HN27C4000FP Series

524288-Word × 8-Bit/262144-Word × 16-Bit CMOS One Time Programmable ROM

HITACHI

ADE-203-310B (Z)
Rev. 2.0
Jun. 22, 1995

Description

The Hitachi HN27C4000FP is a 4-Mbit one time programmable ROM that is organized either as 524288-word × 8-bit or as 262144-word × 16-bit, featuring extra-high speed burst mode that gives two times faster 4-word or 8-byte serial access than normal. And also high speed and fast programming are served as well as the existing Hitachi 4M device HN27C4096 and HN27C4001. Fabricated on advanced fine process and high speed circuitry technique, HN27C4000 makes high speed access time and low power dissipation in either active or stand-by mode. Therefore, it is suitable for all systems featuring high speed microprocessor such as the 80386, 80486, 68030, 68040 and so on.

Features

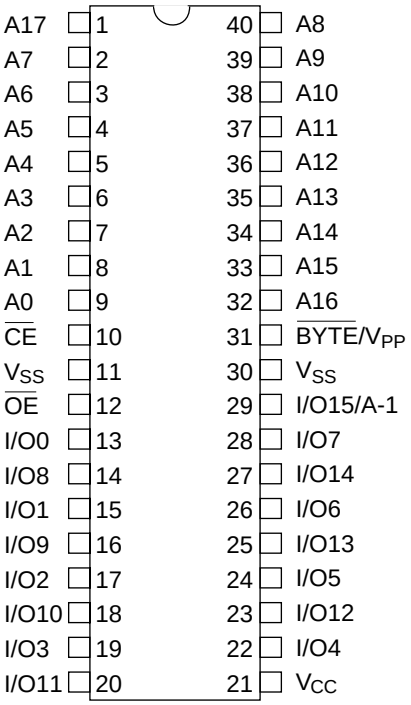
- Organization: 524288-word × 8-bit/262144-word × 16-bit ($\overline{BYTE}/V_{PP}$ enables selection byte-wide or word-wide)
- High speed:
  Access time 120 ns/150 ns (max)
  Burst access time 60 ns/60 ns (max)
- Low power dissipation:
  Standby mode; 5 μW (typ)
  Active mode; 150 mW/MHz (typ)
- Fast high reliability page programming, fast high-reliability programming and option programming:
  Program voltage; +12.5 V DC
  Program time; 3.5 sec (min) (Theoretical in Page programming)
- Inputs and outputs TTL compatible during both read and program modes
- Pin arrangement: 40-pin EIAJ standard pin compatible with HN62414FA/ HN62434FA
- Device identifier mode: Manufacturer code and device code

Ordering Information

Type No.	Access Time	Package
HN27C4000FP-12	120 ns	525-mil 40-pin plastic SOP (FP-40D)
HN27C4000FP-15	150 ns	

Pin Arrangement

HN27C4000FP Series

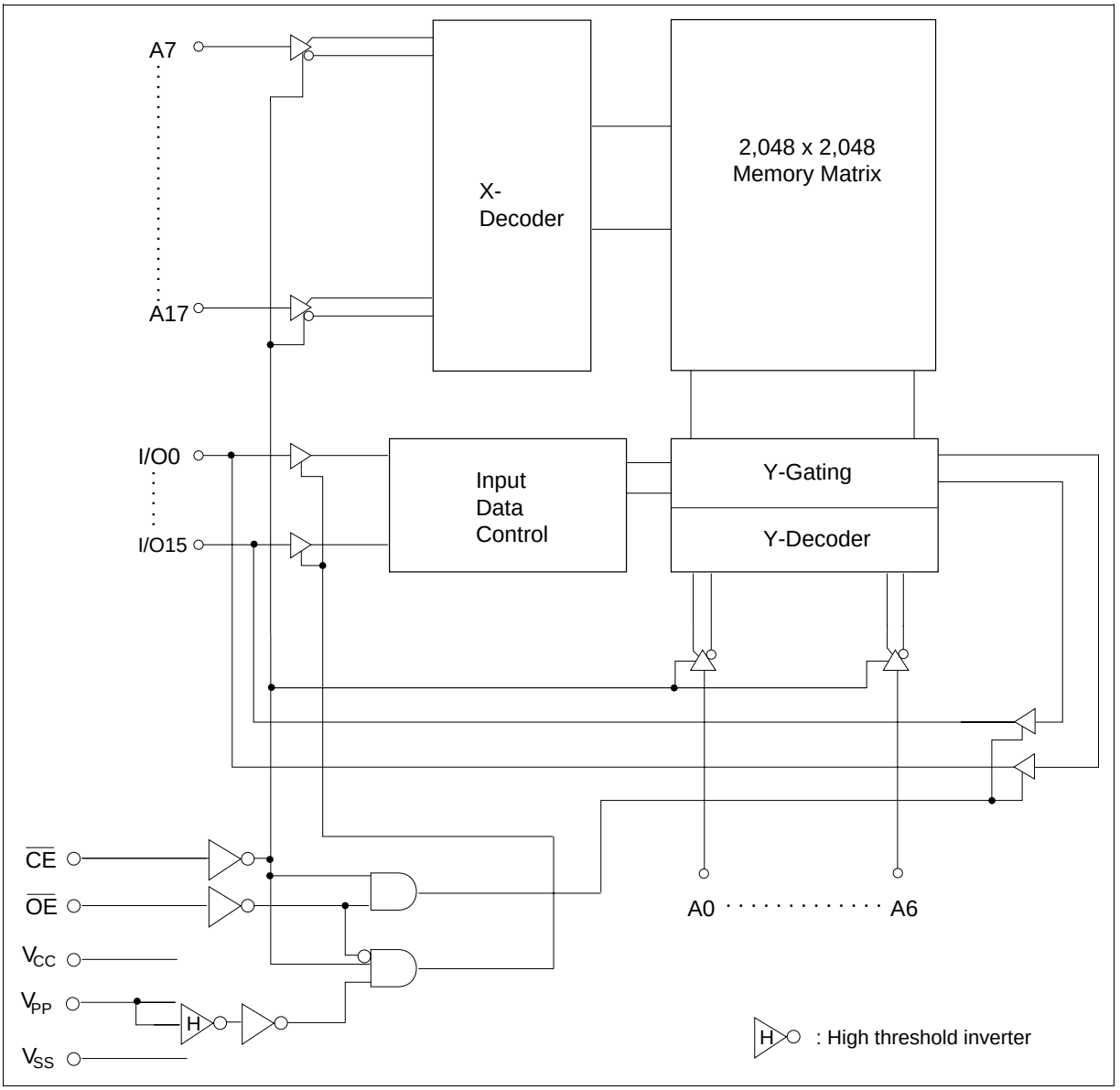


(Top view)

