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# HN27C256AG Series

32768-word × 8-bit UV Erasable and Programmable ROM

# HITACHI

Maintenance only

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## Description

This Hitachi HN27C256AG is a 256-kbit ultraviolet erasable and electrically programmable ROM, featuring high speed and low power dissipation. Fabricated on advanced fine process and high speed circuitry technique, the HN27C256AG makes high speed access time possible for 16 bit microprocessors such as the 8086 and 68000. And low power dissipation in active and standby modes matches our CMOS 256-kbit EPROM. In programming operation, the HN27C256AG realizes faster programming times than our conventional 256-kbit EPROM by Hitachi's Fast High-Reliability Programming Algorithm. Pin arrangement, pin configuration and programming voltage are compatible with our 256-kbit EPROM series, therefore existing programmers can be used with the HN27C256AG.

## Features

- High speed  
Access time: 100/120/150 ns (max)
- Low power dissipation  
Active mode: 25 mW (typ) (f = 1 MHz)  
Standby mode: 5  $\mu$ W (typ)
- High reliability and fast programming  
Programming voltage: +12.5 V DC  
Fast High-Reliability Programming Algorithm available
- Device identifier mode  
Manufacturer code and device code

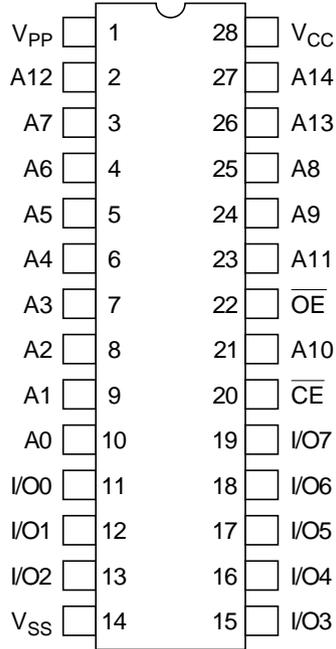
## Ordering Information

Type No.	Access Time	Package
HN27C256AG-10	100 ns	600-mil 28-pin cerdip (DG-28)
HN27C256AG-12	120 ns	
HN27C256AG-15	150 ns	

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Note: This device is not available for new application.

