

**V851™**  
**32-/16-BIT SINGLE-CHIP MICROCONTROLLER**

The  $\mu$ PD70P3000 is a one-time PROM version of the  $\mu$ PD703000. A program can be written only once to the PROM of the one-time PROM and this model is useful for small-scale production of a variety of application sets or early start of production.

Functions in detail are described in the following user's manuals. Be sure to read these manuals when you design your systems.

V851 User's Manual-Hardware : U10935E

V850 Family™ User's Manual-Architecture: U10243E

**FEATURES**

- Compatible with  $\mu$ PD703000
  - Can be replaced with mask ROM model,  $\mu$ PD703000, for mass production of application set
- Internal PROM: 32K bytes
  - Can be written only once
- PROM programming characteristics:  $\mu$ PD27C1001A compatible
- QTOP™ microcomputer compatible

**Remark** QTOP microcomputer is NEC's microcomputer with one-time PROM, with total support of writing service (from program writing, to marking, screening, and verifying).

**ORDERING INFORMATION**

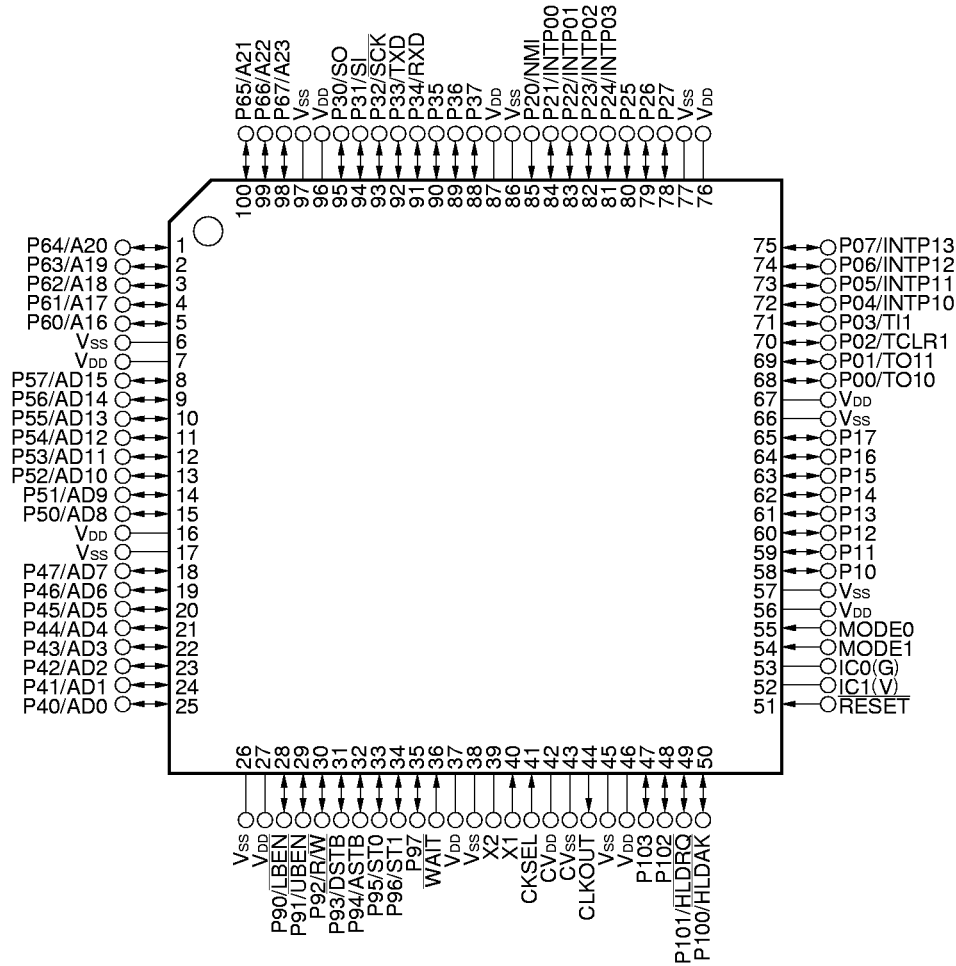
Part Number	Package	Maximum Operating Frequency (MHz)
$\mu$ PD70P3000GC-25-7EA	100-pin plastic QFP (fine pitch) (14 × 14 mm)	25
$\mu$ PD70P3000GC-33-7EA	100-pin plastic QFP (fine pitch) (14 × 14 mm)	33

The one-time PROM model is referred to as "PROM" in this document.

The information in this document is subject to change without notice.

PIN CONFIGURATION (Top View)

(1) Normal operation mode



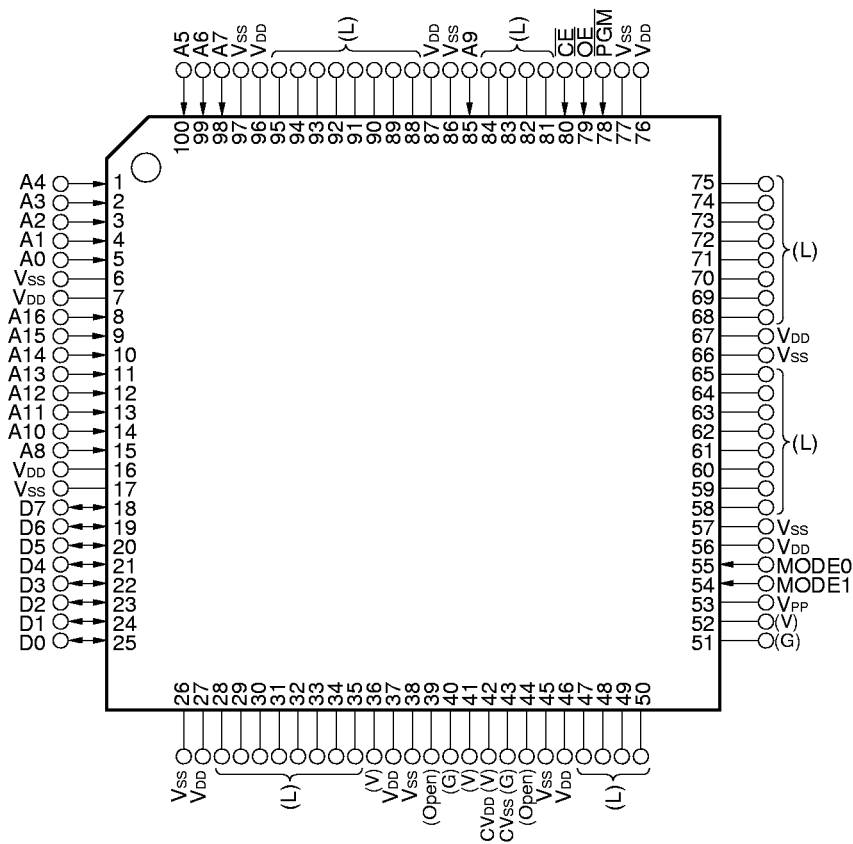
**Caution** The letters in brackets ( ) indicate the processing of the pins not used in the normal operation mode.

**G:** Directly connect this pin to V<sub>SS</sub>.

**V:** Directly connect this pin to V<sub>DD</sub>.

P00-P07	: Port0	A16-A23	: Address Bus
P10-P17	: Port1	LBEN	: Lower Byte Enable
P20-P27	: Port2	UBEN	: Upper Byte Enable
P30-P37	: Port3	R/W	: Read/Write Status
P40-P47	: Port4	DSTB	: Data Strobe
P50-P57	: Port5	ASTB	: Address Strobe
P60-P67	: Port6	ST0, ST1	: Status
P90-P97	: Port9	HLDK	: Hold Acknowledge
P100-P103	: Port10	HLDRQ	: Hold Request
TO10, TO11	: Timer Output	CLKOUT	: Clock Output
TCLR1	: Timer Clear	CKSEL	: Clock Select
TI1	: Timer Input	WAIT	: Wait
INTP00-INTP03,		MODE0, MODE1	: Mode
INTP10-INTP13	: Interrupt Request From Peripherals	RESET	: Reset
NMI	: Non-maskable Interrupt Request	X1, X2	: Crystal
SO	: Serial Output	CVDD	: Clock Generator Power Supply
SI	: Serial Input	CVSS	: Clock Generator Ground
SCK	: Serial Clock	VDD	: Power Supply
TXD	: Transmit Data	VSS	: Ground
RXD	: Receive Data	IC0, IC1	: Internally Connected
AD0-AD15	: Address/Data Bus		

(2) PROM programming mode



**Caution** The letters in brackets ( ) indicate the processing of the pins not used in the normal operation mode.

**L** : Individually connect to V<sub>SS</sub> via resistor.

**G** : Directly connect this pin to V<sub>SS</sub>.

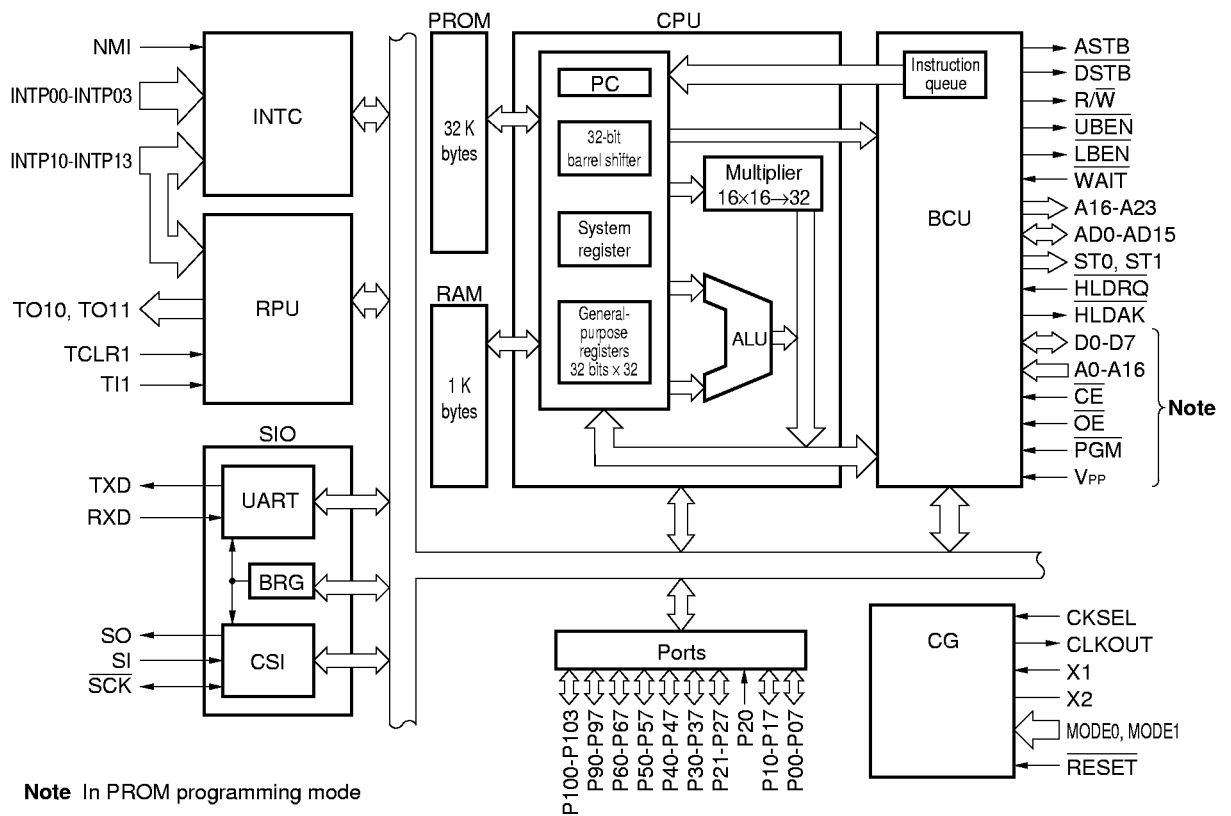
**V** : Directly connect this pin to V<sub>DD</sub>.

**Open** : Connect nothing.

- A0-A16 : Address Bus
- D0-D7 : Data Bus
- $\overline{\text{CE}}$  : Chip Enable
- $\overline{\text{OE}}$  : Output Enable
- PGM : Programming Mode

- MODE0, MODE1 : Programming Mode Set
- V<sub>DD</sub> : Power Supply
- V<sub>SS</sub> : Ground
- V<sub>PP</sub> : Programming Power Supply

INTERNAL BLOCK DIAGRAM



**TABLE OF CONTENTS**

**1. DIFFERENCES BETWEEN μPD70P3000 and μPD703000 ..... 7**

**2. PIN FUNCTIONS ..... 8**

**2.1 Normal Operation Mode (MODE0 = L, MODE1 = H) ..... 8**

        2.1.1 Port pins ..... 8

        2.1.2 Pins other than port pins ..... 9

**2.2 PROM Programming Mode (MODE0 = H, MODE1 = H) ..... 11**

**2.3 I/O Circuits of Pins and Recommended Connections of Unused Pins ..... 12**

**3. PROM PROGRAMMING ..... 14**

    3.1 Operation Mode ..... 14

    3.2 PROM Writing Procedure ..... 16

    3.3 PROM Reading Procedure ..... 20

**4. SCREENING OF ONE-TIME PROM DEVICE ..... 21**

**5. NOTES ON RELEASING STOP MODE WHEN EXTERNAL CLOCK IS USED ..... 21**

**6. ELECTRICAL SPECIFICATIONS ..... 22**

    6.1 Normal Operating Mode ..... 22

        6.1.1 When  $V_{DD} = 5.0\text{ V} \pm 10\%$  ..... 22

        6.1.2 When  $V_{DD} = 3.0\text{ to }3.6\text{ V}$  ..... 41

    6.2 PROM Programming Mode ..... 59

**7. CHARACTERISTICS CURVES (reference) ..... 65**

**8. PACKAGE DRAWINGS ..... 66**

**9. RECOMMENDED SOLDERING CONDITIONS ..... 67**

**APPENDIX PROM WRITING TOOLS ..... 68**

**1. DIFFERENCES BETWEEN μPD70P3000 and μPD703000**

The μPD70P3000 is a PROM version of the μPD703000. Therefore, these two models are identical except for differences because of the ROM specifications (for example, specifications concerning writing and verifying). Table 1-1 shows the differences between the two.

Note that this document mainly describes the PROM specifications of the μPD70P3000. For the other functions, refer to the documents on the μPD703000.

**Table 1-1. Differences between μPD70P3000 and μPD703000**

Item	μPD70P3000	μPD703000
Internal program memory (electrical writing)	One-time PROM (can be written only once)	Mask ROM
PROM programming pin	Provided	None
Setting of MODE0 and MODE1 pins	<ul style="list-style-type: none"> <li>• In normal operation mode MODE0, 1 = LH</li> <li>• In PROM programming mode MODE0, 1 = HH</li> </ul>	<ul style="list-style-type: none"> <li>• In normal operation mode MODE0, 1 = LH</li> <li>• In ROM-less mode MODE0, 1 = LL</li> </ul>
Electrical specifications	Current consumption differs	
Others	Noise immunity and noise radiation differ because circuit scale and mask layout differ.	

**Cautions** 1. The PROM and mask ROM models differ from each other in terms of noise immunity and noise radiation. When replacing the PROM model with the mask ROM model in the course of experimental production to mass production, perform thorough evaluation with the CS model (not ES model) of the mask ROM model.