Pin Description

Pin Name	Function
A0 – A17	Address
I/O0 – I/O14	Input/output
I/O15/A-1	Input/output/address
$\overline{CE}$	Chip enable
$\overline{OE}$	Output enable
V_{CC}	Power supply
$\overline{BYTE}/V_{PP}$	Byte/word selection/ Programming power supply
V_{SS}	Ground

Block Diagram



Mode Selection

Mode	Pin FP-40D	$\overline{CE}$ (10)	$\overline{OE}$ (12)	A9 (39)	$\overline{BYTE}/V_{PP}$ (31)	V_{CC} (21)	I/O0 – I/O7, (13 – 20,	I/O8 – I/O14, 22 – 28,	I/O15/ A-1 29)
Read (X16 bit)		V_{IL}	V_{IL}	X	V_{IH}	V_{CC}	Dout	Dout	Dout
Read (X8 bit)		V_{IL}	V_{IL}	X	V_{IL}	V_{CC}	Dout	High-Z	V_{IH}/V_{IL}
Output disable (X16 bit)		V_{IL}	V_{IH}	X	V_{IH}	V_{CC}	High-Z	High-Z	High-Z
Output disable (X8 bit)		V_{IL}	V_{IH}	X	V_{IL}	V_{CC}	High-Z	High-Z	V_{IH}/V_{IL}
Standby	V_{IH}	X	X	$V_{SS} – V_{CC}$	V_{CC}	High-Z	High-Z	High-Z	
Page program	Page program set	V_{IH}	V_H *2	X	V_{PP}	V_{CC}	High-Z	High-Z	High-Z
	Page data latch	V_{IL}	V_H *2	X	V_{PP}	V_{CC}	Din	Din	Din
	Page program	V_{IL}	V_{IH}	X	V_{PP}	V_{CC}	High-Z	High-Z	High-Z
	Page program verify	V_{IH}	V_{IL}	X	V_{PP}	V_{CC}	Dout	Dout	Dout
	Page program reset	V_{IH}	V_{IH}	X	V_{CC}	V_{CC}	High-Z	High-Z	High-Z
Word program	Program	V_{IL}	V_{IH}	X	V_{PP}	V_{CC}	Din	Din	Din
	Program verify	V_{IH}	V_{IL}	X	V_{PP}	V_{CC}	Dout	Dout	Dout
	Optional verify	V_{IL}	V_{IL}	X	V_{PP}	V_{CC}	Dout	Dout	Dout
	Program inhibit	V_{IH}	V_{IH}	X	V_{PP}	V_{CC}	High-Z	High-Z	High-Z
Identifier		V_{IL}	V_{IL}	V_H *2	$V_{SS} – V_{CC}$	V_{CC}	Code	Code	Code

Notes: 1. X: Don't care.
2. V_H: 12.0 V ± 0.5 V

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit	Notes
All input and output voltages	Vin, Vout	–0.6 *2 to +7.0	V	1, 2
Voltage on pin A9 and $\overline{OE}$	V_{ID}	–0.6 *2 to +13.0	V	2
V_{PP} voltage	V_{PP}	–0.6 to +13.5	V	1
V_{CC} voltage	V_{CC}	–0.6 to +7.0	V	1
Operating temperature range	Topr	0 to +70	°C	
Storage temperature range	Tstg	–65 to +125	°C	3
Storage temperature under bias	Tbias	–20 to +80	°C	

Notes: 1. Relative to V_{SS}.
2. Vin, Vout, V_{ID} min = –2.0 V for pulse width ≤ 20 ns
3. Storage temperature range of device before programming.

Capacitance (Ta = 25°C, f = 1 MHz)

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions	Note
Input capacitance	Cin	—	—	12	pF	Vin = 0 V	Except $\overline{BYTE}/V_{PP}$
Output capacitance	Cout	—	—	20	pF	Vout = 0 V	

Read Operation

DC Characteristics (V_{CC} = 5 V ± 10%, V_{PP} = V_{SS} to V_{CC}, Ta = 0 to +70°C)

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Input leakage current	I_{LI}	—	—	2	µA	Vin = 5.5 V
Output leakage current	I_{LO}	—	—	2	µA	Vout = 5.5 V/0.45 V
V_{PP} current	I_{PP1}	—	1	20	µA	V_{PP} = 5.5 V
Standby V_{CC} current	I_{SB1}	—	—	1	mA	$\overline{CE}$ = V_{IH}
	I_{SB2}	—	1	20	µA	$\overline{CE}$ = V_{CC} ± 0.3 V
Operating V_{CC} current	I_{CC1}	—	—	35	mA	Iout = 0 mA, f = 1 MHz
	I_{CC2}	—	—	120	mA	Iout = 0 mA, f = 10 MHz
Input voltage	V_{IL}	–0.3[*1]	—	0.8	V	
	V_{IH}	2.2	—	V_{CC} + 1[*2]	V	
Output voltage	V_{OL}	—	—	0.45	V	I_{OL} = 2.1 mA
	V_{OH}	2.4	—	—	V	I_{OH} = –400 µA

Notes: 1. V_{IL} min = –1.0 V for pulse width ≤ 50 ns
V_{IL} min = –2.0 V for pulse width ≤ 20 ns
2. V_{IH} max = V_{CC} +1.5 V for pulse width ≤ 20 ns
If V_{IH} is over the specified maximum value, read operation cannot be guaranteed.

AC Characteristics (V_{CC} = 5 V ± 10%, V_{PP} = V_{SS} to V_{CC}, Ta = 0 to +70°C)

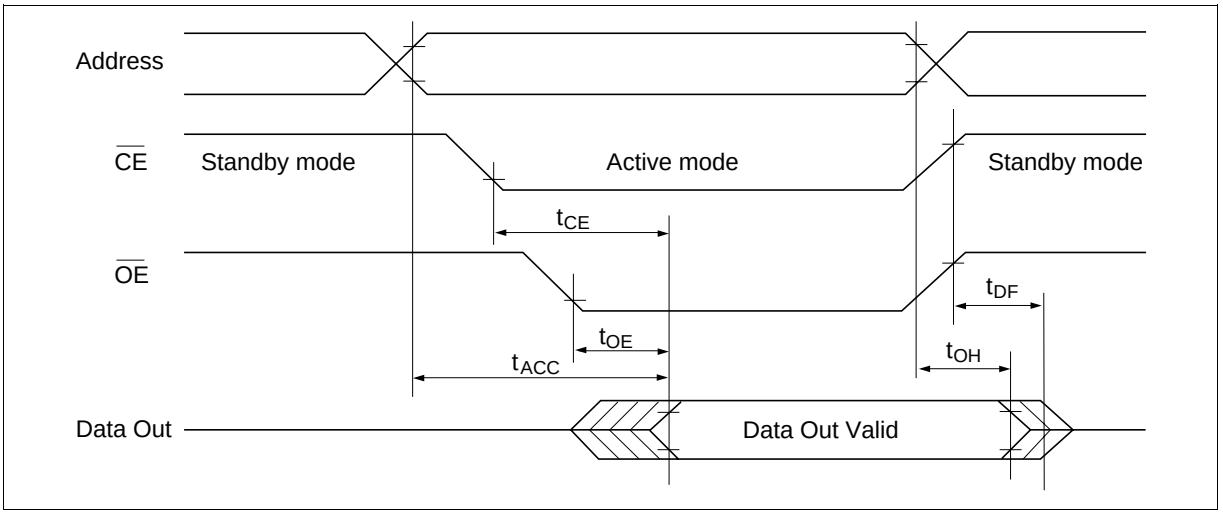
Test Conditions

- Input pulse levels: 0.45 to 2.4 V
- Input rise and fall time: ≤ 10 ns
- Output load: 1 TTL gate +100 pF
- Reference levels for measuring timing: 0.8 V, 2.0 V