## Pin Arrangement

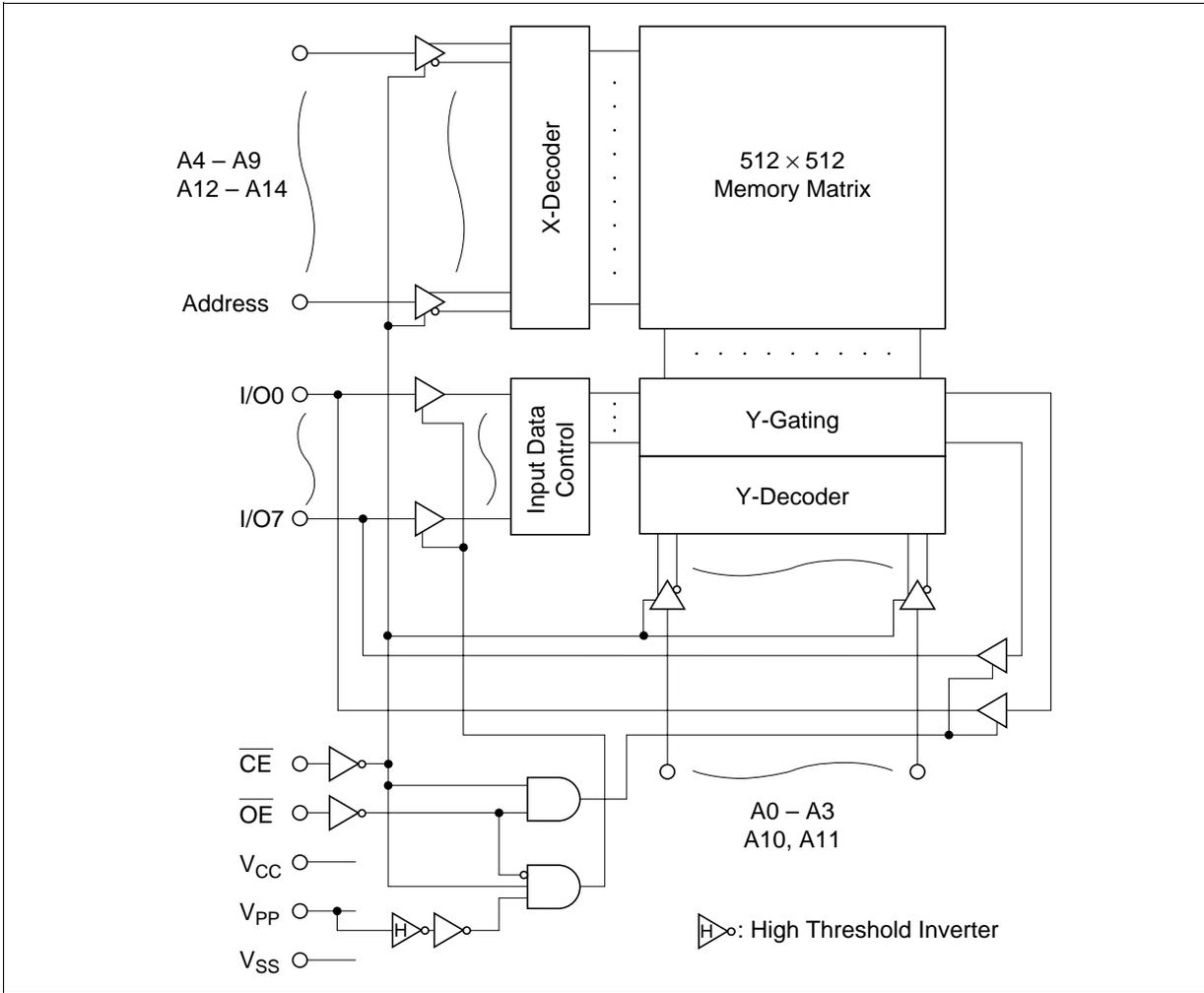


(Top View)

## Pin Description

Pin Name	Function
A0 – A14	Address
I/O0 – I/O7	Input/output
$\overline{CE}$	Chip enable
$\overline{OE}$	Output enable
$V_{CC}$	Power supply
$V_{PP}$	Programming power supply
$V_{SS}$	Ground

Block Diagram



## Mode Selection

Mode	$\overline{\text{CE}}$ (20)	$\overline{\text{OE}}$ (22)	A9 (24)	$V_{PP}$ (1)	$V_{CC}$ (28)	I/O (11 – 13, 15 – 19)
Read	$V_{IL}$	$V_{IL}$	X	$V_{CC}$	$V_{CC}$	Dout
Output disable	$V_{IL}$	$V_{IH}$	X	$V_{CC}$	$V_{CC}$	High-Z
Standby	$V_{IH}$	X	X	$V_{CC}$	$V_{CC}$	High-Z
Program	$V_{IL}$	$V_{IH}$	X	$V_{PP}$	$V_{CC}$	Din
Program verify	$V_{IH}$	$V_{IL}$	X	$V_{PP}$	$V_{CC}$	Dout
Optional verify	$V_{IL}$	$V_{IL}$	X	$V_{PP}$	$V_{CC}$	Dout
Program inhibit	$V_{IH}$	$V_{IH}$	X	$V_{PP}$	$V_{CC}$	High-Z
Identifier	$V_{IL}$	$V_{IL}$	$V_H^{*2}$	$V_{CC}$	$V_{CC}$	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 voltage <sup>*1</sup>	$V_{in}, V_{out}$	-0.6 <sup>*2</sup> to +7.0	V
A9 input voltage <sup>*1</sup>	$V_{ID}$	-0.6 <sup>*2</sup> to +13.5	V
$V_{PP}$ voltage <sup>*1</sup>	$V_{PP}$	-0.6 to +13.5	V
$V_{CC}$ voltage <sup>*1</sup>	$V_{CC}$	-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.  $V_{in}, V_{out}, V_{ID}$  min = -1.0 V for pulse width  $\leq$  50 ns.