2. Directly connect the MODE0 and MODE1 pins to V<sub>DD</sub> or V<sub>SS</sub>.

3. When replacing the PROM model with the mask ROM model, write the same code to the empty area of the on-chip ROM.

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**Remark** L : low level  
H : high level

## 2. PIN FUNCTIONS

### 2.1 Normal Operation Mode (MODE0 = L, MODE1 = H)

#### 2.1.1 Port pins

(1/2)

Pin Name	I/O	Function	Shared with:
P00	I/O	Port 0 8-bit I/O port. Can be set in input or output mode in 1-bit units.	TO10
P01			TO11
P02			TCLR1
P03			TI1
P04			INTP10
P05			INTP11
P06			INTP12
P07			INTP13
P10-P17	I/O	Port 1 8-bit I/O port. Can be set in input or output mode in 1-bit units.	—
P20	Input	Port 2 P20 is an input-only port. Operates as an NMI input when valid edge is input. Bit 0 of the P2 register indicates NMI input status. P21 through P27 are 7-bit I/O ports. Can be set in input or output mode in 1-bit units.	NMI
P21	I/O		INTP00
P22			INTP01
P23			INTP02
P24			INTP03
P25-P27			—
P30	I/O	Port 3 8-bit I/O port. Can be set in input or output mode in 1-bit units.	SO
P31			SI
P32			SCK
P33			TXD
P34			RXD
P35-P37			—
P40-P47	I/O	Port 4 8-bit I/O port. Can be set in input or output mode in 1-bit units.	AD0-AD7
P50-P57	I/O	Port 5 8-bit I/O port. Can be set in input or output mode in 1-bit units.	AD8-AD15
P60-P67	I/O	Port 6 8-bit I/O port. Can be set in input or output mode in 1-bit units.	A16-A23



(2/2)

Pin Name	I/O	Function	Shared with:
P90	I/O	Port 9 8-bit I/O port. Can be set in input or output mode in 1-bit units.	$\overline{\text{LBEN}}$
P91			$\overline{\text{UBEN}}$
P92			$\overline{\text{R/W}}$
P93			$\overline{\text{DSTB}}$
P94			$\overline{\text{ASTB}}$
P95			$\overline{\text{ST0}}$
P96			$\overline{\text{ST1}}$
P97			—
P100	I/O	Port 10 4-bit I/O port. Can be set in input or output mode in 1-bit units.	$\overline{\text{HLDK}}$
P101			$\overline{\text{HLDRQ}}$
P102			—
P103			—

2.1.2 Pins other than port pins

(1/2)

Pin Name	I/O	Function	Shared with:
TO10	Output	Pulse signal output of timer 1	P00
TO11			P01
TCLR1	Input	External clear signal input of timer 1	P02
TI1		External count clock input of timer 1	P03
INTP10	Input	External maskable interrupt request input and external capture trigger input of timer 1	P04
INTP11			P05
INTP12			P06
INTP13			P07
NMI	Input	Non-maskable interrupt request input	P20
INTP00	Input	External maskable interrupt request input	P21
INTP01			P22
INTP02			P23
INTP03			P24
SO	Output	Serial transmit data output of CSI	P30
SI	Input	Serial receive data input of CSI	P31
$\overline{\text{SCK}}$	I/O	Serial clock I/O of CSI	P32
TXD	Output	Serial transmit data output of UART	P33
RXD	Input	Serial receive data input of UART	P34
AD0-AD7	I/O	16-bit multiplexed address/data bus when external memory is connected	P40-P47
AD8-AD15			P50-P57
A16-A23	Output	High-order address bus when external memory is connected	P60-P67
$\overline{\text{LBEN}}$	Output	Low-order byte enable signal output of external data bus	P90
$\overline{\text{UBEN}}$		High-order byte enable signal output of external data bus	P91

(2/2)

Pin Name	I/O	Function	Shared with:
$\overline{R/W}$	Output	External read/write status output	P92
$\overline{DSTB}$		External data strobe signal output	P93
$\overline{ASTB}$		External address strobe signal output	P94
$\overline{ST0}$		External bus cycle status output	P95
$\overline{ST1}$			P96
$\overline{HLD\!A\!K}$	Output	Bus hold acknowledge output	P100
$\overline{HLDRQ}$	Input	Bus hold request input	P101
$\overline{CLKOUT}$	Output	System clock output	—
$\overline{CKSEL}$	Input	Input specifying operation mode of clock generator	—
$\overline{WAIT}$	Input	Control signal input inserting wait state in bus cycle	—
$\overline{MODE0}, \overline{MODE1}$	Input	Operation mode specification	—
$\overline{RESET}$	Input	System reset input	—
X1	Input	System clock oscillator connection. Input external clock to X1 to supply external clock.	—
X2	—		—
$CV_{DD}$	—	Positive power supply for internal clock generator	—
$CV_{SS}$	—	Ground potential for internal clock generator	—
$V_{DD}$	—	Positive power supply	—
$V_{SS}$	—	Ground potential	—
IC0, IC1	—	Internally connected	—

2.2 PROM Programming Mode (MODE0 = H, MODE1 = H)

Pin Name	Function	Corresponding Pin of μPD27C1001A
P60-P67	Low-order address (A0 through A7) input	A0-A7
P50, P20, P51-P57	High-order address (A8 through A16) input	A8, A9, A10-A16
P40-P47	Data I/O	D0-D7
P25	$\overline{CE}$ (chip enable) input	$\overline{CE}$
P26	$\overline{OE}$ (output enable) input	$\overline{OE}$
P27	PGM (program) input	$\overline{PGM}$
V <sub>PP</sub>	Power for program writing	V <sub>PP</sub>
MODE0, MODE1	Operation mode specification	—

### 2.3 I/O Circuits of Pins and Recommended Connections of Unused Pins

Table 2-1 shows the I/O circuit type of each pin in the normal operation mode, and the recommended connections of the unused pins. Figure 2-1 shows a partially simplified diagram of each circuit.

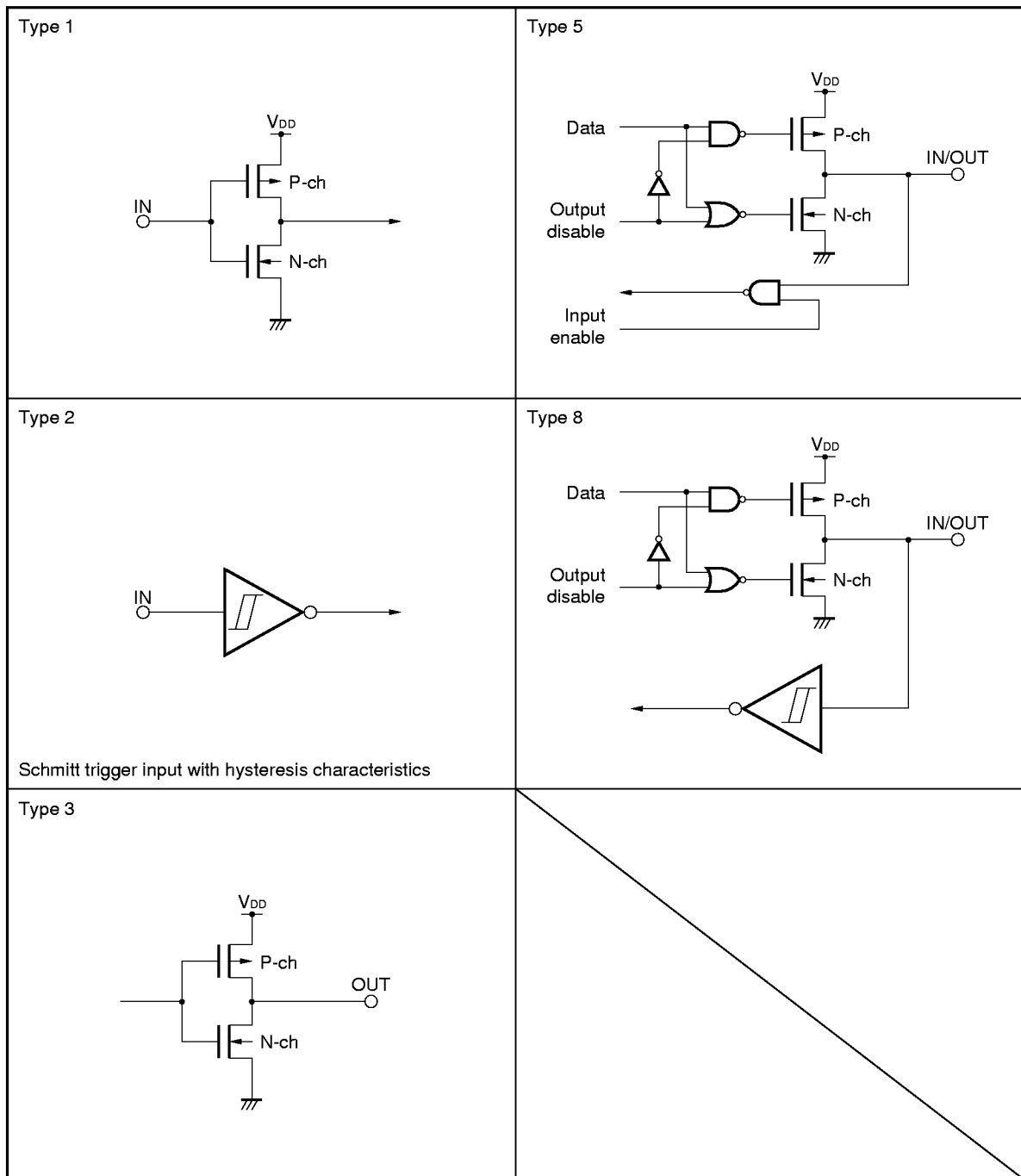
In the PROM programming mode, process the unused pins by referring to the diagram in PIN CONFIGURATION.

When connecting a pin to V<sub>DD</sub> or V<sub>SS</sub> via resistor, use of a resistor of 3 to 10 kΩ is recommended.

**Table 2-1. I/O Circuit Types of Each Pin and Recommended Connections of Unused Pins**

Pin	I/O Circuit Type	Recommended Connections
P00/TO10, P01/TO11	5	Input : Individually connect to V <sub>DD</sub> or V <sub>SS</sub> via resistor.
P02/TCLR1, P03/TI1	8	Output : Open
P04/INTP10-P07/INTP13		
P10-P17	5	
P20/NMI	2	Directly connect to V <sub>SS</sub> .
P21/INTP00-P24/INTP03	8	Input : Individually connect to V <sub>DD</sub> or V <sub>SS</sub> via resistor.
P25	5	Output : Open
P26, P27	8	
P30/SO	5	
P31/SI, P32/SCK	8	
P33/TXD, P34/RXD, P35	5	
P36, P37	8	
P40/AD0-P47/AD7	5	
P50/AD8-P57/AD15		
P60/A16-A67/A23		
P90/LBEN		
P91/UBEN		
P92/R/W		
P93/DSTB		
P94/ASTB		
P95/ST0, P96/ST1		
P97		
P100/HLDAK		
P101/HLDRQ		
P102		
P103		
CLKOUT	3	Open
CKSEL	2	—
WAIT	1	Directly connect to V <sub>DD</sub> .
MODE0, MODE1	2	—
RESET		
IC0	—	Directly connect to V <sub>SS</sub> .
IC1	—	Directly connect to V <sub>DD</sub> .

Figure 2-1. I/O Circuits of Pins



### 3. PROM PROGRAMMING

The μPD70P3000 has a 32K × 8 bit PROM that can be electrically written. To program this PROM, set the PROM programming mode by using the V<sub>PP</sub>, MODE0, and MODE1 pins.

The programming characteristics are compatible with those of the μPD27C1001A.

**Table 3-1. Pin Functions in PROM Programming Mode**

Function	Normal Operation Mode	PROM Programming Mode
Address input	P60/A16-P67/A23, P50/AD8, P20/NMI, P51/AD9-P57/AD15	A0-A16
Data I/O	P40/AD0-P47/AD7	D0-D7
Program input	P27	PGM
Chip enable input	P25	CE
Output enable input	P26	OE
Program voltage	V <sub>PP</sub>	
Mode specification	MODE0, MODE1	

#### 3.1 Operation Mode

To set the programming writing/verify mode, set as follows: V<sub>PP</sub> = + 12.5 V, MODE0 = H, MODE1 = H  
 In this mode, the modes shown in Table 3-2 can be selected by using the CE, OE, and PGM pins.

To read the contents of the PROM, set the read mode.

Connect the unused pins by referring to the diagram in PIN CONFIGURATION.

**Table 3-2. Operation Modes for PROM Programming**

Operation Mode	MODE0	MODE1	CE	OE	PGM	V <sub>PP</sub>	V <sub>DD</sub>	D0-D7
Page data latch mode	H	H	H	L	H	+ 12.5 V	+ 6.5 V	Data input
Page write mode			H	H	L			High impedance
Byte write mode			L	H	L			Data input
Program verify mode			L	L	H			Data output
Program inhibit mode			x	L	L			High impedance <sup>Note</sup>
			x	H	H			
Read mode	H	H	L	L	H	+ 5.0 V	+ 5.0 V	Data output
Output disable mode			L	H	x			High impedance <sup>Note</sup>
Standby mode			H	x	x			High impedance <sup>Note</sup>

**Note** L or H can be input (address input is invalid).

**Remark** x: L or H

**(1) Page data latch mode**

The page data latch mode can be set by making the  $\overline{CE}$  and  $\overline{PGM}$  pins high and  $\overline{OE}$  pin low at the beginning of the page write mode.

In the page data latch mode, 1 page or 4 bytes of data are latched to the internal address/data latch circuit.

**(2) Page write mode**

In this mode, page write is executed by applying a program pulse of 0.1 ms to the  $\overline{PGM}$  pin when  $\overline{CE} = H$  and  $\overline{OE} = H$  after 1 page or 4 bytes of addresses and data have been latched in the page data latch mode. After that, the program is verified when  $\overline{CE} = L$  and  $\overline{OE} = L$ .

If the program cannot be written by applying the program pulse once, writing and verification are repeatedly executed X times ( $X \leq 10$ ).

**(3) Byte write mode**

Byte write is executed by applying a program pulse (active low) of 0.1 ms to the  $\overline{PGM}$  pin when  $\overline{CE} = L$  and  $\overline{OE} = H$ . After that, the program is verified when  $\overline{OE} = L$ .

If the program cannot be written by applying the program pulse once, writing and verification are repeatedly executed X times ( $X \leq 10$ ).

**(4) Program verify mode**

The program verify mode is set when  $\overline{CE} = L$ ,  $\overline{OE} = L$ , and  $\overline{PGM} = H$ .

Check to see if the program has been correctly written, in this mode.

**(5) Program inhibit mode**

The program inhibit mode is used to write a program to one of several  $\mu$ PD70P3000s whose  $\overline{OE}$ ,  $V_{PP}$  and D0 through D7 pins are connected in parallel.

To write a program, either the page write mode or byte write mode above is used. At this time, the program is not written to any device whose  $\overline{PGM}$  pin is made high.

**(6) Read mode**

The read mode is set when  $\overline{CE} = L$ ,  $\overline{OE} = L$ , and  $\overline{PGM} = H$ .

**(7) Output disable mode**

The data output goes into a high-impedance state and the output disable mode is set by making  $\overline{CE}$  low and  $\overline{OE}$  high.

When two or more  $\mu$ PD70P3000s are connected to the data bus, any one of the devices can be selected and data can be read by controlling the  $\overline{OE}$  pin.

**(8) Standby mode**

The standby mode is set by making  $\overline{CE}$  high.

In this mode, the data output goes into a high-impedance state regardless of the status of  $\overline{OE}$ .

