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# HN27C101AG Series

# HN27C301AG Series

131072-word × 8-bit CMOS UV Erasable and Programmable  
ROM

# HITACHI

ADE-203-  
Rev. 0.0  
Dec. 1, 1995

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## Description

The Hitachi HN27C101AG/HN27C301AG is a 1-Mbit ultraviolet erasable and electrically programmable ROM. This device is packaged in a 32-pin dual-in-line package with transparent lid. The transparent lid allows the memory content to be erased with ultraviolet light, whereby a new pattern can then be written into the device.

## Features

- Single power supply:
  - +5 V ± 5% (HN27C101AG-10/HN27C301AG-10)
  - +5 V ± 10% (HN27C101AG/HN27C301AG-12/15/17/20/ 25)
- Fast high-reliability programming mode and fast high-reliability page programming mode
  - Programming voltage: +12.5 V DC
  - Fast high-reliability page programming: 14 sec typ
- High speed inputs and outputs TTL compatible during both read and program modes
- Low power dissipation: 50 mW/MHz typ (active)  
5 μW typ (standby)
- Pin arrangement : 32-pin JEDEC standard (HN27C101AG)  
: replaceable 32 pin MASK ROM (HN27C301AG)
- Device identifier mode: manufacturer code and device code
- Fully compatible with HN27C101G/ HN27C301G series

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## HN27C101AG/HN27C301AG Series

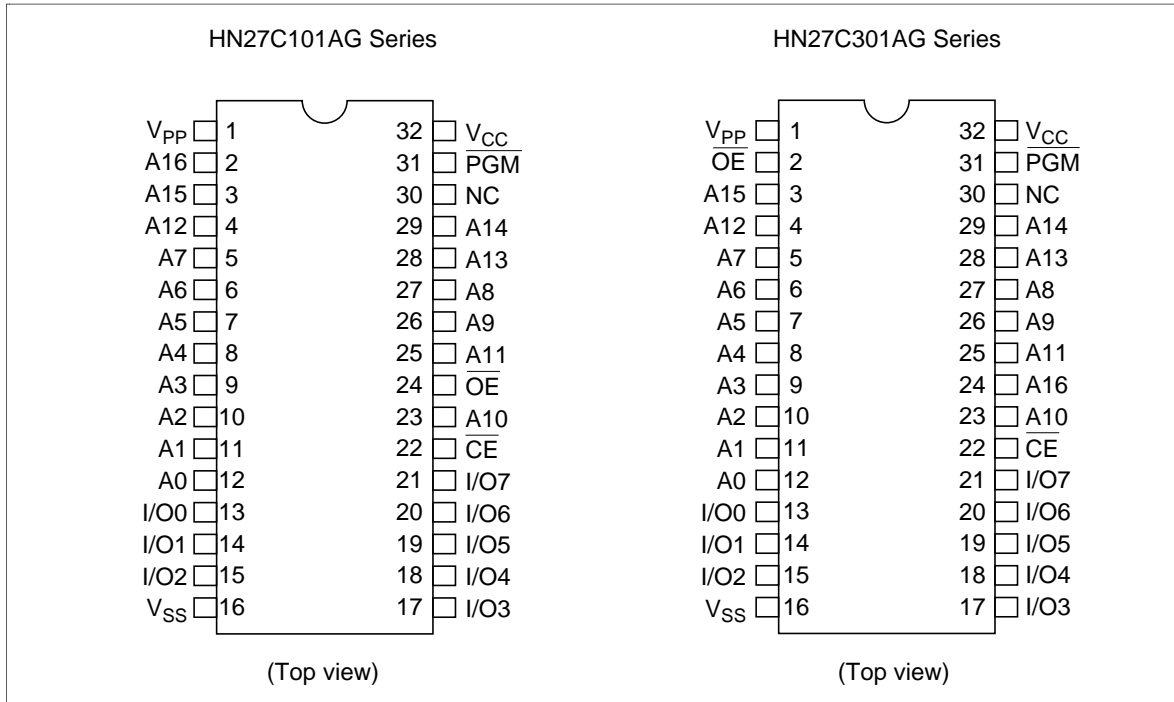
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### Ordering Information

Type No.	Access Time	Package
HN27C101AG-10	100 ns	600-mil 32-pin cerdip (DG-32)
HN27C101AG-12	120 ns	
HN27C101AG-15	150 ns	
HN27C101AG-17	170 ns	
HN27C101AG-20	200 ns	
HN27C101AG-25	250 ns	
HN27C301AG-10	100 ns	
HN27C301AG-12	120 ns	
HN27C301AG-15	150 ns	
HN27C301AG-17	170 ns	
HN27C301AG-20	200 ns	
HN27C301AG-25	250 ns	