		HN27C4000FP					
		-12		-15			
Parameter	**Symbol**	**Min**	**Max**	**Min**	**Max**	**Unit**	**Test Conditions**
Address to output delay	t_{ACC}	—	120	—	150	ns	$\overline{CE}$ = $\overline{OE}$ = V_{IL}
$\overline{CE}$ to output delay	t_{CE}	—	120	—	150	ns	$\overline{OE}$ = V_{IL}
$\overline{OE}$ to output delay	t_{OE}	—	60	—	70	ns	$\overline{CE}$ = V_{IL}
Burst address to output delay	t_{BAC}	—	60	—	60	ns	$\overline{CE}$ = V_{IL}
$\overline{OE}$ high to output float *1	t_{DF}	0	40	0	50	ns	$\overline{CE}$ = V_{IL}
Address to output hold	t_{OH}	5	—	5	—	ns	$\overline{CE}$ = $\overline{OE}$ = V_{IL}

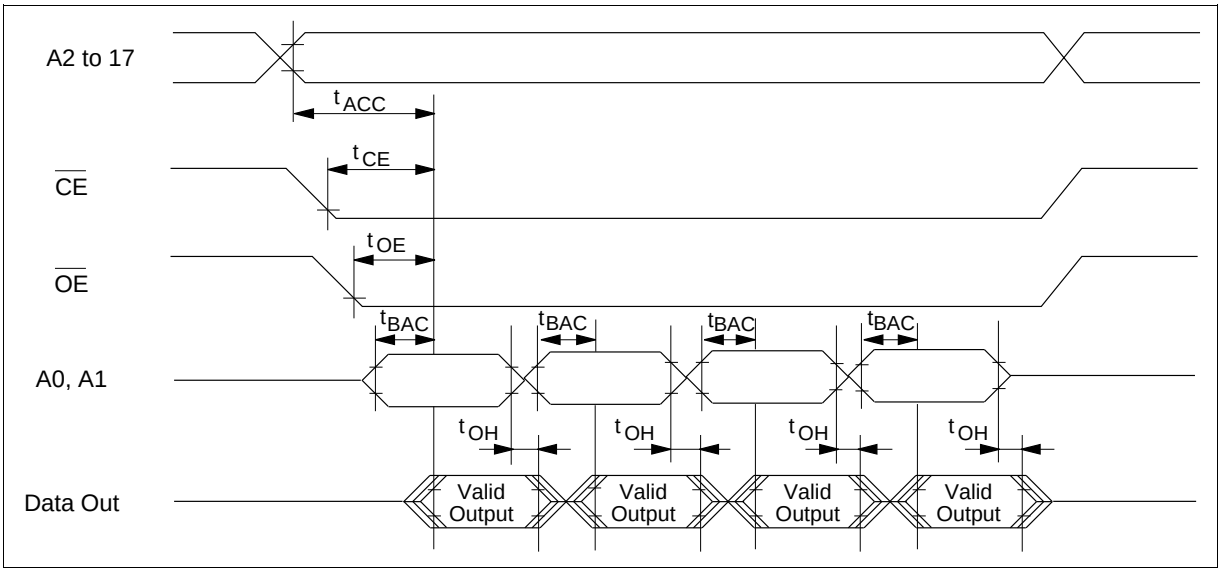
Note: 1. t_{DF} is defined as the time at which the output achieves the open circuit condition and data is no longer driven.

Read Timing Waveform

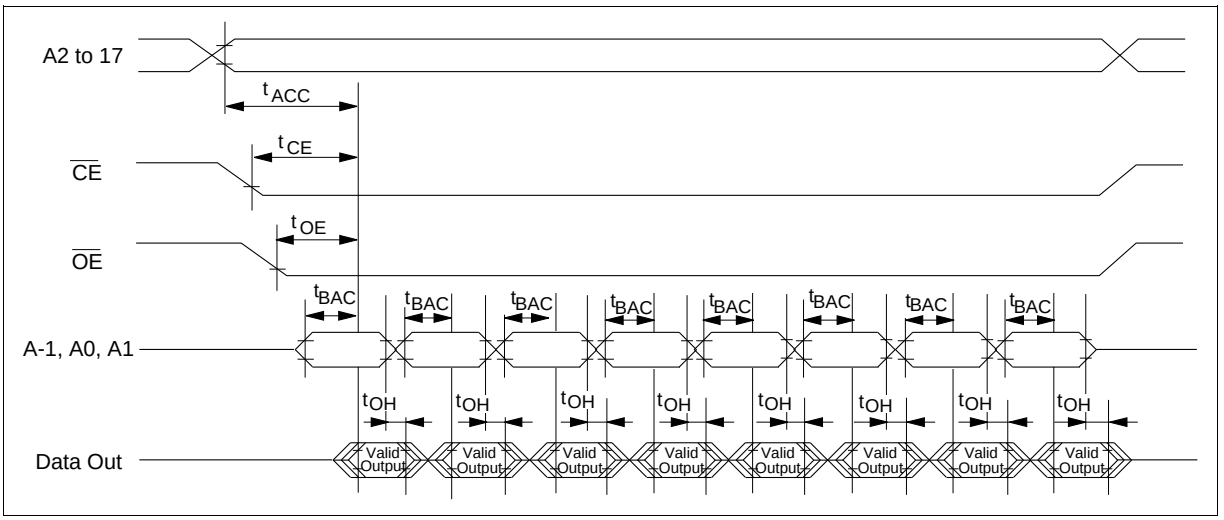


Read Timing Waveform (Burst access mode)

In Burst Access mode, fast read-out of 4 word data is selected by address A0, A1. (Valid only for Read × 16 mode)



In Burst Access mode, fast read-out of 8 byte data is selected by address A-1, A0, A1. (Valid only for Read × 8 mode)