3.2 PROM Writing Procedure

Figure 3-1. Flowchart in Page Program Mode

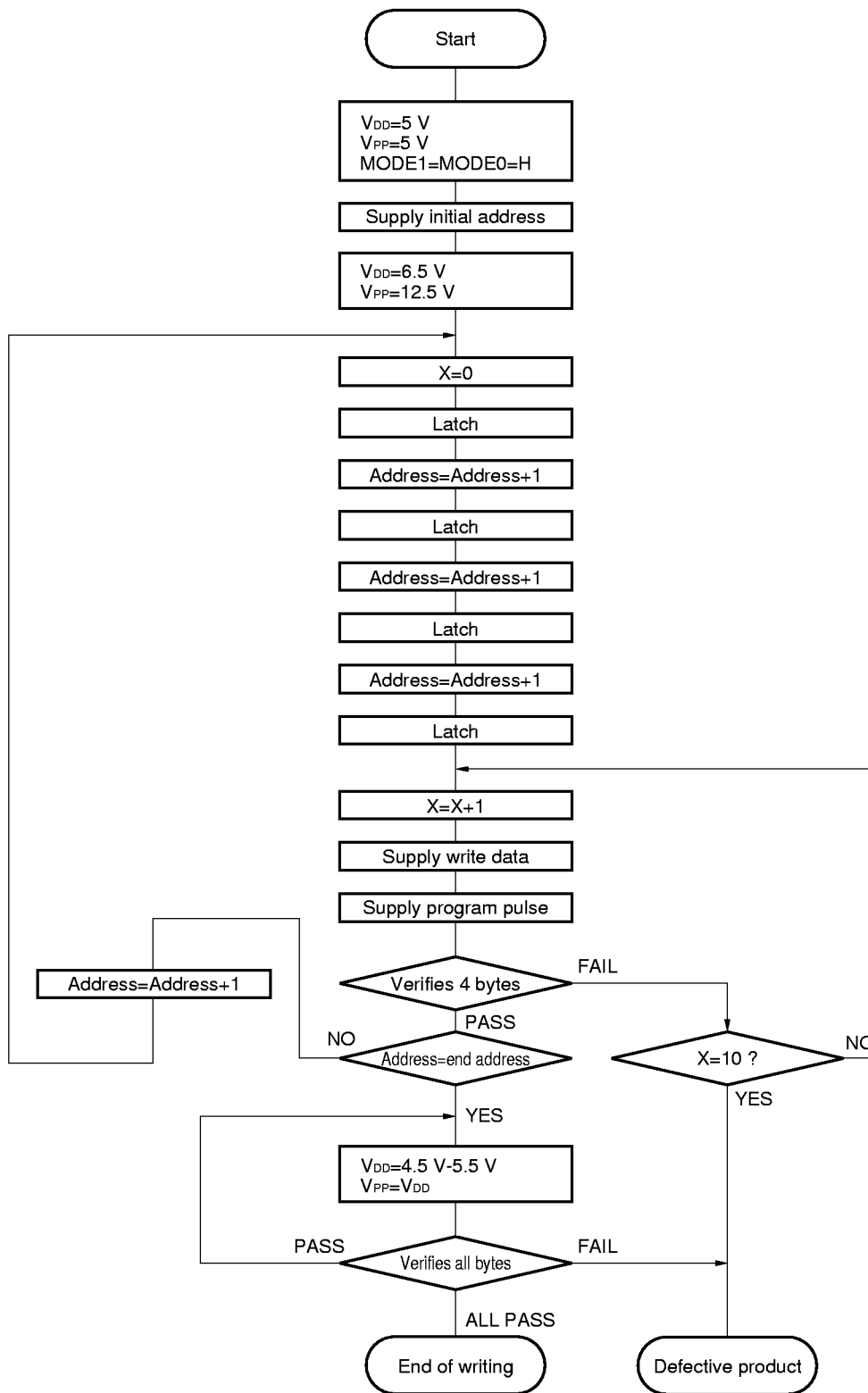
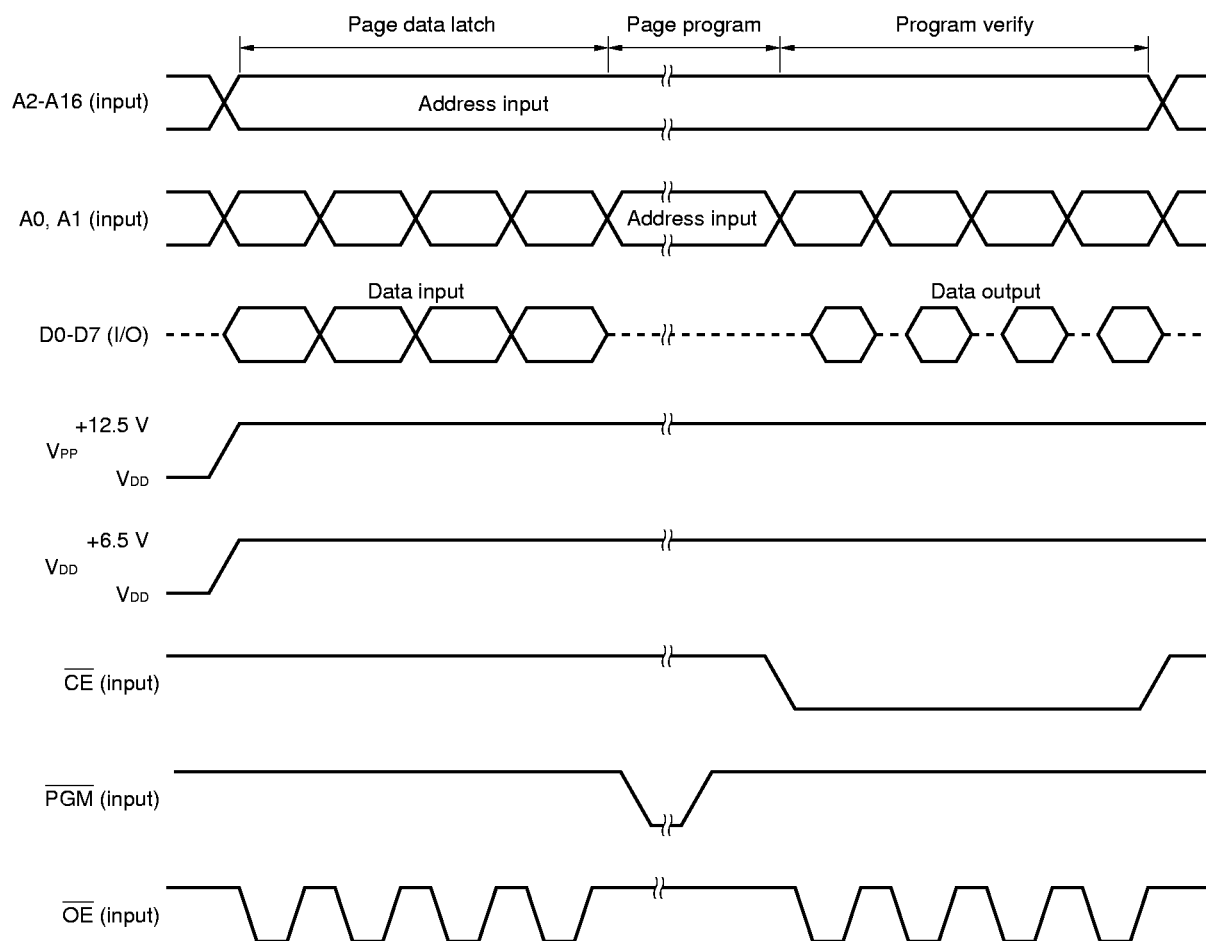




Figure 3-2. PROM Writing/Verify Timing (page program mode)



**Remark** The broken line indicates the high-impedance state.

Figure 3-3. Flowchart in Byte Program Mode

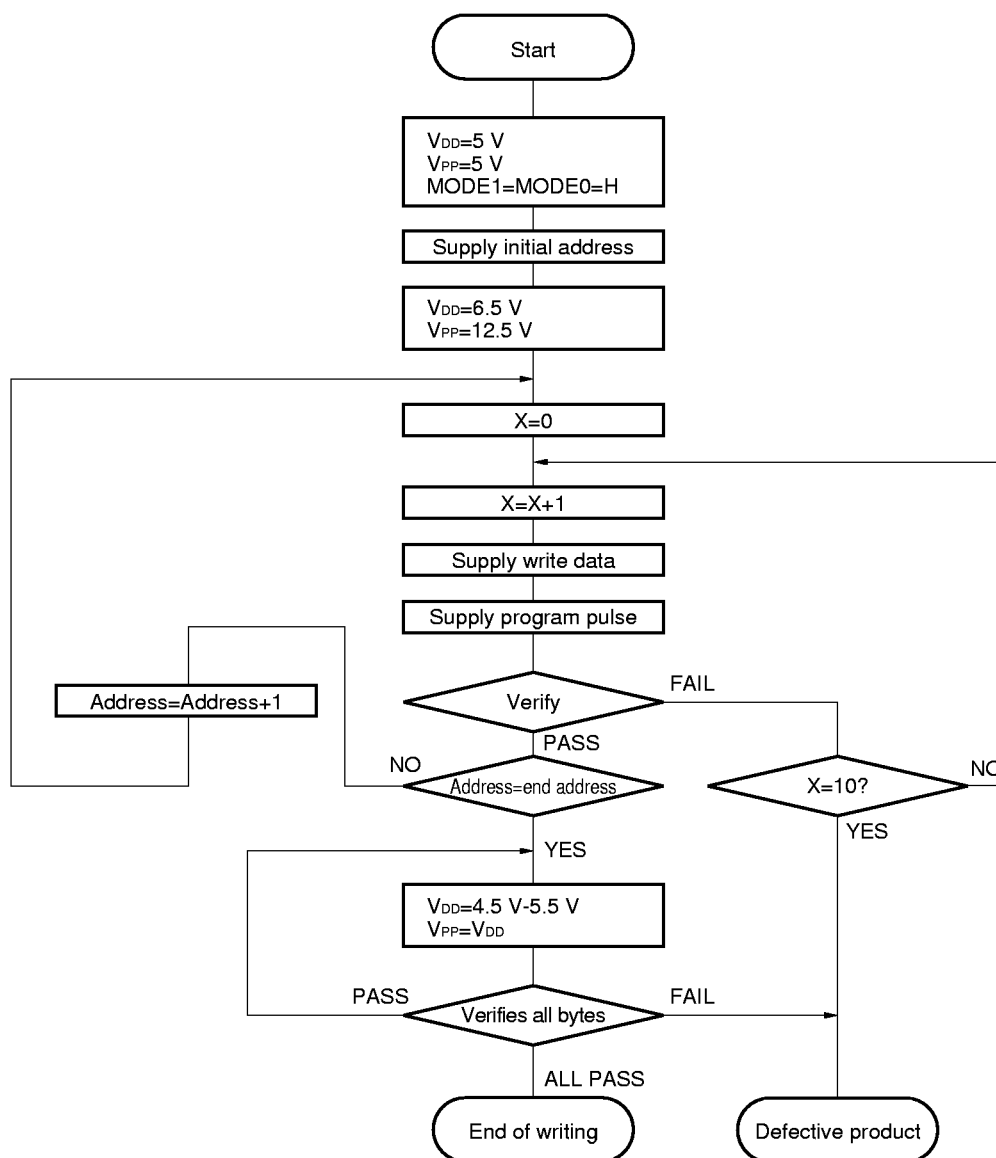
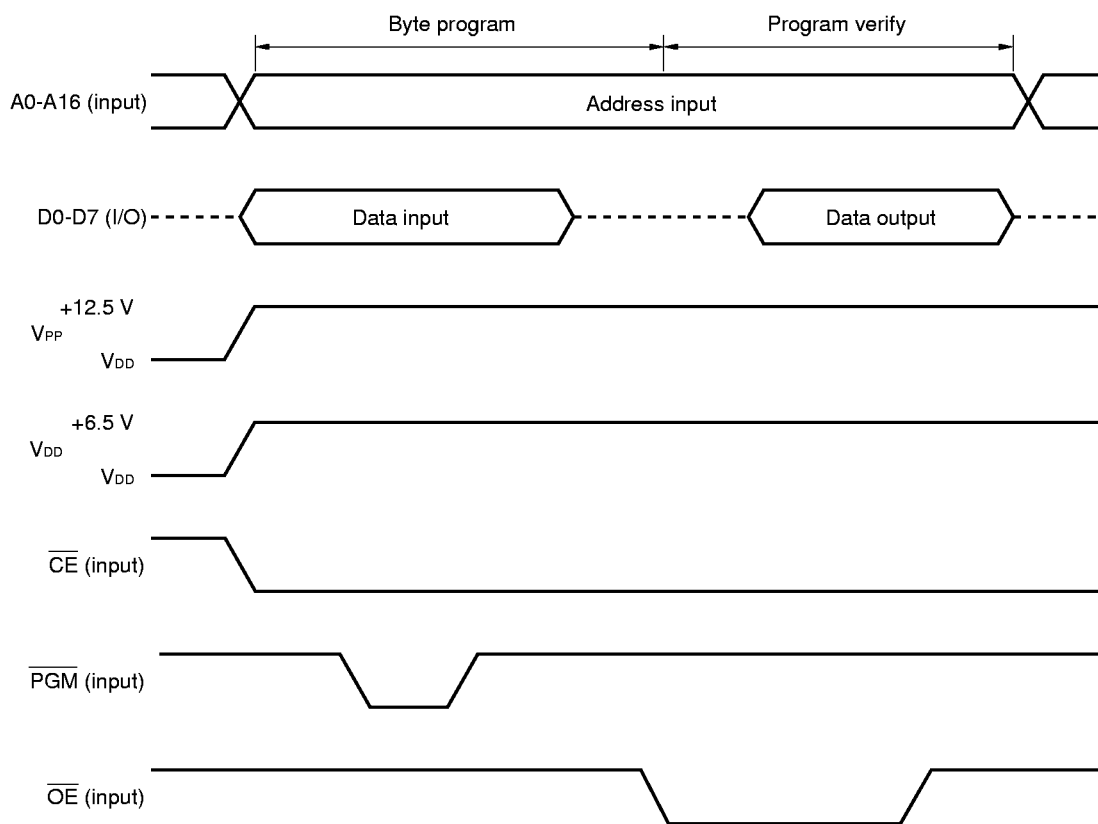


Figure 3-4. PROM Writing/Verifying Timing (byte program mode)



**Remark** The broken line indicates the high-impedance state.

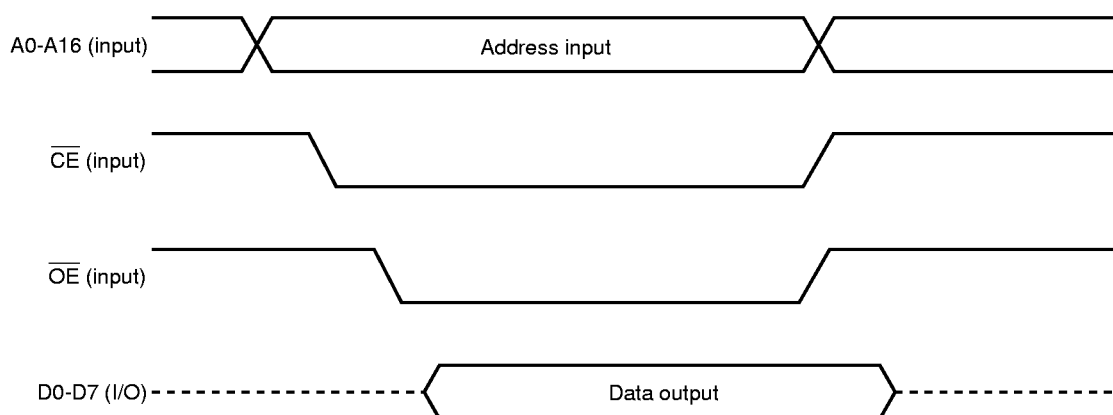
### 3.3 PROM Reading Procedure

The procedure to read the contents of the PROM to the external data bus (D0 through D7) is as follows:

- (1) Fix the MODE0 and MODE1 pins to low level. Connect the unused pins by referring to the diagram in PIN CONFIGURATION.
- (2) Supply + 5 V to the V<sub>DD</sub> and V<sub>PP</sub> pins.
- (3) Input the address of the data to be read to the A0 through A16 pins.
- (4) Set the read mode ( $\overline{CE} = L, \overline{OE} = L$ ).
- (5) Data are output to pins D0 through D7.

Figure 3-5 shows the timing of steps (2) through (5) above.

Figure 3-5. PROM Reading Timing



**Remark** The broken line indicates the high-impedance state.

#### 4. SCREENING OF ONE-TIME PROM DEVICE

Because of its structure, the one-time PROM cannot be completely tested by NEC before shipment. It is recommended to perform screening to verify the PROM, after writing the necessary data to the PROM and storing the device under the following conditions:

Storage Temperature	Storage Time
125 °C	24 hours

NEC offers a service, at a charge, called QTOP microcontroller, for writing, marking, screening, and verifying one-time PROMs. For details, consult NEC.

#### 5. NOTES ON RELEASING STOP MODE WHEN EXTERNAL CLOCK IS USED

When an external clock is used, the clock is supplied by an external system.

To release the STOP mode (by RESET or NMI input), therefore, resume clock supply at least 100  $\mu$ s before inputting the RESET or NMI signal to make sure that a sufficiently long time elapses to allow the PROM to stabilize.

6. ELECTRICAL SPECIFICATIONS

6.1 Normal Operation Mode

Corresponding Electrical Specifications

Part Number	V <sub>DD</sub> = 5.0 V ± 10 %	V <sub>DD</sub> = 3.0 to 3.6 V
μPD70P3000GC-25-7EA	Electrical specifications specified	Outside guaranteed operating range
μPD70P3000GC-33-7EA	Electrical specifications specified	Electrical specifications specified

6.1.1 When V<sub>DD</sub> = 5.0 V ± 10 %

Absolute Maximum Ratings (T<sub>A</sub> = 25 °C)

Parameter	Symbol	Condition	Ratings	Unit
Supply voltage	V <sub>DD</sub>	V <sub>DD</sub> pin	-0.5 to +7.0	V
	CV <sub>DD</sub>	CV <sub>DD</sub> pin	-0.5 to +7.0	V
	CV <sub>SS</sub>	CV <sub>SS</sub> pin	-0.5 to +0.5	V
Input voltage	V <sub>I1</sub>	Except X1 pin, V <sub>DD</sub> = 5.0 V ± 10 %	-0.5 to V <sub>DD</sub> + 0.3	V
	V <sub>I2</sub>	V <sub>PP</sub> pin in PROM programming mode, V <sub>DD</sub> = 5.0 V ± 10 %	-0.5 to +13.5	V
Clock input voltage	V <sub>X</sub>	X1 pin, V <sub>DD</sub> = 5.0 V ± 10 %	-0.5 to V <sub>DD</sub> + 1.0	V
Output current, low	I <sub>OL</sub>	1 pin	4.0	mA
		Total of all pins	100	mA
Output current, high	I <sub>OH</sub>	1 pin	-4.0	mA
		Total of all pins	-100	mA
Output voltage	V <sub>O</sub>	V <sub>DD</sub> = 5.0 V ± 10 %	-0.5 to V <sub>DD</sub> + 0.3	V
Operating ambient temperature	T <sub>A</sub>	When operating at 25 MHz	-40 to +85	°C
		When operating at 33 MHz	-20 to +70	°C
Storage temperature	T <sub>stg</sub>		-65 to +150	°C

- Cautions**
1. Do not directly connect the output (or I/O) pins of two or more IC products, and do not directly connect them to V<sub>DD</sub>, V<sub>CC</sub>, or GND pin. Open-drain pins and open-collector pins may be directly connected to one another however. Moreover, an external circuit that is designed to prevent contention of output can be connected to pins that go into a high-impedance state.
  2. Should the absolute maximum rating of even one of the above parameters be exceeded even momentarily, the quality of the product may be degraded. The absolute maximum ratings are, therefore, the values exceeding which the product may be physically damaged. Use the product so that these values are never exceeded.  
The normal operating ranges of ratings and conditions in which the quality of the product is guaranteed are specified in the following DC Characteristics and AC Characteristics.