## HN27C101AG/HN27C301AG Series

### Pin Arrangement

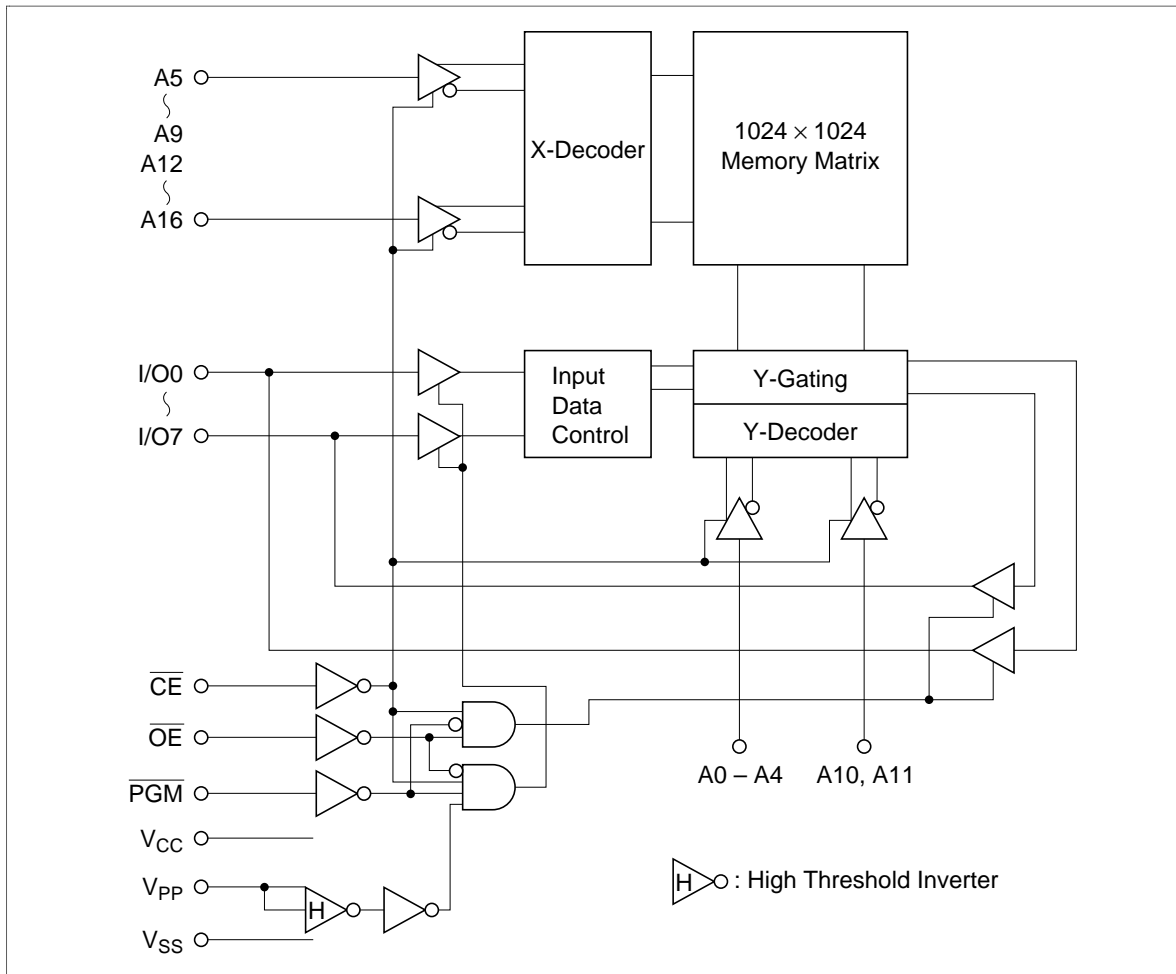


### Pin Description

Pin Name	Function
A0 – A16	Address
I/O0 – I/O7	Input/output
$\overline{CE}$	Chip enable
$\overline{OE}$	Output enable
V <sub>CC</sub>	Power supply
V <sub>PP</sub>	Programming power supply
V <sub>SS</sub>	Ground
PGM	Programming enable
NC	No connection

# HN27C101AG/HN27C301AG Series

## Block Diagram



## HN27C101AG/HN27C301AG Series

### Mode Selection

Mode	$\overline{\text{CE}}$	$\overline{\text{OE}}$	$\overline{\text{PGM}}$	A9	$V_{PP}$	$V_{CC}$	I/O
<b>HN27C101AG</b>	<b>(22)</b>	<b>(24)</b>	<b>(31)</b>	<b>(26)</b>	<b>(1)</b>	<b>(32)</b>	<b>(13 – 15, 17 – 21)</b>
<b>HN27C301AG</b>	<b>(22)</b>	<b>(2)</b>	<b>(31)</b>	<b>(26)</b>	<b>(1)</b>	<b>(32)</b>	<b>(13 – 15, 17 – 21)</b>
Read	$V_{IL}$	$V_{IL}$	$V_{IH}$	X	$V_{CC}$	$V_{CC}$	Dout
Output disable	$V_{IL}$	$V_{IH}$	$V_{IH}$	X	$V_{CC}$	$V_{CC}$	High-Z
Standby	$V_{IH}$	X	X	X	$V_{CC}$	$V_{CC}$	High-Z
Program	$V_{IL}$	$V_{IH}$	$V_{IL}$	X	$V_{PP}$	$V_{CC}$	Din
Program verify	$V_{IL}$	$V_{IL}$	$V_{IH}$	X	$V_{PP}$	$V_{CC}$	Dout
Page data latch	$V_{IH}$	$V_{IL}$	$V_{IH}$	X	$V_{PP}$	$V_{CC}$	Din
Page program	$V_{IH}$	$V_{IH}$	$V_{IL}$	X	$V_{PP}$	$V_{CC}$	High-Z
Program inhibit	$V_{IL}$	$V_{IL}$	$V_{IL}$	X	$V_{PP}$	$V_{CC}$	High-Z
	$V_{IL}$	$V_{IH}$	$V_{IH}$				
	$V_{IH}$	$V_{IL}$	$V_{IL}$				
	$V_{IH}$	$V_{IH}$	$V_{IH}$				
Identifier	$V_{IL}$	$V_{IL}$	$V_{IH}$	$V_H$	$V_{CC}$	$V_{CC}$	Code