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

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Input capacitance	$C_{in}$	—	4	8	pF	$V_{in} = 0\text{ V}$
Output capacitance	$C_{out}$	—	8	12	pF	$V_{out} = 0\text{ V}$

## Read Operation

**DC Characteristics** ( $T_a = 0$  to  $+70^\circ\text{C}$ ,  $V_{CC} = 5\text{ V} \pm 10\%$ ,  $V_{PP} = V_{CC}$ )

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	$\text{mA}$	$f = 10\text{ MHz}$ , $I_{out} = 0\text{ mA}$
	$I_{CC3}$	—	5	15	$\text{mA}$	$f = 1\text{ MHz}$ , $I_{out} = 0\text{ mA}$
Input low voltage <sup>*3</sup>	$V_{IL}$	$-0.3^{*1}$	—	0.8	$\text{V}$	
Input high voltage <sup>*3</sup>	$V_{IH}$	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	$V_{OH1}$	2.4	—	—	$\text{V}$	$I_{OH} = -1.0\text{ mA}$
	$V_{OH2}$	$V_{CC} - 0.7$	—	—	$\text{V}$	$I_{OH} = -100\ \mu\text{A}$

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.

3. Only defined for DC function test.  $V_{IL}$  max =  $0.45\text{ V}$ ,  $V_{IH}$  min =  $2.4\text{ V}$  for AC function test.

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**AC Characteristics** ( $T_a = 0$  to  $+70^\circ\text{C}$ ,  $V_{CC} = 5\text{ V} \pm 10\%$ ,  $V_{PP} = V_{CC}$ )

## Test Conditions

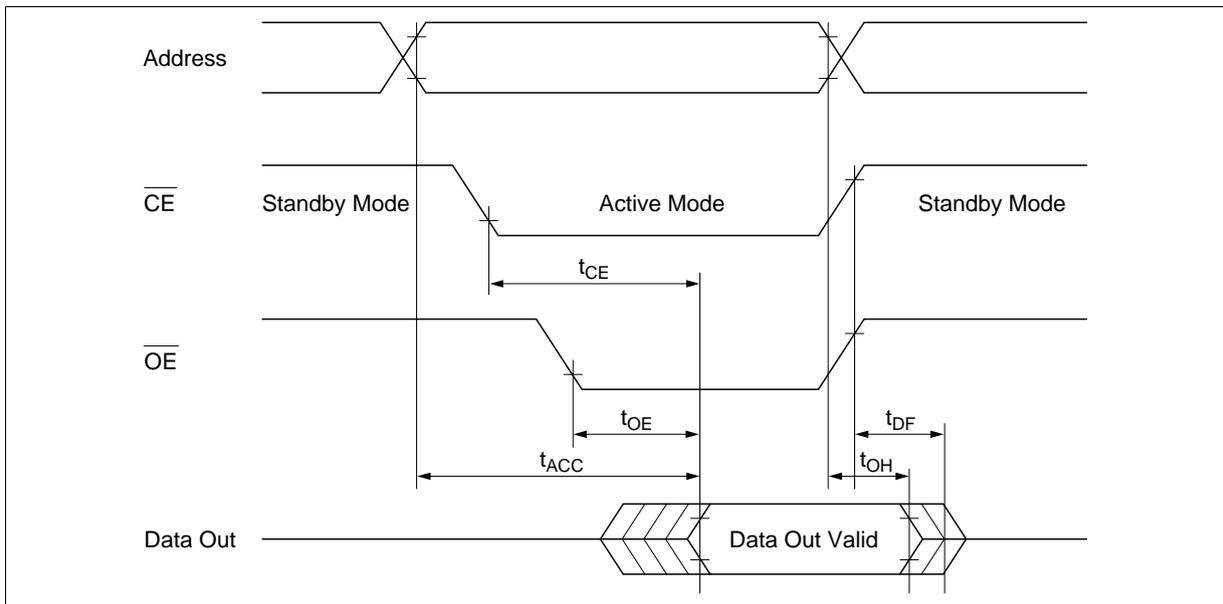
- Input pulse levels: 0.45 V to 2.4 V
- Input rise and fall time:  $\leq 10\text{ ns}$
- Output load: 1TTL gate + 100 pF
- Reference levels for measuring timing: Inputs; 0.8 V and 2.0 V  
Outputs; 0.8 V and 2.0 V