Fast High-Reliability Page Programming

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

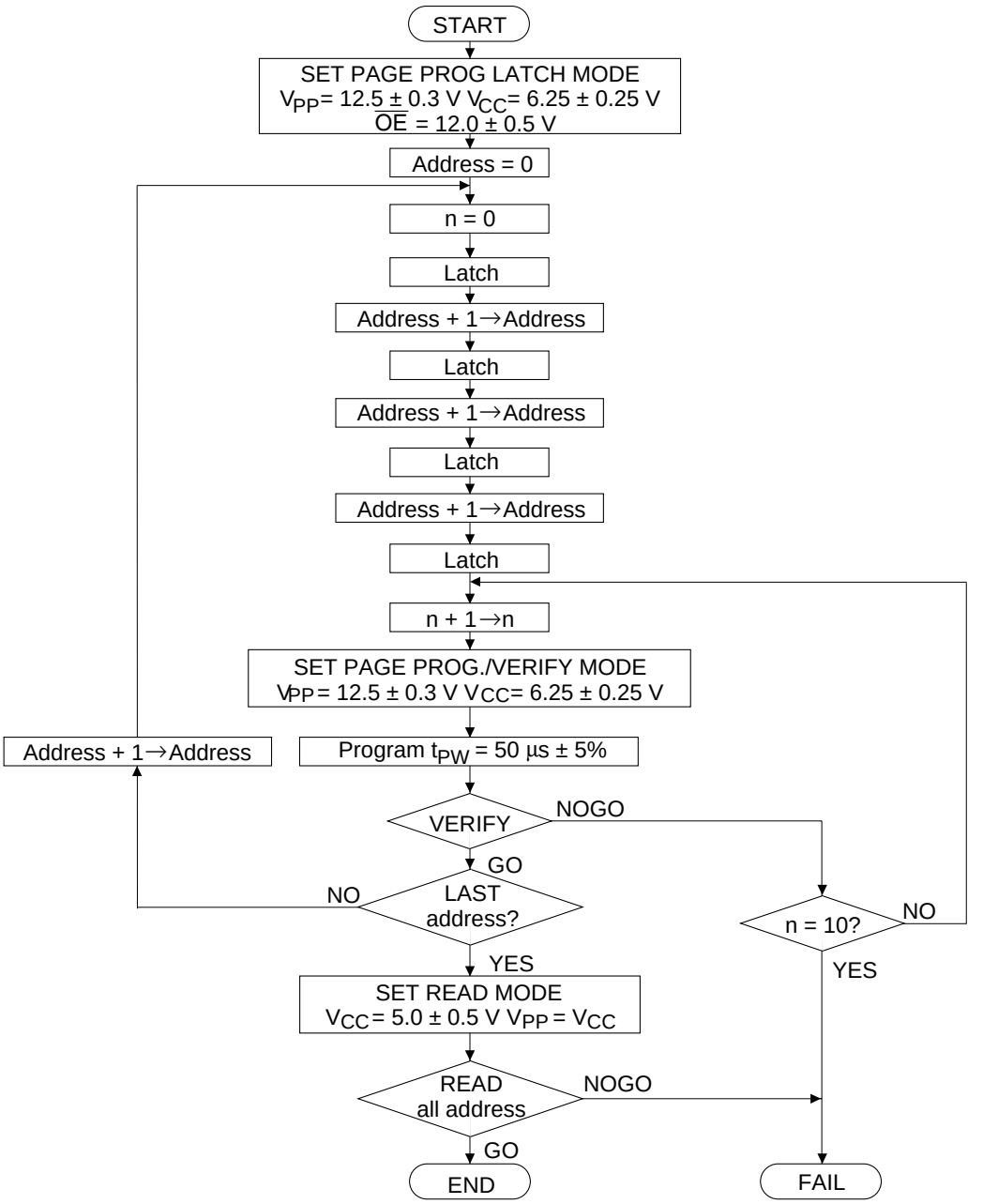
Page Program Set

Apply 12 V to $\overline{OE}$ pin after applying 12.5 V to V_{PP} to set a page program mode.

The device operates in a page program mode until reset.

Page Program Reset

Set V_{PP} to V_{CC} level or less to reset a page program mode.



Fast High-Reliability Page Programming Flowchart

DC Characteristics (V_{CC} = 6.25 V ± 0.25 V, V_{PP} = 12.5 V ± 0.3 V, Ta = 25°C ± 5°C)

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Input leakage current	I_{LI}	—	—	2	µA	Vin = 6.5 V/0.45 V
Output voltage during verify	V_{OL}	—	—	0.45	V	I_{OL} = 2.1 mA
	V_{OH}	2.4	—	—	V	I_{OH} = –400 µA
Operating V_{CC} current	I_{CC}	—	—	50	mA	
Input voltage	V_{IL}	–0.1[*5]	—	0.8	V	
	V_{IH}	2.2	—	V_{CC} + 0.5[*6]	V	
	V_H	11.5	12.0	12.5	V	
V_{PP} supply current	I_{PP}	—	—	70	mA	$\overline{CE}$ = V_{IL}

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 V including overshoot.
3. An influence may be had upon device reliability if the device is installed or removed while V_{PP} = 12.5 V.
4. Do not alter V_{PP} either V_{IL} to 12.5 V or 12.5 V to V_{IL} when $\overline{CE}$ = low.
5. V_{IL} min = –0.6 V for pulse width ≤ 20 ns.
6. If V_{IH} is over the specified maximum value, programming operation cannot be guaranteed.

AC Characteristics (V_{CC} = 6.25 V ± 0.25 V, V_{PP} = 12.5 V ± 0.3 V, Ta = 25°C ± 5°C)