- Notes: 1. X: Don't care  
 2.  $V_H$ : 12.0 V  $\pm$  0.5 V

### Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
All input and output voltages*1	$V_{in}, V_{out}$	-0.6*2 to +7.0	V
A9 input voltage*1	$V_{ID}$	-0.6*2 to +13.5	V
$V_{PP}$ voltage*1	$V_{PP}$	-0.6 to +13.5	V
$V_{CC}$ voltage*1	$V_{CC}$	-0.6 to +7.0	V
Operating temperature range	$T_{opr}$	0 to +70	°C
Storage temperature range	$T_{stg}$	-65 to +125	°C
Storage temperature range under bias	$T_{bias}$	-10 to +80	°C

- Notes: 1. Relative to  $V_{SS}$   
 2.  $V_{in}, V_{out}$  and  $V_{ID}$  min = -1.0 V for pulse width  $\leq$  50 ns

### Capacitance ( $T_a = 25^\circ\text{C}$ , $f = 1$ MHz)

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Input capacitance	$C_{in}$	—	—	10	pF	$V_{in} = 0$ V
Output capacitance	$C_{out}$	—	—	15	pF	$V_{out} = 0$ V

## HN27C101AG/HN27C301AG Series

### Read Operation

**DC Characteristics** ( $V_{CC} = 5\text{ V} \pm 5\%$ ,  $V_{PP} = V_{CC}$ ,  $T_a = 0\text{ to }+70^\circ\text{C}$ ) (HN27C101AG/HN27C301AG-10)  
 ( $V_{CC} = 5\text{ V} \pm 10\%$ ,  $V_{PP} = V_{CC}$ ,  $T_a = 0\text{ to }+70^\circ\text{C}$ )  
 (HN27C101AG/HN27C301AG-12/15/17/20/25)

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Input leakage current	$I_{LI}$	—	—	2	$\mu\text{A}$	$V_{in} = 0\text{ V to }V_{CC}$
Output leakage current	$I_{LO}$	—	—	2	$\mu\text{A}$	$V_{out} = 0\text{ V to }V_{CC}$
$V_{PP}$ current	$I_{PP1}$	—	1	20	$\mu\text{A}$	$V_{PP} = 5.5\text{ V}$
Standby $V_{CC}$ current	$I_{SB1}$	—	—	1	$\text{mA}$	$\overline{CE} = V_{IH}$
	$I_{SB2}$	—	1	20	$\mu\text{A}$	$\overline{CE} = V_{CC} \pm 0.3\text{ V}$
Operating $V_{CC}$ current	$I_{CC1}$	—	—	30	$\text{mA}$	$\overline{CE} = V_{IL}$ , $I_{out} = 0\text{ mA}$
	$I_{CC2}$	—	—	30	$\text{mA}$	$f = 5\text{ MHz}$ , $I_{out} = 0\text{ mA}$
		—	—	50	$\text{mA}$	$f = 10\text{ MHz}$ , $I_{out} = 0\text{ mA}$
Input low voltage	$V_{IL}$	$-0.3^{*1}$	—	0.8	$\text{V}$	
Input high voltage	$V_{IH}$	2.2	—	$V_{CC} + 1.0^{*2}$	$\text{V}$	
Output low voltage	$V_{OL}$	—	—	0.45	$\text{V}$	$I_{OL} = 2.1\text{ mA}$
Output high voltage	$V_{OH}$	2.4	—	—	$\text{V}$	$I_{OH} = -1\text{ mA}$
		$V_{CC} - 0.7$	—	—	$\text{V}$	$I_{OH} = -0.1\text{ mA}$

Notes: 1.  $V_{IL}$  min =  $-1.0\text{ V}$  for pulse width  $\leq 50\text{ ns}$

2.  $V_{IH}$  max =  $V_{CC} + 1.5\text{ V}$  for pulse width  $\leq 20\text{ ns}$

If  $V_{IH}$  is over the specified maximum value, read operation cannot be guaranteed.

## HN27C101AG/HN27C301AG Series

**AC Characteristics** ( $V_{CC} = 5\text{ V} \pm 5\%$ ,  $V_{PP} = V_{CC}$ ,  $T_a = 0\text{ to }+70^\circ\text{C}$ ) (HN27C101AG/HN27C301AG-10)  
 ( $V_{CC} = 5\text{ V} \pm 10\%$ ,  $V_{PP} = V_{CC}$ ,  $T_a = 0\text{ to }+70^\circ\text{C}$ )  
 (HN27C101AG/HN27C301AG-12/15/17/20/25)

### Test Conditions

- Input pulse levels: 0.45 V to 2.4 V
- Input rise and fall time:  $\leq 20\text{ ns}$
- Output load: 1 TTL gate +100 pF
- Reference levels for measuring timing: Inputs; 0.8 V and 2.0 V  
 Outputs; 0.8 V and 2.0 V

		HN27C101AG/HN27C301AG												Test	
		-10		-12		-15		-17		-20		-25			
Parameter	Symbol	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Unit	Conditions
Address to output delay	$t_{ACC}$	—	100	—	120	—	150	—	170	—	200	—	250	ns	$\overline{CE} = \overline{OE} = V_{IL}$
$\overline{CE}$ to output delay	$t_{CE}$	—	100	—	120	—	150	—	170	—	200	—	250	ns	$\overline{OE} = V_{IL}$
$\overline{OE}$ to output delay	$t_{OE}$	—	60	—	60	—	70	—	70	—	70	—	100	ns	$\overline{CE} = V_{IL}$
$\overline{OE}$ high to output float	$t_{DF}$	0	50	0	50	0	50	0	50	0	50	0	60	ns	$\overline{CE} = V_{IL}$
Address to output hold	$t_{OH}$	0	—	0	—	0	—	0	—	0	—	0	—	ns	$\overline{CE} = \overline{OE} = V_{IL}$