### HN27C256AG

Parameter	Symbol	-10		-12		-15		Unit	Test Conditions
		Min	Max	Min	Max	Min	Max		
Address to output delay	$t_{ACC}$	—	100	—	120	—	150	ns	$\overline{CE} = \overline{OE} = V_{IL}$
$\overline{CE}$ to output delay	$t_{CE}$	—	100	—	120	—	150	ns	$\overline{OE} = V_{IL}$
$\overline{OE}$ to output delay	$t_{OE}$	—	60	—	60	—	70	ns	$\overline{CE} = V_{IL}$
$\overline{OE}$ high to output float	$t_{DF}$	0	35	0	40	0	50	ns	$\overline{CE} = V_{IL}$
Address to output hold	$t_{OH}$	5	—	5	—	5	—	ns	$\overline{CE} = \overline{OE} = V_{IL}$

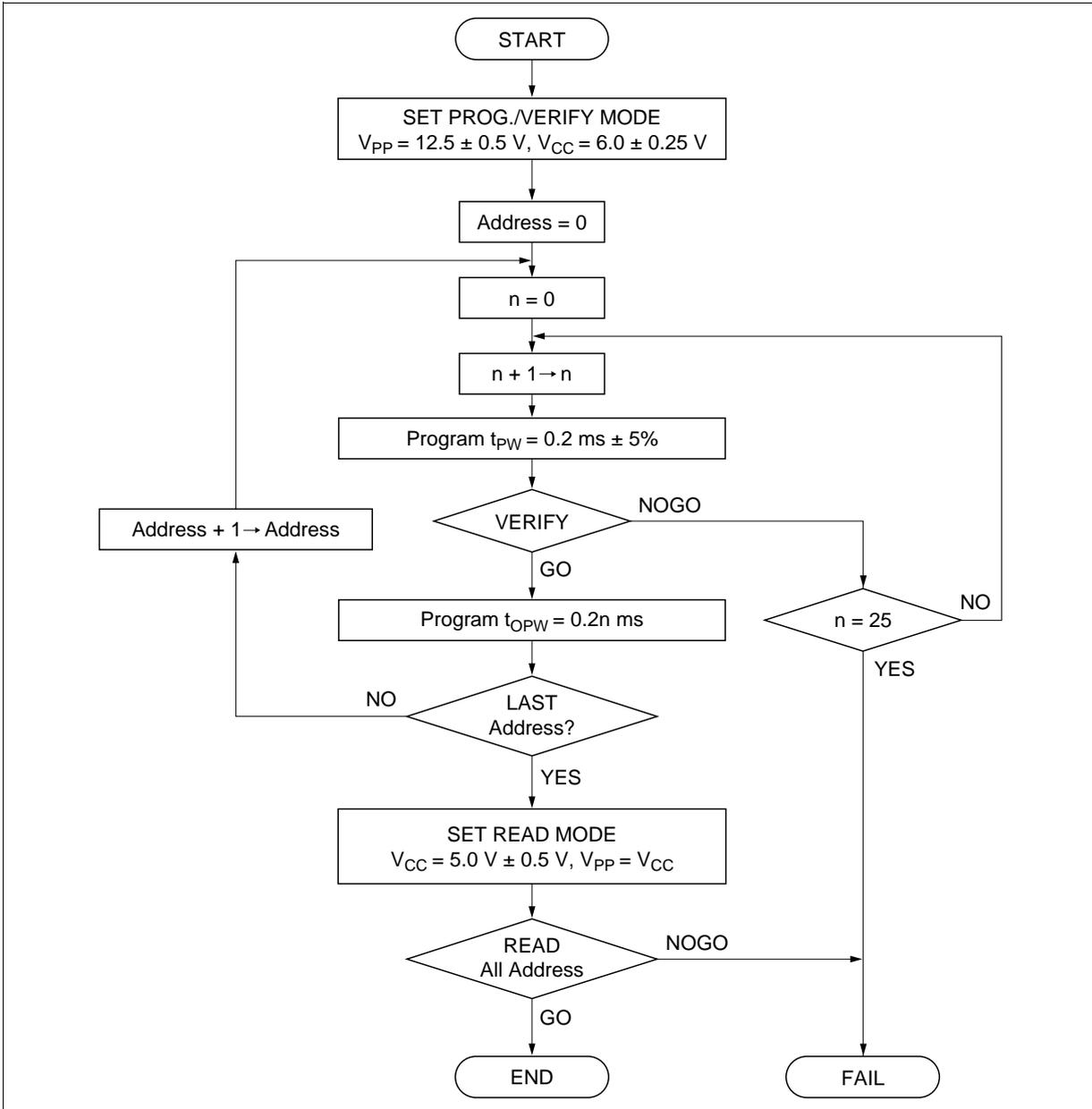
Note:  $t_{DF}$  is defined as the time at which the output achieves the open circuit condition and data is no longer driven.

