



HN58V1001 Series

1M EEPROM (128-kword \times 8-bit)
Ready/Busy and $\overline{\text{RES}}$ function

REJ03C0146-0800Z
(Previous ADE-203-314G (Z) Rev. 7.0)
Rev. 8.00
Nov. 28. 2003

Description

Renesas Technology's HN58V1001 is an electrically erasable and programmable ROM organized as 131072-word \times 8-bit. It has realized high speed, low power consumption and high reliability by employing advanced MNOS memory technology and CMOS process and circuitry technology. It also has a 128-byte page programming function to make the write operations faster.

Features

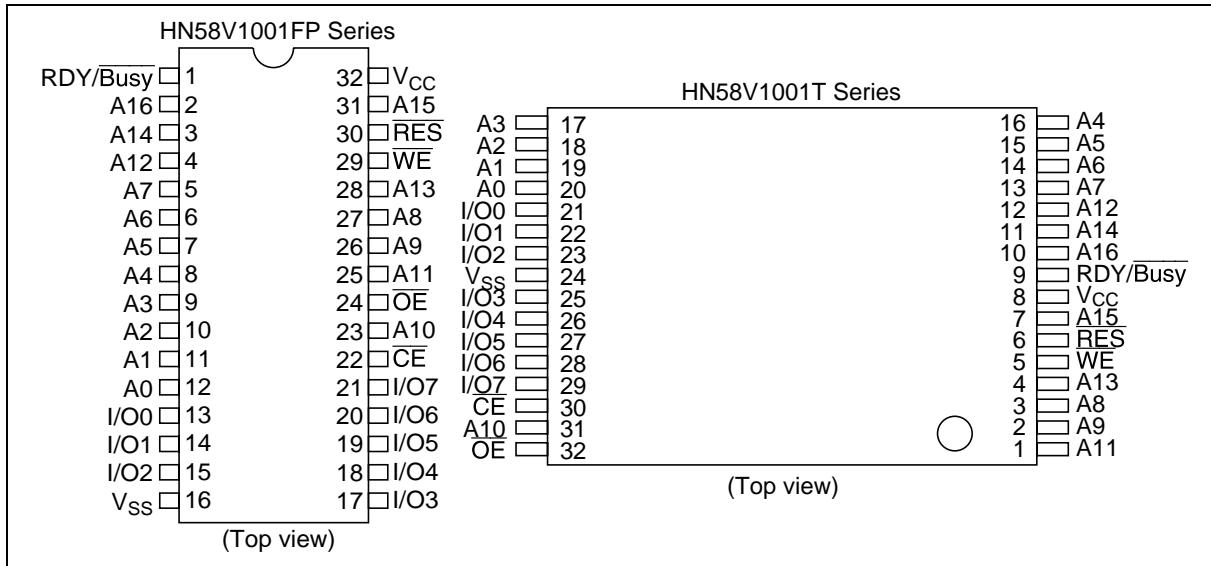
- Single 3 V supply: 2.7 V to 5.5 V
- Access time: 250 ns (max)
- Power dissipation
 - Active: 20 mW/MHz, (typ)
 - Standby: 110 μ W (max)
- On-chip latches: address, data, $\overline{\text{CE}}$, $\overline{\text{OE}}$, $\overline{\text{WE}}$
- Automatic byte write: 15 ms (max)
- Automatic page write (128 bytes): 15 ms (max)
- Data polling and RDY/Busy
- Data protection circuit on power on/off
- Conforms to JEDEC byte-wide standard
- Reliable CMOS with MNOS cell technology
- 10^4 erase/write cycles (in page mode)
- 10 years data retention
- Software data protection
- Write protection by $\overline{\text{RES}}$ pin
- There are also lead free products.

HN58V1001 Series

Ordering Information

| Type No. | Access time | Package |
|-----------------|-------------|---|
| HN58V1001FP-25 | 250 ns | 525 mil 32-pin plastic SOP (FP-32D) |
| HN58V1001T-25 | 250 ns | 32-pin plastic TSOP (TFP-32DA) |
| HN58V1001FP-25E | 250 ns | 525 mil 32-pin plastic SOP (FP-32DV) Lead free |
| HN58V1001T-25E | 250 ns | 32-pin plastic TSOP (TFP-32DAV) Lead free |

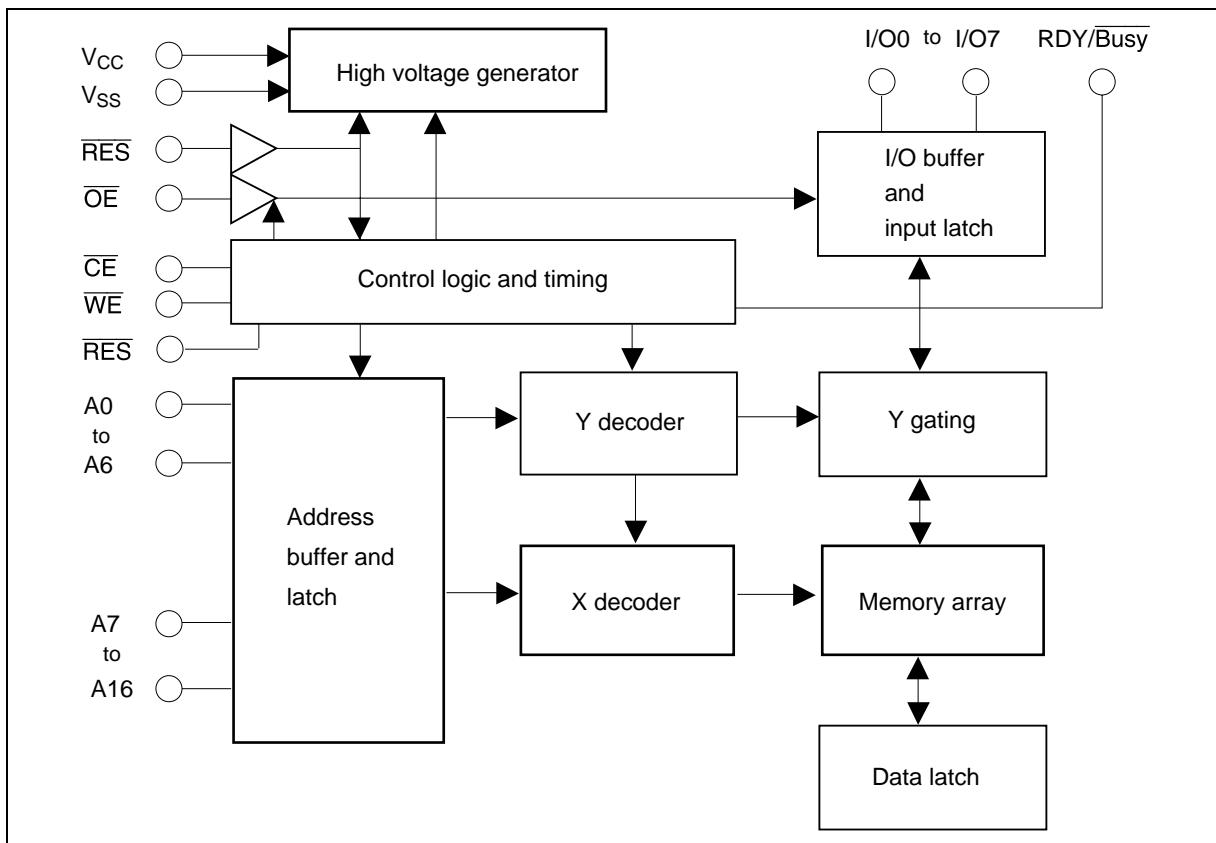
Pin Arrangement



Pin Description

| Pin name | Function |
|-----------------|-------------------|
| A0 to A16 | Address input |
| I/O0 to I/O7 | Data input/output |
| \overline{OE} | Output enable |
| \overline{CE} | Chip enable |
| \overline{WE} | Write enable |
| V_{CC} | Power supply |
| V_{SS} | Ground |
| RDY/Busy | Ready busy |
| RES | Reset |

Block Diagram



Operation Table

| Operation | \overline{CE} | \overline{OE} | \overline{WE} | \overline{RES} | RDY/Busy | I/O |
|---------------|-----------------|------------------------|-----------------|---------------------|--------------------|-------------|
| Read | V_{IL} | V_{IL} | V_{IH} | V_H ^{*1} | High-Z | Dout |
| Standby | V_{IH} | \times ^{*2} | \times | \times | High-Z | High-Z |
| Write | V_{IL} | V_{IH} | V_{IL} | V_H | High-Z to V_{OL} | Din |
| Deselect | V_{IL} | V_{IH} | V_{IH} | V_H | High-Z | High-Z |
| Write Inhibit | \times | \times | V_{IH} | \times | — | — |
| | | V_{IL} | \times | \times | — | — |
| Data Polling | V_{IL} | V_{IL} | V_{IH} | V_H | V_{OL} | Dout (I/O7) |
| Program reset | \times | \times | \times | V_{IL} | High-Z | High-Z |

Notes: 1. Refer to the recommended DC operating conditions.