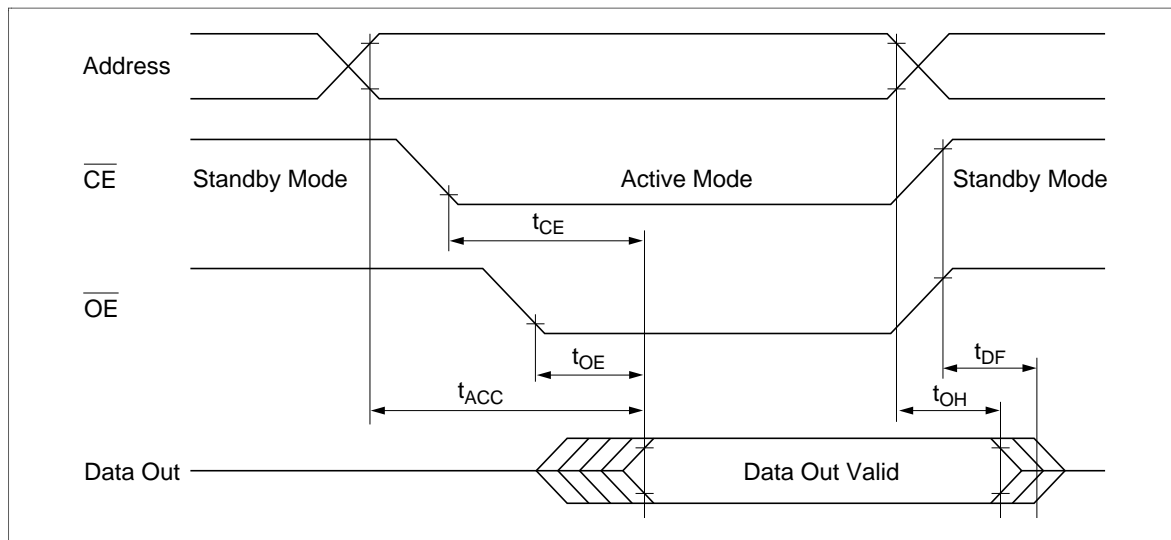
Note:  $t_{DF}$  is defined as the time at which the output achieves the open circuit condition and data is no longer driven.

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## HN27C101AG/HN27C301AG Series

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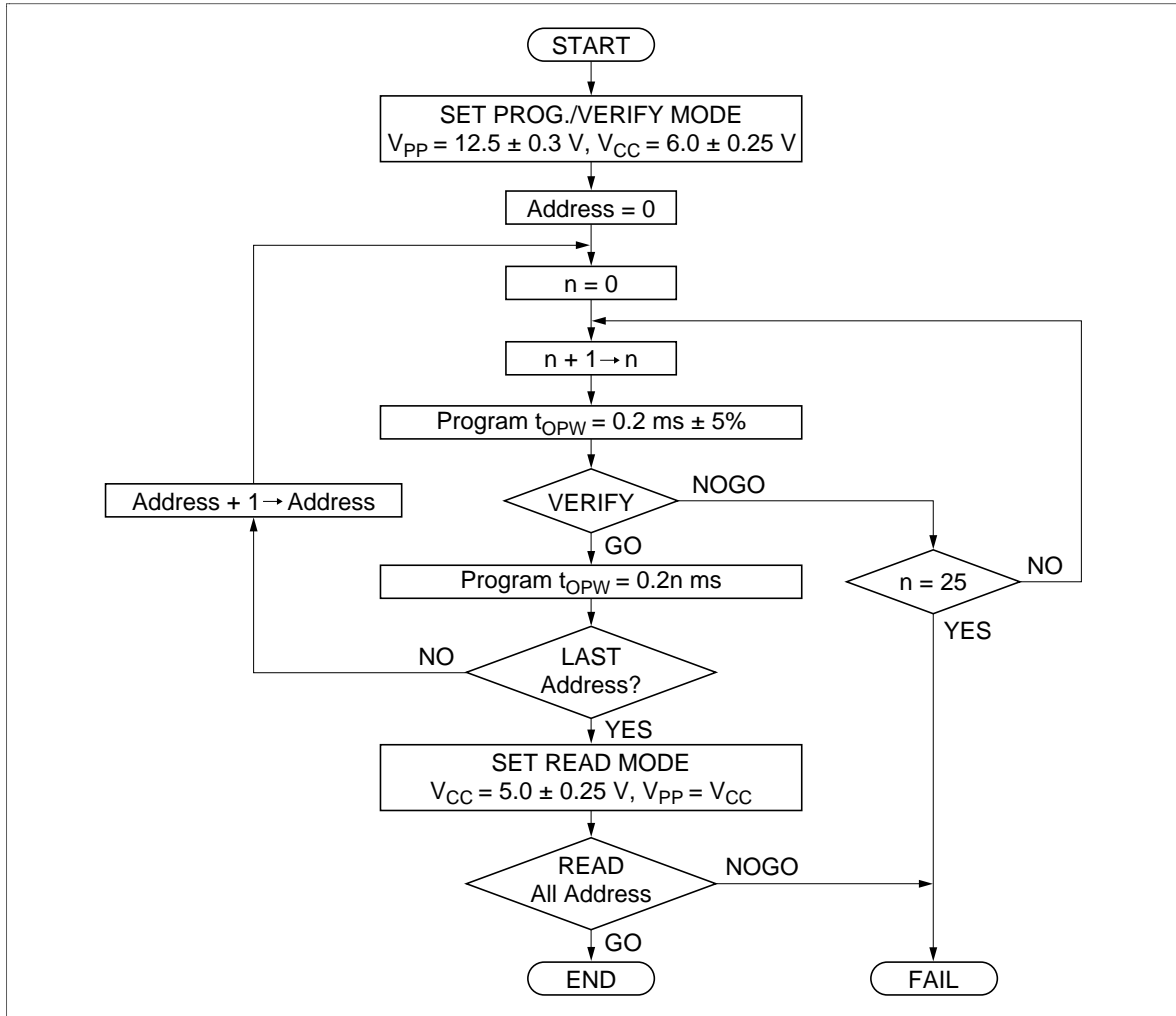
### Read Timing Waveform





**Fast High-Reliability Programming**

This device can be applied the programming algorithm shown in following flowchart. This algorithm allows to obtain faster programming time without any voltage stress to the device nor deterioration in reliability of programmed data.