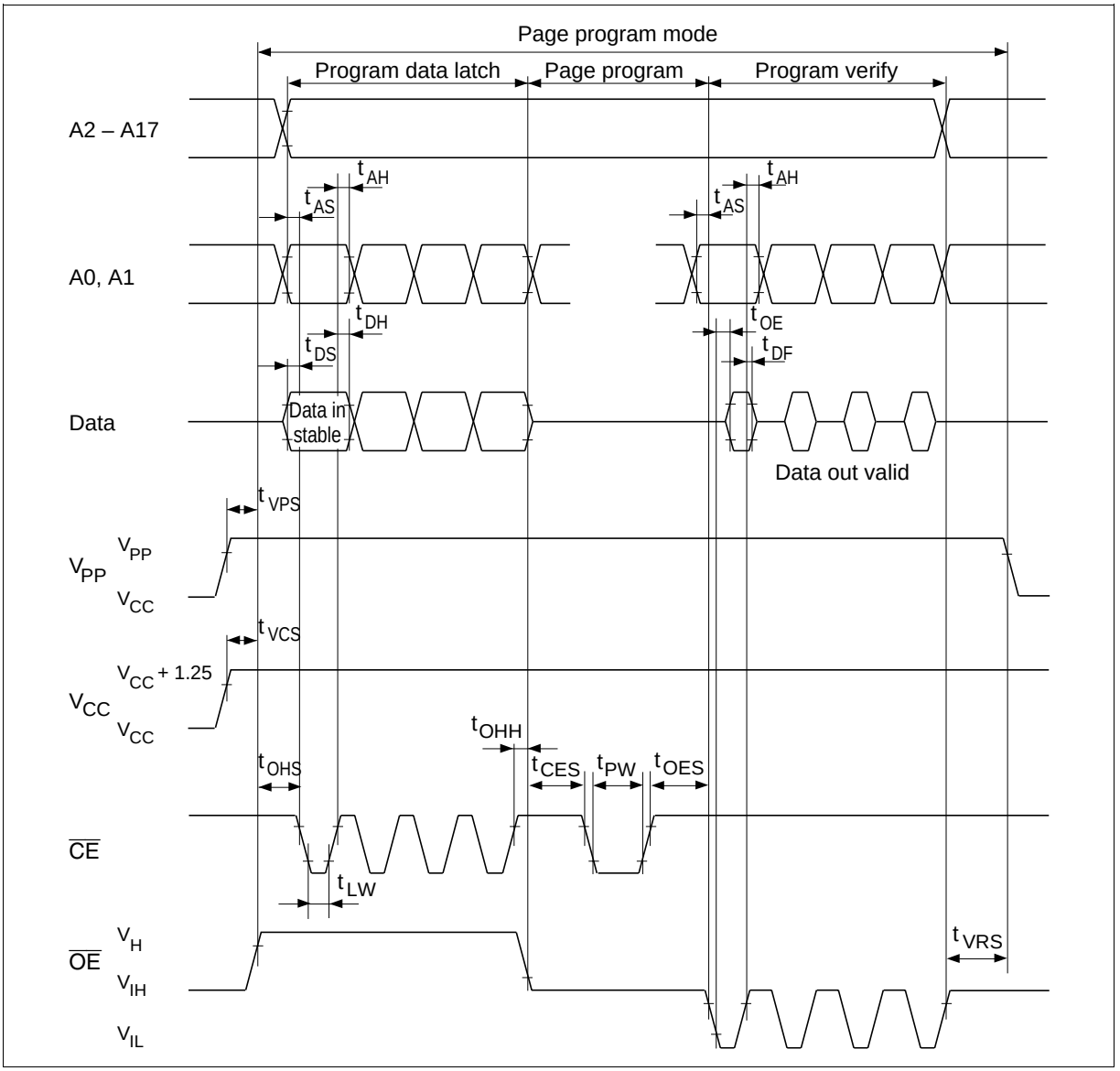
Test Conditions

- Input pulse levels: 0.45 to 2.4 V
- Input rise and fall time: ≤ 20 ns
- Reference levels for measuring timing: Inputs; 0.8 V, 2.0 V,
  Outputs; 0.8 V, 2.0 V

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Address setup time	t_{AS}	2	—	—	µs	
$\overline{OE}$ setup time	t_{OES}	2	—	—	µs	
Data setup time	t_{DS}	2	—	—	µs	
Address hold time	t_{AH}	0	—	—	µs	
Data hold time	t_{DH}	2	—	—	µs	
$\overline{OE}$ high to output float delay	t_{DF} [*1]	0	—	130	ns	
V_{PP} setup time	t_{VPS}	2	—	—	µs	
V_{CC} setup time	t_{VCS}	2	—	—	µs	
$\overline{CE}$ initial programming pulse width	t_{PW}	47.5	50.0	52.5	µs	
$\overline{CE}$ setup time	t_{CES}	2	—	—	µs	
Data valid from $\overline{OE}$	t_{OE}	0	—	150	ns	
$\overline{CE}$ pulse width during data latch	t_{LW}	1	—	—	µs	
$\overline{OE}$ = V_H setup time	t_{OHS}	2	—	—	µs	
$\overline{OE}$ = V_H hold time	t_{OHH}	2	—	—	µs	
V_{PP} hold time[*2]	t_{VRS}	1	—	—	µs	

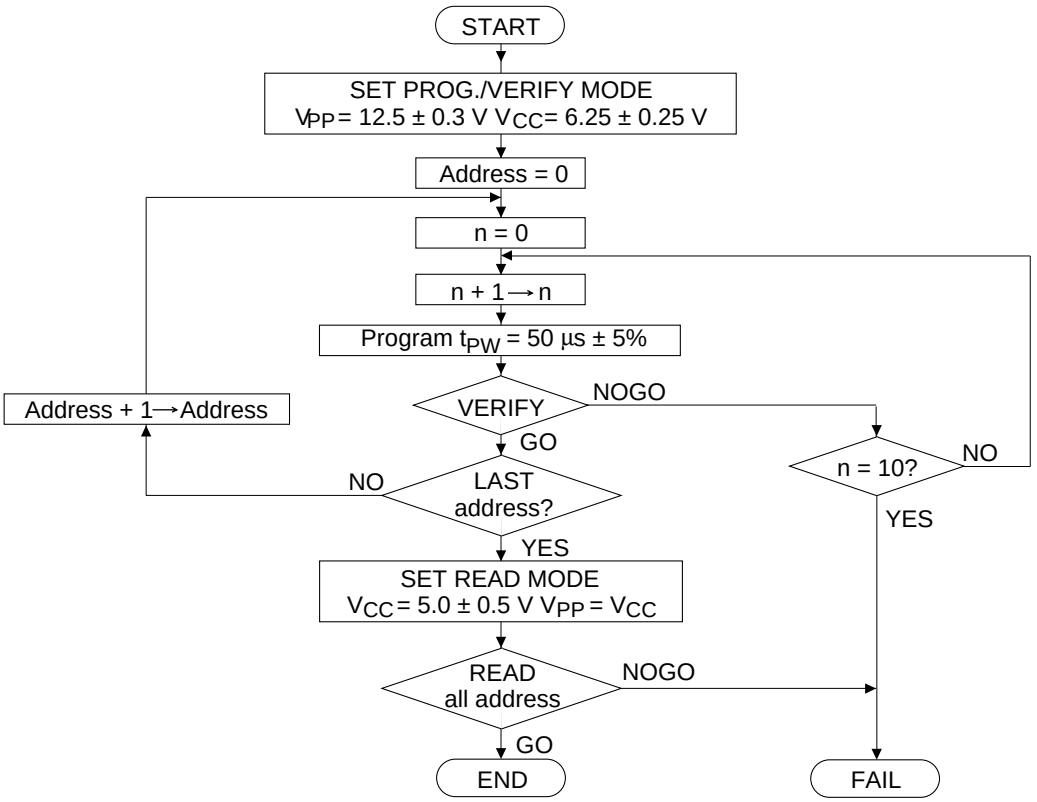
Notes: 1. t_{DF} is defined as the time at which the output achieves the open circuit condition and data is no longer driven.
2. Page program mode will be reset when V_{PP} is set to V_{CC} or less.

