

# HN58V256A Series

# HN58V257A Series

256k EEPROM (32-kword × 8-bit)  
Ready/Busy and  $\overline{\text{RES}}$  function (HN58V257A)

REJ03C0147-0500Z  
(Previous ADE-203-357D (Z) Rev.4.0)  
Rev. 5.00  
Nov. 17. 2003

## Description

Renesas Technology's HN58V256A and HN58V257A are electrically erasable and programmable ROMs organized as 32768-word × 8-bit. They have realized high speed, low power consumption and high reliability by employing advanced MNOS memory technology and CMOS process and circuitry technology. They also have a 64-byte page programming function to make their write operations faster.

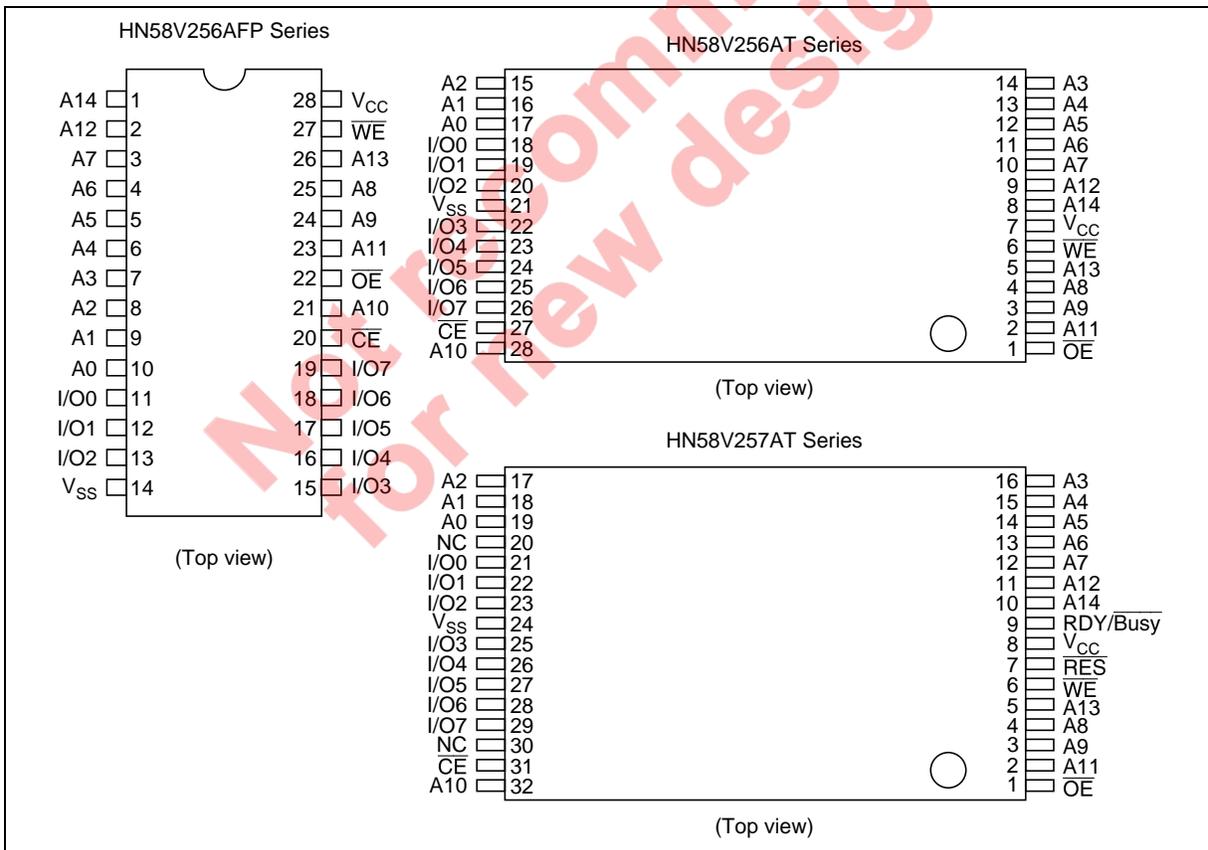
## Features

- Single 3 V supply: 2.7 to 5.5 V
- Access time: 120 ns max
- Power dissipation:
  - Active: 20 mW/MHz, (typ)
  - Standby: 110  $\mu$ W (max)
- On-chip latches: address, data,  $\overline{\text{CE}}$ ,  $\overline{\text{OE}}$ ,  $\overline{\text{WE}}$
- Automatic byte write: 10 ms max
- Automatic page write (64 bytes): 10 ms max
- Ready/Busy (only the HN58V257A series)
- $\overline{\text{Data}}$  polling and Toggle bit
- Data protection circuit on power on/off
- Conforms to JEDEC byte-wide standard
- Reliable CMOS with MNOS cell technology
- $10^5$  erase/write cycles (in page mode)
- 10 years data retention
- Software data protection
- Write protection by  $\overline{\text{RES}}$  pin (only the HN58V257A series)
- Industrial versions (Temperature range:  $-20$  to  $85^\circ\text{C}$  and  $-40$  to  $85^\circ\text{C}$ ) are also available.
- There are free also lead free products.

**Ordering Information**

Type No.	Access time	Package
HN58V256AFP-12	120 ns	400 mil 28-pin plastic SOP (FP-28D)
HN58V256AT-12	120 ns	28-pin plastic TSOP (TFP-28DB)
HN58V257AT-12	120 ns	32-pin plastic TSOP (TFP-32DA)
HN58V256AFP-12E	120 ns	400 mil 28-pin plastic SOP (FP-28DV) Lead Free
HN58V256AT-12E	120 ns	28-pin plastic TSOP (TFP-28DBV) Lead Free
HN58V257AT-12E	120 ns	32-pin plastic TSOP (TFP-32DAV) Lead Free

**Pin Arrangement**



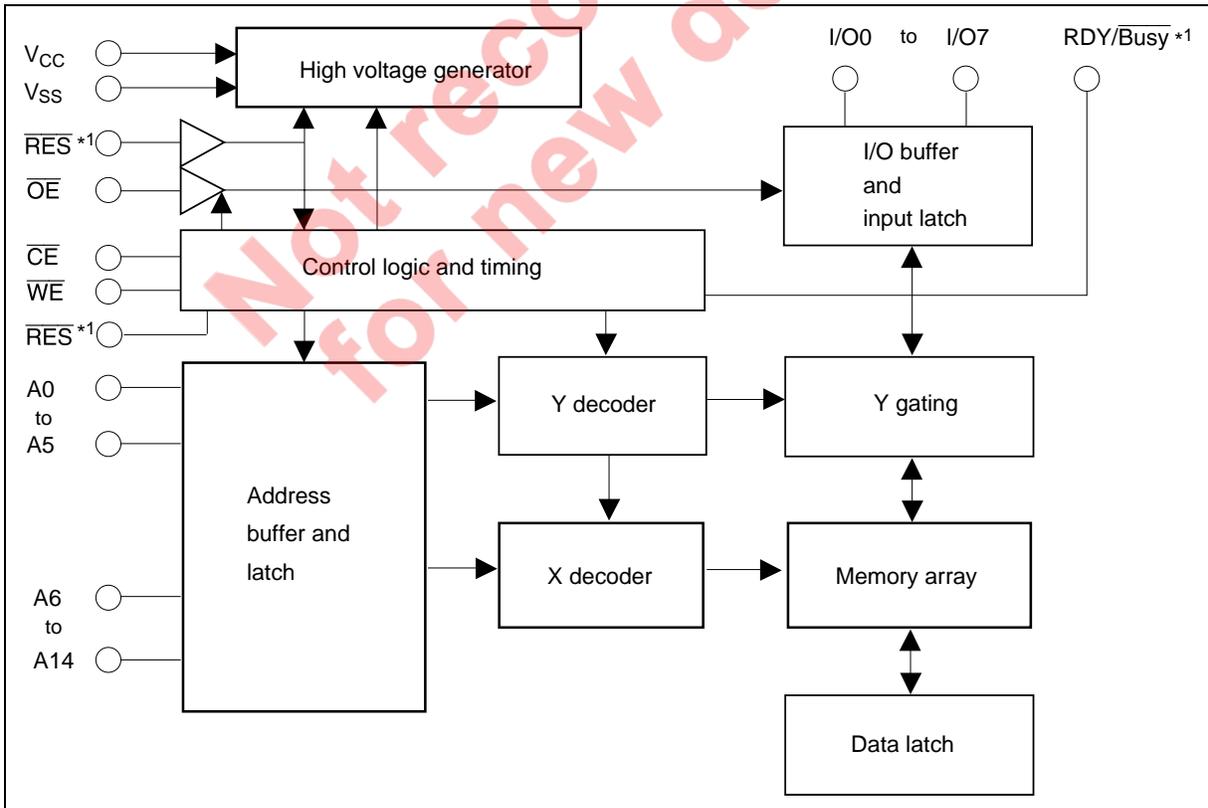
### Pin Description

Pin name	Function
A0 to A14	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
$RDY/\overline{Busy}^{*1}$	Ready busy
$\overline{RES}^{*1}$	Reset
NC	No connection

Note: 1. This function is supported by only the HN58V257A series.