**Fast High-Reliability Programming Flowchart**

## HN27C101AG/HN27C301AG Series

DC Characteristics ( $T_a = 25\text{ }^\circ\text{C} \pm 5^\circ\text{C}$ ,  $V_{CC} = 6\text{ V} \pm 0.25\text{ V}$ ,  $V_{PP} = 12.5\text{ V} \pm 0.3\text{ V}$ )

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Input leakage current	$I_{LI}$	—	—	2	$\mu\text{A}$	$V_{in} = 0\text{ V to } V_{CC}$
$V_{PP}$ supply current	$I_{PP}$	—	—	40	mA	$\overline{CE} = \overline{PGM} = V_{IL}$
Operating $V_{CC}$ current	$I_{CC}$	—	—	30	mA	
Input low level	$V_{IL}$	$-0.1^{*5}$	—	0.8	V	
Input high level	$V_{IH}$	2.2	—	$V_{CC} + 0.5^{*6}$	V	
Output low voltage during verify	$V_{OL}$	—	—	0.45	V	$I_{OL} = 2.1\text{ mA}$
Output high voltage during verify	$V_{OH}$	2.4	—	—	V	$I_{OH} = -400\text{ }\mu\text{A}$

- Notes:
1.  $V_{CC}$  must be applied simultaneously or before  $V_{PP}$  and removed simultaneously or after  $V_{PP}$ .
  2.  $V_{PP}$  must not exceed 13.5 V including overshoot.
  3. An influence may be had upon device reliability if the device is installed or removed while  $V_{PP} = 12.5\text{ V}$ .
  4. Do not alter  $V_{PP}$  either  $V_{IL}$  to 12.5 V or 12.5 V to  $V_{IL}$  when  $\overline{CE} = \text{Low}$ .
  5.  $V_{IL}$  min =  $-0.6\text{ V}$  for pulse width  $\leq 20\text{ ns}$