## Read Timing Waveform



**Fast High-Reliability Programming**

This device can be applied the Fast High-Reliability Programming Algorithm shown in following flowchart. This algorithm offers both faster programming time and high reliability data retention. A theoretical programming time (except blank checking and verifying time) is one-tenth of conventional high performance programming algorithm's. Regarding the model and software version of the programmers available this algorithm, please contact programmer maker.



## HN27C256AG Series

**DC Characteristics** ( $T_a = 25^\circ\text{C} \pm 5^\circ\text{C}$ ,  $V_{CC} = 6\text{ V} \pm 0.25\text{ V}$ ,  $V_{PP} = 12.5\text{ V} \pm 0.5\text{ V}$ )

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	$I_{PP}$	—	—	30	mA	$\overline{CE} = V_{IL}$
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	$I_{OH} = -400\ \mu\text{A}$

- 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.

**AC Characteristics** ( $T_a = 25^\circ\text{C} \pm 5^\circ\text{C}$ ,  $V_{CC} = 6\text{ V} \pm 0.25\text{ V}$ ,  $V_{PP} = 12.5\text{ V} \pm 0.5\text{ V}$ )

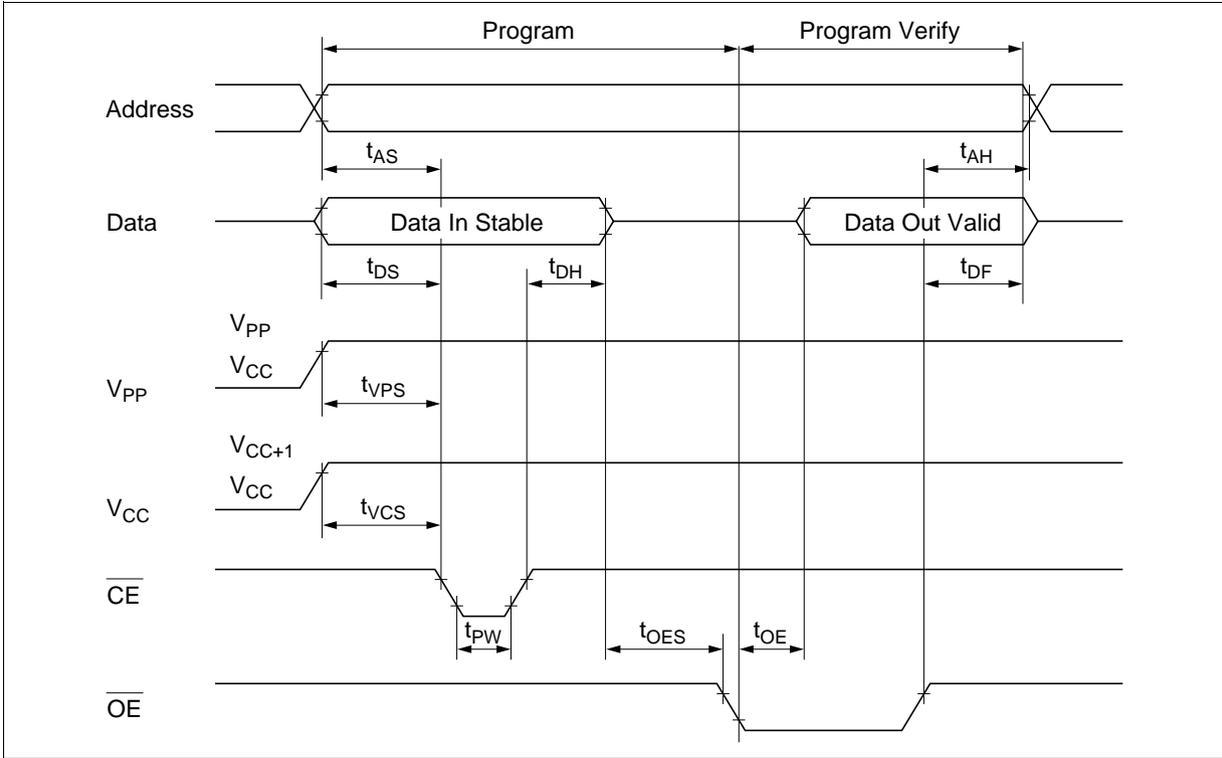
**Test Conditions**

- 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	—	—	$\mu\text{s}$	
$V_{PP}$ setup time	$t_{VPS}$	2	—	—	$\mu\text{s}$	
$V_{CC}$ setup time	$t_{VCS}$	2	—	—	$\mu\text{s}$	
$\overline{CE}$ initial programming pulse width	$t_{PW}$	0.19	0.20	0.21	ms	
$\overline{CE}$ over programming pulse width	$t_{OPW}^{*1}$	0.19	—	5.25	ms	
Data valid from $\overline{OE}$	$t_{OE}$	0	—	150	ns	
$\overline{OE}$ to output float delay	$t_{DF}^{*2}$	—	—	130	ns	

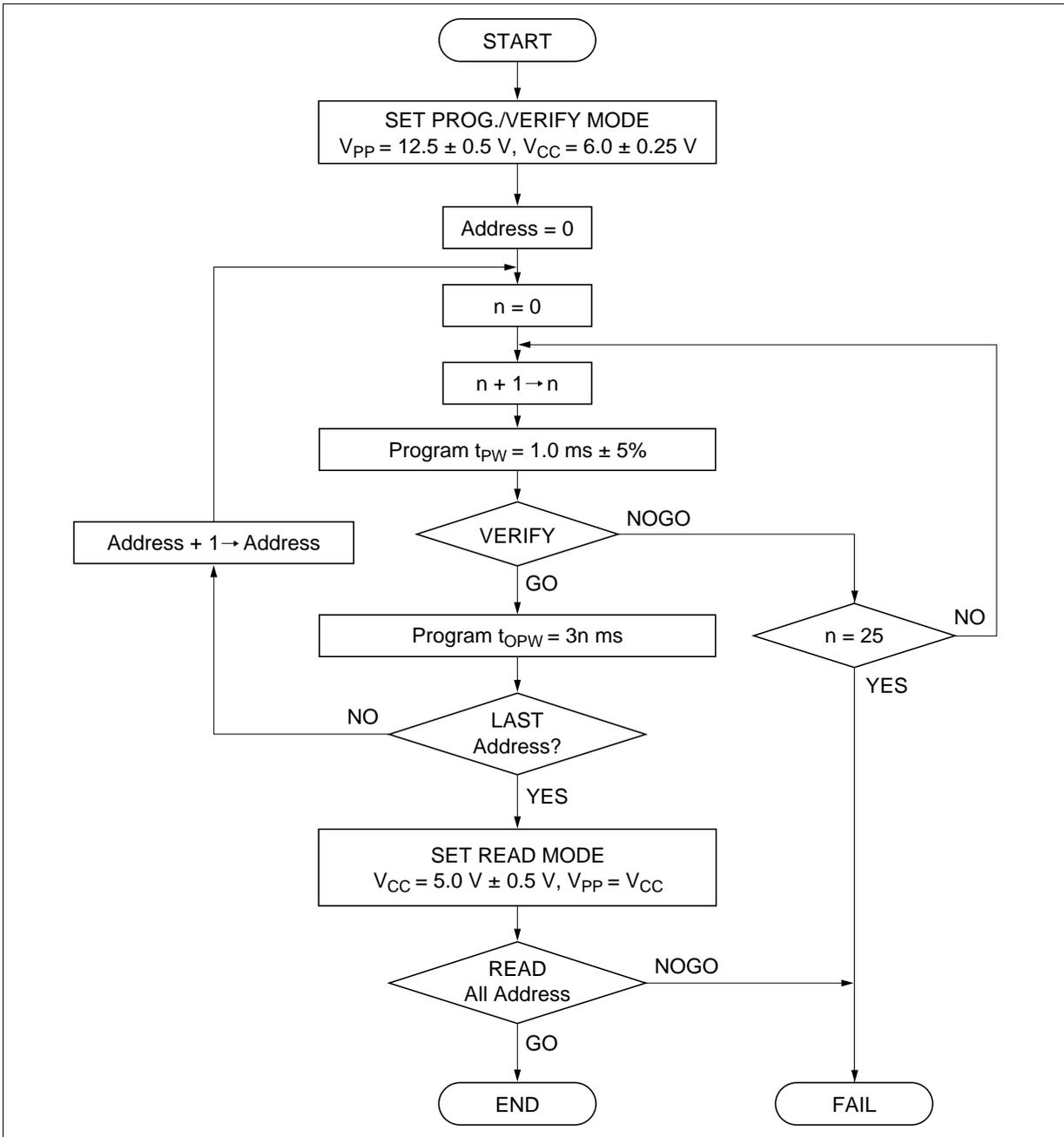
- Notes: 1. Refer to the Fast High-Reliability Programming Flowchart for  $t_{OPW}$ .
2.  $t_{DF}$  is defined as the time at which the output achieves the open circuit condition and data is no longer driven.