### Block Diagram

Note: 1. This function is supported by only the HN58V257A series.



## Operation Table

Operation	$\overline{CE}$	$\overline{OE}$	$\overline{WE}$	$\overline{RES}^{*3}$	$\overline{RDY/Busy}^{*3}$	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	$\times$	$\times$	$V_{IH}$	$\times$	—	—
	$\times$	$V_{IL}$	$\times$	$\times$	—	—
Data polling	$V_{IL}$	$V_{IL}$	$V_{IH}$	$V_H$	$V_{OL}$	Data out (I/O7)
Program reset	$\times$	$\times$	$\times$	$V_{IL}$	High-Z	High-Z

- Notes: 1. Refer to the recommended DC operating condition.  
 2.  $\times$ : Don't care  
 3. This function is supported by only the HN58V267A series.

## 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 <sup>*1</sup> to +7.0 <sup>*3</sup>	V
Operating temperature range <sup>*2</sup>	$T_{opr}$	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  
 3. Should not exceed  $V_{CC} + 1.0$  V.

## 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 <sup>*1</sup>	—	0.6	V
	$V_{IH}$	1.9 <sup>*2</sup>	—	$V_{CC} + 0.3^{*3}$	V
	$V_H^{*4}$	$V_{CC} - 0.5$	—	$V_{CC} + 1.0$	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 for  $V_{CC} = 3.6$  to 5.5 V is 2.4 V.  
 3.  $V_{IH}$  max:  $V_{CC} + 1.0$  V for pulse width  $\leq$  50 ns.  
 4. This function is supported by only the HN58V257A series.

## HN58V256A Series, HN58V257A Series

### DC Characteristics (Ta = 0 to +70°C, V<sub>CC</sub> = 2.7 to 5.5 V)

Parameter	Symbol	Min	Typ	Max	Unit	Test conditions
Input leakage current	I <sub>LI</sub>	—	—	2* <sup>1</sup>	μA	V <sub>CC</sub> = 5.5 V, Vin = 5.5 V
Output leakage current	I <sub>LO</sub>	—	—	2	μA	V <sub>CC</sub> = 5.5 V, Vout = 5.5/0.4 V
Standby V <sub>CC</sub> current	I <sub>CC1</sub>	—	—	20	μA	$\overline{CE} = V_{CC}$
	I <sub>CC2</sub>	—	—	1	mA	$\overline{CE} = V_{IH}$
Operating V <sub>CC</sub> current	I <sub>CC3</sub>	—	—	8	mA	Iout = 0 mA, Duty = 100%, Cycle = 1 μs, V <sub>CC</sub> = 3.6 V
				12	mA	Iout = 0 mA, Duty = 100%, Cycle = 1 ns, V <sub>CC</sub> = 5.5 V
				12	mA	Iout = 0 mA, Duty = 100%, Cycle = 120 μs, V <sub>CC</sub> = 3.6 V
				30	mA	Iout = 0 mA, Duty = 100%, Cycle = 120 ns, V <sub>CC</sub> = 5.5 V
Output low voltage	V <sub>OL</sub>	—	—	0.4	V	I <sub>OL</sub> = 2.1 mA
Output high voltage	V <sub>OH</sub>	V <sub>CC</sub> × 0.8	—	—	V	I <sub>OH</sub> = -400 μA

Note: 1. I<sub>LI</sub> on RES = 100 μA max (only the HN58V257A series)

### Capacitance (Ta = +25°C, f = 1 MHz)

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

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

**AC Characteristics** (Ta = 0 to +70°C, V<sub>CC</sub> = 2.7 to 5.5 V)

**Test Conditions**

- Input pulse levels: 0.4 V to 2.4 V (V<sub>CC</sub> ≤ 3.6V), 0.4V to 3.0 V (V<sub>CC</sub> > 3.6 V), 0 V to V<sub>CC</sub> ( $\overline{\text{RES}}$  pin<sup>\*2</sup>)
- Input rise and fall time: ≤ 5 ns
- Input timing reference levels: 0.8, 1.8 V
- Output load: 1TTL Gate +100 pF
- Output reference levels: 1.5 V, 1.5 V

**Read Cycle**

HN58V256A/HN58V257A					
-12					
Parameter	Symbol	Min	Max	Unit	Test conditions
Address to output delay	t <sub>ACC</sub>	—	120	ns	$\overline{\text{CE}} = \overline{\text{OE}} = V_{\text{IL}}, \overline{\text{WE}} = V_{\text{IH}}$
$\overline{\text{CE}}$ to output delay	t <sub>CE</sub>	—	120	ns	$\overline{\text{OE}} = V_{\text{IL}}, \overline{\text{WE}} = V_{\text{IH}}$
$\overline{\text{OE}}$ to output delay	t <sub>OE</sub>	10	60	ns	$\overline{\text{CE}} = V_{\text{IL}}, \overline{\text{WE}} = V_{\text{IH}}$
Address to output hold	t <sub>OH</sub>	0	—	ns	$\overline{\text{CE}} = \overline{\text{OE}} = V_{\text{IL}}, \overline{\text{WE}} = V_{\text{IH}}$
$\overline{\text{OE}}$ ( $\overline{\text{CE}}$ ) high to output float <sup>*1</sup>	t <sub>DF</sub>	0	40	ns	$\overline{\text{CE}} = V_{\text{IL}}, \overline{\text{WE}} = V_{\text{IH}}$
$\overline{\text{RES}}$ low to output float <sup>*1,2</sup>	t <sub>DFR</sub>	0	350	ns	$\overline{\text{CE}} = \overline{\text{OE}} = V_{\text{IL}}, \overline{\text{WE}} = V_{\text{IH}}$
$\overline{\text{RES}}$ to output delay <sup>*2</sup>	t <sub>RR</sub>	0	600	ns	$\overline{\text{CE}} = \overline{\text{OE}} = V_{\text{IL}}, \overline{\text{WE}} = V_{\text{IH}}$