Fast High-Reliability Page Programming Timing Waveform



Fast High-Reliability Programming

This device can be applied the fast high-reliability programming algorithm shown in the 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

DC Characteristics (V_{CC} = 6.25 V ± 0.25 V, V_{PP} =12.5 V ± 0.3 V, Ta = 25°C ± 5°C)

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Input leakage current	I_{LI}	—	—	2	µA	Vin = 6.5 V/0.45 V
V_{PP} supply current	I_{PP}	—	—	40	mA	$\overline{CE}$ = V_{IL}
Operating V_{CC} current	I_{CC}	—	—	50	mA	
Input voltage	V_{IL}	–0.1[*5]	—	0.8	V	
	V_{IH}	2.2	—	V_{CC} + 0.5[*6]	V	
Output voltage	V_{OL}	—	—	0.45	V	I_{OL} = 2.1 mA
	V_{OH}	2.4	—	—	V	I_{OH} = –400 µA

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 V including overshoot.
3. An influence may be had upon device reliability if the device is installed or removed while V_{PP} = 12.5 V.
4. Do not alter V_{PP} either V_{IL} to 12.5 V or 12.5 V to V_{IL} when $\overline{CE}$ = low.
5. V_{IL} min = –0.6 V for pulse width ≤ 20 ns.
6. If V_{IH} is over the specified maximum value, programming operation cannot be guaranteed.

AC Characteristics (V_{CC} = 6.25 V ± 0.25 V, V_{PP} = 12.5 V ± 0.3 V, Ta = 25°C ± 5°C)

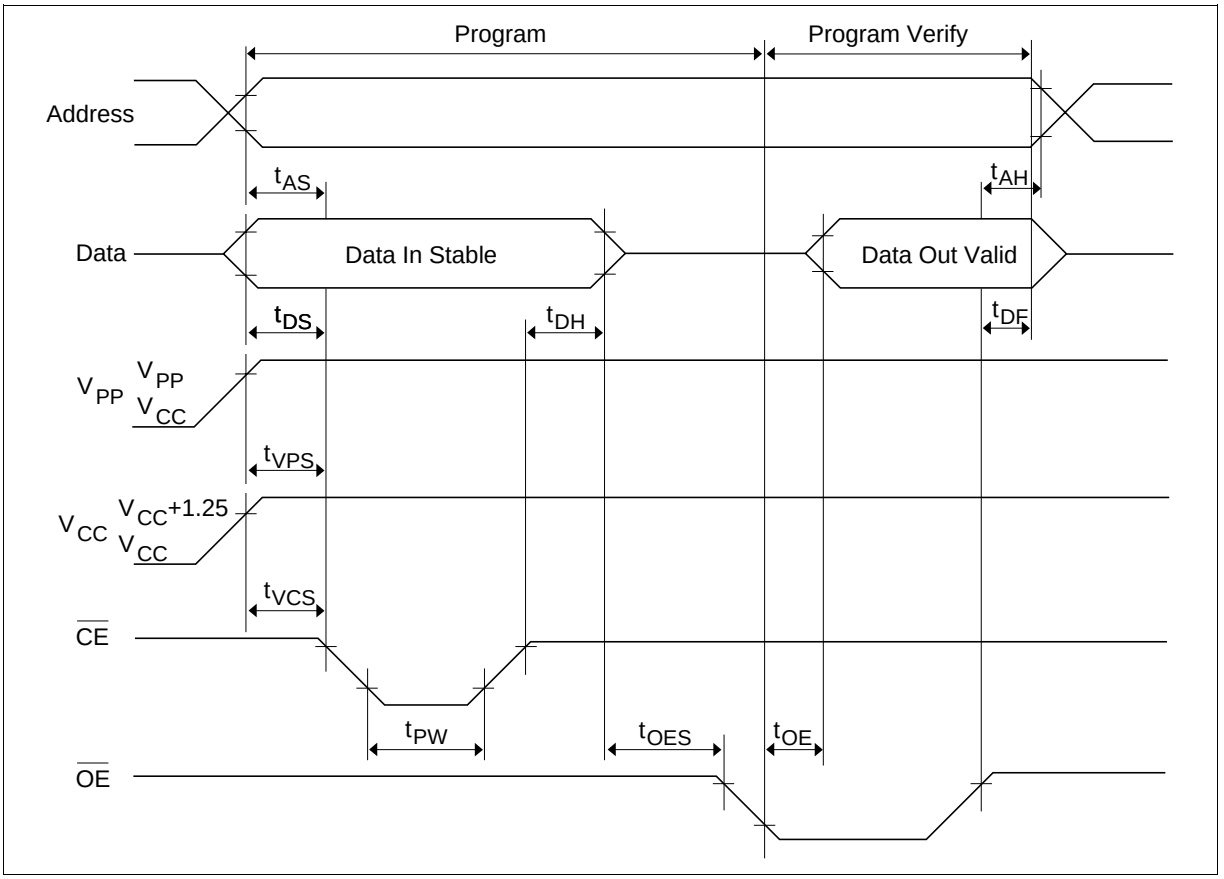
Test Conditions

- Input pulse levels: 0.45 to 2.4 V
- Input rise and fall time: ≤ 20 ns
- Reference levels for measuring timings: 0.8 V, 2.0 V

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Address setup time	t_{AS}	2	—	—	µs	
$\overline{OE}$ setup time	t_{OES}	2	—	—	µs	
Data setup time	t_{DS}	2	—	—	µs	
Address hold time	t_{AH}	0	—	—	µs	
Data hold time	t_{DH}	2	—	—	µs	
$\overline{OE}$ to output float delay	t_{DF}[*1]	0	—	130	ns	
V_{PP} setup time	t_{VPS}	2	—	—	µs	
V_{CC} setup time	t_{VCS}	2	—	—	µs	
$\overline{CE}$ initial programming pulse width	t_{PW}	47.5	50.0	52.5	µs	
Data valid from $\overline{OE}$	t_{OE}	0	—	150	ns	