## Fast High-Reliability Programming Timing Waveform



**High Performance Programming**

This device can be applied the high performance programming algorithm shown in following flowchart. This algorithm is as same as our 256-kbit EPROM series so existing programmers can be used with this device. This algorithm allows to obtain faster programming time without any voltage stress to the device nor deterioration in reliability of programmed data.



## HN27C256AG Series

**DC Characteristics** ( $T_a = 25^\circ\text{C} \pm 5^\circ\text{C}$ ,  $V_{CC} = 6\text{ V} \pm 0.25\text{ V}$ ,  $V_{PP} = 12.5\text{ V} \pm 0.5\text{ V}$ )

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	$I_{PP}$	—	—	30	mA	$\overline{CE} = V_{IL}$
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	$I_{OH} = -400\ \mu\text{A}$

- 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.

**AC Characteristics** ( $T_a = 25^\circ\text{C} \pm 5^\circ\text{C}$ ,  $V_{CC} = 6\text{ V} \pm 0.25\text{ V}$ ,  $V_{PP} = 12.5\text{ V} \pm 0.5\text{ V}$ )

**Test Conditions**

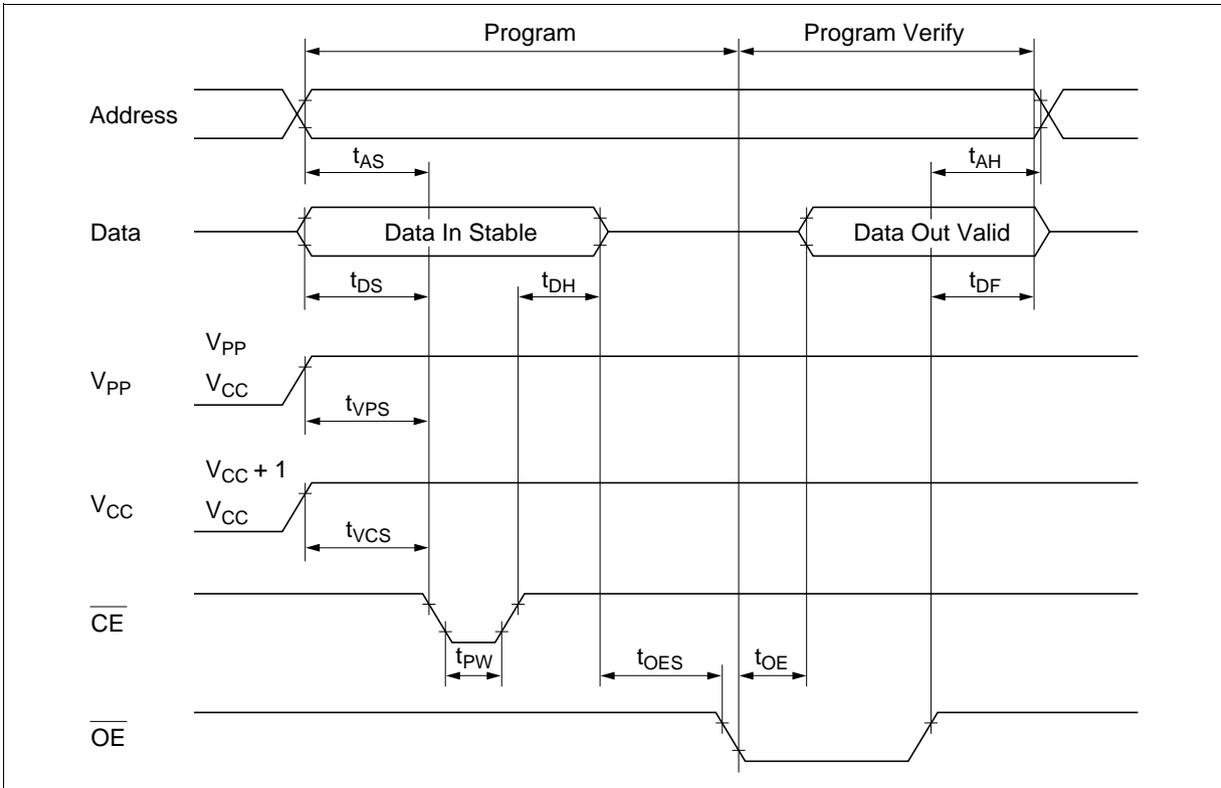
- Input pulse levels: 0.45 V to 2.4 V
- Input rise and fall time:  $\leq 20\text{ ns}$
- Reference levels for measuring timing: Inputs; 0.8 V and 2.0 V  
Outputs; 0.8 V and 2.0 V

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	—	—	$\mu\text{s}$	
$V_{PP}$ setup time	$t_{VPS}$	2	—	—	$\mu\text{s}$	
$V_{CC}$ setup time	$t_{VCS}$	2	—	—	$\mu\text{s}$	
$\overline{CE}$ initial programming pulse width	$t_{PW}$	0.95	1.0	1.05	ms	
$\overline{CE}$ over programming pulse width	$t_{OPW}^{*1}$	2.85	—	78.75	ms	