Write Cycle

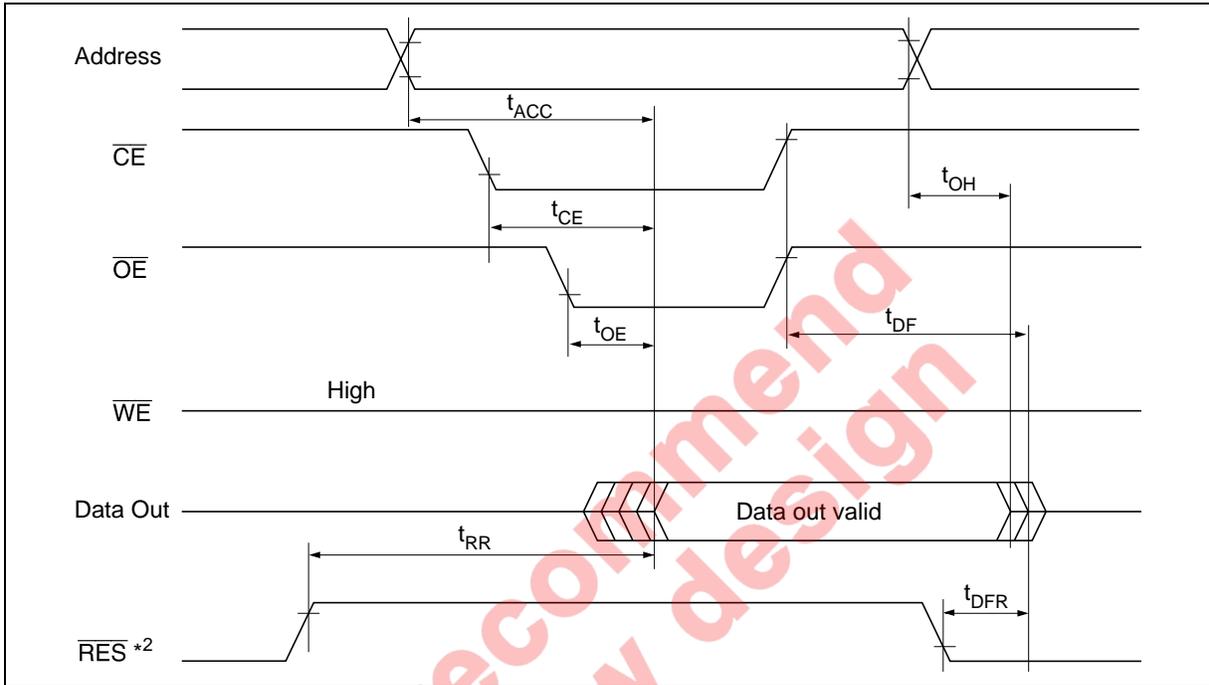
Parameter	Symbol	Min* <sup>3</sup>	Typ	Max	Unit	Test conditions
Address setup time	$t_{AS}$	0	—	—	ns	
Address hold time	$t_{AH}$	50	—	—	ns	
$\overline{CE}$ to write setup time ( $\overline{WE}$ controlled)	$t_{CS}$	0	—	—	ns	
$\overline{CE}$ hold time ( $\overline{WE}$ controlled)	$t_{CH}$	0	—	—	ns	
$\overline{WE}$ 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	$t_{DS}$	70	—	—	ns	
Data hold time	$t_{DH}$	0	—	—	ns	
$\overline{WE}$ pulse width ( $\overline{WE}$ controlled)	$t_{WIP}$	200	—	—	ns	
$\overline{CE}$ pulse width ( $\overline{CE}$ controlled)	$t_{CW}$	200	—	—	ns	
Data latch time	$t_{DL}$	100	—	—	ns	
Byte load cycle	$t_{BLC}$	0.3	—	30	$\mu$ s	
Byte load window	$t_{BL}$	100	—	—	$\mu$ s	
Write cycle time	$t_{WC}$	—	—	$10^{*4}$	ms	
Time to device busy	$t_{DB}$	120	—	—	ns	
Write start time	$t_{DW}$	$0^{*5}$	—	—	ns	
Reset protect time* <sup>2</sup>	$t_{RP}$	100	—	—	$\mu$ s	
Reset high time* <sup>2,6</sup>	$t_{RES}$	1	—	—	$\mu$ 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.

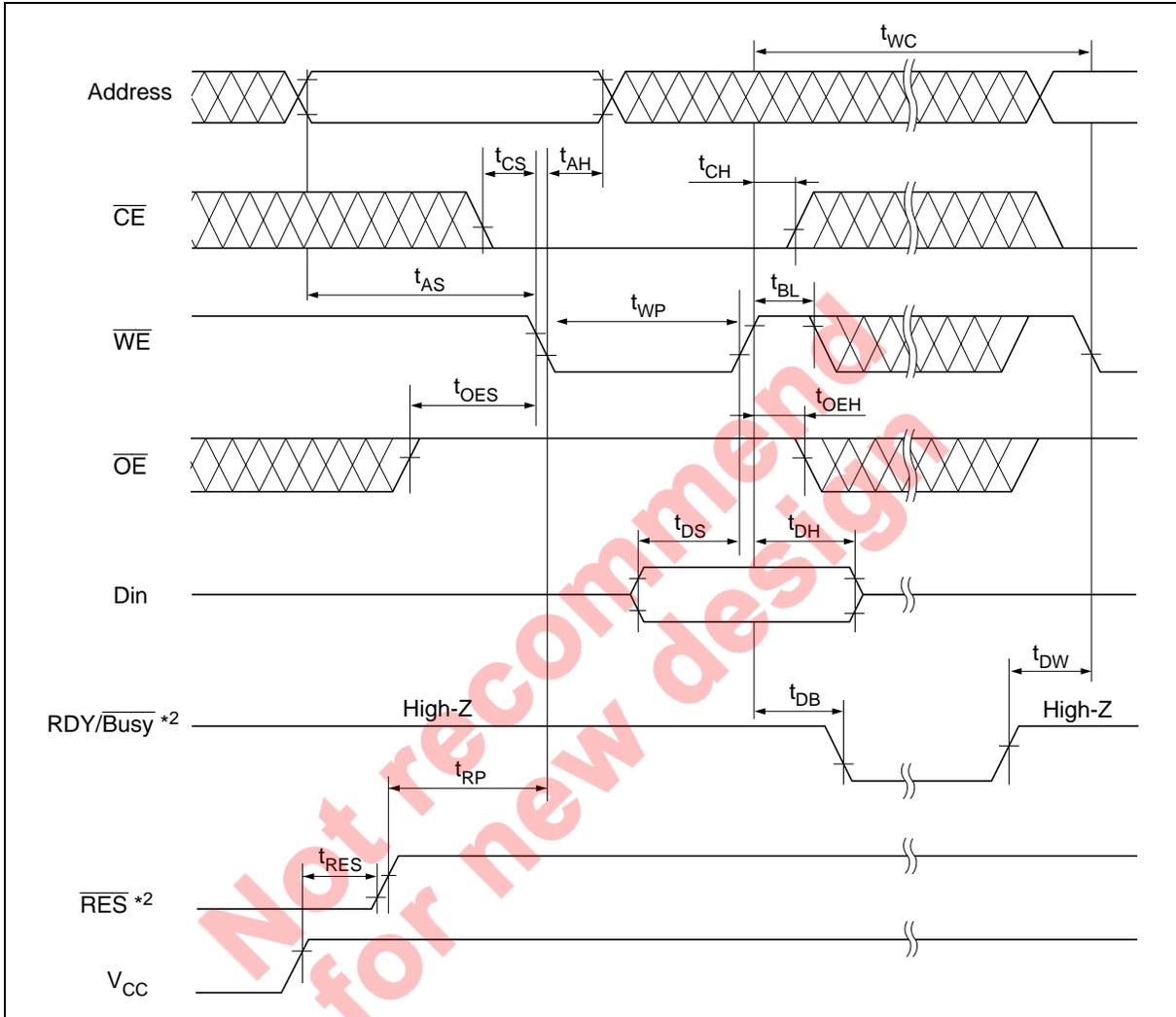
2. This function is supported by only the HN58V257A series.
3. Use this device in longer cycle than this value.
4.  $t_{WC}$  must be longer than this value unless polling techniques or RDY/ $\overline{Busy}$  (only the HN58V257A series) are used. This device automatically completes the internal write operation within this value.
5. Next read or write operation can be initiated after  $t_{DW}$  if polling techniques or RDY/ $\overline{Busy}$  (only the HN58V257A series) are used.
6. This parameter is sampled and not 100% tested.
7. A6 through A14 are page addresses and these addresses are latched at the first falling edge of  $\overline{WE}$ .
8. A6 through A14 are page addresses and these addresses are latched at the first falling edge of  $\overline{CE}$ .
9. See AC read characteristics.