  6. If  $V_{IH}$  is over the specified maximum value, programming operation cannot be guaranteed.

## HN27C101AG/HN27C301AG Series

AC Characteristics ( $T_a = 25^\circ\text{C} \pm 5^\circ\text{C}$ ,  $V_{CC} = 6\text{ V} \pm 0.25\text{ V}$ ,  $V_{PP} = 12.5\text{ V} \pm 0.3\text{ V}$ )

### Test Conditions

- Input pulse levels: 0.45 V to 2.4 V
- Input rise and fall time:  $\leq 20\text{ ns}$
- Reference levels for measuring timing: Inputs; 0.8 V and 2.0 V  
Outputs; 0.8 V and 2.0 V

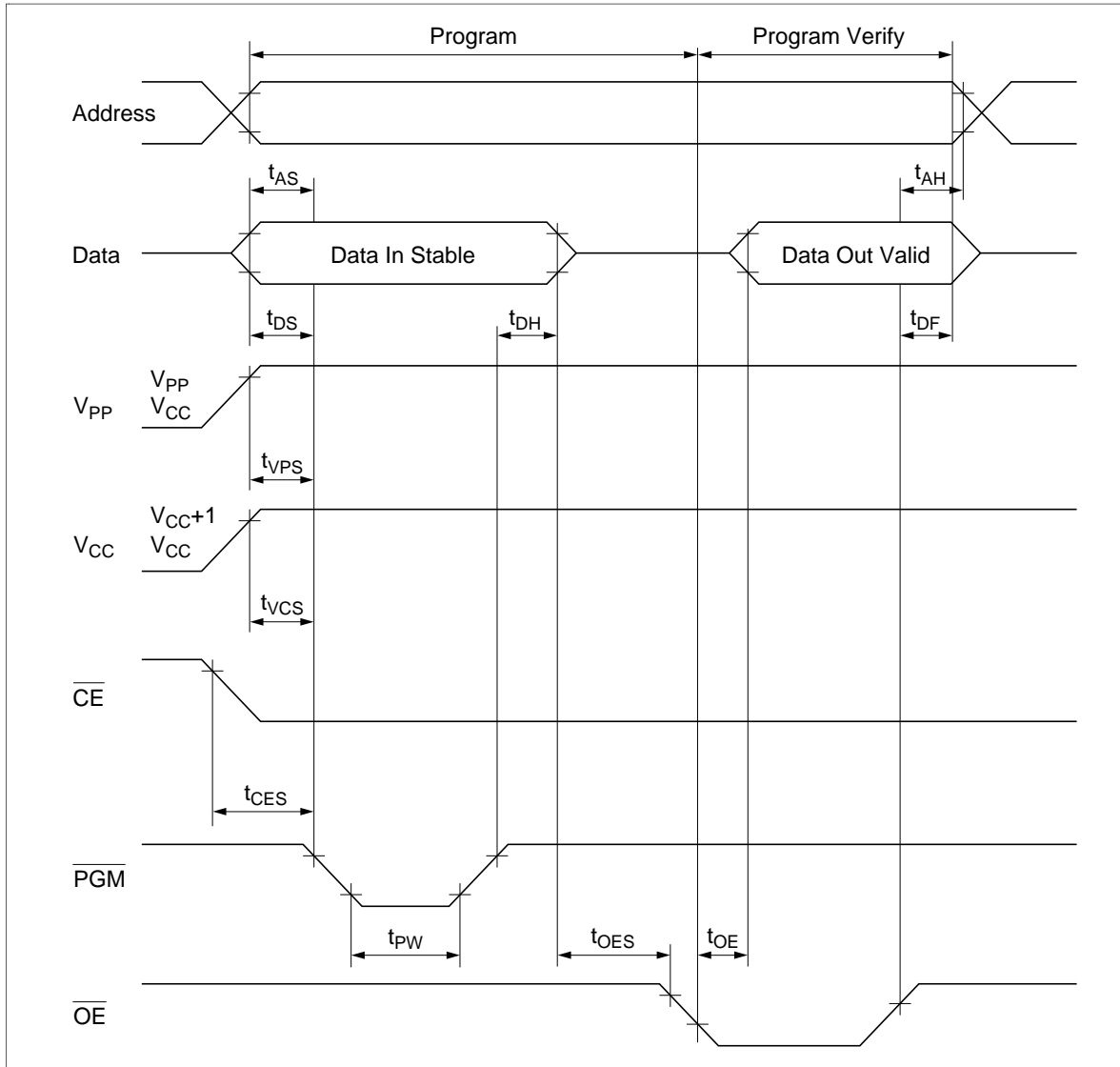
Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Address setup time	$t_{AS}$	2	—	—	$\mu\text{s}$	
$\overline{OE}$ setup time	$t_{OES}$	2	—	—	$\mu\text{s}$	
Data setup time	$t_{DS}$	2	—	—	$\mu\text{s}$	
Address hold time	$t_{AH}$	0	—	—	$\mu\text{s}$	
Data hold time	$t_{DH}$	2	—	—	$\mu\text{s}$	
$\overline{OE}$ to output float delay	$t_{DF}^{*1}$	0	—	130	ns	
$V_{PP}$ setup time	$t_{VPS}$	2	—	—	$\mu\text{s}$	
$V_{CC}$ setup time	$t_{VCS}$	2	—	—	$\mu\text{s}$	
PGM initial programming pulse width	$t_{PW}$	0.19	0.2	0.21	ms	
PGM overprogramming pulse width	$t_{OPW}^{*2}$	0.19	—	5.25	ms	
$\overline{CE}$ setup time	$t_{CES}$	2	—	—	$\mu\text{s}$	
Data valid from $\overline{OE}$	$t_{OE}$	0	—	150	ns	

