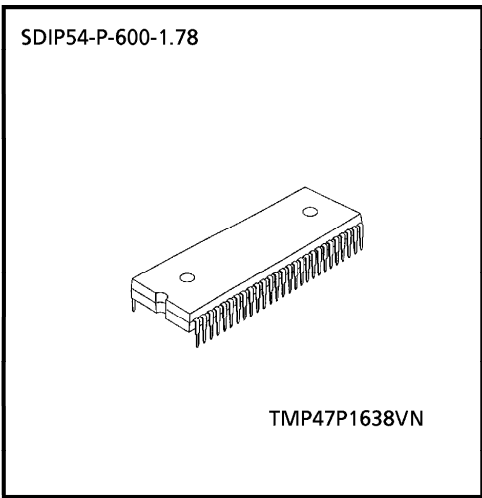
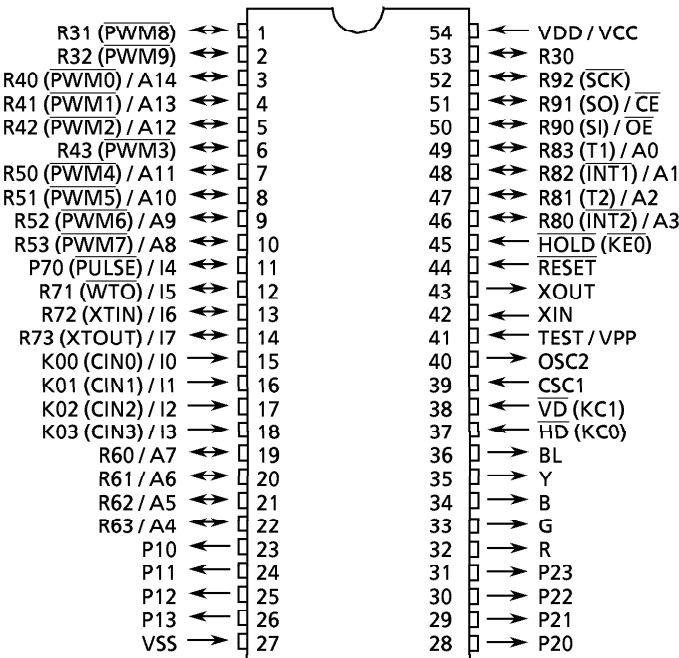
TMP47P1638VN

The 47P1638V is the OTP microcontroller with 128kbits PROM. For program operation, the programming is achieved by using with EPROM programmer (TMM27256AD type) and adaptor socket. The function of this device is exactly same as the 47C1238A/1638A.

| PART No.     | ROM                  | RAM         | PACKAGE           | ADAPTOR SOCKET |
|--------------|----------------------|-------------|-------------------|----------------|
| TMP47P1638VN | OTP<br>16384 × 8-bit | 512 × 4-bit | SDIP54-P-600-1.78 | BM1169         |

PIN ASSIGNMENT (TOP VIEW)

SDIP54-P-600-1.78



## PIN FUNCTION

The 47P1638V has MCU mode and PROM mode.

## (1) MCU mode

The 47C1238A and the 47C1638A are pin compatible (TEST pin for out-going test. Be fixed to low level).

## (2) PROM mode

| PIN NAME                                     | Input / Output | FUNCTIONS                               | PIN NAME (MCU mode) |
|----------------------------------------------|----------------|-----------------------------------------|---------------------|
| A14 to A12                                   | Input          | Address inputs                          | R40 to R42          |
| A11 to A8                                    |                |                                         | R50 to R53          |
| A7 to A4                                     |                |                                         | R60 to R63          |
| A3 to A0                                     |                |                                         | R80 to R83          |
| I7 to I4                                     | I/O            | Data Inputs / outputs                   | R73 to R70          |
| I3 to I0                                     |                |                                         | K03 to K00          |
| $\overline{\text{CE}}$                       | Input          | Chip Enable input                       | R91                 |
| $\overline{\text{OE}}$                       |                | Output Enable input                     | R90                 |
| VPP                                          | Power supply   | + 12.5 V / 5 V (Program supply voltage) | TEST                |
| VCC                                          |                | + 5 V                                   | VDD                 |
| VSS                                          |                | 0 V                                     | VSS                 |
| $\overline{\text{HD}}, \overline{\text{VD}}$ | Input          | Be fixed to low level                   |                     |
| R32 to R30                                   | I/O            | Open                                    |                     |
| R43                                          |                |                                         |                     |
| R92                                          |                |                                         |                     |
| P13 to P10                                   | Output         |                                         |                     |
| P23 to P20                                   |                |                                         |                     |
| BL, Y, R, G, B                               |                |                                         |                     |
| $\overline{\text{RESET}}$                    | Input          |                                         |                     |
| $\overline{\text{HOLD}}$                     | Input          |                                         |                     |
| XIN                                          | Input          | Resonator connecting pins               |                     |
| XOUT                                         | Output         |                                         |                     |
| OSC 1                                        | Input          | Open                                    |                     |
| OSC 2                                        | Output         |                                         |                     |