2. \times : Don't care

Absolute Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|-----------|----------------------------|------|
| Supply voltage relative to V_{SS} | V_{CC} | -0.6 to +7.0 | V |
| Input voltage relative to V_{SS} | V_{IN} | -0.5 ^{*1} to +7.0 | V |
| Operating temperature range ^{*2} | T_{OPR} | 0 to +70 | °C |
| Storage temperature range | T_{STG} | -55 to +125 | °C |

Notes: 1. V_{IN} min = -3.0 V for pulse width \leq 50 ns

2. Including electrical characteristics and data retention

Recommended DC Operating Conditions

| Parameter | Symbol | Min | Typ | Max | Unit |
|-----------------------|-----------|--------------------|-----|----------------|------|
| Supply voltage | V_{CC} | 2.7 | 3.0 | 5.5 | V |
| | V_{SS} | 0 | 0 | 0 | V |
| Input voltage | V_{IL} | -0.3 ^{*1} | — | 0.8 | V |
| | V_{IH} | 1.9 ^{*2} | — | $V_{CC} + 0.3$ | V |
| | V_H | $V_{CC} - 0.5$ | — | $V_{CC} + 1.0$ | V |
| Operating temperature | T_{OPR} | 0 | — | +70 | °C |

Notes: 1. V_{IL} (min): -1.0 V for pulse width \leq 50 ns

2. V_{IH} (min): 2.2 V for V_{CC} = 3.6 to 5.5 V

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DC Characteristics (Ta = 0 to +70°C, V_{cc} = 2.7 V to 5.5 V)

| Parameter | Symbol | Min | Typ | Max | Unit | Test conditions |
|-----------------------------------|------------------|-----------------------|-----|-----------------|------|--|
| Input leakage current | I _{LI} | — | — | 2* ¹ | µA | V _{cc} = 3.6 V, Vin = 3.6 V |
| Output leakage current | I _{LO} | — | — | 2 | µA | V _{cc} = 3.6 V, Vout = 3.6/0.4 V |
| Standby V _{cc} current | I _{CC1} | — | — | 20 | µA | $\overline{CE} = V_{cc}$ |
| | I _{CC2} | — | — | 1 | mA | $\overline{CE} = V_{IH}$ |
| Operating V _{cc} current | I _{CC3} | — | — | 6 | mA | Iout = 0 mA, Duty = 100%, Cycle = 1 µs, V _{cc} = 3.3 V |
| | | — | — | 15 | mA | Iout = 0 mA, Duty = 100%, Cycle = 250 ns, V _{cc} = 3.3 V |
| Output low voltage | V _{OL} | — | — | 0.4 | V | I _{OL} = 2.1 mA |
| Output high voltage | V _{OH} | V _{cc} × 0.8 | — | — | V | I _{OH} = -400 µA |

Notes: 1. I_{LI} on \overline{RES} : 100 µA (max)

Capacitance (Ta = +25°C, f = 1 MHz)

| Parameter | Symbol | Min | Typ | Max | Unit | Test conditions |
|----------------------------------|--------|-----|-----|-----|------|-----------------|
| Input capacitance* ¹ | Cin | — | — | 6 | pF | Vin = 0 V |
| Output capacitance* ¹ | Cout | — | — | 12 | pF | Vout = 0 V |

Note: 1. This parameter is periodically sampled and not 100% tested.

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AC Characteristics ($T_a = 0$ to $+70^\circ\text{C}$, $V_{cc} = 2.7$ V to 5.5 V)

Test Conditions

- Input pulse levels: 0.4 V to 2.4 V
0 V to V_{cc} (\overline{RES} pin)
- Input rise and fall time: ≤ 20 ns
- Output load: 1TTL Gate +100 pF
- Reference levels for measuring timing: 0.8 V, 1.8 V

Read Cycle

HN58V1001-25

| Parameter | Symbol | Min | Max | Unit | Test conditions |
|---|-----------|-----|-----|------|--|
| Address to output delay | t_{ACC} | — | 250 | ns | $\overline{CE} = \overline{OE} = V_{IL}, \overline{WE} = V_{IH}$ |
| \overline{CE} to output delay | t_{CE} | — | 250 | ns | $\overline{OE} = V_{IL}, \overline{WE} = V_{IH}$ |
| \overline{OE} to output delay | t_{OE} | 10 | 120 | ns | $\overline{CE} = V_{IL}, \overline{WE} = V_{IH}$ |
| Address to output hold | t_{OH} | 0 | — | ns | $\overline{CE} = \overline{OE} = V_{IL}, \overline{WE} = V_{IH}$ |
| \overline{OE} (\overline{CE}) high to output float ¹ | t_{DF} | 0 | 50 | ns | $\overline{CE} = V_{IL}, \overline{WE} = V_{IH}$ |
| \overline{RES} low to output float ¹ | t_{DFR} | 0 | 350 | ns | $\overline{CE} = \overline{OE} = V_{IL}, \overline{WE} = V_{IH}$ |
| \overline{RES} to output delay | t_{RR} | 0 | 600 | ns | $\overline{CE} = \overline{OE} = V_{IL}, \overline{WE} = V_{IH}$ |

Write Cycle

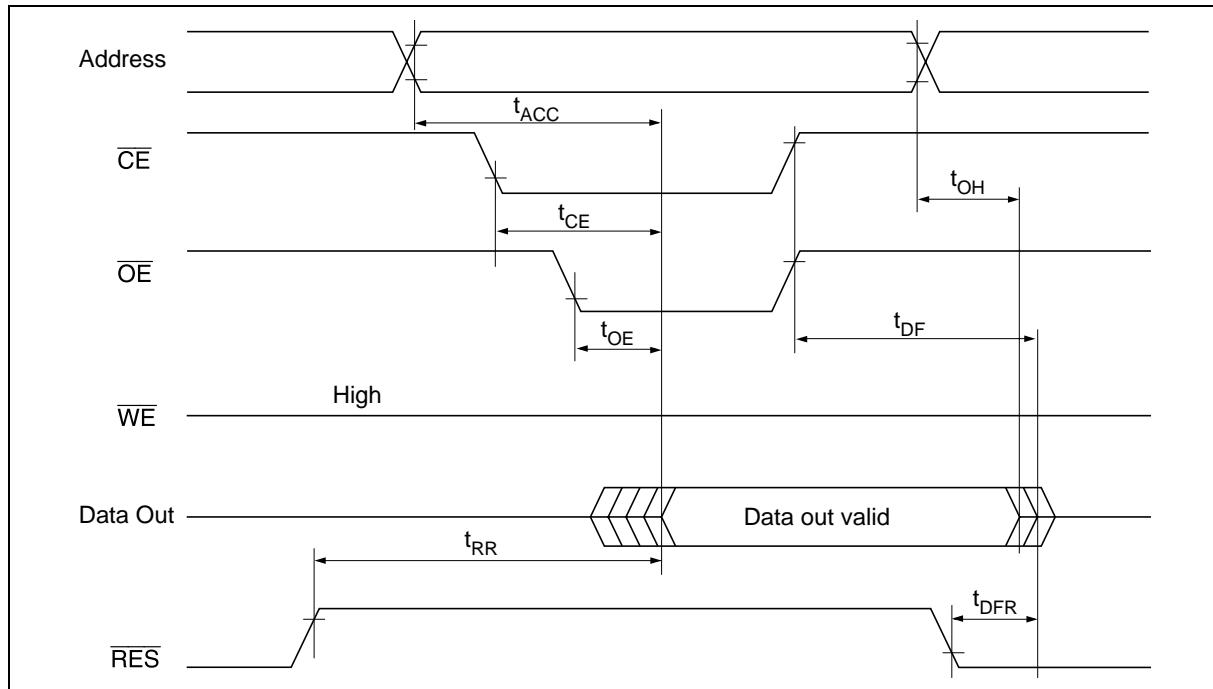
| Parameter | Symbol | Min ^{*2} | Typ | Max | Unit | Test conditions |
|---|-----------|-------------------|-----|------------------|---------|-----------------|
| Address setup time | t_{AS} | 0 | — | — | ns | |
| Address hold time | t_{AH} | 150 | — | — | ns | |
| \overline{CE} to write setup time (\overline{WE} controlled) | t_{CS} | 0 | — | — | ns | |
| \overline{CE} hold time (\overline{WE} controlled) | t_{CH} | 0 | — | — | ns | |
| \overline{WE} to write setup time (\overline{CE} controlled) | t_{WS} | 0 | — | — | ns | |
| \overline{WE} hold time (\overline{CE} controlled) | t_{WH} | 0 | — | — | ns | |
| \overline{OE} to write setup time | t_{OES} | 0 | — | — | ns | |
| \overline{OE} hold time | t_{OEH} | 0 | — | — | ns | |
| Data setup time | t_{DS} | 100 | — | — | ns | |
| Data hold time | t_{DH} | 10 | — | — | ns | |
| \overline{WE} pulse width (\overline{WE} controlled) | t_{WP} | 250 | — | — | ns | |
| \overline{CE} pulse width (\overline{CE} controlled) | t_{CW} | 250 | — | — | ns | |
| Data latch time | t_{DL} | 750 | — | — | ns | |
| Byte load cycle | t_{BLC} | 1.0 | — | 30 | μ s | |
| Byte load window | t_{BL} | 100 | — | — | μ s | |
| Write cycle time | t_{WC} | — | — | 15 ^{*3} | ms | |
| Time to device busy | t_{DB} | 120 | — | — | ns | |
| Write start time | t_{DW} | 250 ^{*4} | — | — | ns | |
| Reset protect time | t_{RP} | 100 | — | — | μ s | |
| Reset high time ^{*5} | t_{RES} | 1 | — | — | μ s | |