Data valid from $\overline{OE}$	$t_{OE}$	0	—	150	ns	
$\overline{OE}$ to output float delay	$t_{DF}^{*2}$	—	—	130	ns	

Notes: 1. Refer to the high performance programming flowchart for  $t_{OPW}$ .

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

## High Performance Programming Timing Waveform



## Erase

Erase of HN27C256AG is performed by exposure to ultraviolet light of 2537 Å and all the output data are changed to “1” after this erase procedure. The minimum integrated dose (i.e. UV intensity × exposure time) for erase is 15 W · sec/cm<sup>2</sup>.

## Mode Description

### Device Identifier Mode

Programming condition of EPROM is various according to EPROM manufacturers and device types. It may cause miss operation. To countermeasure it, some EPROMs provide maker identifier code. Users can write EPROM by reading out write condition coded before shipped. Some commercial programmers can set write condition by recognizing this code. This function enables effective program. Regarding commercial programmers that can recognize this device’s identifier code, please contact programmer maker.

**HN27C256AG Series Identifier Code**

<b>Identifier</b>	<b>A0 (10)</b>	<b>I/O7 (19)</b>	<b>I/O6 (18)</b>	<b>I/O5 (17)</b>	<b>I/O4 (16)</b>	<b>I/O3 (15)</b>	<b>I/O2 (13)</b>	<b>I/O1 (12)</b>	<b>I/O0 (11)</b>	<b>Hex Data</b>
Manufacturer code	$V_{IL}$	0	0	0	0	0	1	1	1	07
Device code	$V_{IH}$	0	0	1	1	0	0	0	1	31

Notes: 1.  $A9 = 12.0\text{ V} \pm 0.5\text{ V}$ .

2.  $A1 - A8, A10 - A14, \overline{CE}, \overline{OE} = V_{IL}$ .

# HN27C256AG Series

## Package Dimensions

HN27C256AG Series (DG-28)

Unit: mm