OPERATIONAL DESCRIPTION

The following is an explanation of hardware configuration and operation in relation to the 47P1638V. The 47P1638V is the same as the 47C1238A/1638A except that an OTP is used instead of a built-in mask ROM.

1. OPERATION mode

The 47P1638V has an MCU mode and a PROM mode.

1.1 MCU mode

The MCU mode is set by fixing the TEST/VPP pin at the "L" level. Operation in the MCU mode is the same as the 47C1238A/1638A, except that the TEST/VPP pin does not have a built in pull-down resistor and cannot be used open.

1.1.1 Program Memory

The program storage area is the same as the 47C1638A.

When using the 47P1638V check 47C1238A operation, place data conversion tables at two locations.

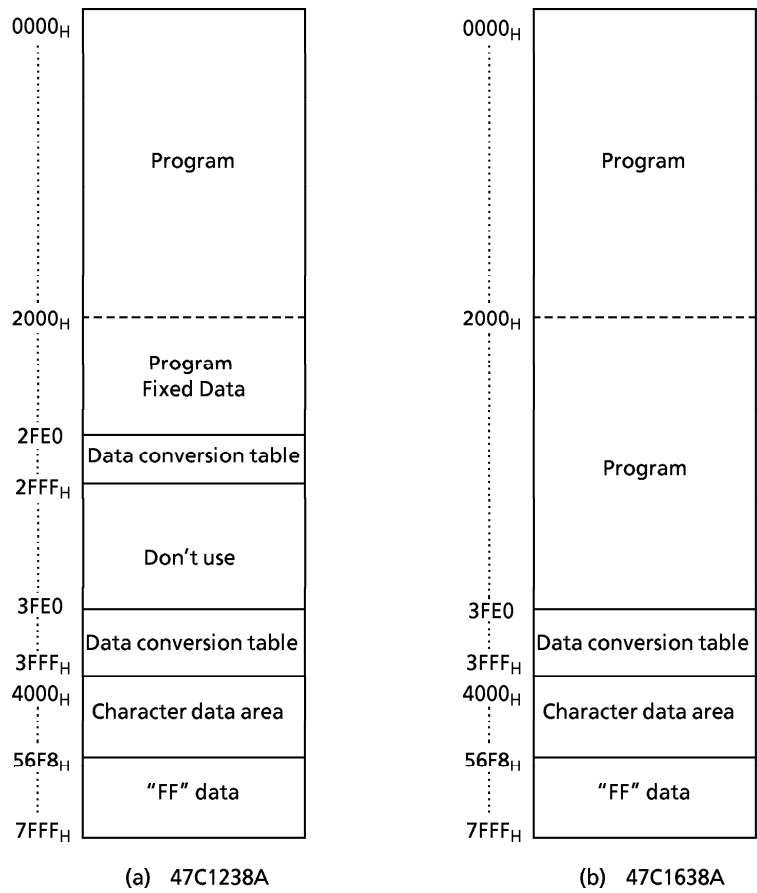


Figure 1-1. Program area

Note. "FF" data have to be written in address "\*\*\*9<sub>H</sub>" to "\*\*\*F<sub>H</sub>" of character data area.  
And "1" data have to be written in bit "7" of character data area.

1.1.2 Data Memory

The 47P1638V has two built-in 256 × 4-bit data memory banks (DMB0, DMB1).