Note: 1. 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

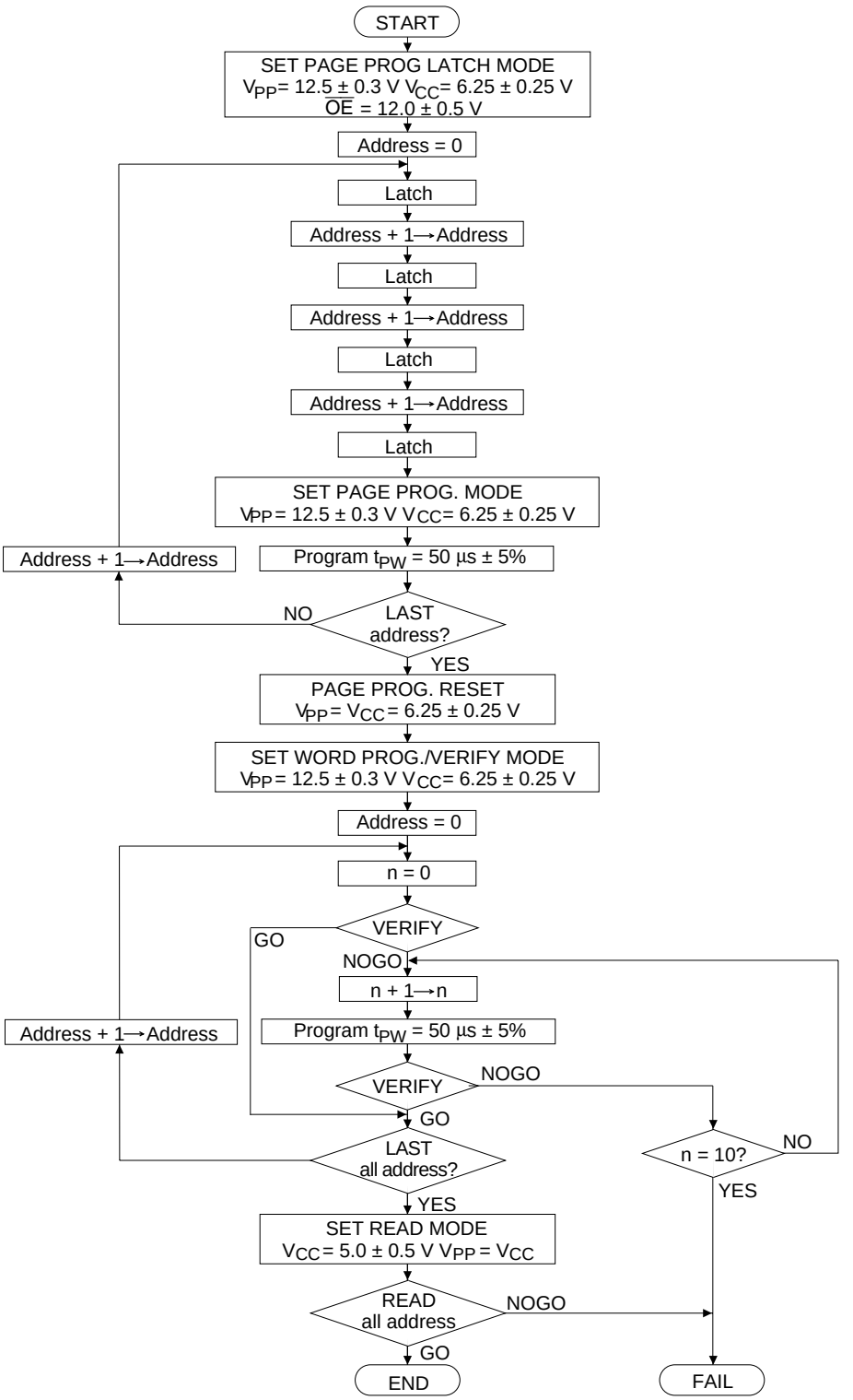


Optional Page Programming

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

This programming algorithm is the combination of page programming and word verify. It can avoid the increase of programming verify time when a programmer with slow machine cycle is used, and shorten the total programming time.

Regarding the timing specifications for page programming and word verify, please refer to the specifications for fast high-reliability page programming and fast high-reliability programming.



Optional Page Programming Flowchart

DC Characteristics (V_{CC} = 6.25 V ± 0.25 V, V_{PP} =12.5 V ± 0.3 V, Ta =25°C ± 5°C)

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Input leakage current	I_{LI}	—	—	2	µA	Vin = 6.5 V/0.45 V
Output voltage during verify	V_{OL}	—	—	0.45	V	I_{OL} = 2.1 mA
	V_{OH}	2.4	—	—	V	I_{OH} = –400 µA
Operating V_{CC} current	I_{CC}	—	—	50	mA	
Input voltage	V_{IL}	–0.1[*5]	—	0.8	V	
	V_{IH}	2.2	—	V_{CC} + 0.5[*6]	V	
	V_H	11.5	12.0	12.5	V	
V_{PP} supply current	I_{PP}	—	—	70	mA	$\overline{CE}$ = V_{IL}

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 V including overshoot.
3. An influence may be had upon device reliability if the device is installed or removed while V_{PP} = 12.5 V.
4. Do not alter V_{PP} either V_{IL} to 12.5 V or 12.5 V to V_{IL} when $\overline{CE}$ = low.
5. V_{IL} min = –0.6 V for pulse width ≤ 20 ns.
6. If V_{IH} is over the specified maximum value, programming operation cannot be guaranteed.

AC Characteristics (V_{CC} = 6.25 V ± 0.25 V, V_{PP} = 12.5 V ± 0.3 V, Ta = 25°C ± 5°C)