**Capacitance (T<sub>A</sub> = 25 °C, V<sub>DD</sub> = V<sub>SS</sub> = 0 V)**

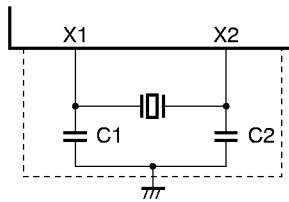
Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Input capacitance	C <sub>i</sub>	f <sub>c</sub> = 1 MHz Pins other than tested pin: 0 V			15	pF
I/O capacitance	C <sub>io</sub>				15	pF
Output capacitance	C <sub>o</sub>				15	pF

**Operating Conditions**

Operation Mode	Internal Operating Clock Frequency (ϕ)	Operating Temperature (T <sub>A</sub> )	Supply Voltage (V <sub>DD</sub> )
Direct mode	0 to 25 MHz	-40 to +85 °C	5.0 V ± 10 %
	0 to 33 MHz	-20 to +70 °C	
PLL mode	Self oscillation frequency to 25 MHz	-40 to +85 °C	5.0 V ± 10 %
	Self oscillation frequency to 33 MHz	-20 to +70 °C	

Recommended Oscillation Circuit

(a) Ceramic resonator connection (TDK, Murata Mfg.: T<sub>A</sub> = -40 to +85 °C, Kyocera: T<sub>A</sub> = -20 to +80 °C)

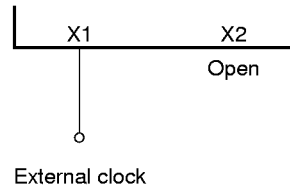


Manufacturer	Part Number	Oscillation Frequency f <sub>xx</sub> (MHz)	Recommended Circuit Constants		Oscillation Voltage Range		Oscillation Stabilization Time (MAX.) T <sub>OST</sub> (ms)
			C1 (pF)	C2 (pF)	MIN. (V)	MAX. (V)	
TDK Corp.	FCR2.0MC3	2.0	Provided	Provided	4.5	5.5	0.26
	CCR3.2MC3	3.2	Provided	Provided	4.5	5.5	0.62
	FCR5.0MC5	5.0	Provided	Provided	4.5	5.5	0.30
	CCR5.0MC3	5.0	Provided	Provided	4.5	5.5	0.38
	CCR6.6MC3	6.6	Provided	Provided	4.5	5.5	0.32
Kyocera Corp.	KBR-2.0MS	2.0	82	82	4.5	5.5	1.2
	KBR-2.7MS	2.7	68	68	4.5	5.5	0.8
	KBR-3.2MS	3.2	47	47	4.5	5.5	0.3
	KBR-5.0MSA	5.0	33	33	4.5	5.5	0.4
	KBR-6.6MS	6.6	33	33	4.5	5.5	0.2
Murata Mfg. Co., Ltd.	CSA5.00MG	5.0	30	30	4.5	5.5	0.13
	CST5.00MGW	5.0	Provided	Provided	4.5	5.5	0.13
	CSA6.60MTZ	6.6	30	30	4.5	5.5	0.10
	CST6.60MTW	6.6	Provided	Provided	4.5	5.5	0.10

- Cautions**
1. Connect the oscillation circuit as closely to X2 pin as possible.
  2. Do not route any other signal lines in the range indicated by the broken line in the above figure.
  3. Thoroughly evaluate the matching between the μPD70P3000 and resonator.



(b) External clock input



**Caution** Input CMOS level voltage to the X1 pin.

**DC Characteristics (T<sub>A</sub> = -40 to +85 °C, V<sub>DD</sub> = 5.0 V ± 10 %, V<sub>SS</sub> = 0 V): μPD70P3000GC-25**  
**(T<sub>A</sub> = -20 to +70 °C, V<sub>DD</sub> = 5.0 V ± 10 %, V<sub>SS</sub> = 0 V): μPD70P3000GC-33**

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	
Input voltage, high	V <sub>IH</sub>	Except X1 and <b>Note 1</b>	2.2		V <sub>DD</sub>	V	
		<b>Note 1</b>	0.8 V <sub>DD</sub>		V <sub>DD</sub>	V	
Input voltage, low	V <sub>IL</sub>	Except X1 and <b>Note 1</b>	0		+0.8	V	
		<b>Note 1</b>	0		0.2 V <sub>DD</sub>	V	
X1 clock input voltage, high	V <sub>XH</sub>	Direct mode	0.8 V <sub>DD</sub>		V <sub>DD</sub>	V	
		PLL mode	0.8 V <sub>DD</sub>		V <sub>DD</sub>	V	
X1 clock input voltage, low	V <sub>XL</sub>	Direct mode	0		0.6	V	
		PLL mode	0		0.6	V	
Schmitt trigger input threshold voltage	V <sub>T</sub> <sup>+</sup>	<b>Note 1</b> , rising		3.0		V	
	V <sub>T</sub> <sup>-</sup>	<b>Note 1</b> , falling		2.0		V	
Schmitt trigger input hysteresis width	V <sub>T</sub> <sup>+</sup> - V <sub>T</sub> <sup>-</sup>	<b>Note 1</b>	0.5			V	
Output voltage, high	V <sub>OH</sub>	I <sub>OH</sub> = -2.5 mA	0.7 V <sub>DD</sub>			V	
		I <sub>OH</sub> = -100 μA	V <sub>DD</sub> - 0.4			V	
Output voltage, low	V <sub>OL</sub>	I <sub>OL</sub> = 2.5 mA			0.45	V	
Input leakage current, high	I <sub>LIH</sub>	V <sub>I</sub> = V <sub>DD</sub>			10	μA	
Input leakage current, low	I <sub>LIL</sub>	V <sub>I</sub> = 0 V			-10	μA	
Output leakage current, high	I <sub>LOH</sub>	V <sub>O</sub> = V <sub>DD</sub>			10	μA	
Output leakage current, low	I <sub>LOL</sub>	V <sub>O</sub> = 0 V			-10	μA	
Supply current	Operating	I <sub>DD1</sub>	Direct mode		1.6 × φ + 14	2.5 × φ + 15	mA
			PLL mode		1.7 × φ + 16	2.7 × φ + 18	mA
	In HALT mode	I <sub>DD2</sub>	Direct mode		0.5 × φ + 3	0.7 × φ + 10	mA
			PLL mode		0.6 × φ + 5	0.9 × φ + 13	mA
	In IDLE mode	I <sub>DD3</sub>	Direct mode		8 × φ + 300	10 × φ + 500	μA
			PLL mode		0.1 × φ + 2	0.2 × φ + 3	mA
	In STOP mode	I <sub>DD4</sub>	<b>Note 2</b>		1	50	μA
			<b>Note 3</b>			200	μA

- Notes**
1. RESET, P02/TCLR1, P03/TI1, P04/INTP10 through P07/INTP13, P20/NMI, P21/INTP00 through P24/INTP03, P26, P27, P31/SI, P32/SCK, P36, P37, MODE0, MODE1, CKSEL
  2. When operating at 25 MHz: -40 °C ≤ T<sub>A</sub> ≤ +50 °C  
 When operating at 33 MHz: -20 °C ≤ T<sub>A</sub> ≤ +50 °C
  3. When operating at 25 MHz: 50 °C < T<sub>A</sub> ≤ 85 °C  
 When operating at 33 MHz: 50 °C < T<sub>A</sub> ≤ 70 °C

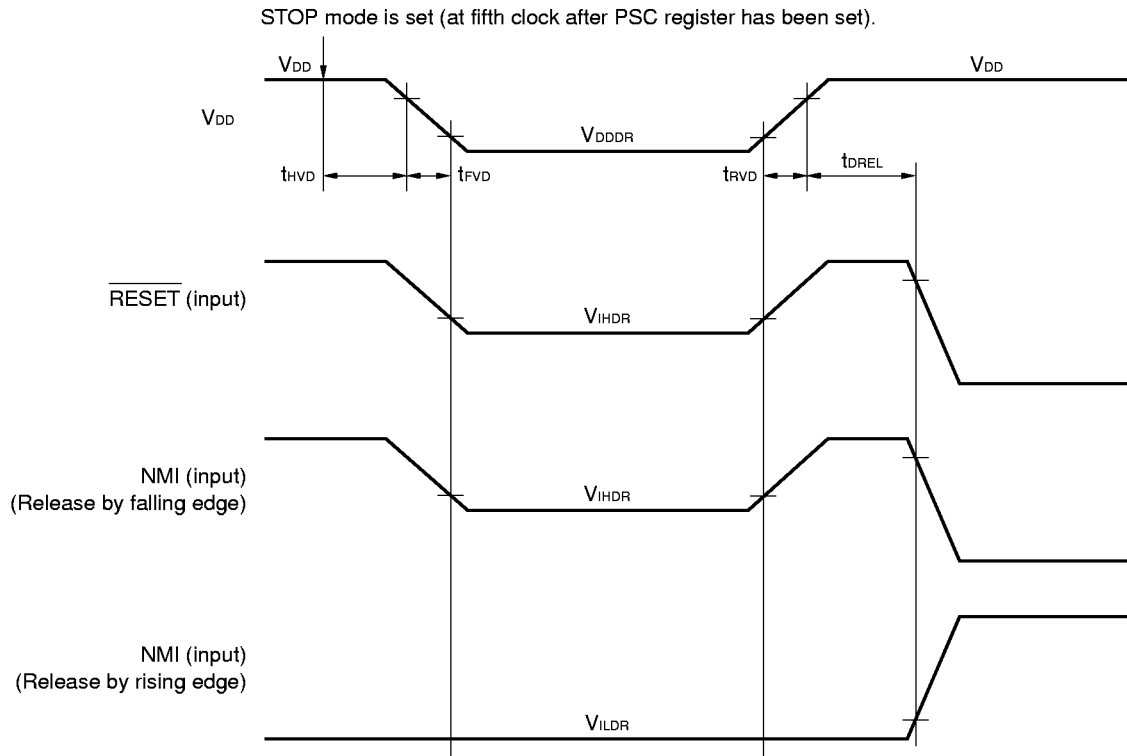
- Remarks**
1. TYP. value is a value for your reference at T<sub>A</sub> = 25 °C and V<sub>DD</sub> = 5.0 V.
  2. φ: Internal operating clock frequency

**Data Retention Characteristics (T<sub>A</sub> = -40 to +85 °C): μPD70P3000GC-25**  
**(T<sub>A</sub> = -20 to +70 °C): μPD70P3000GC-33**

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Data hold voltage	V <sub>DDDR</sub>	STOP mode	1.5		5.5	V
Data hold current	I <sub>DDDR</sub>	V <sub>DD</sub> = V <sub>DDDR</sub>	<b>Note 1</b>	0.2 V <sub>DDDR</sub>	50	μA
			<b>Note 2</b>	0.2 V <sub>DDDR</sub>	200	μA
Supply voltage rise time	t <sub>rVD</sub>		200			μs
Supply voltage fall time	t <sub>fVD</sub>		200			μs
Supply voltage hold time (vs. STOP mode setting)	t <sub>hVD</sub>		0			ms
STOP mode release signal input time	t <sub>dREL</sub>		0			ns
Data hold input voltage, high	V <sub>IHDR</sub>	<b>Note 3</b>	0.9 V <sub>DDDR</sub>		V <sub>DDDR</sub>	V
Data hold input voltage, low	V <sub>ILDR</sub>	<b>Note 3</b>	0		0.1 V <sub>DDDR</sub>	V

- Notes**
- When operating at 25 MHz: -40 °C ≤ T<sub>A</sub> ≤ +50 °C  
 When operating at 33 MHz: -20 °C ≤ T<sub>A</sub> ≤ +50 °C
  - When operating at 25 MHz: 50 °C < T<sub>A</sub> ≤ 85 °C  
 When operating at 33 MHz: 50 °C < T<sub>A</sub> ≤ 70 °C
  - $\overline{\text{RESET}}$ , P02/TCLR1, P03/TI1, P04/INTP10 through P07/INTP13, P20/NMI, P21/INTP00 through P24/INT03, P26, P27, P31/SI, P32/ $\overline{\text{SCK}}$ , P36, P37, MODE0, MODE1, CKSEL, X1

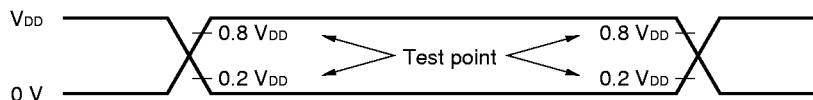
**Remark** TYP. value is a value for your reference at T<sub>A</sub> = 25 °C and V<sub>DD</sub> = 5.0 V.



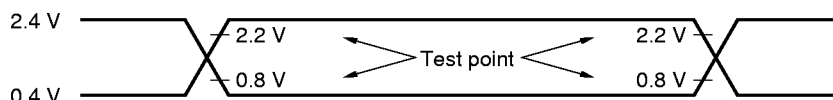
AC Characteristics ( $T_A = -40$  to  $+85$  °C,  $V_{DD} = 5.0$  V  $\pm$  10 %,  $V_{SS} = 0$  V): μPD70P3000GC-25  
 ( $T_A = -20$  to  $+70$  °C,  $V_{DD} = 5.0$  V  $\pm$  10 %,  $V_{SS} = 0$  V): μPD70P3000GC-33

AC test input wave

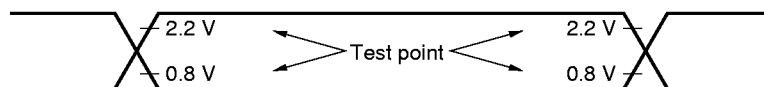
- (a)  $\overline{\text{RESET}}$ , P02/TCLR1, P03/TI1, P04/INTP10 through P07/INTP13, P20/NMI, P21/INTP00 through P24/INTP03, P26, P27, P31/SI, P32/SCK, P36, P37, MODE0, MODE1, CKSEL, X1



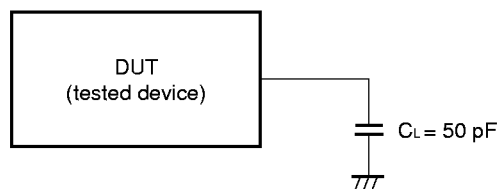
- (b) Other than (a)



AC test output test point



Load condition



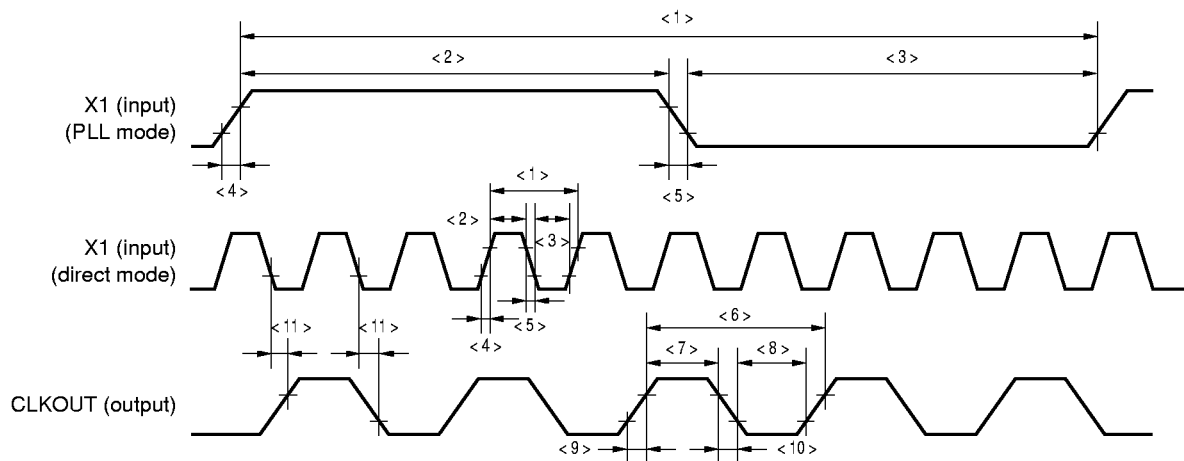
**Caution** If the load capacitance exceeds 50 pF due to the circuit configuration, decrease the load capacitance of this device to less than 50 pF by using a buffer.