### 1.1.3 Input/Output Circuitry

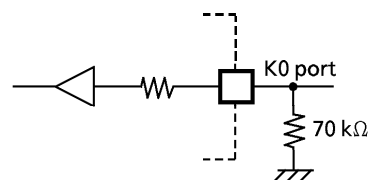
#### (1) Control pins

This is the same as for the 47C1238A/1638A except that there is no built in pull-down resistor for the TEST pin. Input/output circuitry of the 47P1638V control pins is shown below.

| CONTROL PIN                                          | I/O              | CIRCUITRY | REMARKS                                                                                                                                               |
|------------------------------------------------------|------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| XIN<br>XOUT                                          | Input<br>Output  |           | Resonator connecting pins<br>$R = 1\text{ k}\Omega$ (typ.)<br>$R_f = 1.5\text{ M}\Omega$ (typ.)<br>$R_O = 2\text{ k}\Omega$ (typ.)                    |
| XTIN<br>XTOUT                                        | Input<br>Output  |           | Resonator connecting pins<br>$R = 1\text{ k}\Omega$ (typ.)<br>$(R_{fs} = 6\text{ M}\Omega \text{ typ.})$<br>$(R_O = 220\text{ k}\Omega \text{ typ.})$ |
| $\overline{\text{RESET}}$                            | Input            |           | Hysteresis input<br>Contained pull-up resistor<br>$R_{IN} = 220\text{ k}\Omega$ (typ.)<br>$R = 1\text{ k}\Omega$ (typ.)                               |
| $\overline{\text{HOLD}}$ ( $\overline{\text{KE0}}$ ) | Input<br>(Input) |           | Hysteresis input<br>(Sense input)<br>$R = 1\text{ k}\Omega$ (typ.)                                                                                    |
| TEST                                                 | Input            |           | Not contained<br>pull-down resistor<br>$R = 1\text{ k}\Omega$ (typ.)                                                                                  |
| OSC1<br>OSC2                                         | Input<br>Output  |           | Oscillation terminals for OSD<br>$R = 1\text{ k}\Omega$ (typ.)<br>$R_f = 1.5\text{ M}\Omega$ (typ.)<br>$R_O = 2\text{ k}\Omega$ (typ.)                |
| $\overline{\text{HD}}$<br>$\overline{\text{VD}}$     | Input            |           | Synchronous signal Input<br>Hysteresis input<br>$R = 1\text{ k}\Omega$ (typ.)                                                                         |

## (2) I/O port

The input/output circuit of the 47P1638V is the same as I/O code PA of the 47C1238A/1638A. When this chip is used as evaluator with the I/O code, it is necessary to provide such as external resistors.



Pull-down resistor for code PC

Figure 1-2. Example of External Circuitry

The input / output circuitries of the 47P1638V I/O ports it as follows.

| PORT                   | I/O    | INPUT/OUTPUT CIRCUITRY (code : PA)                                                                                                                                                    | REMARKS                                                                                         |
|------------------------|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| K0                     | Input  |                                                                                                                                                                                       | Not contained<br>Pull-up<br>or<br>Pull-down resistor<br>$R = 1\text{ k}\Omega$ (typ.)           |
| P1<br>P2               | Output |                                                                                                                                                                                       | Sink open drain<br>Initial "Hi-Z"<br>High drive current<br>$I_{OL} = 20\text{ mA}$ (typ.)       |
| R3                     | I/O    |                                                                                                                                                                                       | Push-pull output<br>Initial "High"<br><br>$R = 1\text{ k}\Omega$ (typ.)                         |
| R4<br>R5               | I/O    |                                                                                                                                                                                       | Tri-state I/O<br>Initial "Hi-Z"<br><br>$R = 1\text{ k}\Omega$ (typ.)                            |
| R6<br>R7<br>R8<br>R9   | I/O    | <div style="display: inline-block; width: 45%; vertical-align: top;"> <p>R6, R7</p> </div> <div style="display: inline-block; width: 45%; vertical-align: top;"> <p>R8, R9</p> </div> | Sink open drain<br>Initial "Hi-Z"<br>Hysteresis input (R8, R9)<br>$R = 1\text{ k}\Omega$ (typ.) |
| R<br>G<br>B<br>Y<br>BL | Output |                                                                                                                                                                                       | Tri-state output<br>Initial "Hi-z"                                                              |

## 1.2 PROM mode

The PROM mode is set by setting the  $\overline{\text{RESET}}$ ,  $\overline{\text{HOLD}}$  pins to the "L" level. The PROM mode can be used as a general-purpose PROM writer for program writing and verification. (A high-speed program mode is used set the ROM type the same as for the TMM 27256AD)