## Timing Waveforms

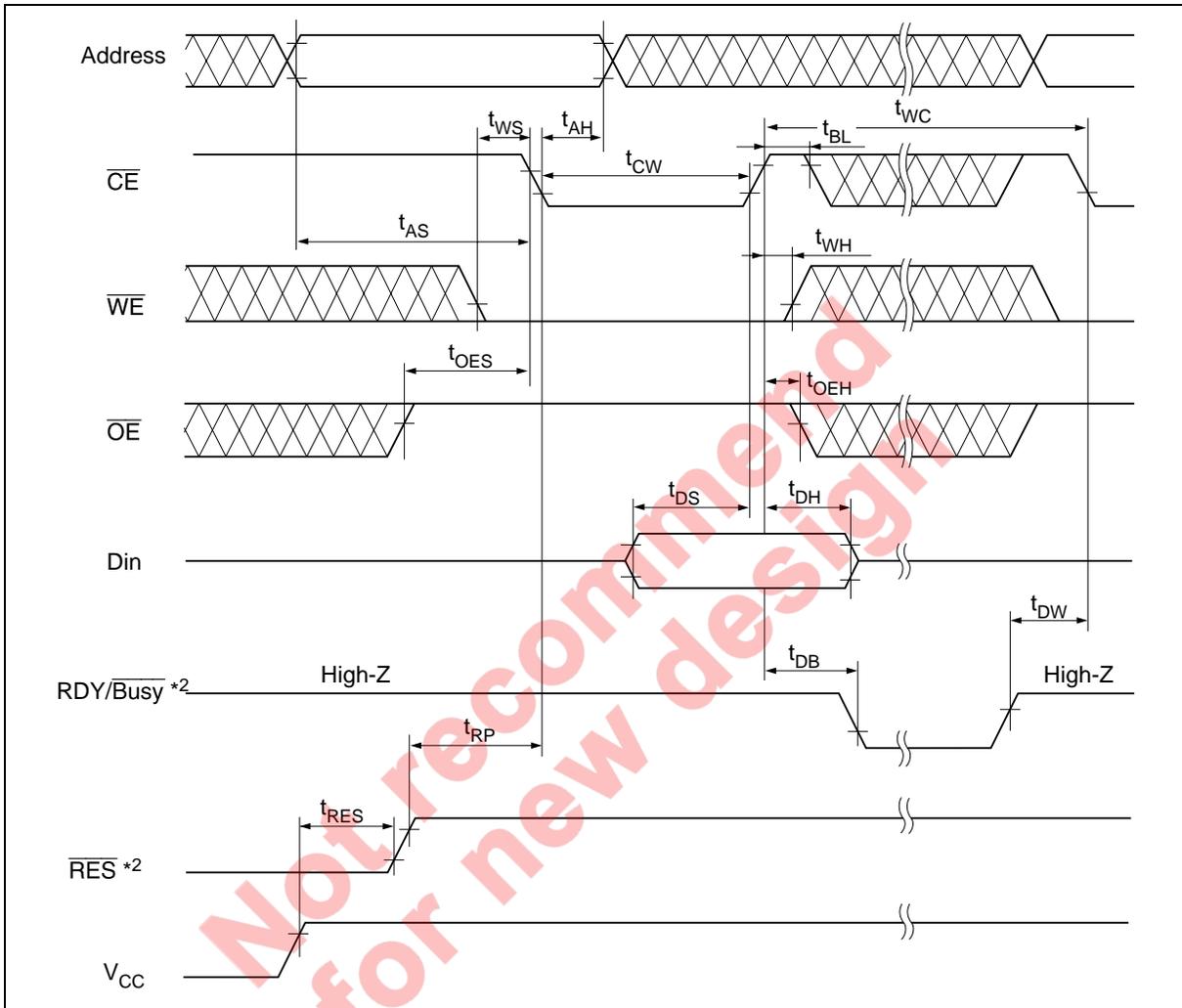
### Read Timing Waveform



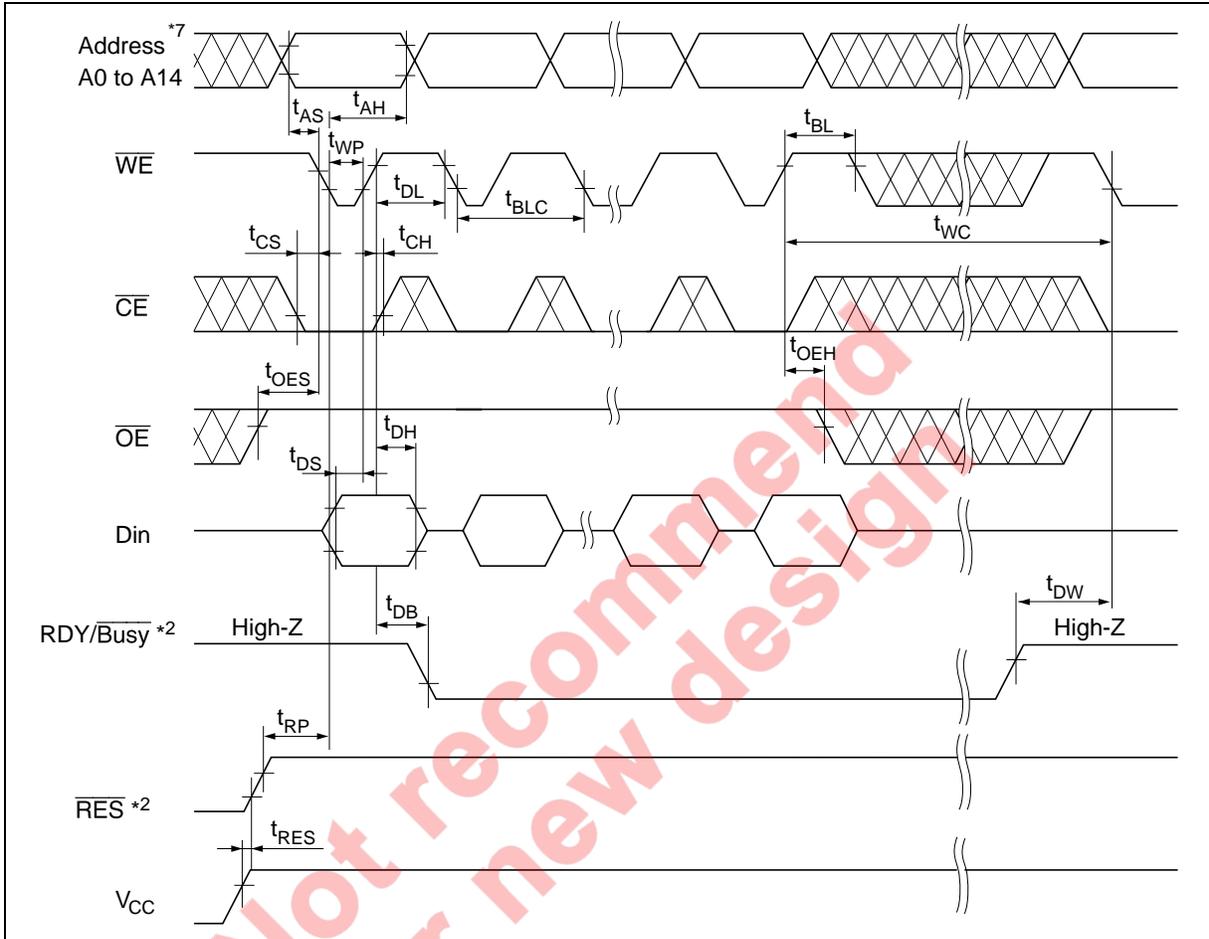
Byte Write Timing Waveform (1) ( $\overline{WE}$  Controlled)



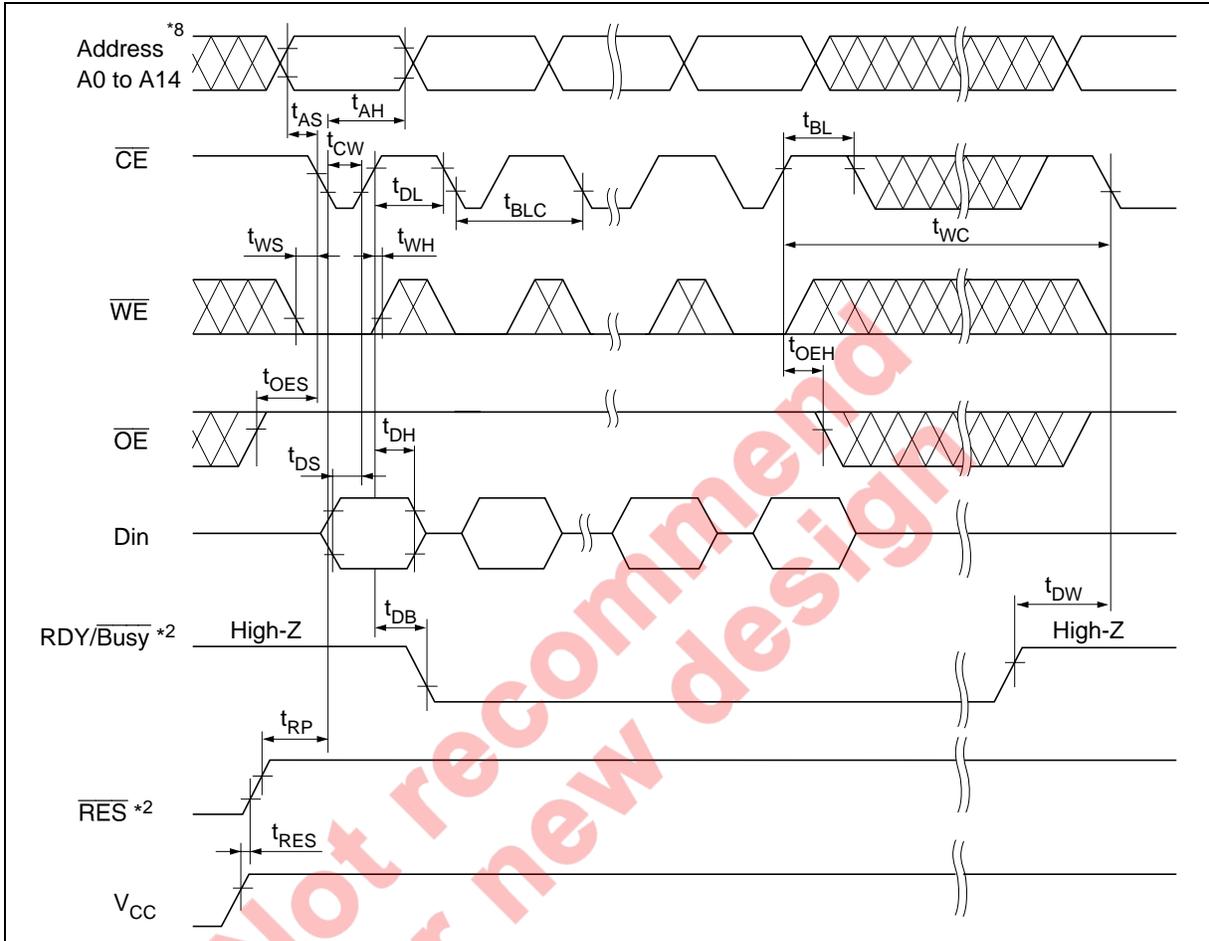
Byte Write Timing Waveform (2) ( $\overline{\text{CE}}$  Controlled)