Notes: 1. t_{DF} and t_{DFR} are defined as the time at which the outputs achieve the open circuit conditions and are no longer driven.

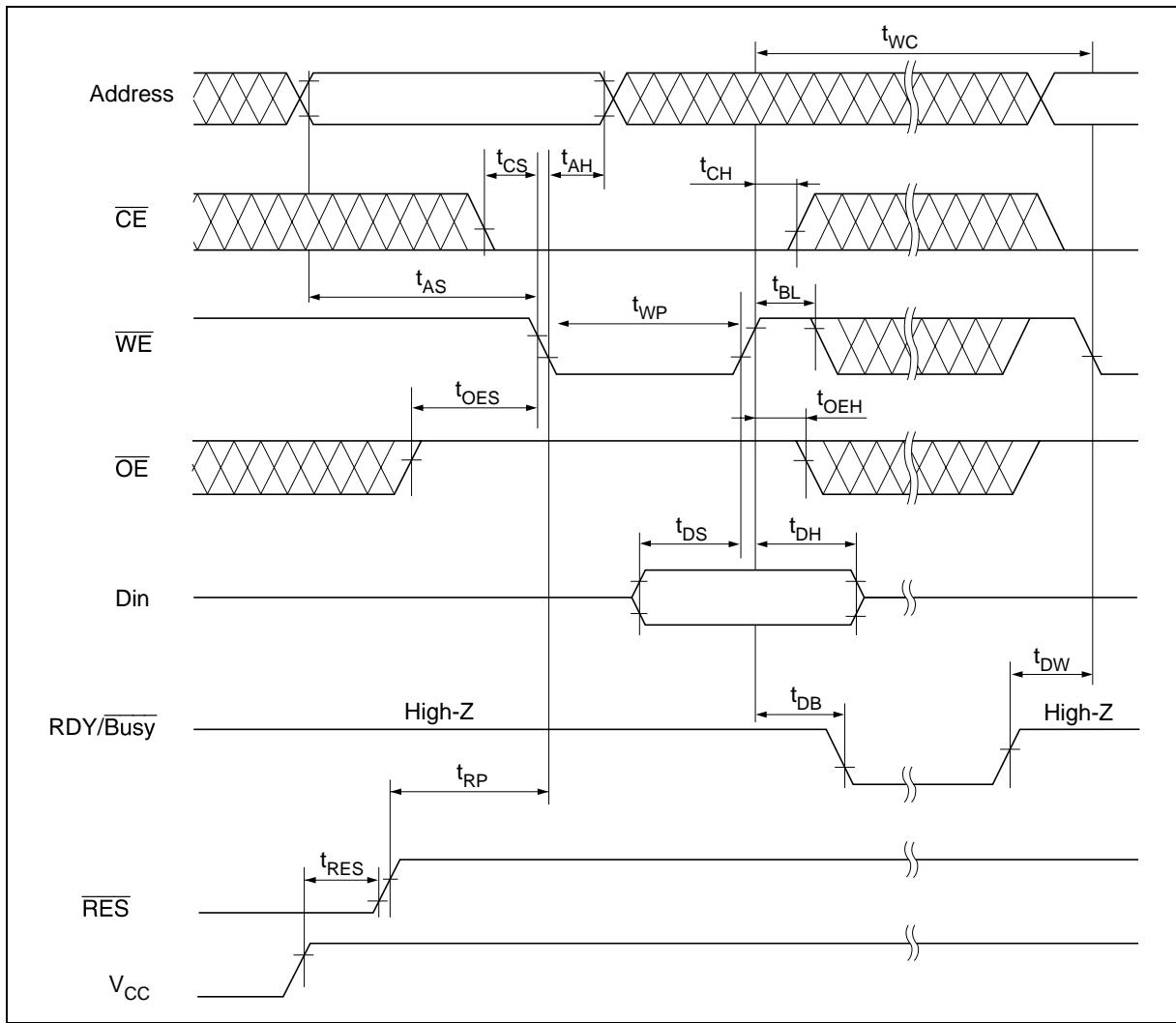
2. Use this device in longer cycle than this value.
3. t_{WC} must be longer than this value unless polling techniques or RDY/Busy are used. This device automatically completes the internal write operation within this value.
4. Next read or write operation can be initiated after t_{DW} if polling techniques or RDY/Busy are used.
5. This parameter is sampled and not 100% tested.
6. A7 to A16 are page addresses and must be same within the page write operation.
7. See AC read characteristics.