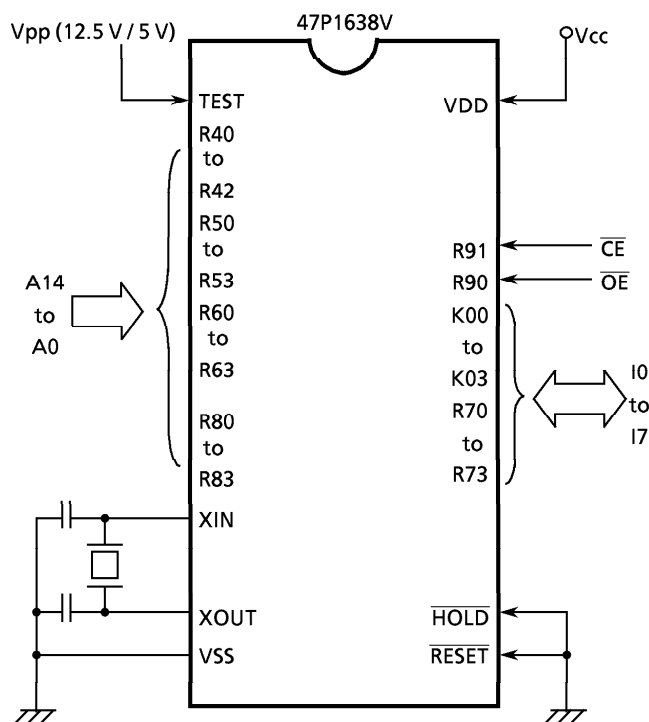


Figure 1-3. Setting for PROM mode

### 1.2.1 Programming flow chart (High-speed programming mode)

The high-speed programming mode is activated by applying the programming voltage of Vpp (12.5 V) under Vcc = 6 V. After addresses and input data are stable, the programming is performed by supplying 1ms of program pulse (single) to  $\overline{\text{CE}}$  input. The data is verified by using Program Verify mode. If the program data is not correct, additional 1ms of program pulse is supplied until the programming operates correctly (max. 25 times). Further, program pulse with a pulse width 3 times that of required for programming (number of programming X 1 ms) is resupplied. This completes programming of one address.

Subsequently, repeat the same procedures by changing addresses and input data. When all programming has been ended, the data in all address should be verified under Vcc = Vpp = 5 V.