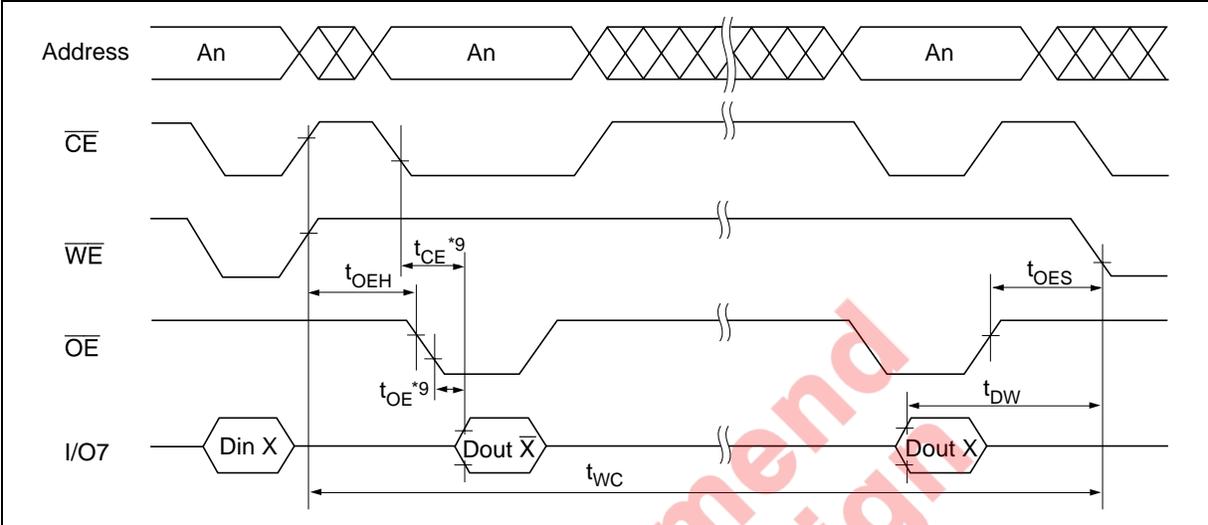
Page Write Timing Waveform (1) ( $\overline{WE}$  Controlled)



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



Data Polling Timing Waveform



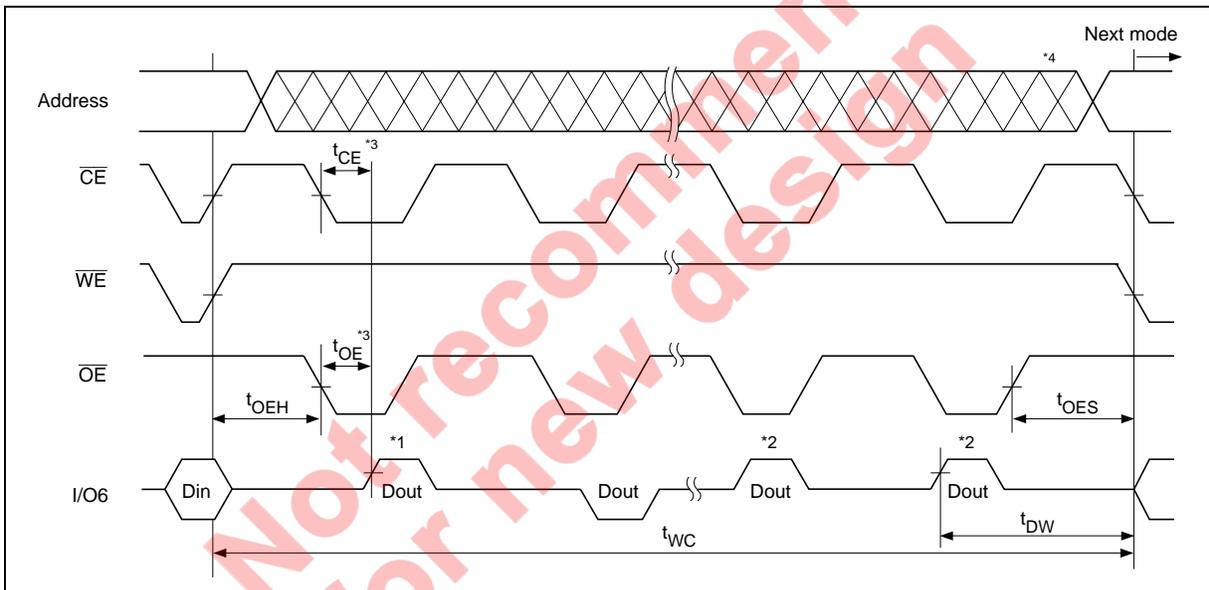
Not recommended for new designs

**Toggle bit**

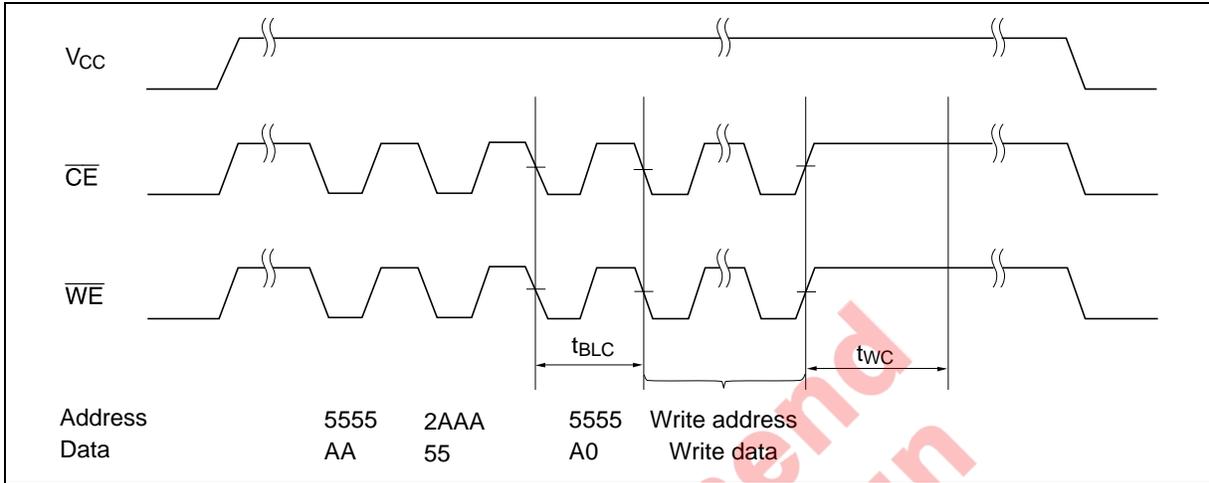
This device provide another function to determine the internal programming cycle. If the EEPROM is set to read mode during the internal programming cycle, I/O6 will change from “1” to “0” (toggling) for each read. When the internal programming cycle is finished, toggling of I/O6 will stop and the device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