Timing Waveforms

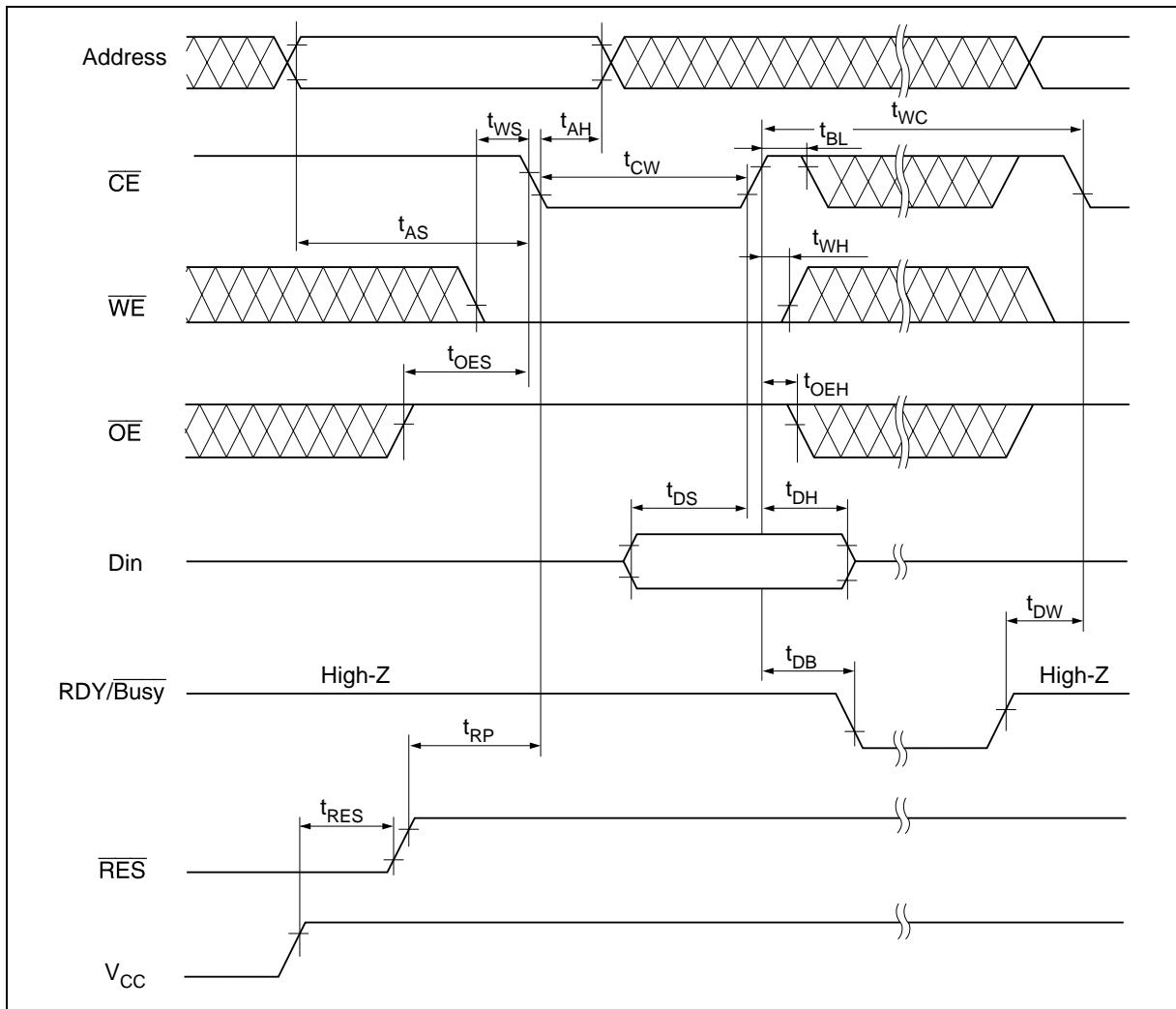
Read Timing Waveform



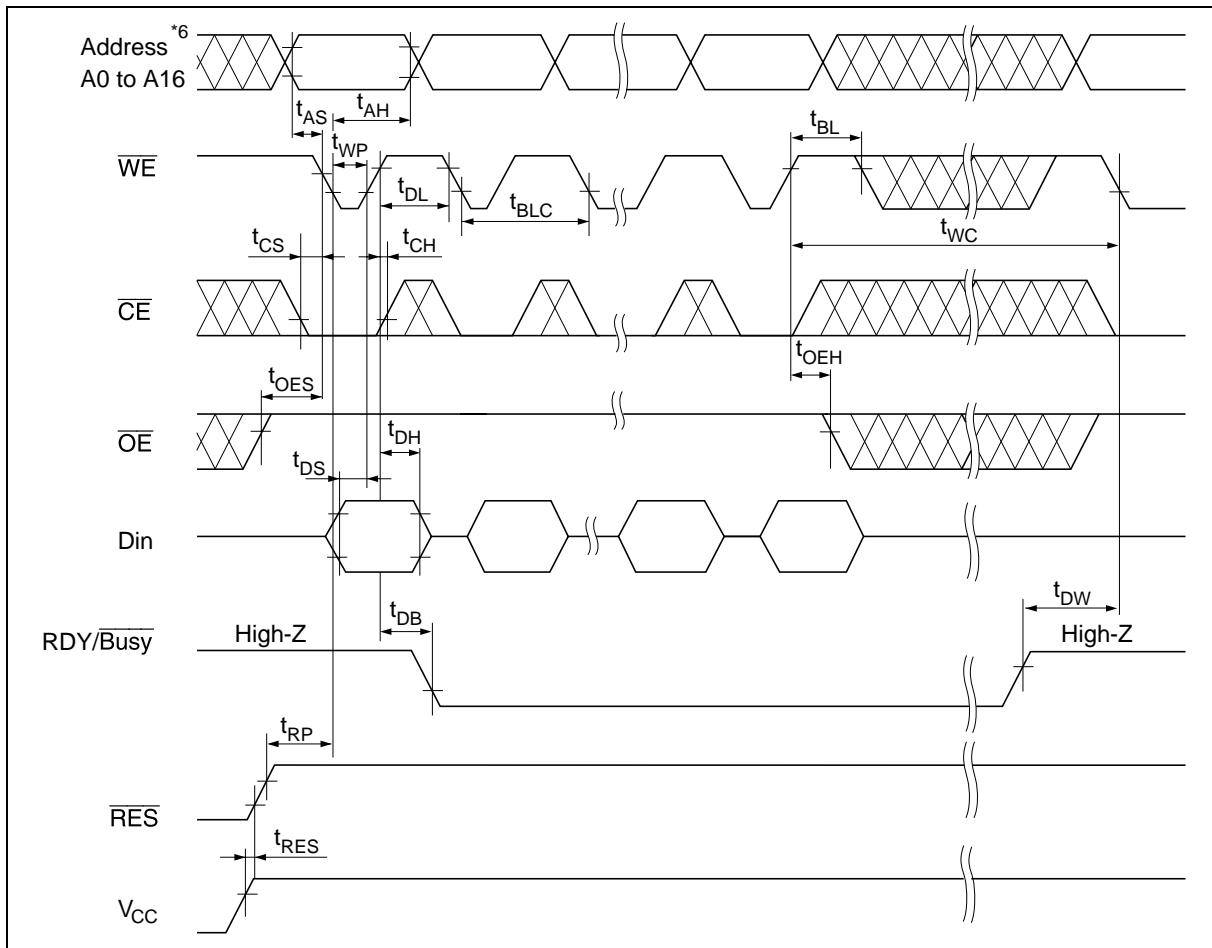
Byte Write Timing Waveform (1) ($\overline{\text{WE}}$ Controlled)



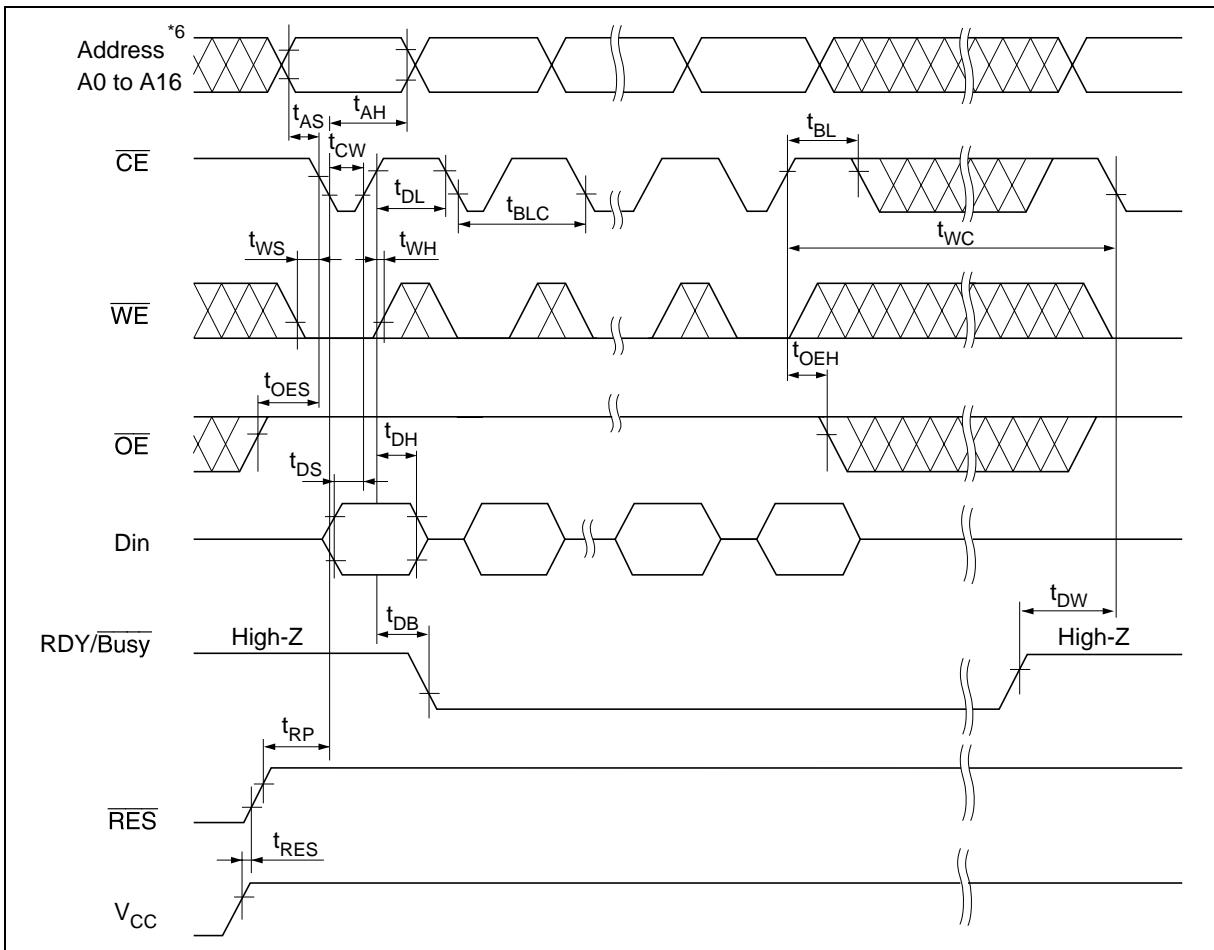
Byte Write Timing Waveform (2) ($\overline{\text{CE}}$ Controlled)