(1) Clock timing

Parameter	Symbol		Condition	μPD70P3000-25		μPD70P3000-33		Unit
				MIN.	MAX.	MIN.	MAX.	
X1 input cycle	<1>	t <sub>CYX</sub>	Direct mode	20	DC	15	DC	ns
			PLL mode	200	315	150	334	ns
X1 input width, high	<2>	t <sub>WXH</sub>	Direct mode	7		6		ns
			PLL mode	80		60		ns
X1 input width, low	<3>	t <sub>WXL</sub>	Direct mode	7		6		ns
			PLL mode	80		60		ns
X1 input rise time	<4>	t <sub>XR</sub>	Direct mode		7		7	ns
			PLL mode		15		10	ns
X1 input fall time	<5>	t <sub>XF</sub>	Direct mode		7		7	ns
			PLL mode		15		10	ns
CPU operating frequency	—	φ		0	25	0	33	MHz
CLKOUT output cycle	<6>	t <sub>CYK</sub>		40	DC	30	DC	ns
CLKOUT width, high	<7>	t <sub>WKH</sub>		0.5 T - 5		0.5 T - 5		ns
CLKOUT width, low	<8>	t <sub>WKL</sub>		0.5 T - 5		0.5 T - 5		ns
CLKOUT rise time	<9>	t <sub>XR</sub>			5		5	ns
CLKOUT fall time	<10>	t <sub>XF</sub>			5		5	ns
X1 ↓→ CLKOUT delay time	<11>	t <sub>DXK</sub>	Direct mode	3	17	3	17	ns

**Remark** T = t<sub>CYK</sub>

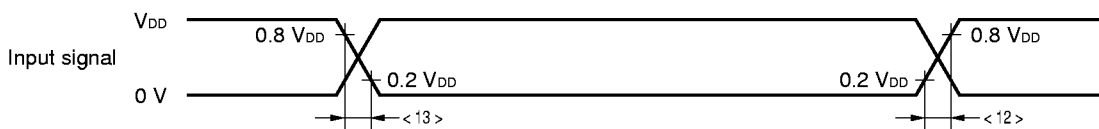
Parameter	Symbol		Condition	μPD70P3000-25	μPD70P3000-33	Unit
				TYP.	TYP.	
Self oscillation frequency	—	φ <sub>P</sub>	PLL mode	2.8	2.8	MHz



(2) Input waveform

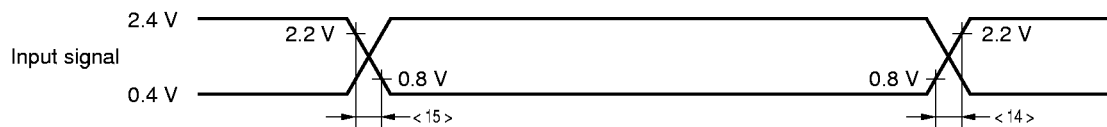
(a) RESET, P02/TCLR1, P03/TI1, P04/INTP10 through P07/INTP13, P20/NMI, P21/INTP00 through P24/INTP03, P26, P27, P31/SI, P32/SCK, P36, P37, MODE0, MODE1, CKSEL, X1

Parameter	Symbol	Condition	μPD70P3000-25		μPD70P3000-33		Unit
			MIN.	MAX.	MIN.	MAX.	
Input rise time	<12>	t <sub>IR2</sub>		20		20	ns
Input fall time	<13>	t <sub>IF2</sub>		20		20	ns



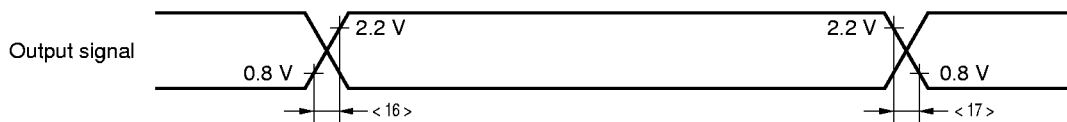
(b) Other than (a)

Parameter	Symbol	Condition	μPD70P3000-25		μPD70P3000-33		Unit
			MIN.	MAX.	MIN.	MAX.	
Input rise time	<14>	t <sub>IR1</sub>		10		10	ns
Input fall time	<15>	t <sub>IF1</sub>		10		10	ns



(3) Output waveform (other than CLKOUT)

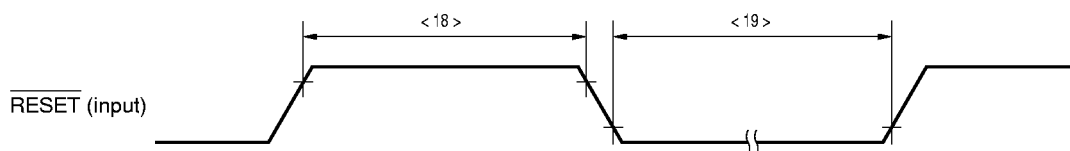
Parameter	Symbol	Condition	μPD70P3000-25		μPD70P3000-33		Unit
			MIN.	MAX.	MIN.	MAX.	
Output rise time	<16>	t <sub>OR</sub>		10		10	ns
Output fall time	<17>	t <sub>OF</sub>		10		10	ns



(4) Reset timing

Parameter	Symbol	Condition	μPD70P3000-25		μPD70P3000-33		Unit
			MIN.	MAX.	MIN.	MAX.	
RESET width, high	<18>	t <sub>WRSH</sub>	500		500		ns
RESET width, low	<19>	On power application, or on releasing STOP mode	500 + T <sub>OST</sub>		500 + T <sub>OST</sub>		ns
		Except on power application, or except on releasing STOP mode	500		500		ns

**Remark** T<sub>OST</sub>: oscillation stabilization time



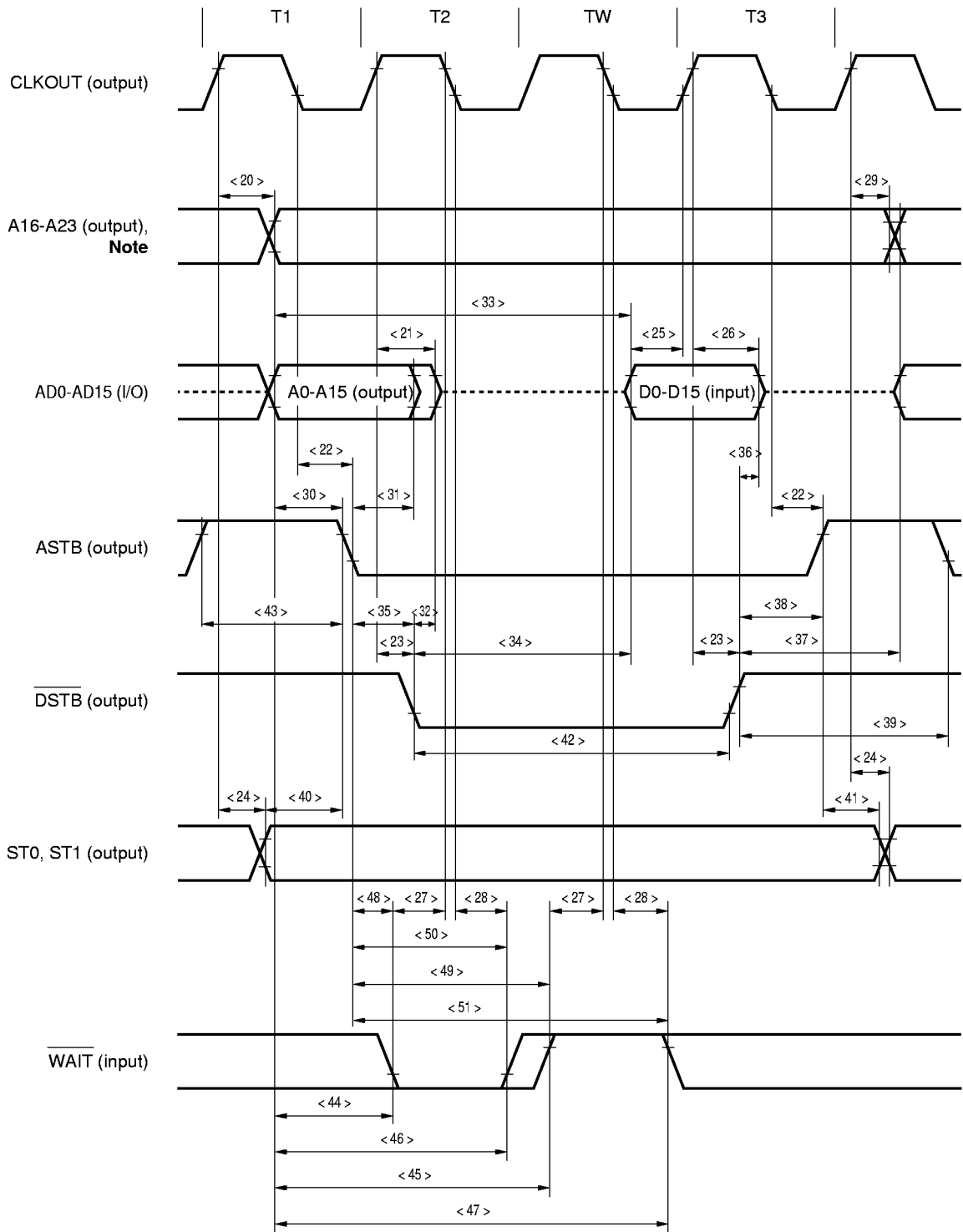
(5) Read timing (1/2)

Parameter	Symbol	Condition	μPD70P3000-25		μPD70P3000-33		Unit	
			MIN.	MAX.	MIN.	MAX.		
CLKOUT ↑→ address delay time	<20>	t <sub>DKA</sub>	3	20	3	20	ns	
CLKOUT ↑→ address float delay time	<21>	t <sub>FKA</sub>	3	15	3	15	ns	
CLKOUT ↓→ ASTB delay time	<22>	t <sub>DKST</sub>	3	15	3	15	ns	
CLKOUT ↓→ $\overline{\text{DSTB}}$ delay time	<23>	t <sub>DKD</sub>	3	15	3	15	ns	
CLKOUT ↑→ status delay time	<24>	t <sub>DKS</sub>	3	15	3	15	ns	
Data input setup time (vs. CLKOUT ↑)	<25>	t <sub>SDK</sub>	5		5		ns	
Data input hold time (vs. CLKOUT ↑)	<26>	t <sub>HKID</sub>	5		5		ns	
$\overline{\text{WAIT}}$ setup time (vs. CLKOUT ↓)	<27>	t <sub>SWTK</sub>	5		5		ns	
$\overline{\text{WAIT}}$ hold time (vs. CLKOUT ↓)	<28>	t <sub>HKWT</sub>	5		5		ns	
Address hold time (vs. CLKOUT ↑)	<29>	t <sub>HKA</sub>	0		0		ns	
Address setup time (vs. ASTB ↓)	<30>	t <sub>SAST</sub>	0.5 T - 10		0.5 T - 10		ns	
Address hold time (vs. ASTB ↓)	<31>	t <sub>HSTA</sub>	0.5 T - 10		0.5 T - 10		ns	
$\overline{\text{DSTB}}$ ↓→ address float delay time	<32>	t <sub>FDA</sub>		0		0	ns	
Data input setup time (vs. address)	<33>	t <sub>SAID</sub>		(2 + n) T - 20		(2 + n) T - 20	ns	
Data input setup time (vs. $\overline{\text{DSTB}}$ ↓)	<34>	t <sub>SDID</sub>		(1 + n) T - 20		(1 + n) T - 20	ns	
ASTB ↓→ $\overline{\text{DSTB}}$ ↓ delay time	<35>	t <sub>DSTD</sub>	0.5 T - 10		0.5 T - 10		ns	
Data input hold time (vs. $\overline{\text{DSTB}}$ ↑)	<36>	t <sub>HDID</sub>	0		0		ns	
$\overline{\text{DSTB}}$ ↑→ address output delay time	<37>	t <sub>DDA</sub>	(1 + i) T		(1 + i) T		ns	
$\overline{\text{DSTB}}$ ↑→ ASTB ↑ delay time	<38>	t <sub>DDSTH</sub>	0.5 T - 10		0.5 T - 10		ns	
$\overline{\text{DSTB}}$ ↑→ ASTB ↓ delay time	<39>	t <sub>DDSTL</sub>	(1.5 + i) T - 10		(1.5 + i) T - 10		ns	
Status setup time (vs. ASTB ↓)	<40>	t <sub>SSST</sub>	0.5 T - 10		0.5 T - 10		ns	
Status hold time (vs. ASTB ↑)	<41>	t <sub>HSTS</sub>	0.5 T - 10		0.5 T - 10		ns	
$\overline{\text{DSTB}}$ width, low	<42>	t <sub>WDL</sub>	(1 + n) T - 10		(1 + n) T - 10		ns	
ASTB width, high	<43>	t <sub>WSTH</sub>	T - 10		T - 10		ns	
$\overline{\text{WAIT}}$ setup time (vs. address)	<44>	t <sub>SAWT1</sub>	n ≥ 1		1.5 T - 20		1.5 T - 20	ns
	<45>	t <sub>SAWT2</sub>			(1.5 + n) T - 20		(1.5 + n) T - 20	ns
$\overline{\text{WAIT}}$ hold time (vs. address)	<46>	t <sub>HAWT1</sub>	n ≥ 1	(0.5 + n) T		(0.5 + n) T		ns
	<47>	t <sub>HAWT2</sub>		(1.5 + n) T		(1.5 + n) T		ns
$\overline{\text{WAIT}}$ setup time (vs. ASTB ↓)	<48>	t <sub>SSTWT1</sub>	n ≥ 1		T - 15		T - 15	ns
	<49>	t <sub>SSTWT2</sub>			(1 + n) T - 15		(1 + n) T - 15	ns
$\overline{\text{WAIT}}$ hold time (vs. ASTB ↓)	<50>	t <sub>HSTWT1</sub>	n ≥ 1	nT		nT		ns
	<51>	t <sub>HSTWT2</sub>		(1 + n) T		(1 + n) T		ns

- Remarks**
1. T = t<sub>cyk</sub>
  2. n indicates the number of wait clocks inserted in the bus cycle. The sampling timing differs when the programmable wait state is inserted.
  3. i indicates the number of idle states (0 or 1) to be inserted in the read cycle.
  4. Be sure to observe at least one of data input hold times t<sub>HKID</sub> (<26>) and t<sub>HDID</sub> (<36>).