**Toggle bit Waveform**

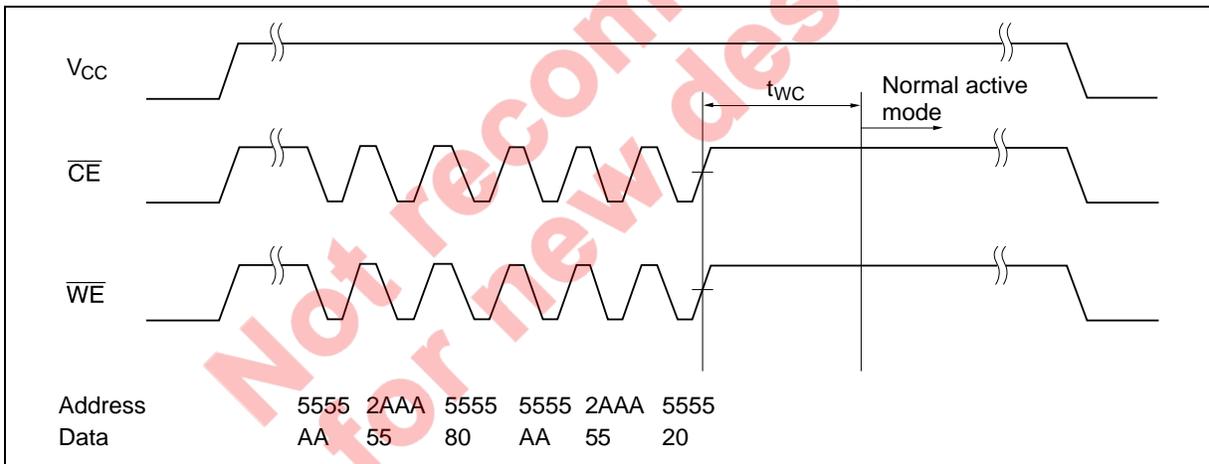
- Notes: 1. I/O6 beginning state is “1”.  
 2. I/O6 ending state will vary.  
 3. See AC read characteristics.  
 4. Any address location can be used, but the address must be fixed.



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 64 bytes of data to be written into the EEPROM in a single write cycle. Following the initial byte cycle, an additional 1 to 63 bytes can be written in the same manner. Each additional byte load cycle must be started within 30  $\mu$ s from the preceding falling edge of  $\overline{WE}$  or  $\overline{CE}$ . When  $\overline{CE}$  or  $\overline{WE}$  is high for 100  $\mu$ s after data input, the EEPROM enters write mode automatically and the input data are written into the EEPROM.

### Data Polling

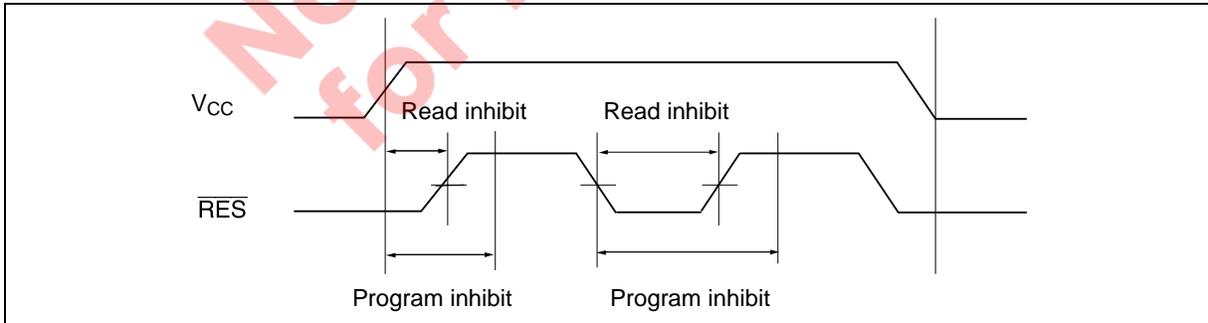
Data polling indicates the status that the EEPROM is in a write cycle or not. If EEPROM is set to read mode during a write cycle, an inversion of the last byte of data outputs from I/O7 to indicate that the EEPROM is performing a write operation.

### RDY/ $\overline{Busy}$ Signal (only the HN58V257A series)

RDY/ $\overline{Busy}$  signal also allows the status of the EEPROM to be determined. The 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 a write cycle, the RDY/ $\overline{Busy}$  signal changes state to high impedance.

### $\overline{RES}$ Signal (only the HN58V257A series)

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.



### $\overline{\text{WE}}$ , $\overline{\text{CE}}$ Pin Operation

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

### Write/Erase Endurance and Data Retention Time

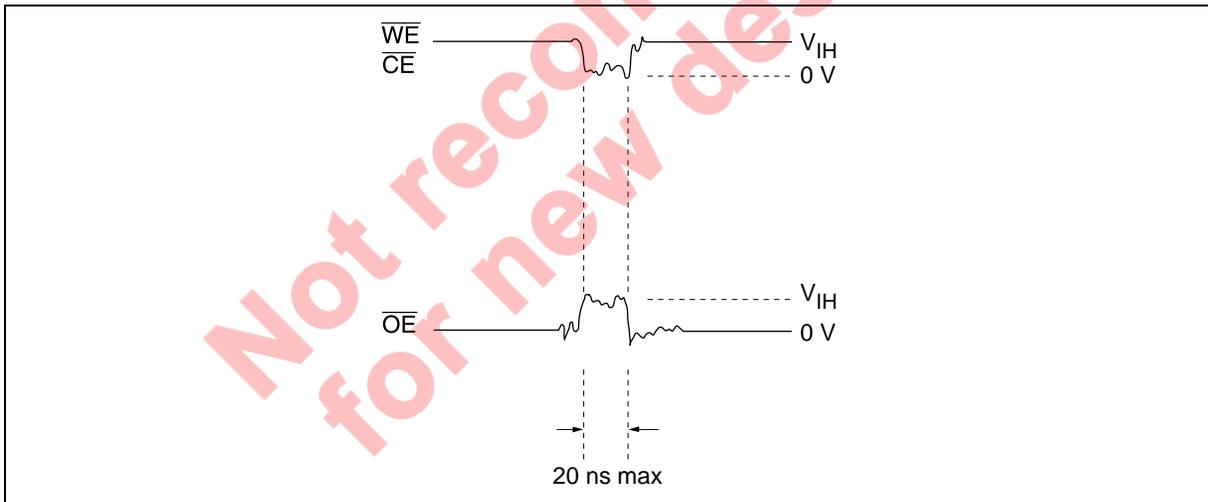
The endurance is  $10^5$  cycles in case of the page programming and  $10^4$  cycles in case of the byte programming (1% cumulative failure rate). The data retention time is more than 10 years when a device is page-programmed less than  $10^4$  cycles.

### Data Protection

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

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

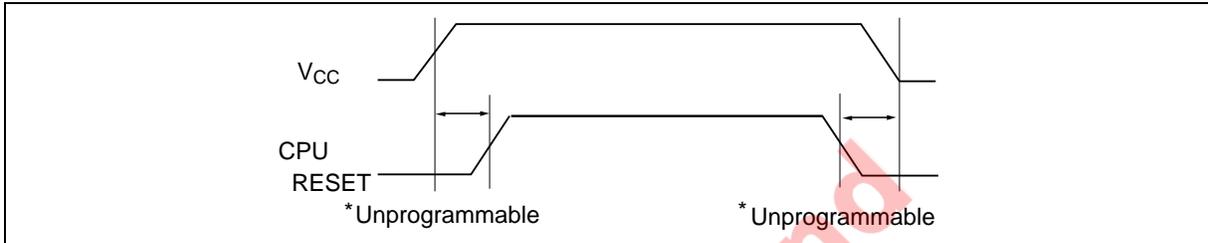


## HN58V256A Series, HN58V257A Series

### 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 $\overline{CE}$ , $\overline{OE}$ , $\overline{WE}$

To realize the unprogrammable state, the input level of control pins must be held as shown in the table below.

$\overline{CE}$	$V_{CC}$	×	×
$\overline{OE}$	×	$V_{SS}$	×
$\overline{WE}$	×	×	$V_{CC}$

×: Don't care.