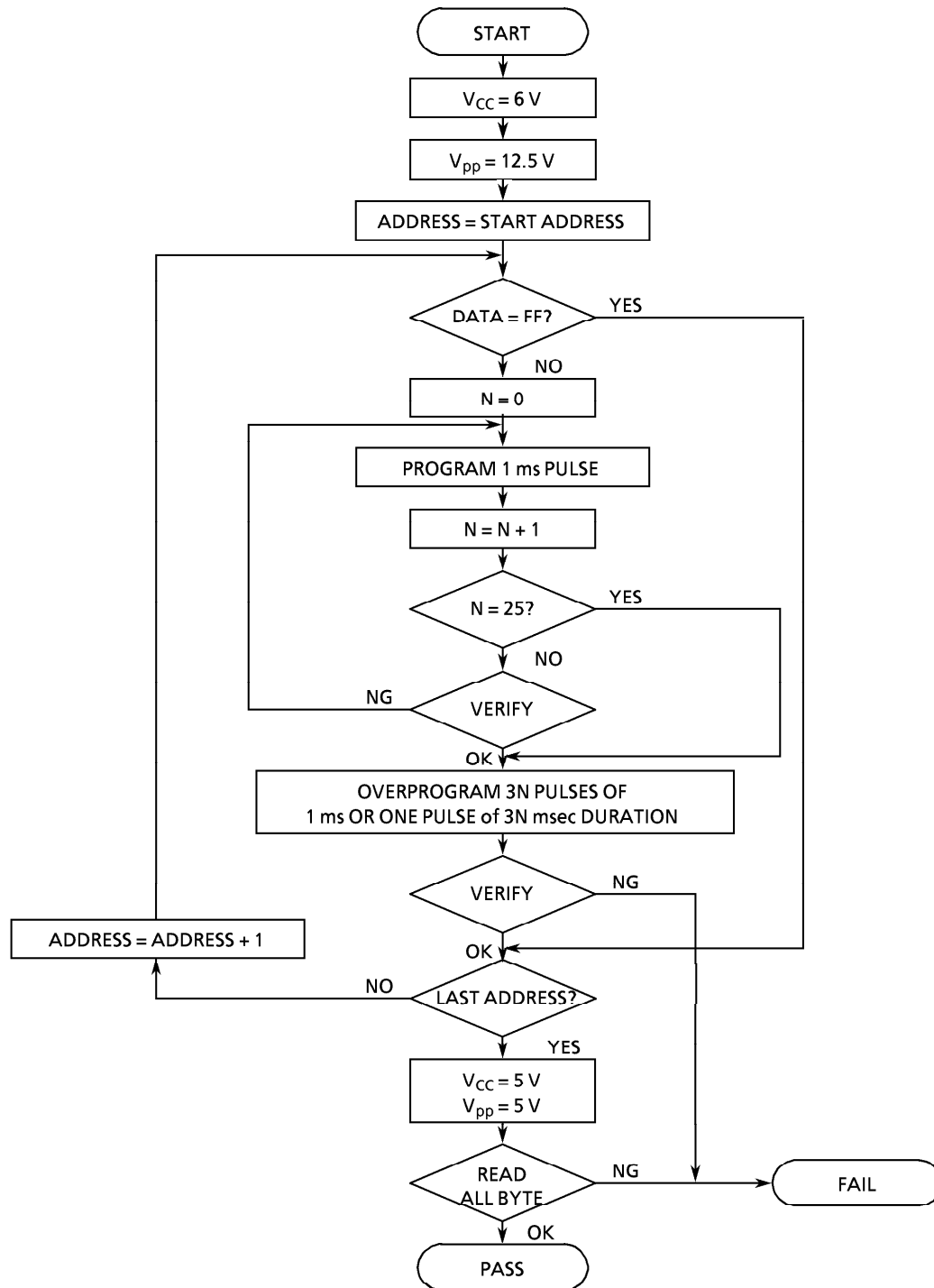


Figure1-4. FLOW CHART



## ELECTRICAL CHARACTERISTICS

ABSOLUTE MAXIMUM RATINGS (V<sub>SS</sub> = 0 V)

| PARAMETER                    | SYMBOL              | PINS                                | RATING                         | UNIT |
|------------------------------|---------------------|-------------------------------------|--------------------------------|------|
| Supply Voltage               | V <sub>DD</sub>     |                                     | – 0.3 to 7                     | V    |
| Program Voltage              | V <sub>pp</sub>     | TEST / VPP pin                      | – 0.3 to 14.0                  | V    |
| Input Voltage                | V <sub>IN</sub>     |                                     | – 0.3 to V <sub>DD</sub> + 0.3 | V    |
| Output Voltage               | V <sub>OUT1</sub>   | Except sink open drain pin, R7 port | – 0.3 to V <sub>DD</sub> + 0.3 | V    |
|                              | V <sub>OUT2</sub>   | Sink open drain pin except R7 port  | – 0.3 to 10                    |      |
| Output Current (Per 1 pin)   | I <sub>OUT1</sub>   | P1, P2 port                         | 30                             | mA   |
|                              | I <sub>OUT2</sub>   | R3, R6, R7, R8, R9 port             | 3.2                            |      |
| Output Current (Total)       | Σ I <sub>OUT1</sub> | P1, P2 port                         | 60                             | mA   |
| Power Dissipation            | PD                  |                                     | 600                            | mW   |
| Soldering Temperature (time) | T <sub>sld</sub>    |                                     | 260 (10 s)                     | °C   |
| Storage Temperature          | T <sub>stg</sub>    |                                     | – 55 to 125                    | °C   |
| Operating Temperature        | T <sub>opr</sub>    |                                     | – 30 to 70                     | °C   |

RECOMMENDED OPERATING CONDITIONS (V<sub>SS</sub> = 0 V, T<sub>opr</sub> = – 30 to 70 °C)

| PARAMETER          | SYMBOL           | PINS                    | CONDITIONS              | Min.                   | Max.                   | UNIT |
|--------------------|------------------|-------------------------|-------------------------|------------------------|------------------------|------|
| Supply Voltage     | V <sub>DD</sub>  |                         | in the Normal mode      | 4.5                    | 6.0                    | V    |
|                    |                  |                         | in the SLOW mode        | 2.7                    |                        |      |
|                    |                  |                         | in the HOLD mode        | 2.0                    |                        |      |
| Input High Voltage | V <sub>IH1</sub> | Except Hysteresis Input | V <sub>DD</sub> ≥ 4.5 V | V <sub>DD</sub> × 0.7  | V <sub>DD</sub>        | V    |
|                    | V <sub>IH2</sub> | Hysteresis Input        |                         | V <sub>DD</sub> × 0.75 |                        |      |
|                    | V <sub>IH3</sub> |                         | V <sub>DD</sub> < 4.5 V | V <sub>DD</sub> × 0.9  |                        |      |
| Input Low Voltage  | V <sub>IL1</sub> | Except Hysteresis Input | V <sub>DD</sub> ≥ 4.5 V | 0                      | V <sub>DD</sub> × 0.3  | V    |
|                    | V <sub>IL2</sub> | Hysteresis Input        |                         |                        | V <sub>DD</sub> × 0.25 |      |
|                    | V <sub>IL3</sub> |                         | V <sub>DD</sub> < 4.5 V |                        | V <sub>DD</sub> × 0.1  |      |
| Clock Frequency    | f <sub>c</sub>   | XIN, XOUT               |                         | 0.4                    | 6.0                    | MHz  |
|                    | f <sub>s</sub>   | XTIN, XTOUT             |                         | 30.0                   | 34.0                   | kHz  |
|                    | f <sub>OSD</sub> | OSC1, OSC2              |                         | –                      | 8.0                    | MHz  |