(5) Read Timing (2/2): 1 wait



**Note**  $\overline{R/\overline{W}}$  (output),  $\overline{UBEN}$  (output),  $\overline{LBEN}$  (output)

**Remark** The broken line indicates the high-impedance state.

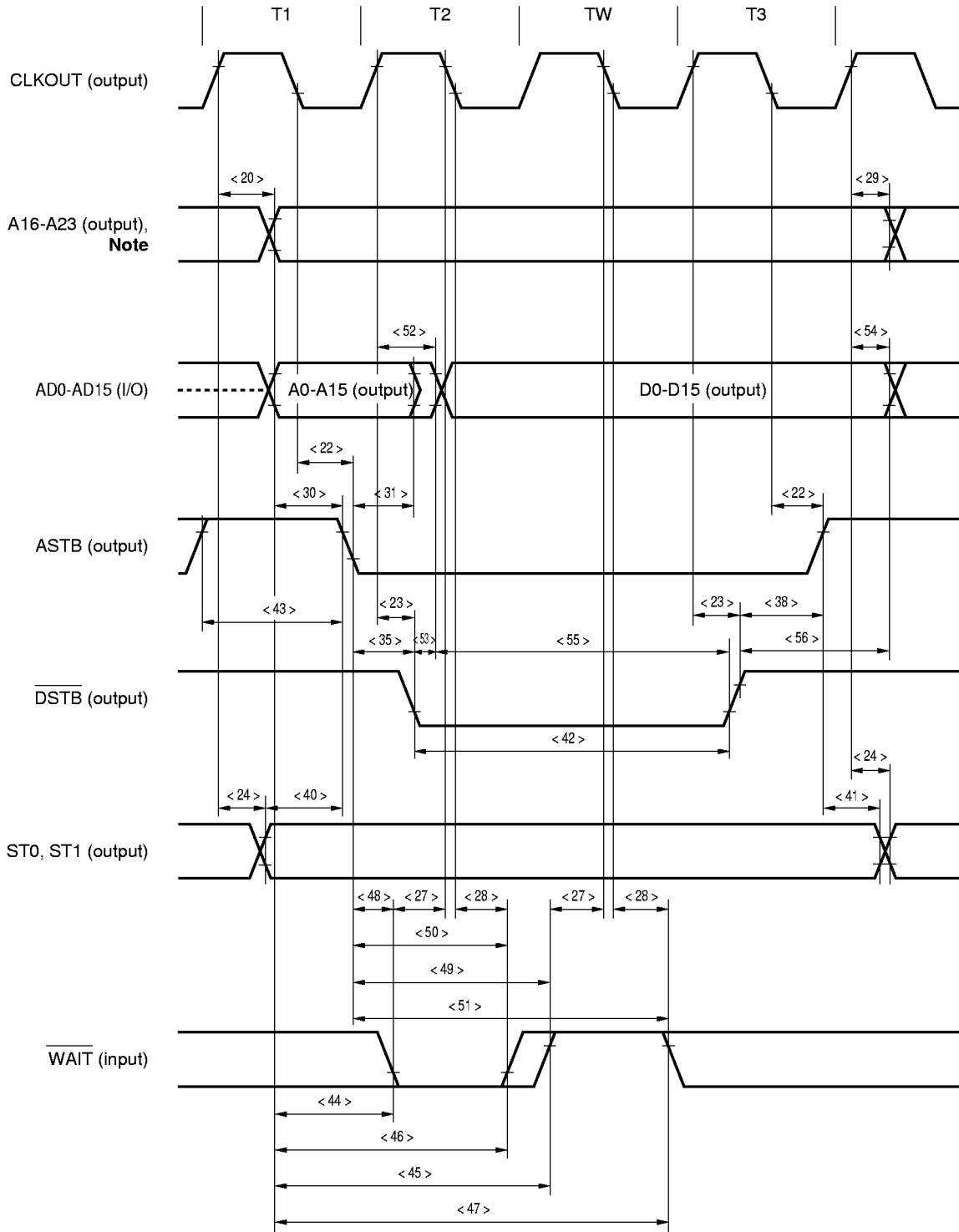
(6) Write timing (1/2)

Parameter	Symbol		Condition	μPD70P3000-25		μPD70P3000-33		Unit
				MIN.	MAX.	MIN.	MAX.	
CLKOUT ↑→ address delay time	<20>	t <sub>DKA</sub>		3	20	3	20	ns
CLKOUT ↓→ ASTB delay time	<22>	t <sub>DKST</sub>		3	15	3	15	ns
CLKOUT ↑→ $\overline{\text{DSTB}}$ delay time	<23>	t <sub>DKD</sub>		3	15	3	15	ns
CLKOUT ↑→ status delay time	<24>	t <sub>DKS</sub>		3	15	3	15	ns
$\overline{\text{WAIT}}$ setup time (vs. CLKOUT ↓)	<27>	t <sub>SWTK</sub>		5		5		ns
$\overline{\text{WAIT}}$ hold time (vs. CLKOUT ↓)	<28>	t <sub>HKWT</sub>		5		5		ns
Address hold time (vs. CLKOUT ↑)	<29>	t <sub>HKA</sub>		0		0		ns
Address setup time (vs. ASTB ↓)	<30>	t <sub>SAST</sub>		0.5 T - 10		0.5 T - 10		ns
Address hold time (vs. ASTB ↓)	<31>	t <sub>HSTA</sub>		0.5 T - 10		0.5 T - 10		ns
ASTB ↓→ $\overline{\text{DSTB}}$ ↓ delay time	<35>	t <sub>DDSTD</sub>		0.5 T - 10		0.5 T - 10		ns
$\overline{\text{DSTB}}$ ↑→ ASTB ↑ delay time	<38>	t <sub>DDSTH</sub>		0.5 T - 10		0.5 T - 10		ns
Status setup time (vs. ASTB ↓)	<40>	t <sub>SSST</sub>		0.5 T - 10		0.5 T - 10		ns
Status hold time (vs. ASTB ↑)	<41>	t <sub>HSTS</sub>		0.5 T - 10		0.5 T - 10		ns
$\overline{\text{DSTB}}$ width, low	<42>	t <sub>WDL</sub>		(1 + n) T - 10		(1 + n) T - 10		ns
ASTB width, high	<43>	t <sub>WSTH</sub>		T - 10		T - 10		ns
$\overline{\text{WAIT}}$ setup time (vs. address)	<44>	t <sub>SAWT1</sub>	n ≥ 1		1.5 T - 20		1.5 T - 20	ns
	<45>	t <sub>SAWT2</sub>			(1.5 + n) T - 20		(1.5 + n) T - 20	ns
$\overline{\text{WAIT}}$ hold time (vs. address)	<46>	t <sub>HAWT1</sub>	n ≥ 1	(0.5 + n) T		(0.5 + n) T		ns
	<47>	t <sub>HAWT2</sub>		(1.5 + n) T		(1.5 + n) T		ns
$\overline{\text{WAIT}}$ setup time (vs. ASTB ↓)	<48>	t <sub>SSWT1</sub>	n ≥ 1		T - 15		T - 15	ns
	<49>	t <sub>SSWT2</sub>			(1 + n) T - 15		(1 + n) T - 15	ns
$\overline{\text{WAIT}}$ hold time (vs. ASTB ↓)	<50>	t <sub>HSTWT1</sub>	n ≥ 1	nT		nT		ns
	<51>	t <sub>HSTWT2</sub>		(1 + n) T		(1 + n) T		ns
CLKOUT ↑→ data output delay time	<52>	t <sub>DKOD</sub>			20		20	ns
$\overline{\text{DSTB}}$ ↓→ data output delay time	<53>	t <sub>DDOD</sub>			10		10	ns
Data output hold time (vs. CLKOUT ↑)	<54>	t <sub>HKOD</sub>		0		0		ns
Data output setup time (vs. $\overline{\text{DSTB}}$ ↑)	<55>	t <sub>SODD</sub>		(1 + n) T - 15		(1 + n) T - 15		ns
Data output hold time (vs. $\overline{\text{DSTB}}$ ↑)	<56>	t <sub>HDOD</sub>		T - 10		T - 10		ns

Remarks 1. T = t<sub>cyk</sub>

2. n indicates the number of wait clocks inserted in the bus cycle. The sampling timing differs when the programmable wait state is inserted.

(6) Write timing (2/2): 1 wait



**Note** R/W (output),  $\overline{UBEN}$  (output),  $\overline{LBEN}$  (output)

**Remark** The broken line indicates the high-impedance state.

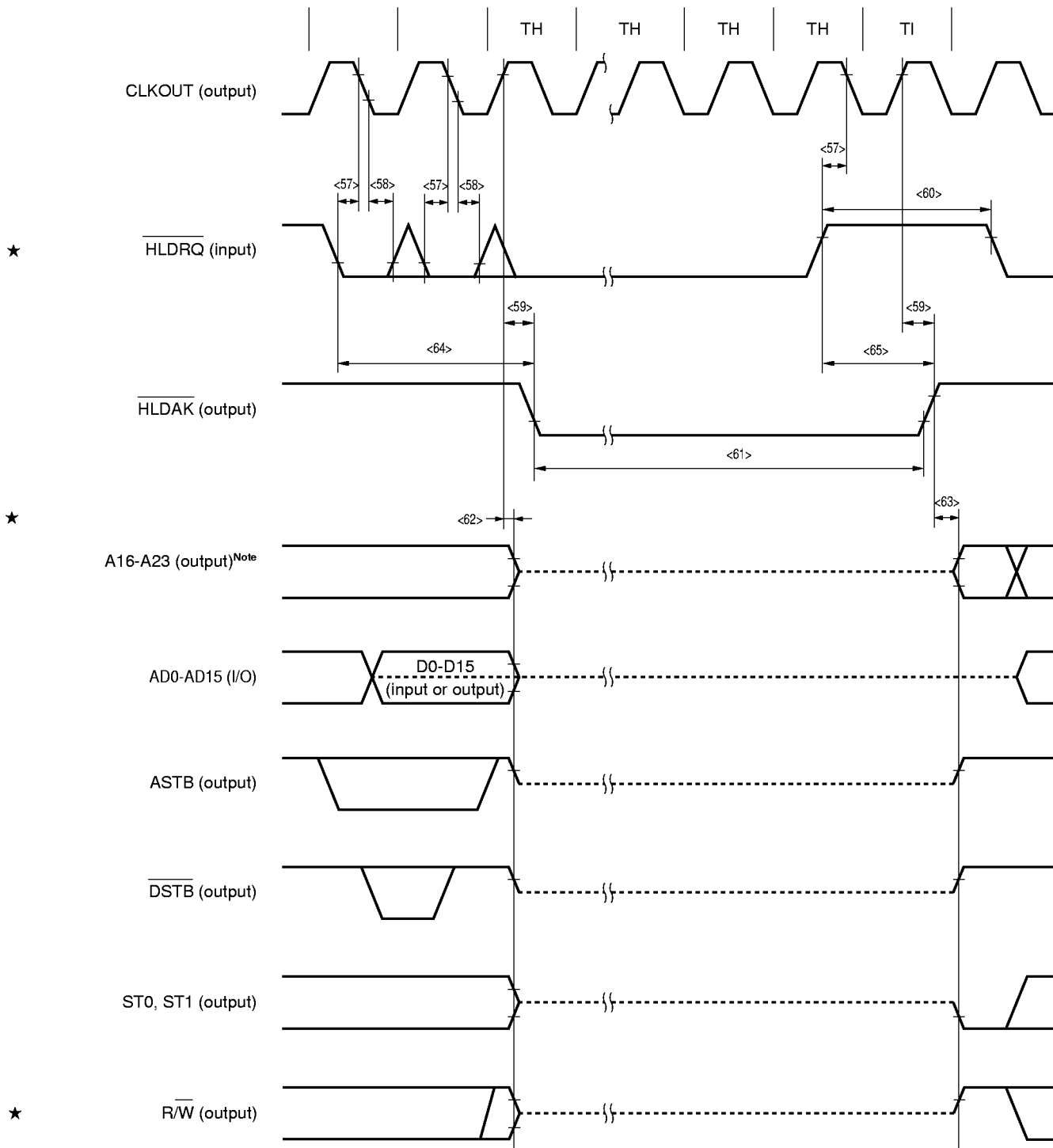
(7) Bus hold timing (1/2)

Parameter	Symbol	Condition	μPD70P3000-25		μPD70P3000-33		Unit
			MIN.	MAX.	MIN.	MAX.	
$\overline{\text{HLDRQ}}$ setup time (vs. CLKOUT ↓)	<57>	t <sub>SHOK</sub>	5		5		ns
$\overline{\text{HLDRQ}}$ hold time (vs. CLKOUT ↓)	<58>	t <sub>HKHQ</sub>	5		5		ns
CLKOUT ↑ → $\overline{\text{HLDAK}}$ delay time	<59>	t <sub>DKHA</sub>		20		20	ns
$\overline{\text{HLDRQ}}$ width, high	<60>	t <sub>WHQH</sub>	T + 10		T + 10		ns
$\overline{\text{HLDAK}}$ width, low	<61>	t <sub>WHAL</sub>	T - 10		T - 10		ns
★ CLKOUT ↑ → bus float delay time	<62>	t <sub>DKF</sub>		20		20	ns
$\overline{\text{HLDAK}}$ ↑ → bus output delay time	<63>	t <sub>DHAC</sub>	-3		-3		ns
$\overline{\text{HLDRQ}}$ ↓ → $\overline{\text{HLDAK}}$ ↓ delay time	<64>	t <sub>DHQHA1</sub>		(2 n + 7.5) T + 20		(2 n + 7.5) T + 20	ns
$\overline{\text{HLDRQ}}$ ↑ → $\overline{\text{HLDAK}}$ ↑ delay time	<65>	t <sub>DHQHA2</sub>	0.5 T	1.5 T + 20	0.5 T	1.5 T + 20	ns

Remarks 1. T = t<sub>cyk</sub>

2. n indicates the number of wait clocks inserted in the bus cycle. The sampling timing differs when the programmable wait state is inserted.

(7) Bus hold timing (2/2)



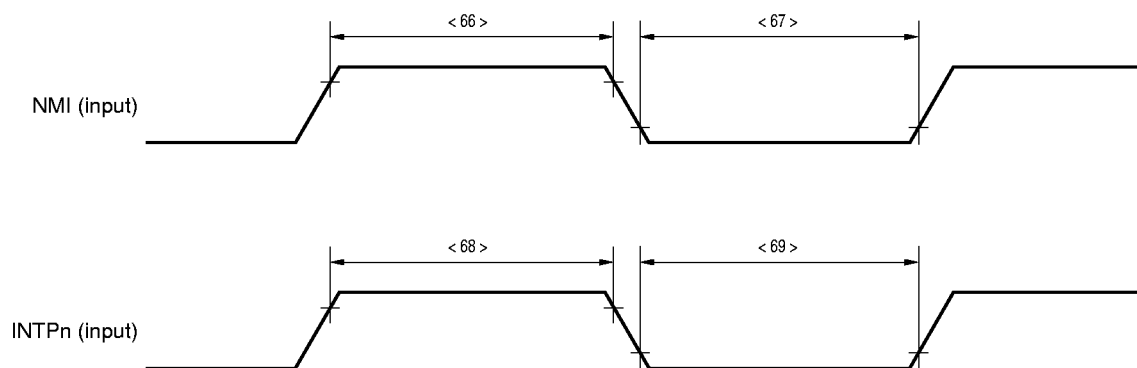
**Note**  $\overline{UBEN}$  (output) and  $\overline{LBEN}$  (output)

**Remark** The broken line indicates the high-impedance state.

(8) Interrupt timing

Parameter	Symbol		Condition	μPD70P3000-25		μPD70P3000-33		Unit
				MIN.	MAX.	MIN.	MAX.	
NMI width, high	<66>	t <sub>WNH</sub>		500		500		ns
NMI width, low	<67>	t <sub>WNL</sub>		500		500		ns
INTPn width, high	<68>	t <sub>WITH</sub>	n = 00, 01, 02, 03, 10, 11, 12, 13	3 T + 10		3 T + 10		ns
INTPn width, low	<69>	t <sub>WITL</sub>	n = 00, 01, 02, 03, 10, 11, 12, 13	3 T + 10		3 T + 10		ns

Remark T = t<sub>cyk</sub>



Remark n = 00, 01, 02, 03, 10, 11, 12, 13

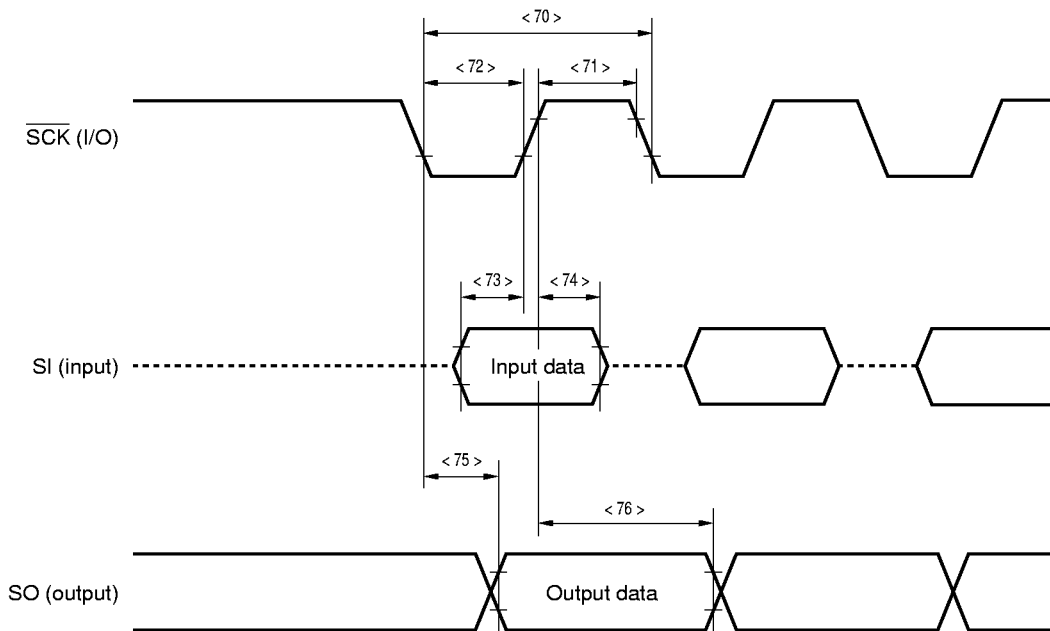
(9) CSI timing

(a) Master mode

Parameter	Symbol	Condition	μPD70P3000-25		μPD70P3000-33		Unit
			MIN.	MAX.	MIN.	MAX.	
$\overline{\text{SCK}}$ cycle	<70>	$t_{\text{CYSK}}$	160		120		ns
$\overline{\text{SCK}}$ width, high	<71>	$t_{\text{WSKH}}$	$0.5 t_{\text{CYSK}} - 20$		$0.5 t_{\text{CYSK}} - 20$		ns
$\overline{\text{SCK}}$ width, low	<72>	$t_{\text{WSKL}}$	$0.5 t_{\text{CYSK}} - 20$		$0.5 t_{\text{CYSK}} - 20$		ns
SI setup time (vs. $\overline{\text{SCK}} \uparrow$ )	<73>	$t_{\text{SSISK}}$	30		30		ns
SI hold time (vs. $\overline{\text{SCK}} \uparrow$ )	<74>	$t_{\text{HSKSI}}$	0		0		ns
SO output delay time (vs. $\overline{\text{SCK}} \downarrow$ )	<75>	$t_{\text{BSKSO}}$		18		18	ns
SO output hold time (vs. $\overline{\text{SCK}} \uparrow$ )	<76>	$t_{\text{HSKSO}}$	$0.5 t_{\text{CYSK}} - 5$		$0.5 t_{\text{CYSK}} - 5$		ns