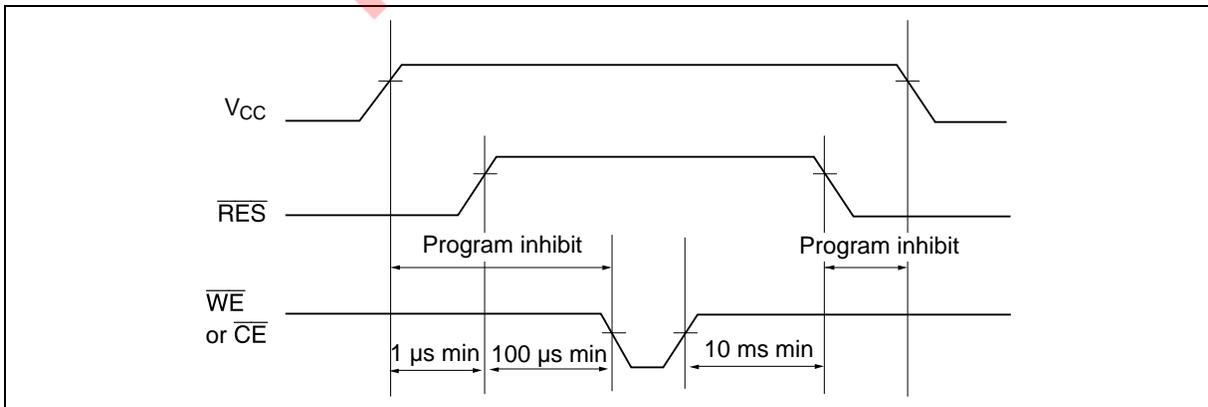
$V_{CC}$ : Pull-up to  $V_{CC}$  level.

$V_{SS}$ : Pull-down to  $V_{SS}$  level.

#### 2.2 Protection by $\overline{RES}$ (only the HN58V257A series)

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.

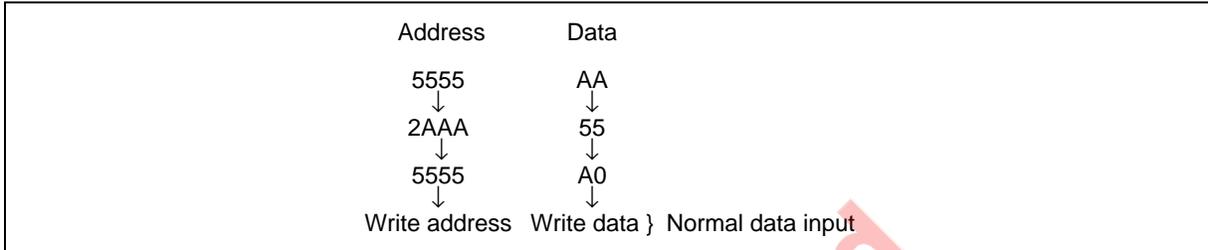
The EEPROM breaks off programming operation when  $\overline{RES}$  becomes low, programming operation doesn't finish correctly in case that  $\overline{RES}$  falls low during programming operation.  $\overline{RES}$  should be kept high for 10 ms after the last data input.



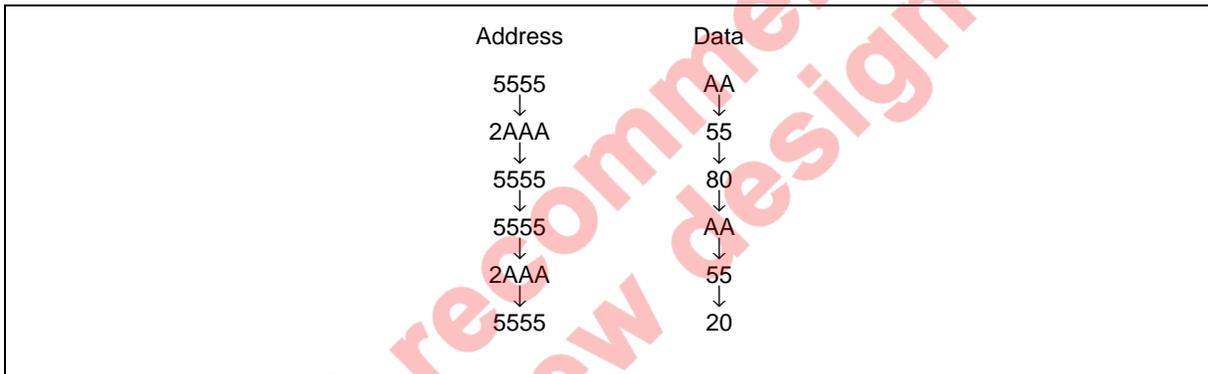
## HN58V256A Series, HN58V257A Series

### 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.

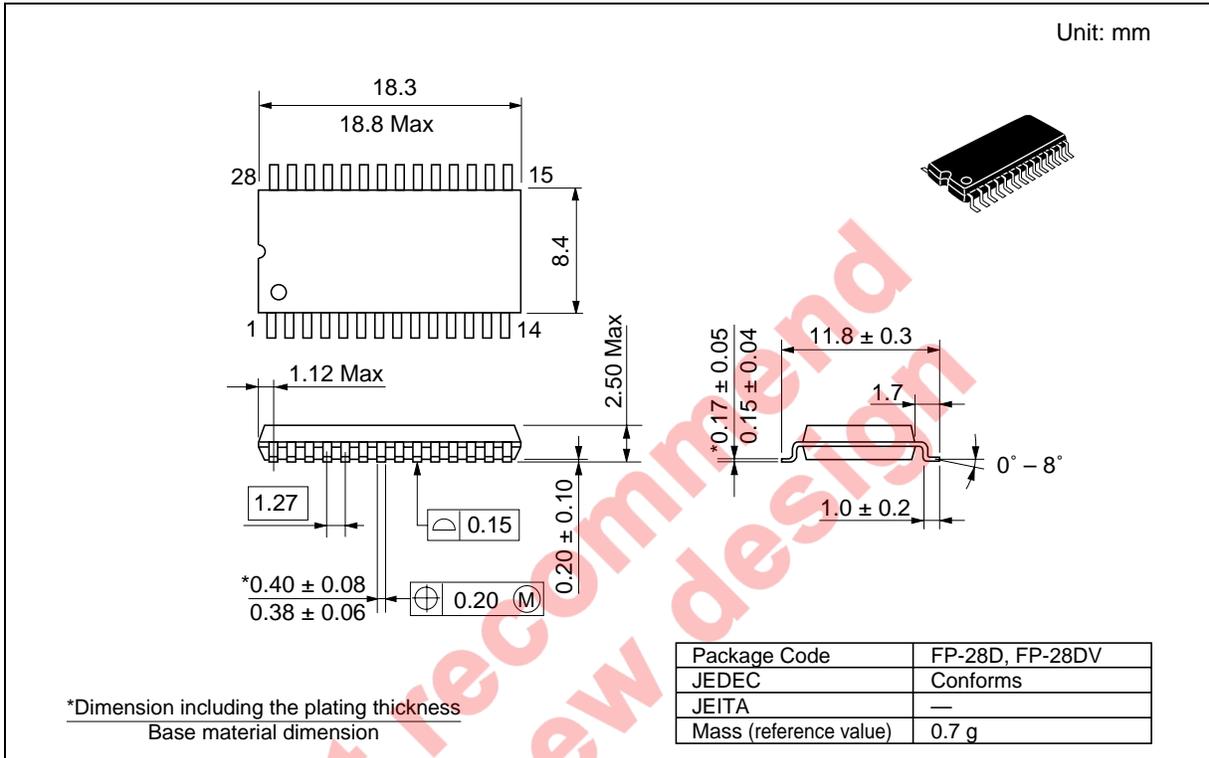


The software data protection is not enabled at the shipment.

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 Renesas Technology's sales offices.