Note. Input Voltage V<sub>IH3</sub>, V<sub>IL3</sub>: in the SLOW or HOLD mode

D.C. CHARACTERISTICS (V<sub>SS</sub> = 0 V, T<sub>opr</sub> = -30 to 70 °C)

| PARAMETER                             | SYMBOL           | PINS                                          | CONDITIONS                                          | Min. | Typ. | Max. | UNIT |
|---------------------------------------|------------------|-----------------------------------------------|-----------------------------------------------------|------|------|------|------|
| Hysteresis Voltage                    | V <sub>HS</sub>  | Hysteresis Input                              |                                                     | —    | 0.7  | —    | V    |
| Input Current                         | I <sub>IN1</sub> | K0 port, TEST, RESET, HOLD                    | V <sub>DD</sub> = 5.5 V,                            | —    | —    | ± 2  | μA   |
|                                       | I <sub>IN2</sub> | R port (open drain)                           | V <sub>IN</sub> = 5.5 V / 0 V                       |      |      |      |      |
| Input Low Current                     | I <sub>IL</sub>  | R port (push-pull)                            | V <sub>DD</sub> = 5.5 V, V <sub>IN</sub> = 0.4 V    | —    | —    | - 2  | mA   |
| Input Resistance                      | R <sub>IN2</sub> | RESET                                         |                                                     | 100  | 220  | 450  | kΩ   |
| Output Leakage Current                | I <sub>LO</sub>  | Tri-state<br>R3, R6, R8, R9 port (open drain) | V <sub>DD</sub> = 5.5 V, V <sub>OUT</sub> = 5.5 V   | —    | —    | ± 2  | μA   |
| Output High Voltage                   | V <sub>OH1</sub> | R port (push-pull)                            | V <sub>DD</sub> = 4.5 V, I <sub>OH</sub> = - 200 μA | 2.4  | —    | —    | V    |
|                                       | V <sub>OH2</sub> | R port (tri-state), OSD output                | V <sub>DD</sub> = 4.5 V, I <sub>OH</sub> = - 0.7 mA | 4.1  | —    | —    |      |
| Output Low Voltage                    | V <sub>OL1</sub> | R3, R6~R9 port                                | V <sub>DD</sub> = 4.5 V, I <sub>OL</sub> = 1.6 mA   | —    | —    | 0.4  | V    |
|                                       | V <sub>OL2</sub> | R port (tri-state), OSD output                | V <sub>DD</sub> = 4.5 V, I <sub>OL</sub> = 0.7 mA   |      |      |      |      |
| Output Low Current                    | I <sub>OL</sub>  | Ports P1, P2                                  | V <sub>DD</sub> = 4.5 V, V <sub>OL</sub> = 1.0 V    | —    | 20   | —    | mA   |
| Supply Current<br>(in the Nomal mode) | I <sub>DD</sub>  |                                               | V <sub>DD</sub> = 5.5 V<br>f <sub>c</sub> = 4 MHz   | —    | 3    | 6    | mA   |
| Supply Current<br>(in the SLOW mode)  | I <sub>DDS</sub> |                                               | V <sub>DD</sub> = 3.0 V                             | —    | 30   | 60   | μA   |
| Supply Current<br>(in the HOLD mode)  | I <sub>DDH</sub> |                                               | V <sub>DD</sub> = 5.5 V                             | —    | 0.5  | 10   | μA   |

Note 1. Typ. values show those at T<sub>opr</sub> = 25 °C, V<sub>DD</sub> = 5 V.