(b) Slave mode

Parameter	Symbol	Condition	μPD70P3000-25		μPD70P3000-33		Unit
			MIN.	MAX.	MIN.	MAX.	
$\overline{\text{SCK}}$ cycle	<70>	$t_{\text{CYSK}}$	160		120		ns
$\overline{\text{SCK}}$ width, high	<71>	$t_{\text{WSKH}}$	50		30		ns
$\overline{\text{SCK}}$ width, low	<72>	$t_{\text{WSKL}}$	50		30		ns
SI setup time (vs. $\overline{\text{SCK}} \uparrow$ )	<73>	$t_{\text{SSISK}}$	10		10		ns
SI hold time (vs. $\overline{\text{SCK}} \uparrow$ )	<74>	$t_{\text{HSKSI}}$	10		10		ns
SO output delay time (vs. $\overline{\text{SCK}} \downarrow$ )	<75>	$t_{\text{BSKSO}}$		30		30	ns
SO output hold time (vs. $\overline{\text{SCK}} \uparrow$ )	<76>	$t_{\text{HSKSO}}$	$t_{\text{WSKH}}$		$t_{\text{WSKH}}$		ns

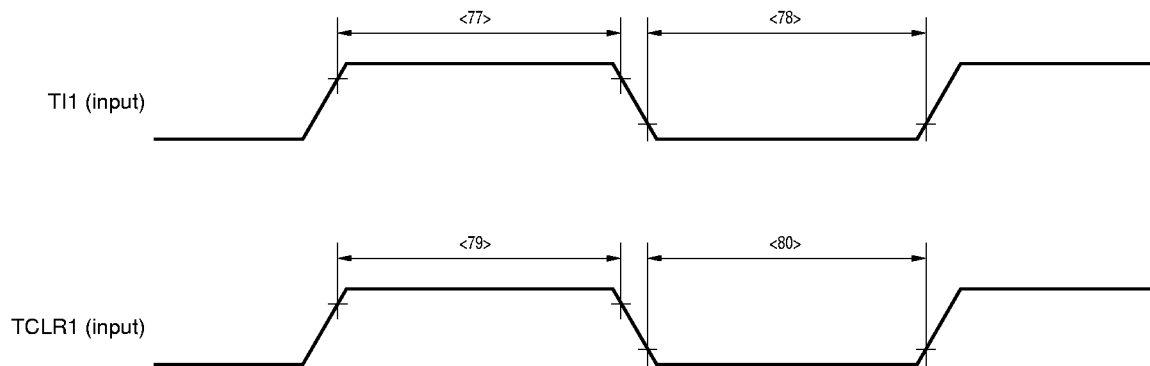


**Remark** The broken line indicates the high-impedance state.

(10) RPU timing

Parameter	Symbol	Condition	μPD70P3000-25		μPD70P3000-33		Unit
			MIN.	MAX.	MIN.	MAX.	
TI1 width, high	<77> $t_{WTIH}$		3 T + 10		3 T + 10		ns
TI1 width, low	<78> $t_{WTIL}$		3 T + 10		3 T + 10		ns
TCLR1 width, high	<79> $t_{WTCH}$		3 T + 10		3 T + 10		ns
TCLR1 width, low	<80> $t_{WTCL}$		3 T + 10		3 T + 10		ns

Remark T =  $t_{CYK}$





6.1.2 When V<sub>DD</sub> = 3.0 to 3.6 V

**Absolute Maximum Ratings (T<sub>A</sub> = 25 °C)**

Parameter	Symbol	Condition	Ratings	Unit
Supply voltage	V <sub>DD</sub>	V <sub>DD</sub> pin	-0.5 to +7.0	V
	CV <sub>DD</sub>	CV <sub>DD</sub> pin	-0.5 to +7.0	V
	DV <sub>SS</sub>	CV <sub>SS</sub> pin	-0.5 to +0.5	V
Input voltage	V <sub>I1</sub>	Except X1 pin, V <sub>DD</sub> = 3.0 to 3.6 V	-0.5 to V <sub>DD</sub> + 0.3	V
	V <sub>I2</sub>	V <sub>PP</sub> pin in PROM programming mode, V <sub>DD</sub> = 3.0 to 3.6 V	-0.5 to +13.5	V
Clock input voltage	V <sub>X</sub>	X1 pin, V <sub>DD</sub> = 3.0 to 3.6 V	-0.5 to V <sub>DD</sub> + 1.0	V
Output current, low	I <sub>OL</sub>	1 pin	4.0	mA
		Total of all pins	100	mA
Output current, high	I <sub>OH</sub>	1 pin	-4.0	mA
		Total of all pins	-100	mA
Output voltage	V <sub>O</sub>	V <sub>DD</sub> = 3.0 to 3.6 V	-0.5 to V <sub>DD</sub> + 0.3	V
Operating ambient temperature	T <sub>A</sub>		-20 to +70	°C
Storage temperature	T <sub>stg</sub>		-65 to +150	°C

**Cautions** 1. Do not directly connect the output (or I/O) pins of two or more IC products, and do not directly connect them to V<sub>DD</sub>, V<sub>CC</sub>, or GND pin. Open-drain pins and open-collector pins may be directly connected to one another however. Moreover, an external circuit that is designed to prevent contention of output can be connected to pins that go into a high-impedance state.

2. Should the absolute maximum rating of even one of the above parameters be exceeded even momentarily, the quality of the product may be degraded. The absolute maximum ratings are, therefore, the values exceeding which the product may be physically damaged. Use the product so that these values are never exceeded.

The normal operating ranges of ratings and conditions in which the quality of the product is guaranteed are specified in the following DC Characteristics and AC Characteristics.

**Capacitance (T<sub>A</sub> = 25 °C, V<sub>DD</sub> = V<sub>SS</sub> = 0 V)**

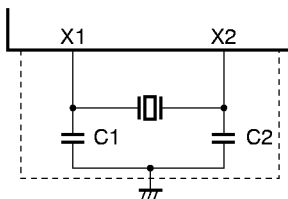
Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Input capacitance	C <sub>I</sub>	fc = 1 MHz			15	pF
I/O capacitance	C <sub>IO</sub>	Pins other than tested pin: 0 V			15	pF
Output capacitance	C <sub>O</sub>				15	pF

**Operating Conditions**

Operation Mode	Internal Operating Clock Frequency (φ)	Operating Temperature (T <sub>A</sub> )	Supply Voltage (V <sub>DD</sub> )
Direct mode	0 to 12 MHz	-20 to +70 °C	3.0 to 3.6 V
PLL mode	Self oscillation frequency to 12 MHz	-20 to +70 °C	3.0 to 3.6 V

Recommended Oscillation Circuit

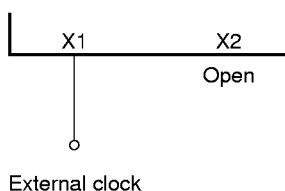
(a) Ceramic resonator connection ( $T_A = -40$  to  $+ 85$  °C)



Manufacturer	Part Number	Oscillation Frequency $f_{xx}$ (MHz)	Recommended Circuit Constants		Oscillation Voltage Range		Oscillation Stabilization Time (MAX.) $T_{OST}$ (ms)
			C1 (pF)	C2 (pF)	MIN. (V)	MAX. (V)	
TDK Corp	FGR2.0MC3	2.0	Provided	Provided	3.0	3.6	0.26
	CCR3.2MC3	3.2	Provided	Provided	3.0	3.6	0.62
Murata Mfg. Co., Ltd.	CSA2.00MG	2.0	30	30	2.7	3.6	0.24
	CST2.00MG	2.0	Provided	Provided	2.7	3.6	0.24
	CSA2.70MG	2.7	30	30	2.7	3.6	0.16
	CST2.70MGW	2.7	Provided	Provided	2.7	3.6	0.16
	CSA3.20MG	3.2	30	30	2.7	3.6	0.13
	CST3.20MGW	3.2	Provided	Provided	2.7	3.6	0.13

- Cautions**
1. Connect the oscillation circuit as closely to X2 pin as possible.
  2. Do not route any other signal lines in the range indicated by the broken line in the above figure.
  3. Thoroughly evaluate the matching between the μPD70P3000 and resonator.

(b) External clock input



**Caution** Input CMOS level voltage to the X1 pin.

DC Characteristics (T<sub>A</sub> = -20 to +70 °C, V<sub>DD</sub> = 3.0 to 3.6 V, V<sub>SS</sub> = 0 V)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit	
Input voltage, high	V <sub>IH</sub>	Except X1 and <b>Note</b>	0.7 V <sub>DD</sub>		V <sub>DD</sub>	V	
		<b>Note</b>	0.8 V <sub>DD</sub>		V <sub>DD</sub>	V	
Input voltage, low	V <sub>IL</sub>	Except X1 and <b>Note</b>	0		0.2 V <sub>DD</sub>	V	
		<b>Note</b>	0		0.2 V <sub>DD</sub>	V	
X1 clock input voltage, high	V <sub>XH</sub>	Direct mode	0.8 V <sub>DD</sub>		V <sub>DD</sub>	V	
		PLL mode	0.8 V <sub>DD</sub>		V <sub>DD</sub>	V	
X1 clock input voltage, low	V <sub>XL</sub>	Direct mode	0		0.6	V	
		PLL mode	0		0.6	V	
Schmitt trigger input threshold voltage	V <sub>T</sub> <sup>+</sup>	<b>Note</b> , rising		3.0		V	
	V <sub>T</sub> <sup>-</sup>	<b>Note</b> , falling		2.0		V	
Schmitt trigger input hysteresis width	V <sub>T</sub> <sup>+</sup> - V <sub>T</sub> <sup>-</sup>	<b>Note</b>	0.5			V	
Output voltage, high	V <sub>OH</sub>	I <sub>OH</sub> = -2.5 mA	0.7 V <sub>DD</sub>			V	
		I <sub>OH</sub> = -100 μA	V <sub>DD</sub> - 0.5			V	
Output voltage, low	V <sub>OL</sub>	I <sub>OL</sub> = 2.5 mA			0.45	V	
Input leakage current, high	I <sub>LIH</sub>	V <sub>I</sub> = V <sub>DD</sub>			10	μA	
Input leakage current, low	I <sub>LIL</sub>	V <sub>I</sub> = 0 V			-10	μA	
Output leakage current, high	I <sub>LOH</sub>	V <sub>O</sub> = V <sub>DD</sub>			10	μA	
Output leakage current, low	I <sub>LOL</sub>	V <sub>O</sub> = 0 V			-10	μA	
Supply current	Operating	I <sub>DD1</sub>	Direct mode		1.0 × φ + 9.5	1.5 × φ + 10	mA
			PLL mode		1.1 × φ + 11	1.8 × φ + 12	mA
	In HALT mode	I <sub>DD2</sub>	Direct mode		0.3 × φ + 2	0.5 × φ + 6.5	mA
			PLL mode		0.4 × φ + 3.5	0.6 × φ + 8.5	mA
	In IDLE mode	I <sub>DD3</sub>	Direct mode		5.3 × φ + 200	6.5 × φ + 325	μA
			PLL mode		0.07 × φ + 1.5	0.15 × φ + 2	mA
	In STOP mode	I <sub>DD4</sub>	-20 °C ≤ T <sub>A</sub> ≤ 50 °C		1	40	μA
			50 °C < T <sub>A</sub> ≤ 70 °C			200	μA

**Note** RESET, P02/TCLR1, P03/TI1, P04/INTP10 through P07/INTP13, P20/NMI, P21/INTP00 through P24/INTP03, P26, P27, P31/SI, P32/SCK, P36, P37, MODE0, MODE1, CKSEL

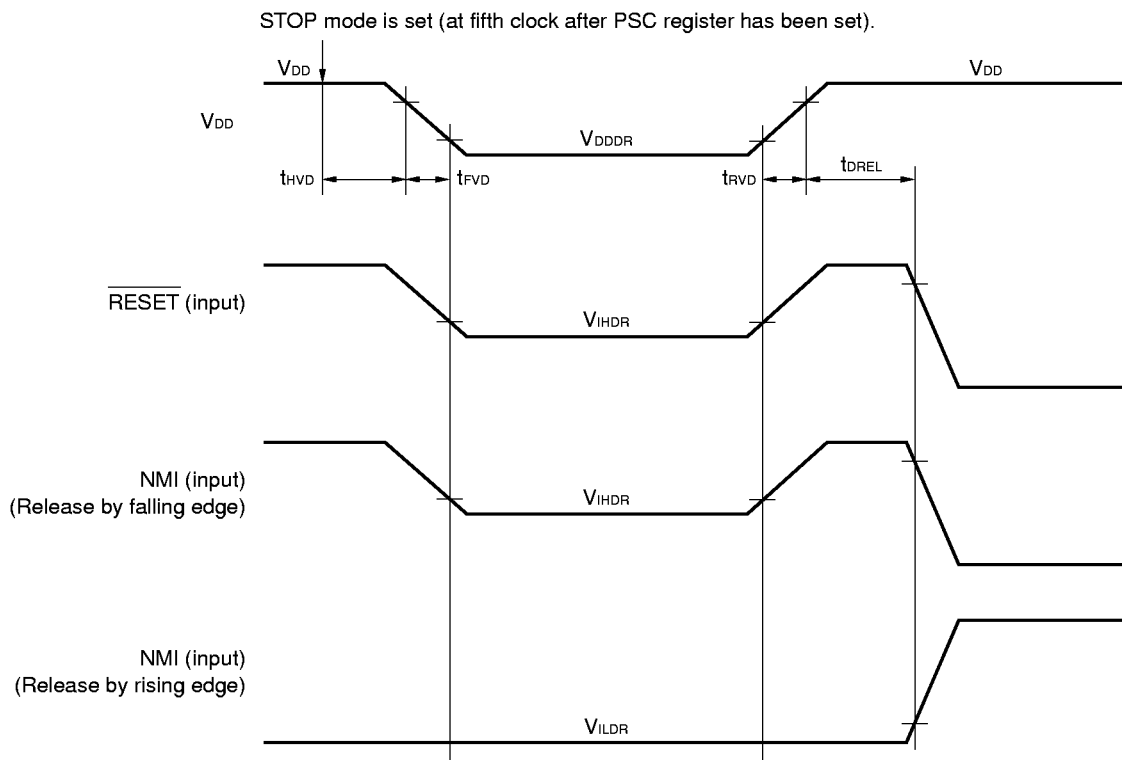
- Remarks**
1. TYP. value is a value for your reference at T<sub>A</sub> = 25 °C and V<sub>DD</sub> = 3.3 V.
  2. φ : Internal operating clock frequency

Data Retention Characteristics (T<sub>A</sub> = -20 to +70 °C)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Data hold voltage	V <sub>DDDR</sub>	STOP mode	1.5		3.6	V
Data hold current	I <sub>DDDR</sub>	V <sub>DD</sub> = V <sub>DDDR</sub> -20 °C ≤ T <sub>A</sub> ≤ +50 °C		0.2 V <sub>DDDR</sub>	40	μA
			50 °C < T <sub>A</sub> ≤ 70 °C		0.2 V <sub>DDDR</sub>	200
Supply voltage rise time	t <sub>rVD</sub>		200			μs
Supply voltage fall time	t <sub>fVD</sub>		200			μs
Supply voltage hold time (vs. STOP mode setting)	t <sub>hVD</sub>		0			ms
STOP mode release signal input time	t <sub>dREL</sub>		0			ns
Data hold input voltage, high	V <sub>IHDR</sub>	<b>Note</b>	0.9 V <sub>DDDR</sub>		V <sub>DDDR</sub>	V
Data hold input voltage, low	V <sub>ILDR</sub>	<b>Note</b>	0		0.1 V <sub>DDDR</sub>	V

**Note**  $\overline{\text{RESET}}$ , P02/TCLR1, P03/TI1, P04/INTP10 through P07/INTP13, P20/NMI, P21/INTP00 through P24/INT03, P26, P27, P31/SI, P32/ $\overline{\text{SCK}}$ , P36, P37, MODE0, MODE1, CKSEL, X1

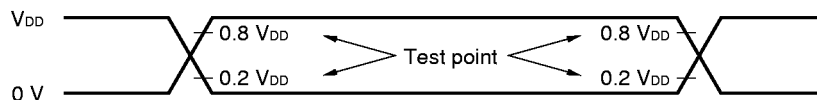
**Remark** TYP. value is a value for your reference at T<sub>A</sub> = 25 °C and V<sub>DD</sub> = 3.3 V.