Package Dimensions

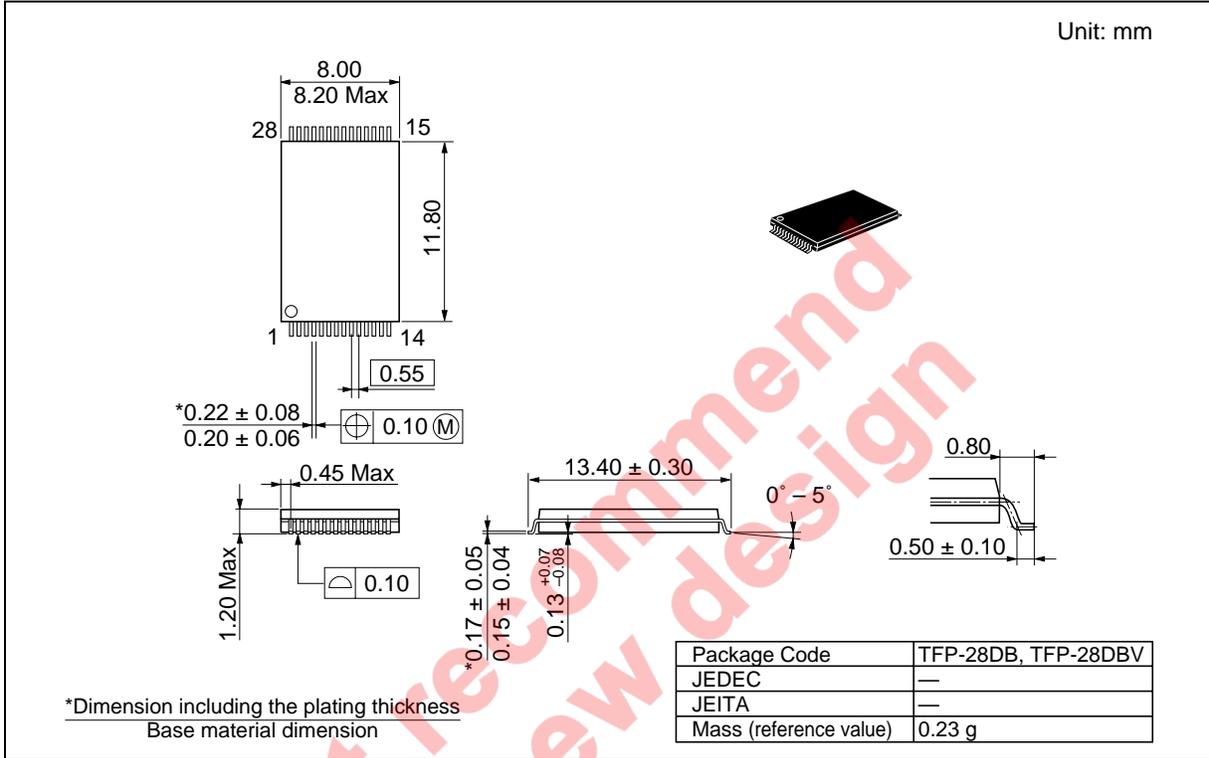
HN58V256AFP Series (FP-28D, FP-28DV)



HN58V256A Series, HN58V257A Series

Package Dimensions (cont.)

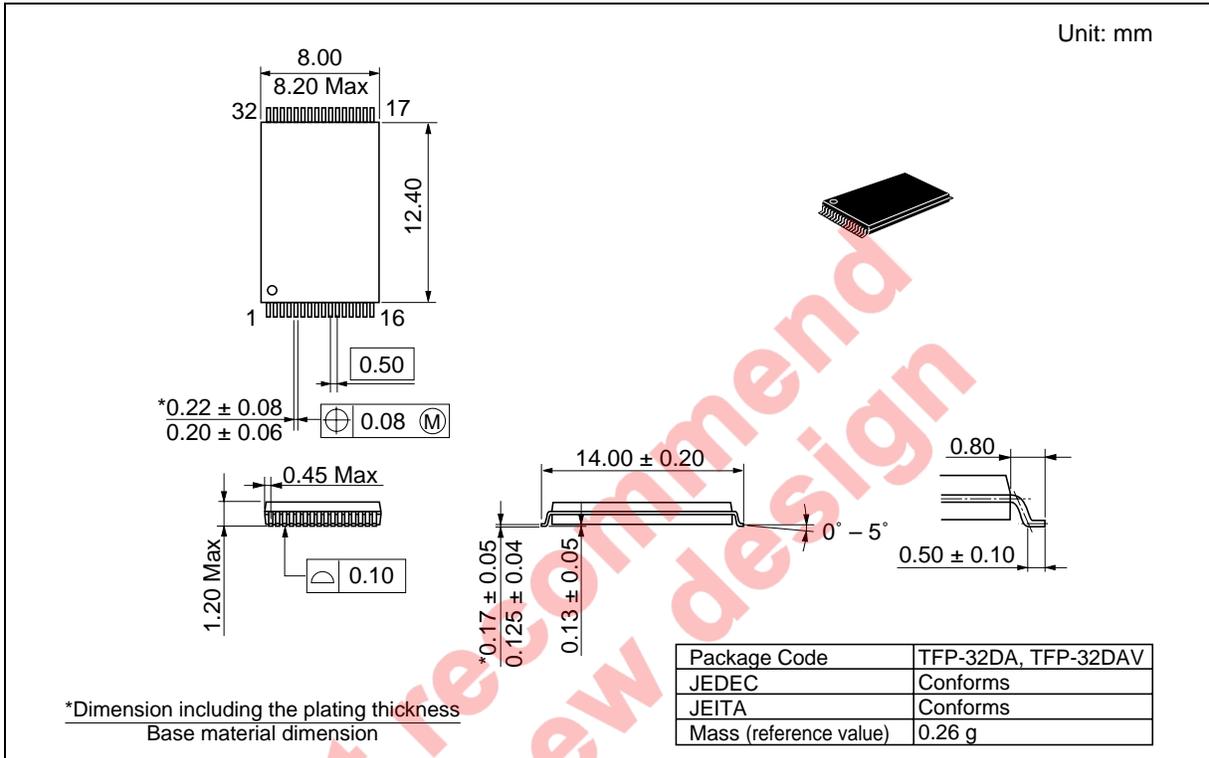
HN58V256AT Series (TFP-28DB, TFP-28DBV)



HN58V256A Series, HN58V257A Series

Package Dimensions (cont.)

HN58V257AT Series (TFP-32DA, TFP-32DAV)



## Revision History

## HN58V256A/HN58V257A Series Data Sheet

Rev.	Date	Contents of Modification	
		Page	Description
0.0	Mar. 15. 1995	—	Initial issue
0.1	Aug. 7. 1995	—	Determination of package type: — HN58V256AT series (TFP-28DB) — Deletion of HN58V256AP series (DP-28) — Deletion of HN58V256AFPI-12/15 — Deletion of HN58V256AT-12SR/15SR — Deletion of HN58V257AT-12SR/15SR
		4	Absolute Maximum Rating Deletion of Device Group Deletion of Operating temperature range – 20 to + 85°C and – 40 to +85°C
		4	Recommended DC Operating Conditions Deletion of Device Group Deletion of Operating temperature range –20/—/85°C and –40/—/85°C Deletion of note 4 Change order of notes
1.0	Apr. 12. 1995	—	Change of format
		2	Operating Information Deletion of HN58V256A-15 and HN58V257A-15 Deletion of note 1 Deletion of Compatible type No. Deletion of Operating temperature range
		3	Pin Description Addition of note 1
		3	Block Diagram Addition of note 1
		—	Mode Selection Addition of note 3
		4	Absolute Maximum Ratings Addition of note 4
		4	Recommended DC operating Condition $V_{IH}$ (min) 2.4 V to 1.9 V Addition of note 4
		5	DC Characteristics $I_{CC3}$ (max): 8/12/20/30 mA to 8/12/15/30 mA
		6	AC Characteristics Test condition: Input pulse levels: 0 V to 3.0 V to 0.4 V to 2.4 V ( $V_{CC} \leq 3.6$ V), 0.4 V to 3.0 V ( $V_{CC} > 3.6$ V) Addition of note 2 Read Timing Waveform: Addition of note 1 Write Cycle: $t_{DS}$ (min): 50 ns to 70 ns Addition of note 4, 5 Byte Write Timing Waveform (1) and (2): Addition of note 1 Page Write Timing Waveform (1) and (2): Addition of note 2

## Revision Record (cont.)

Rev.	Date	Contents of Modification	
		Page	Description
1.0	Apr. 12. 1995	6	Timing Waveforms Data Polling Timing Waveform: Addition of note 1 Toggle bit Waveform: Addition of note 4
		16	Functional Description Data Protection 2-(2) Addition of figure
2.0	Mar. 4. 1997	16	Functional Description Data protection 3: Addition of note
3.0	May. 20. 1997	16	Functional Description Data protection 3: Change of Description
4.0	Oct. 24. 1997	8	Timing Waveforms Read Timing Waveform: Correct error
5.00	Nov. 17. 2003	— 2 20-22	Change format issued by Renesas Technology Corp. Ordering Information Addition of HN58V256AFP-12E, HN58V256AT-12E, HN58V257AT-12E Package Dimensions FP-28D to FP-28D, FP-28DV TFP-28DB to TFP-28DB, TFP-28DBV TFP-32DA to TFP-32DA, TFP-32DAV

Not recommended  
for new design

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To our customers,

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April 1<sup>st</sup>, 2010  
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