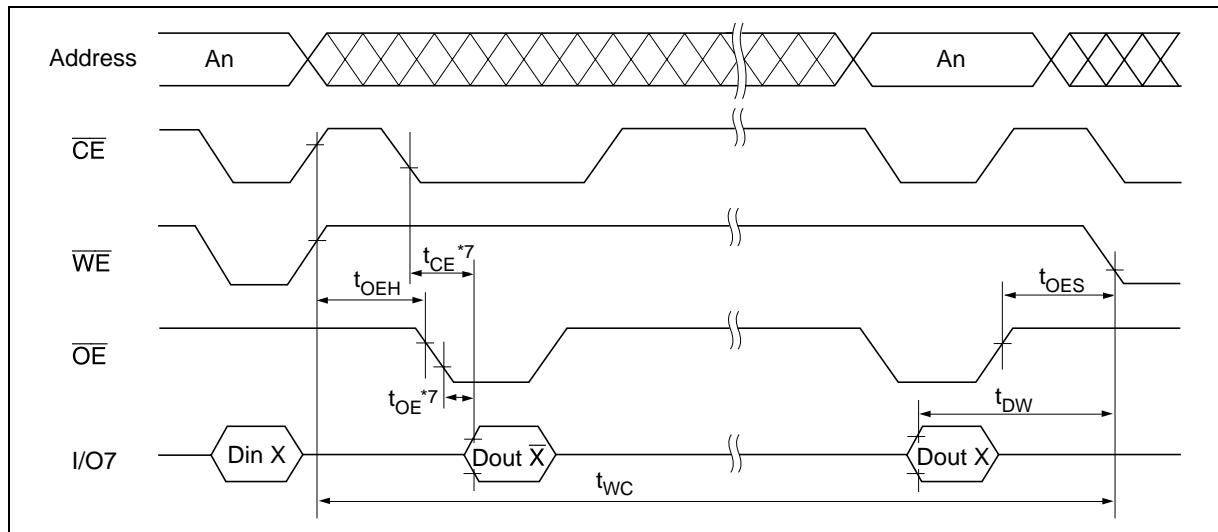
Page Write Timing Waveform (1) (\overline{WE} Controlled)



Page Write Timing Waveform (2) (\overline{CE} Controlled)



Data Polling Timing Waveform



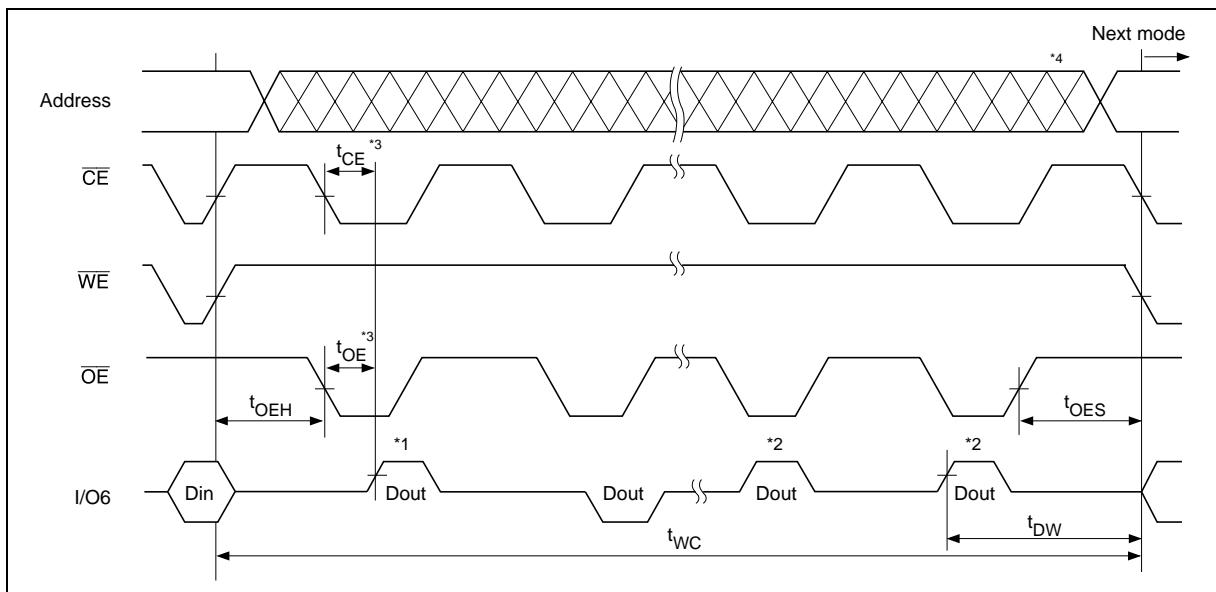
Toggle bit

This device provide another function to determine the internal programming cycle. If the EEPROM is set to read mode during the internal programming cycle, I/O6 will charge from “1” to “0” (toggling) for each read. When the internal programming cycle is finished, toggling of I/O6 will stop and the device can be accessible for next read or program.

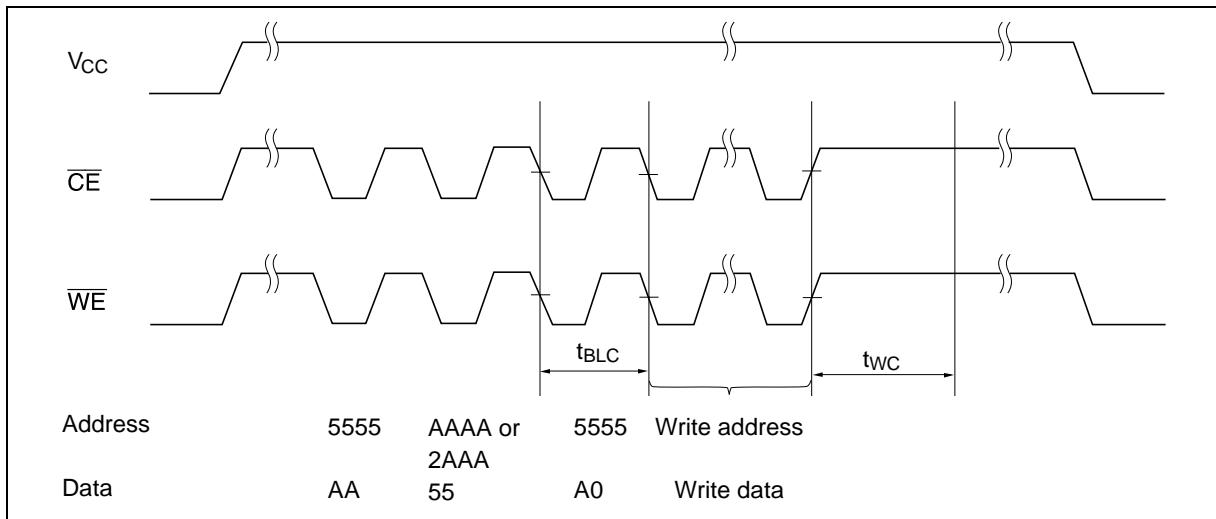
Notes:

1. I/O6 beginning state is “1”.
2. I/O6 ending state will vary.
3. See AC read characteristics.
4. Any location can be used, but the address must be fixed.