Note 2. Input Current I<sub>IN1</sub> : The current through resistor is not included, when the pull-up/pull-down resistor is contained.

Note 3. Supply Current

I<sub>DD</sub>, I<sub>DDH</sub> : V<sub>IN</sub> = 5.3 V / 0.2 V

The K0 port is open when the pull-up / pull-down resistor is contained.

The voltage applied to the R port is within the valid range V<sub>IL</sub> or V<sub>IH</sub>.

I<sub>DDS</sub> : V<sub>IN</sub> = 2.8V / 0.2V

Low frequency clock is only oscillated (connecting XTIN, XTOUT)  
comparator function is disabled.

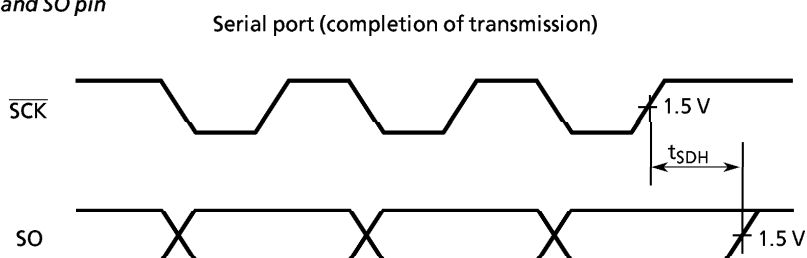
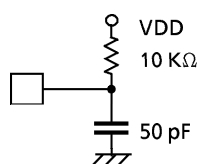
## A / D CONVERSION CHARACTERISTICS

| PARAMETER            | SYMBOL           | PINS         | CONDITIONS | Min.            | Typ. | Max.            | UNIT |
|----------------------|------------------|--------------|------------|-----------------|------|-----------------|------|
| Analog Input Voltage | V <sub>AIN</sub> | CIN3 to CIN0 |            | V <sub>SS</sub> | —    | V <sub>DD</sub> | V    |
| A/D Conversion Error | —                |              |            | —               | —    | ± 1/2           | LSB  |

**A.C. CHARACTERISTICS** ( $V_{SS} = 0\text{ V}$ ,  $V_{DD} = 4.5\text{ to }6.0\text{ V}$ ,  $T_{opr} = -30\text{ to }70\text{ }^{\circ}\text{C}$ )

| PARAMETER                    | SYMBOL    | CONDITION                    | Min.               | Typ. | Max. | UNIT          |
|------------------------------|-----------|------------------------------|--------------------|------|------|---------------|
| Instruction Cycle Time       | $t_{cy}$  | in the NORMAL mode           | 1.3                | —    | 20   | $\mu\text{s}$ |
|                              |           | in the SLOW mode             | 235                |      | 267  |               |
| High level Clock Pulse Width | $t_{WCH}$ | For external clock operation | 80                 | —    | —    | ns            |
| Low level Clock Pulse Width  | $t_{WCL}$ |                              |                    |      |      |               |
| Shift Data Hold Time         | $t_{SDH}$ |                              | $0.5 t_{cy} - 300$ | —    | —    | ns            |

**Note.** Shift data Hold Time  
External circuit for  $\overline{\text{SCK}}$  pin and SO pin

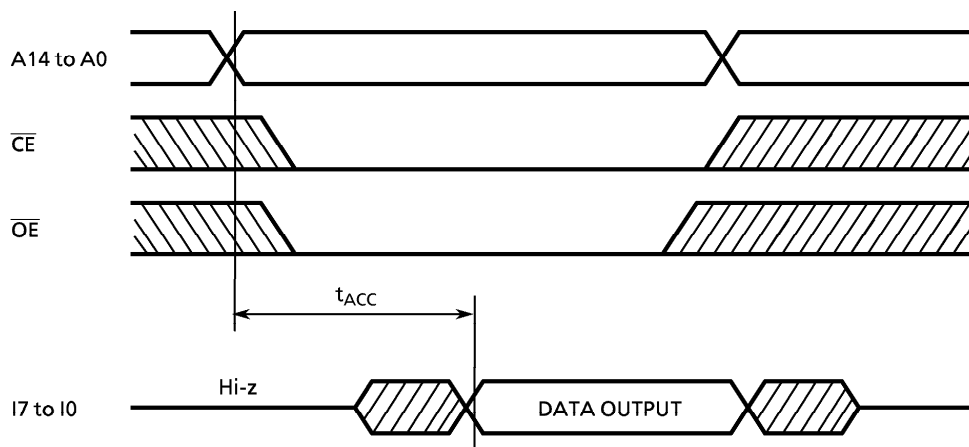

**RECOMMENDED OSCILLATING CONDITIONS** ( $V_{SS} = 0\text{ V}$ ,  $V_{DD} = 4.5\text{ to }6.0\text{ V}$ ,  $T_{opr} = -30\text{ to }70\text{ }^{\circ}\text{C}$ )

Recommended oscillating conditions of the 47P1638V are equal to those of the 47C1238A/1638A.