Notes: 1.  $t_{DF}$  is defined as the time at which the output achieves the open circuit condition and data is no longer driven.

2. Refer to the programming flowchart for  $t_{OPW}$ .

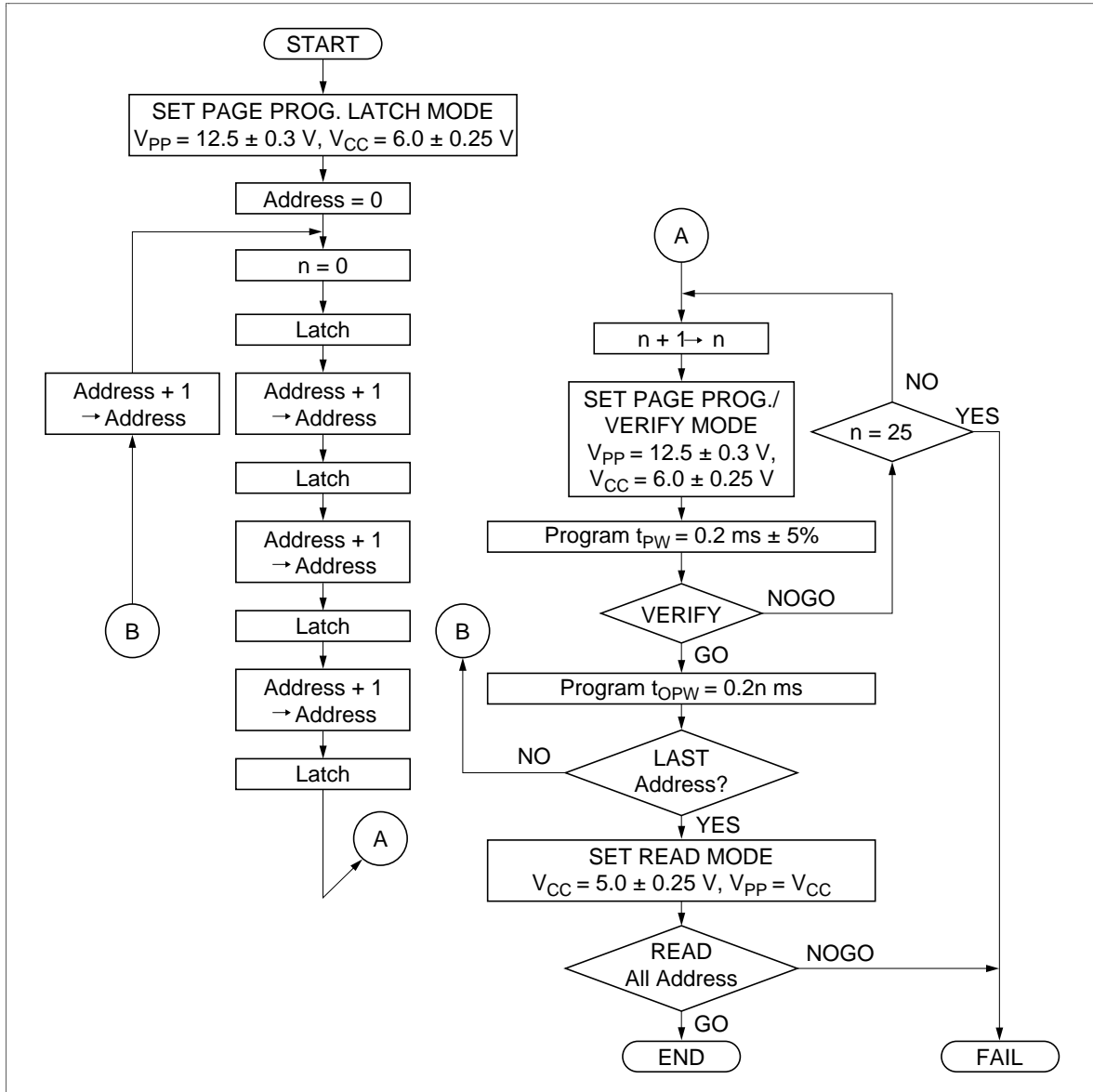
# HN27C101AG/HN27C301AG Series

## Fast High-Reliability Programming Timing Waveform



**Fast High-Reliability Page Programming**

This device can be applied the high performance page programming algorithm shown in following flowchart. This algorithm allows to obtain faster programming time without any voltage stress to the device nor deterioration in reliability of programmed data.



**Fast High-Reliability Page Programming Flowchart**

## HN27C101AG/HN27C301AG Series

DC Characteristics ( $T_a = 25\text{ }^\circ\text{C} \pm 5^\circ\text{C}$ ,  $V_{CC} = 6\text{ V} \pm 0.25\text{ V}$ ,  $V_{PP} = 12.5\text{ V} \pm 0.3\text{ V}$ )

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Input leakage current	$I_{LI}$	—	—	2	$\mu\text{A}$	$V_{in} = 0\text{ V to } V_{CC}$
$V_{PP}$ supply current	$I_{PP}$	—	—	50	mA	$\overline{CE} = \overline{OE} = V_{IH}$ , $\overline{PGM} = V_{IL}$
Operating $V_{CC}$ current	$I_{CC}$	—	—	30	mA	
Input low level	$V_{IL}$	$-0.1^{*5}$	—	0.8	V	
Input high level	$V_{IH}$	2.2	—	$V_{CC} + 0.5^{*6}$	V	
Output low voltage during verify	$V_{OL}$	—	—	0.45	V	$I_{OL} = 2.1\text{ mA}$
Output high voltage during verify	$V_{OH}$	2.4	—	—	V	$I_{OH} = -400\text{ }\mu\text{A}$

- Notes:
- $V_{CC}$  must be applied simultaneously or before  $V_{PP}$  and removed simultaneously or after  $V_{PP}$ .
  - $V_{PP}$  must not exceed 13.5 V including overshoot.
  - An influence may be had upon device reliability if the device is installed or removed while  $V_{PP} = 12.5\text{ V}$ .
  - Do not alter  $V_{PP}$  either  $V_{IL}$  to 12.5 V or 12.5 V to  $V_{IL}$  when  $\overline{CE} = \text{Low}$ .
  - $V_{IL}$  min =  $-0.6\text{ V}$  for pulse width  $\leq 20\text{ ns}$
  - If  $V_{IH}$  is over the specified maximum value, programming operation cannot be guaranteed.

## HN27C101AG/HN27C301AG Series

AC Characteristics ( $T_a = 25^\circ\text{C} \pm 5^\circ\text{C}$ ,  $V_{CC} = 6\text{ V} \pm 0.25\text{ V}$ ,  $V_{PP} = 12.5\text{ V} \pm 0.3\text{ V}$ )

### Test conditions

- Input pulse levels: 0.45 V to 2.4 V
- Input rise and fall time:  $\leq 20\text{ ns}$
- Reference levels for measuring timing: Inputs; 0.8 V and 2.0 V  
Outputs; 0.8 V and 2.0 V