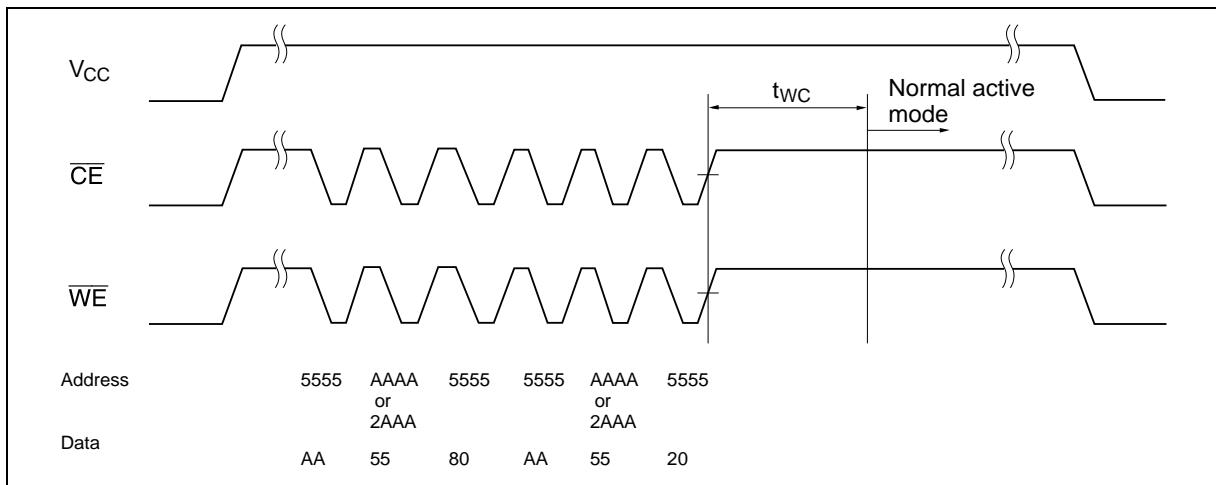
Toggle bit Waveform



Software Data Protection Timing Waveform (1) (in protection mode)



Software Data Protection Timing Waveform (2) (in non-protection mode)



Functional Description

Automatic Page Write

Page-mode write feature allows 1 to 128 bytes of data to be written into the EEPROM in a single write cycle. Following the initial byte cycle, an additional 1 to 127 bytes can be written in the same manner. Each additional byte load cycle must be started within 30 μ s from the preceding falling edge of \overline{WE} or \overline{CE} . When \overline{CE} or \overline{WE} is kept high for 100 μ s after data input, the EEPROM enters write mode automatically and the input data are written into the EEPROM.

Data Polling

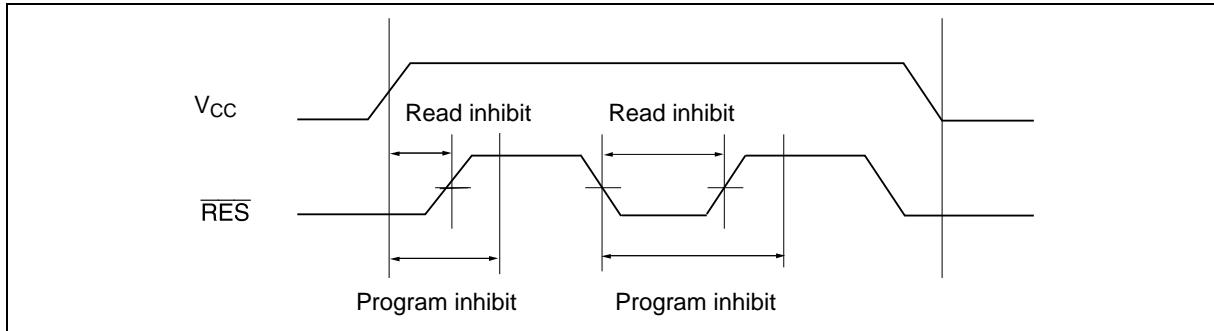
Data polling allows the status of the EEPROM to be determined. If EEPROM is set to read mode during a write cycle, an inversion of the last byte of data to be loaded outputs from I/O7 to indicate that the EEPROM is performing a write operation.

RDY/ \overline{Busy} Signal

$\overline{RDY}/\overline{Busy}$ signal also allows status of the EEPROM to be determined. The $\overline{RDY}/\overline{Busy}$ signal has high impedance except in write cycle and is lowered to V_{OL} after the first write signal. At the end of write cycle, the $\overline{RDY}/\overline{Busy}$ signal changes state to high impedance.

\overline{RES} Signal

When \overline{RES} is low, the EEPROM cannot be read or programmed. Therefore, data can be protected by keeping \overline{RES} low when V_{CC} is switched. \overline{RES} should be high during read and programming because it doesn't provide a latch function.



\overline{WE} , \overline{CE} Pin Operation

During a write cycle, addresses are latched by the falling edge of \overline{WE} or \overline{CE} , and data is latched by the rising edge of \overline{WE} or \overline{CE} .

Write/Erase Endurance and Data Retention Time

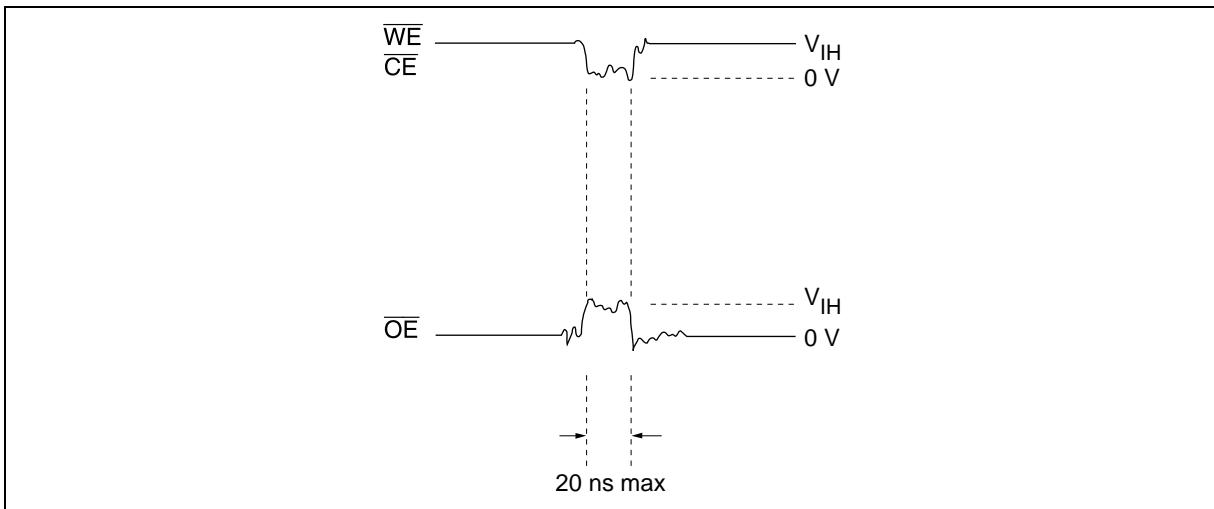
The endurance is 10^4 cycles in case of the page programming and 10^3 cycles in case of the byte programming (1% cumulative failure rate). The data retention time is more than 10 years when a device is page-programmed less than 10^4 cycles.

Data Protection

To prevent this phenomenon, this device has a noise cancellation function that cuts noise if its width is 20 ns or less in program mode.

1. Data Protection against Noise on Control Pins (\overline{CE} , \overline{OE} , \overline{WE}) during Operation

During readout or standby, noise on the control pins may act as a trigger and turn the EEPROM to programming mode by mistake. Be careful not to allow noise of a width of more than 20 ns on the control pins.