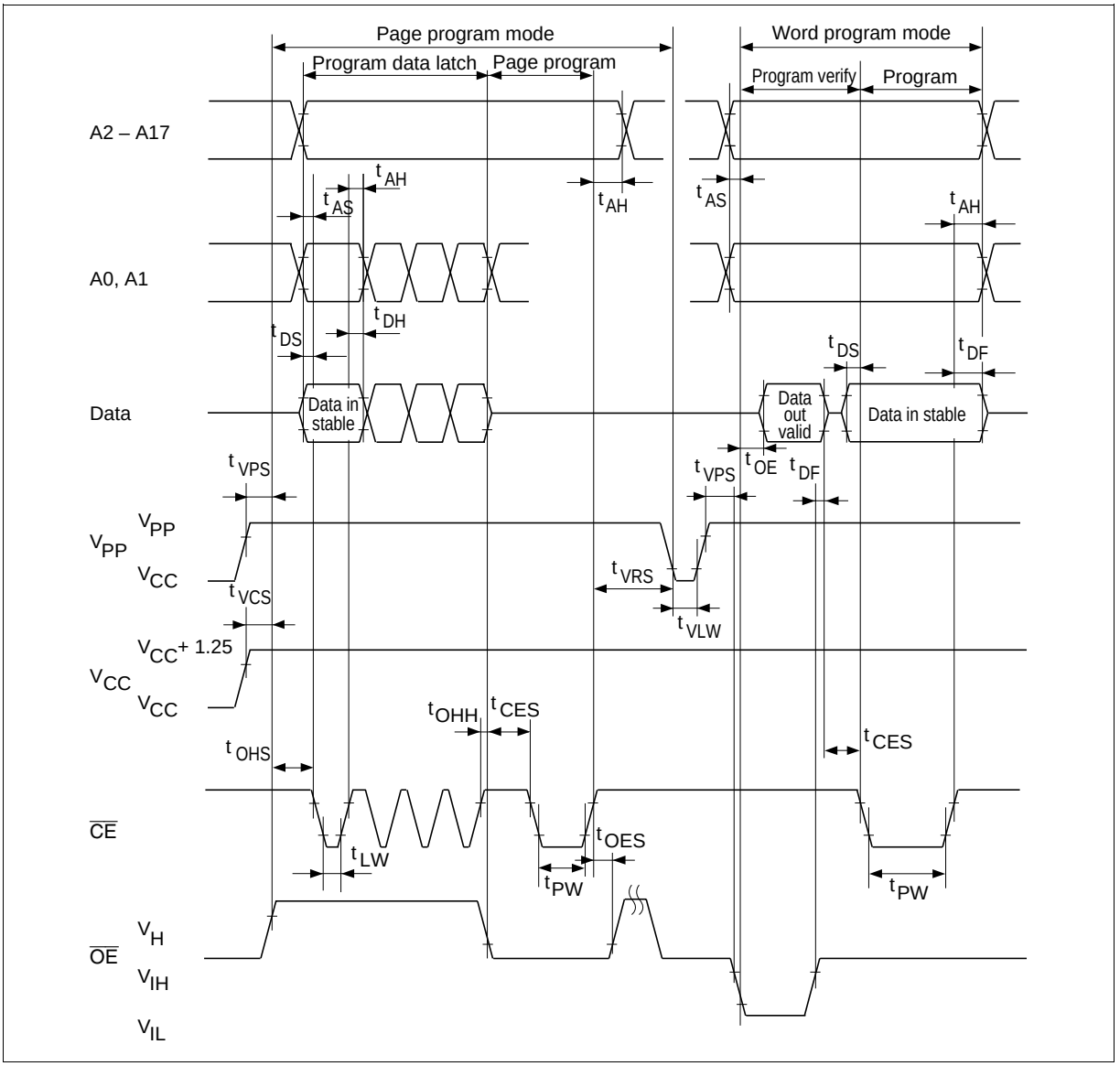
Test Conditions

- Input pulse levels: ≤ 0.45 V to 2.4 V
- Input rise and fall time: ≤ 20 ns
- Reference levels for measuring timings: Inputs; 0.8 V, 2.0 V
  Outputs; 0.8 V, 2.0 V

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Address setup time	t_{AS}	2	—	—	µs	
$\overline{OE}$ setup time	t_{OES}	2	—	—	µs	
Data setup time	t_{DS}	2	—	—	µs	
Address hold time	t_{AH}	0	—	—	µs	
Data hold time	t_{DH}	2	—	—	µs	
$\overline{OE}$ high to output float delay	t_{DF} [*1]	0	—	130	ns	
V_{PP} setup time	t_{VPS}	2	—	—	µs	
V_{CC} setup time	t_{VCS}	2	—	—	µs	
$\overline{CE}$ initial programming pulse width	t_{PW}	47.5	50.0	52.5	µs	
$\overline{CE}$ setup time	t_{CES}	2	—	—	µs	
Data valid from $\overline{OE}$	t_{OE}	0	—	150	ns	
$\overline{CE}$ pulse width during data latch	t_{LW}	1	—	—	µs	
$\overline{OE}$ = V_H setup time	t_{OHS}	2	—	—	µs	
$\overline{OE}$ = V_H hold time	t_{OHH}	2	—	—	µs	
Page programming reset time[*2]	t_{VLW}	1	—	—	µs	
V_{PP} hold time[*2]	t_{VRS}	1	—	—	µs	

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. Page program mode will be reset when V_{PP} is set to V_{CC} or less.

Option Page Programming Timing Waveform



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.

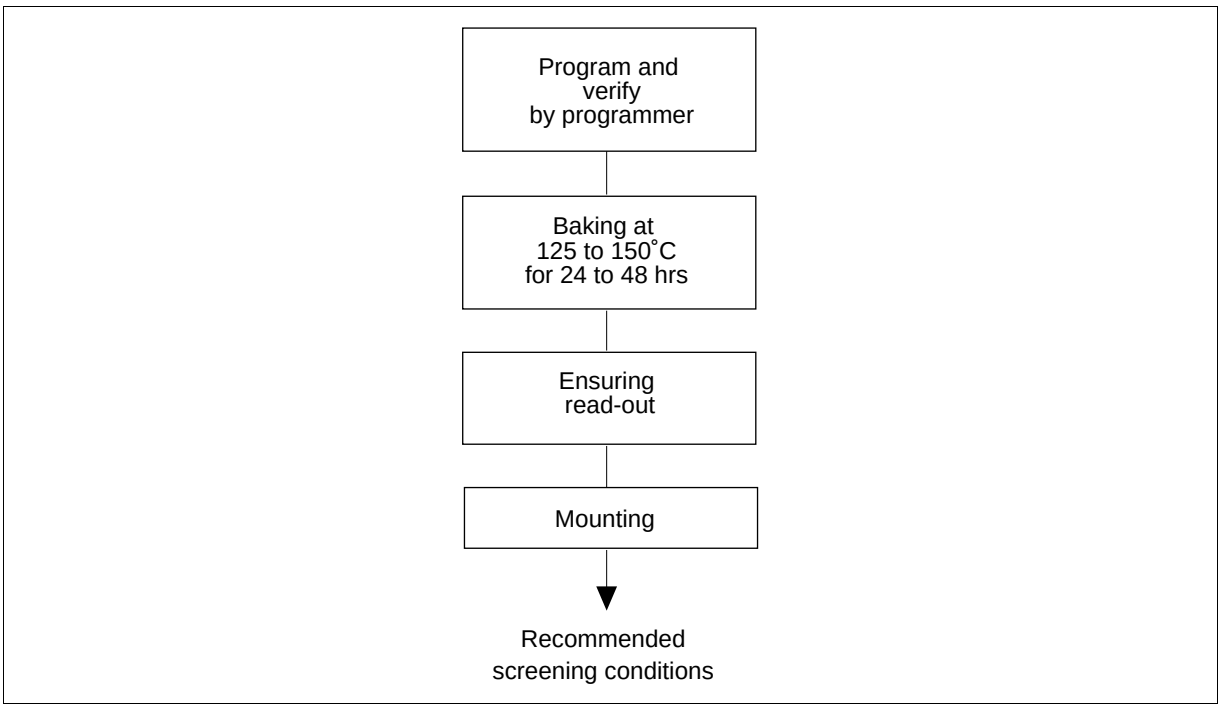
HN27C4000FP Identifier Code

Identifier	FP-40D	A0 (9)	I/O8 – I/O15 —	I/O7 (28)	I/O6 (26)	I/O5 (24)	I/O4 (22)	I/O3 (19)	I/O2 (17)	I/O1 (15)	I/O0 (13)	Hex Data
Manufacturer code		V_{IL}	X	0	0	0	0	0	1	1	1	07
Device code		V_{IH}	X	1	0	1	0	0	0	0	1	A1

Notes: 1. V_{CC} = 5.0 V ± 10%
2. A9 = 12.0 V ± 0.5 V
3. $\overline{CE}$, $\overline{OE}$ = V_{IL}
4. A1 – A8, A10 – A17: Don't care.
5. X: Don't care.

Recommended Screening Conditions

Before mounting, please make the screening (baking without bias) shown below.



Package Dimensions

HN27C4000FP Series (FP-40D) Unit: mm