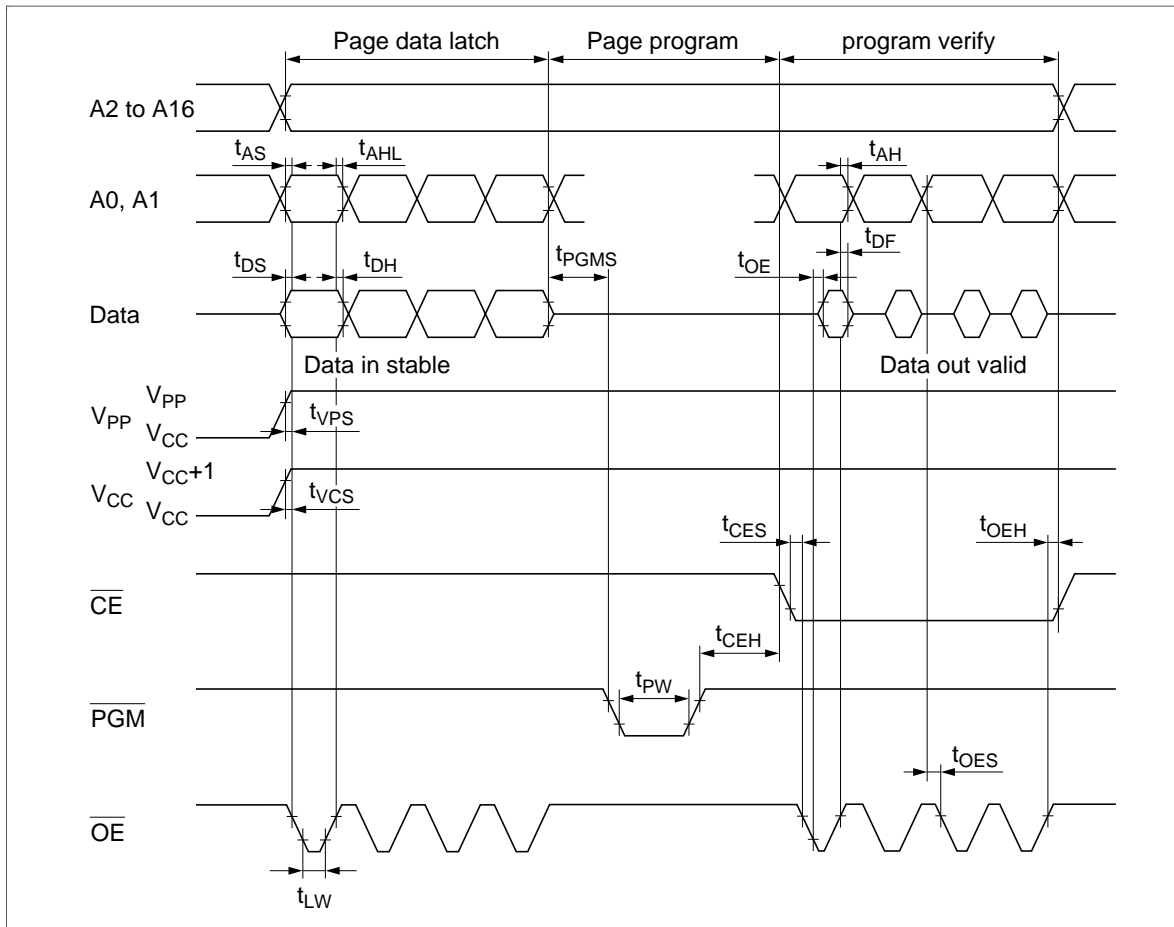
Parameter	Symbol	Min	Typ	Max	Unit
Address setup time	$t_{AS}$	2	—	—	$\mu\text{s}$
$\overline{OE}$ setup time	$t_{OES}$	2	—	—	$\mu\text{s}$
Data setup time	$t_{DS}$	2	—	—	$\mu\text{s}$
Address hold time	$t_{AH}$	0	—	—	$\mu\text{s}$
	$t_{AHL}$	2	—	—	$\mu\text{s}$
Data hold time	$t_{DH}$	2	—	—	$\mu\text{s}$
$\overline{OE}$ to output float delay	$t_{DF}^{*1}$	0	—	130	ns
$V_{PP}$ setup time	$t_{VPS}$	2	—	—	$\mu\text{s}$
$V_{CC}$ setup time	$t_{VCS}$	2	—	—	$\mu\text{s}$
$\overline{PGM}$ initial programming pulse width	$t_{PW}$	0.19	0.2	0.21	ms
$\overline{PGM}$ overprogramming pulse width	$t_{OPW}^{*2}$	0.19	—	5.25	ms
$\overline{CE}$ setup time	$t_{CES}$	2	—	—	$\mu\text{s}$
Data valid from $\overline{OE}$	$t_{OE}$	0	—	150	ns
$\overline{OE}$ pulse width during data latch	$t_{LW}$	1	—	—	$\mu\text{s}$
$\overline{PGM}$ setup time	$t_{PGMS}$	2	—	—	$\mu\text{s}$
$\overline{CE}$ hold time	$t_{CEH}$	2	—	—	$\mu\text{s}$
$\overline{OE}$ hold time	$t_{OEH}$	2	—	—	$\mu\text{s}$

Notes: 1.  $t_{DF}$  is defined as the time at which the output achieves the open circuit condition and data is no longer driven.

2. Refer to the programming flowchart for  $t_{OPW}$ .

# HN27C101AG/HN27C301AG Series

## Fast High-Reliability Page Programming Timing Waveform



### Erase

Erasure of this device is performed by exposure to ultraviolet light of 2537 Å and all the output data are changed to „1“ after this erasure procedure. The minimum integrated dose (i.e. UV intensity × exposure time) for erasure is 15 W. sec/cm<sup>2</sup>.



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## HN27C101AG/HN27C301AG Series

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### Mode Description

#### Device Identifier Mode

The device identifier mode allows the reading out of binary codes that identify manufacturer and type of device, from outputs of EPROM. By this mode, the device will be automatically matched its own corresponding programming algorithm, using programming equipment.

#### HN27C101AG Identifier Code

Identifier	A0 (12)	A9 (26)	I/O7 (21)	I/O6 (20)	I/O5 (19)	I/O4 (18)	I/O3 (17)	I/O2 (15)	I/O1 (14)	I/O0 (13)	Hex Data
Manufacturer code	V <sub>IL</sub>	V <sub>H</sub>	0	0	0	0	0	1	1	1	07
Device code	V <sub>IH</sub>	V <sub>H</sub>	0	0	1	1	1	0	0	0	38

#### HN27C301AG Identifier Code

Identifier	A0 (12)	A9 (26)	I/O7 (21)	I/O6 (20)	I/O5 (19)	I/O4 (18)	I/O3 (17)	I/O2 (15)	I/O1 (14)	I/O0 (13)	Hex Data
Manufacturer code	V <sub>IL</sub>	V <sub>H</sub>	0	0	0	0	0	1	1	1	07
Device code	V <sub>IH</sub>	V <sub>H</sub>	1	0	1	1	1	0	0	1	B9

- Notes: 1. V<sub>H</sub> = 12.0 V ± 0.5 V  
2. A1–A8, A10–A16,  $\overline{CE}$ ,  $\overline{OE}$  = V<sub>IL</sub>, PGM = V<sub>IH</sub>

# HN27C101AG/HN27C301AG Series

## Package Dimensions

HN27C101AG/HN27C301AG Series (DG-32)

Unit: mm