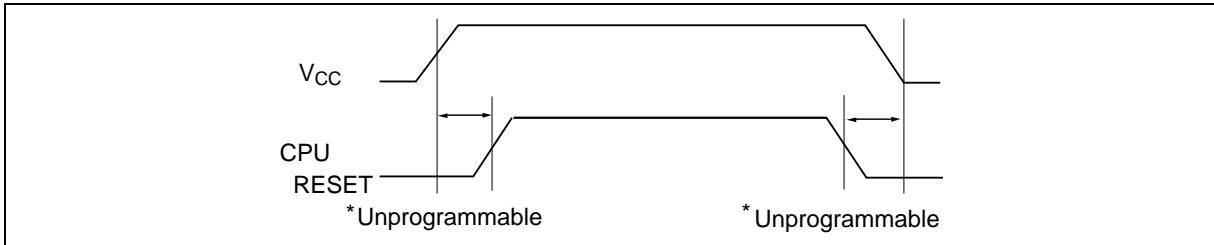


HN58V1001 Series

2. Data Protection at V_{CC} On/Off

When V_{CC} is turned on or off, noise on the control pins generated by external circuits (CPU, etc) may act as a trigger and turn the EEPROM to program mode by mistake. To prevent this unintentional programming, the EEPROM must be kept in an unprogrammable state while the CPU is in an unstable state.

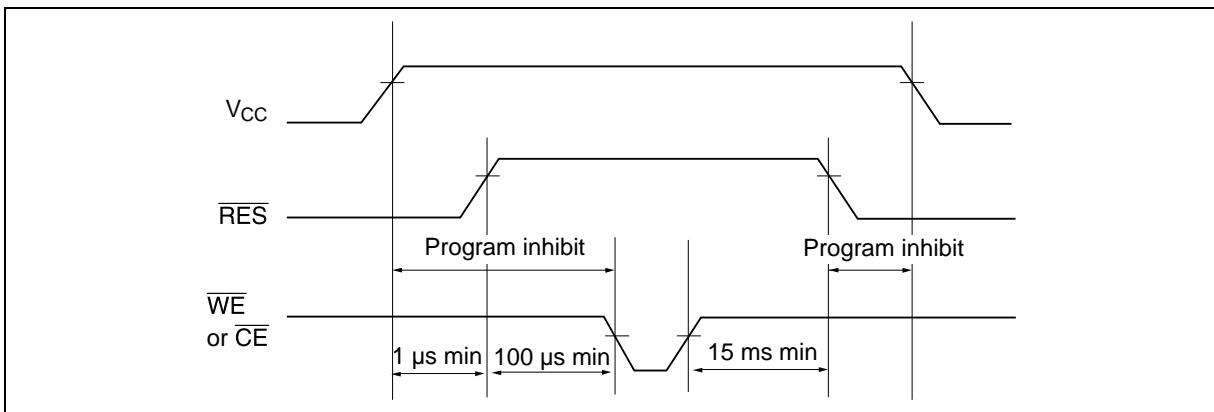
Note: The EEPROM should be kept in unprogrammable state during V_{CC} on/off by using CPU RESET signal.



2.1 Protection by \overline{RES}

The unprogrammable state can be realized by that the CPU's reset signal inputs directly to the EEPROM's \overline{RES} pin. \overline{RES} should be kept V_{ss} level during V_{CC} on/off.

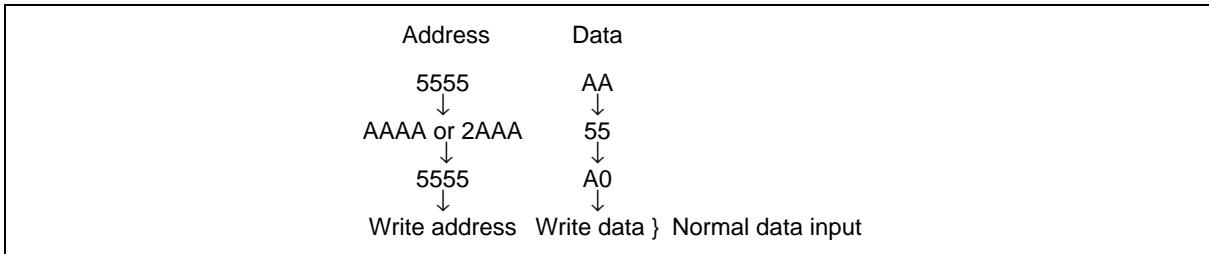
The EEPROM brakes off programming operation when \overline{RES} becomes low, programming operation doesn't finish correctly in case that \overline{RES} falls low during programming operation. \overline{RES} should be kept high for 15 ms after the last data input.



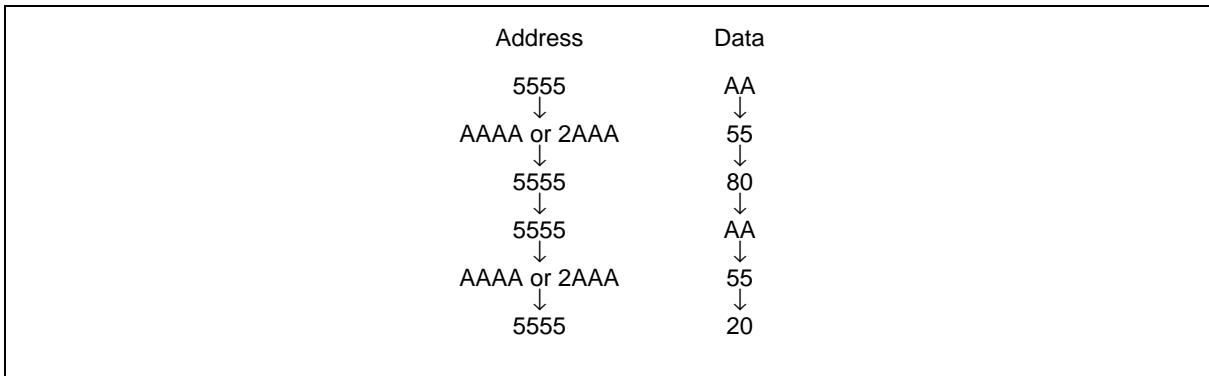
HN58V1001 Series

3. Software data protection

To prevent unintentional programming, this device has the software data protection (SDP) mode. The SDP is enabled by inputting the following 3 bytes code and write data. SDP is not enabled if only the 3 bytes code is input. To program data in the SDP enable mode, 3 bytes code must be input before write data.



The SDP mode is disabled by inputting the following 6 bytes code. Note that, if data is input in the SDP disable cycle, data can not be written.



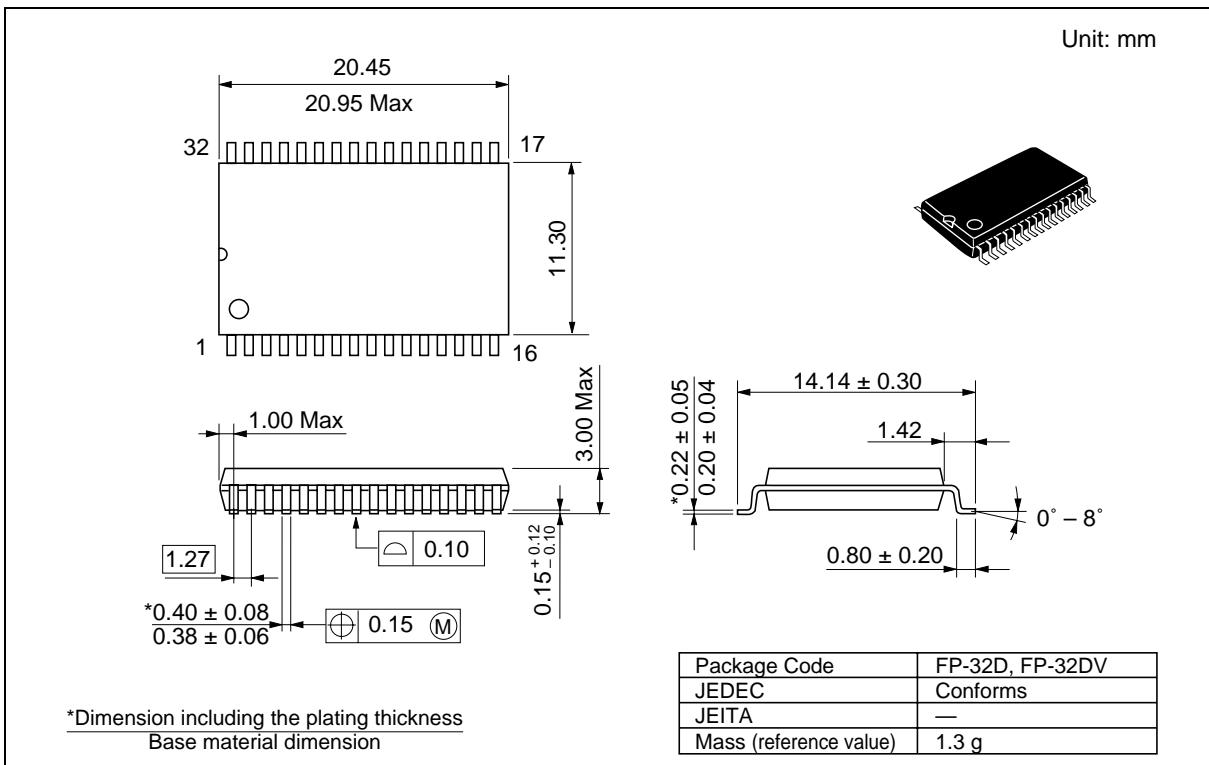
The software data protection is not enabled at the shipment.