**DC/AC CHARACTERISTICS** ( $V_{SS} = 0\text{ V}$ )

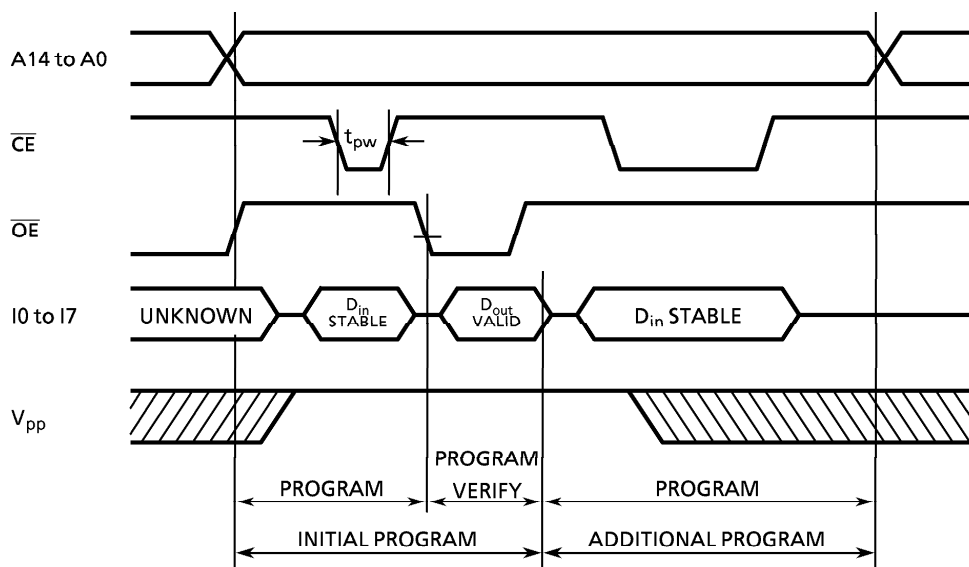
**(1) Read Operation**

| PARAMETER                 | SYMBOL    | CONDITION                        | Min.                | Typ. | Max.                | UNIT |
|---------------------------|-----------|----------------------------------|---------------------|------|---------------------|------|
| Output Level High Voltage | $V_{IH4}$ |                                  | $V_{CC} \times 0.7$ | —    | $V_{CC}$            | V    |
| Output Level Low Voltage  | $V_{IL4}$ |                                  | 0                   | —    | $V_{CC} \times 0.3$ | V    |
| Supply Voltage            | $V_{CC}$  |                                  | 4.75                | —    | 6.0                 | V    |
| Programming Voltage       | $V_{PP}$  |                                  |                     |      |                     |      |
| Address Access Time       | $t_{ACC}$ | $V_{CC} = 5.0 \pm 0.25\text{ V}$ | 0                   | —    | 350                 | ns   |



## (2) High Speed Programming Operation

| PARAMETER                     | SYMBOL    | CONDITION                 | Min.                | Typ. | Max.                | UNIT |
|-------------------------------|-----------|---------------------------|---------------------|------|---------------------|------|
| Input High Voltage            | $V_{IH4}$ |                           | $V_{CC} \times 0.7$ | —    | $V_{CC}$            | V    |
| Input Low Voltage             | $V_{IL4}$ |                           | 0                   | —    | $V_{CC} \times 0.3$ | V    |
| Supply Voltage                | $V_{CC}$  |                           | 5.75                | —    | 6.25                | V    |
| $V_{PP}$ Power Supply Voltage | $V_{PP}$  |                           | 12.25               | 12.5 | 12.75               | V    |
| Programming Pulse Width       | $t_{PW}$  | $V_{CC} = 6.0 \pm 0.25$ V | 0.95                | 1.0  | 1.05                | ms   |



*Note : An electrical shield by metal shield plate on the surface of the IC package should be recommendable in order to prevent the device from the high electric fieldstress applied from CRT (Cathode Ray Tube) for continuous reliable operation.*