Note: There are some differences between Renesas Technology's and other company's for enable/disable sequence of software data protection. If there are any questions , please contact with Rnesas Technology's sales offices.

HN58V1001 Series

Package Dimensions

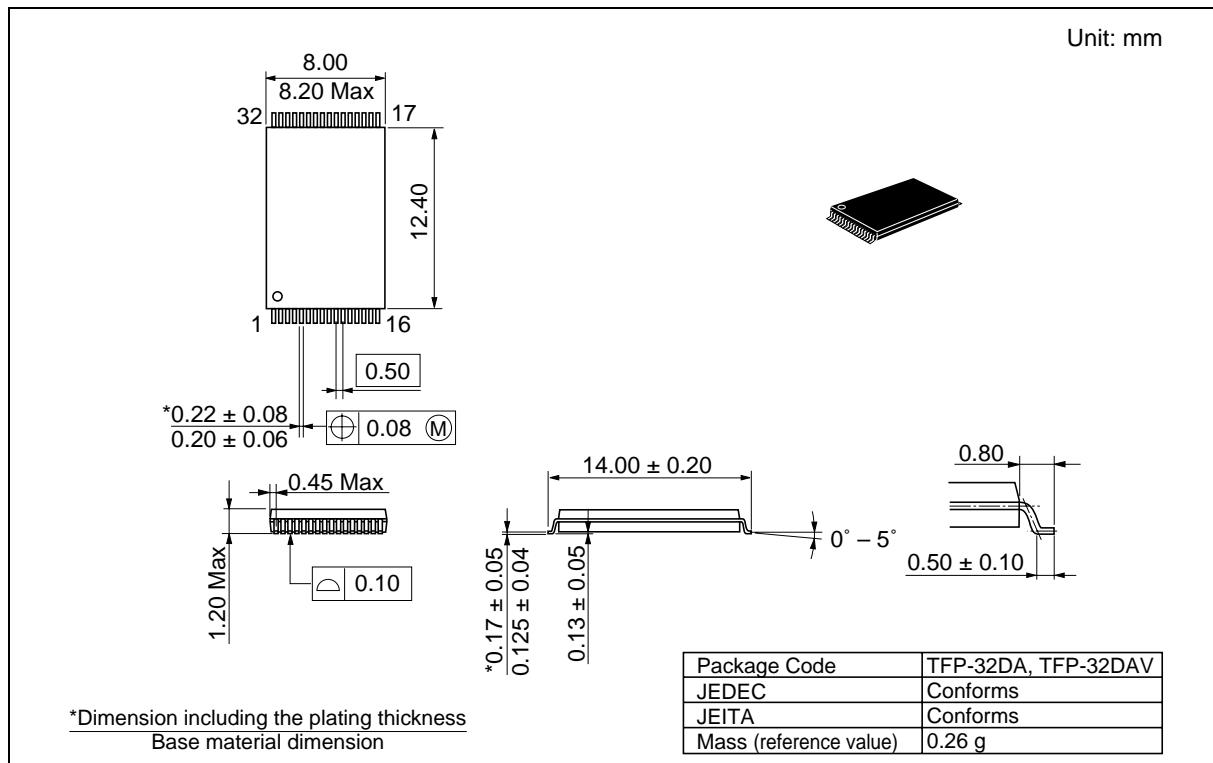
HN58V1001FP Series (FP-32D, FP-32DV)



HN58V1001 Series

Package Dimensions (cont.)

HN58V1001T Series (TFP-32DA, TFP-32DAV)



Revision History

HN58V1001 Series Data Sheet

| Rev. | Date | Contents of Modification | |
|------|---------------|--------------------------|--|
| | | Page | Description |
| 0.0 | Jul. 11. 1991 | — | Initial issue |
| 1.0 | Jan. 30. 1992 | — | HN58V1001P/FP/T/R-20 to HN58V1001P/FP/T/R-25 — Low power dissipation 100 μ W max (standby) to 110 μ W max (standby) |
| | | 3 | Pin Description V_{CC} power: +5 V to +3V |
| | | 4 | Recommended DC Operating Conditions V_{IH} min: 1.9 V to 2.0 V V_{IH} max: V_{CC} +1 V to V_{CC} +0.3 V V_H min: V_{CC} -1 V to V_{CC} -0.5 V |
| | | 5 | DC Characteristics I_{CC3} max: 10 mA to 6 mA 25 mA to 15 mA I_{CC3} test conditions: cycle = 1 μ s/200 ns to cycle = 1 μ s/250 ns at V_{CC} = 3.3 V |
| | | 6 | AC Characteristics t_{ACC}/t_{CE} max: 200 ns to 250 ns t_{OE} max: 90 ns to 120 ns t_{DF} max: 70 ns to 50 ns t_{WC} min: 10 ms to 15 ms t_{CS}/t_{CH} to t_{WS}/t_{WH} (\overline{CE} Controlled) t_{DL} min: 300 ns to 750 ns t_{BLIC} min: 0.55 μ s to 1.0 μ s t_{DW} min: 150 ns to 250 ns |
| | | 16 | Functional Description Deletion of Write Protection(2) Change of Data Protection 2 Software data protection |
| | | 8 | Address: AAAA to AAAA or 2AAA Change of Read Timing Waveform |
| 2.0 | Feb. 20. 1993 | — | Mode Selection I/O (11-13, 15-19) to I/O (13-15, 17-21) |
| | | 5 | DC Characteristics V_{IH} min: 2.0 V to 1.9 V |
| | | 6 | AC Characteristics t_{RR} max: 450 ns to 600 ns t_{DH} min: 0 ns to 10 ns |
| | | — | Deletion of Mode Description |
| | | — | Addition of Reset function |
| | | — | Change of erase/write cycles in page mode: 10^5 to 10^4 |
| | | — | Change of erase/write cycles in byte mode: 10^4 to 10^3 |
| | | 16 | Functional Description 10 ms to 15 ms |
| 3.0 | Apr. 23. 1993 | — | Addition of Toggle Bit |

Revision Record (cont.)

| Rev. | Date | Contents of Modification | |
|------|---------------|--------------------------|---|
| | | Page | Description |
| 4.0 | Nov.25. 1994 | 5 | Capacitance Addition of note: 1 |
| | | 6 | AC Characteristics Write cycle: Addition of note 2,3 Addition of t_{DW} min: 250 ns |
| | | 9 | Page write timing waveform Addition of note: 1 |
| 5.0 | May. 23. 1995 | — | Deletion of HN58V1001R series (TFP-32DAR) |
| 6.0 | Apr. 30. 1997 | — | Change of format 6 AC Characteristics Addition of note.7 8 Timing Waveforms Toggle bit Addition of note.3, 4 16 Functional Description Addition of CPU Reset timing waveform Data protection 3: Addition of note 20 Package Dimensions Change of FP-32D, TFP-32DA |
| 7.0 | Oct. 31. 1997 | 8 | Timing Waveforms Read Timing Waveform: Correct error |
| 8.00 | Nov. 28. 2003 | — | Change format issued by Renesas Technology Corp. 2 Ordering Information Deletion of HN58V1001P-25 Addition of HN58V1001FP-25E, HN58V1001T-25E 20-21 Package Dimensions Deletion of DP-32 FP-32D to FP-32D, FP-32DV TFP-32DA to TFP-32DA, TFP-32DAV |

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