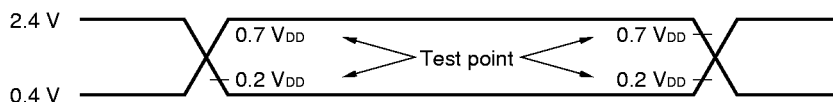
AC Characteristics ( $T_A = -20$  to  $+70$  °C,  $V_{DD} = 3.0$  to  $3.6$  V,  $V_{SS} = 0$  V)

AC test input wave

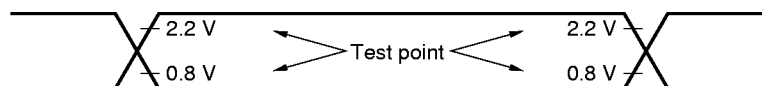
- (a)  $\overline{\text{RESET}}$ , P02/TCLR1, P03/TI1, P04/INTP10 through P07/INTP13, P20/NMI, P21/INTP00 through P24/INTP03, P26, P27, P31/SI, P32/ $\overline{\text{SCK}}$ , P36, P37, MODE0, MODE1, CKSEL, X1



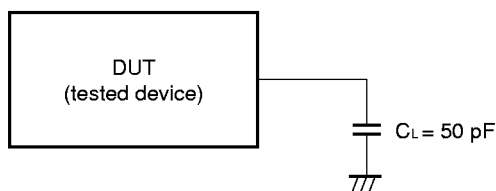
- (b) Other than (a)



AC test output test point



Load condition



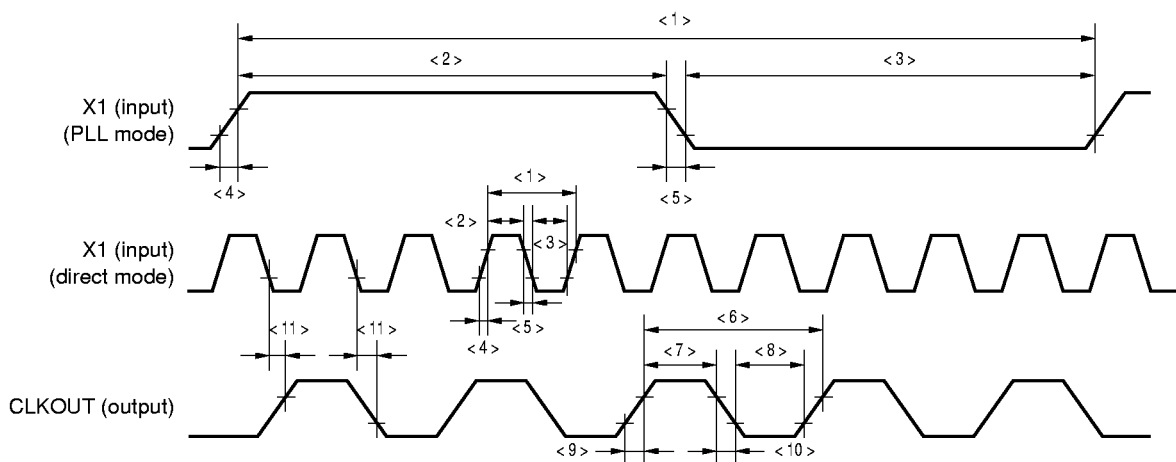
**Caution** If the load capacitance exceeds 50 pF due to the circuit configuration, decrease the load capacitance of this device to less than 50 pF by using a buffer.

(1) Clock timing

Parameter	Symbol	Condition	MIN.	MAX.	Unit
X1 input cycle	<1> $t_{CYX}$	Direct mode	41	DC	ns
		PLL mode	416	500	ns
X1 input width, high	<2> $t_{WXH}$	Direct mode	7		ns
		PLL mode	170		ns
X1 input width, low	<3> $t_{WXL}$	Direct mode	7		ns
		PLL mode	170		ns
X1 input rise time	<4> $t_{XR}$	Direct mode		7	ns
		PLL mode		15	ns
X1 input fall time	<5> $t_{XF}$	Direct mode		7	ns
		PLL mode		15	ns
CPU operating frequency	— $\phi$		0	12	MHz
CLKOUT output cycle	<6> $t_{CYK}$		82	DC	ns
CLKOUT width, high	<7> $t_{WKH}$		0.5 T – 15		ns
CLKOUT width, low	<8> $t_{WKL}$		0.5 T – 15		ns
CLKOUT rise time	<9> $t_{XR}$			15	ns
CLKOUT fall time	<10> $t_{XF}$			15	ns
X1 ↓→ CLKOUT delay time	<11> $t_{DXK}$	Direct mode	3	30	ns

Remark T =  $t_{CYK}$

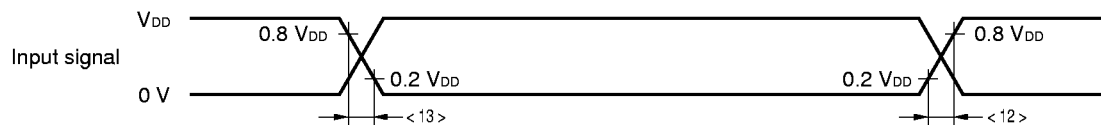
Parameter	Symbol	Condition	TYP.	Unit
Self-running oscillation frequency	— $\phi_P$	PLL mode	2.8	MHz



(2) Input waveform

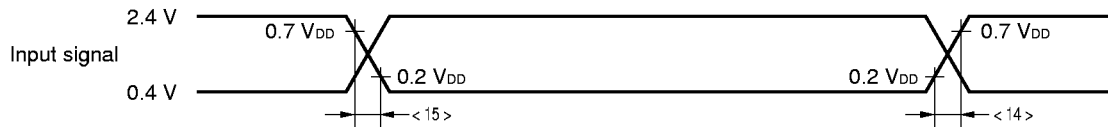
(a)  $\overline{\text{RESET}}$ , P02/TCLR1, P03/TI1, P04/INTP10 through P07/INTP13, P20/NMI, P21/INTP00 through P24/INTP03, P26, P27, P31/SI, P32/SCK, P36, P37, MODE0, MODE1, CKSEL, X1

Parameter	Symbol	Condition	MIN.	MAX.	Unit
Input rise time	<12> $t_{R2}$			20	ns
Input fall time	<13> $t_{F2}$			20	ns



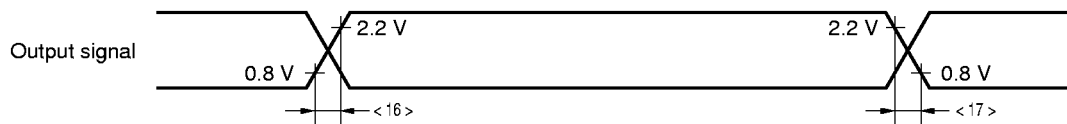
(b) Other than (a)

Parameter	Symbol	Condition	MIN.	MAX.	Unit
Input rise time	<14> $t_{R1}$			10	ns
Input fall time	<15> $t_{F1}$			10	ns



(3) Output waveform (other than CLKOUT)

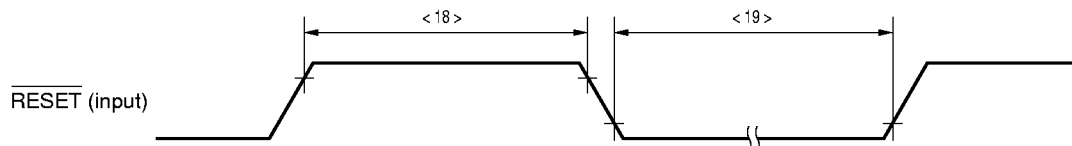
Parameter	Symbol	Condition	MIN.	MAX.	Unit
Output rise time	<16> $t_{oR}$			20	ns
Output fall time	<17> $t_{oF}$			20	ns



(4) Reset timing

Parameter	Symbol	Condition	MIN.	MAX.	Unit
$\overline{\text{RESET}}$ width, high	<18> $t_{WRSH}$		500		ns
$\overline{\text{RESET}}$ width, low	<19> $t_{WRSL}$	On power application, or on releasing STOP mode	500 + $T_{osT}$		ns
		Except on power application, or except on releasing STOP mode	500		ns

**Remark**  $T_{osT}$ : oscillation stabilization time





[MEMO]

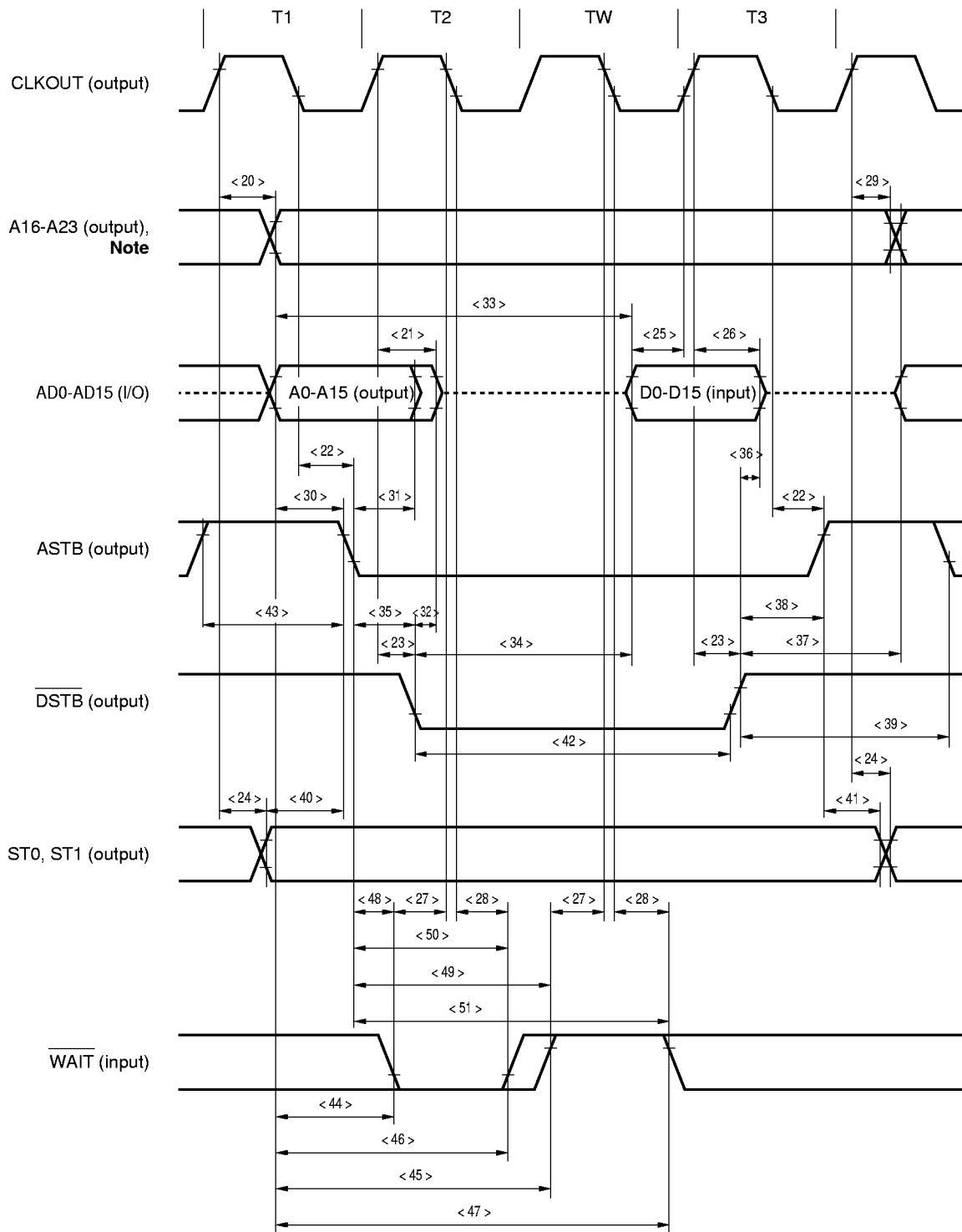
(5) Read timing (1/2)

Parameter	Symbol	Condition	MIN.	MAX.	Unit
CLKOUT ↑→ address delay time	<20> t <sub>DKA</sub>		3	32	ns
CLKOUT ↑→ address float delay time	<21> t <sub>FKA</sub>		3	32	ns
CLKOUT ↓→ ASTB delay time	<22> t <sub>DKST</sub>		3	32	ns
CLKOUT ↓→ $\overline{\text{DSTB}}$ delay time	<23> t <sub>DKD</sub>		3	32	ns
CLKOUT ↑→ status delay time	<24> t <sub>DKS</sub>		3	32	ns
Data input setup time (vs. CLKOUT ↑)	<25> t <sub>SIDK</sub>		5		ns
Data input hold time (vs. CLKOUT ↑)	<26> t <sub>HKID</sub>		5		ns
$\overline{\text{WAIT}}$ setup time (vs. CLKOUT ↓)	<27> t <sub>SWTK</sub>		7		ns
$\overline{\text{WAIT}}$ hold time (vs. CLKOUT ↓)	<28> t <sub>HKWT</sub>		7		ns
Address hold time (vs. CLKOUT ↑)	<29> t <sub>HKA</sub>		0		ns
Address setup time (vs. ASTB ↓)	<30> t <sub>SAST</sub>		0.5 T – 25		ns
Address hold time (vs. ASTB ↓)	<31> t <sub>HSTA</sub>		0.5 T – 25		ns
$\overline{\text{DSTB}}$ ↓→ address float delay time	<32> t <sub>FDA</sub>			0	ns
Data input setup time (vs. address)	<33> t <sub>SAID</sub>			(2 + n) T – 45	ns
Data input setup time (vs. $\overline{\text{DSTB}}$ ↓)	<34> t <sub>SDID</sub>			(1 + n) T – 35	ns
ASTB ↓→ $\overline{\text{DSTB}}$ ↓ delay time	<35> t <sub>DSTD</sub>		0.5 T – 15		ns
Data input hold time (vs. $\overline{\text{DSTB}}$ ↑)	<36> t <sub>HDID</sub>		0		ns
$\overline{\text{DSTB}}$ ↑→ address output delay time	<37> t <sub>DDA</sub>		(1 + i) T		ns
$\overline{\text{DSTB}}$ ↑→ ASTB ↑ delay time	<38> t <sub>DDSTH</sub>		0.5 T – 15		ns
$\overline{\text{DSTB}}$ ↑→ ASTB ↓ delay time	<39> t <sub>DDSTL</sub>		(1.5 + i) T – 15		ns
Status setup time (vs. ASTB ↓)	<40> t <sub>SSST</sub>		0.5 T – 15		ns
Status hold time (vs. ASTB ↑)	<41> t <sub>HSTS</sub>		0.5 T – 20		ns
$\overline{\text{DSTB}}$ width, low	<42> t <sub>WDL</sub>		(1 + n) T – 15		ns
ASTB width, high	<43> t <sub>WSTH</sub>		T – 20		ns
$\overline{\text{WAIT}}$ setup time (vs. address)	<44> t <sub>SAWT1</sub>	n ≥ 1		1.5 T – 50	ns
	<45> t <sub>SAWT2</sub>			(1.5 + n) T – 50	ns
$\overline{\text{WAIT}}$ hold time (vs. address)	<46> t <sub>HAWT1</sub>	n ≥ 1	(0.5 + n) T		ns
	<47> t <sub>HAWT2</sub>		(1.5 + n) T		ns
$\overline{\text{WAIT}}$ setup time (vs. ASTB ↓)	<48> t <sub>SSWT1</sub>	n ≥ 1		T – 35	ns
	<49> t <sub>SSWT2</sub>			(1 + n) T – 35	ns
$\overline{\text{WAIT}}$ hold time (vs. ASTB ↓)	<50> t <sub>HSTWT1</sub>	n ≥ 1	nT		ns
	<51> t <sub>HSTWT2</sub>		(1 + n) T		ns

Remarks 1. T = t<sub>cyk</sub>

2. n indicates the number of wait clocks inserted in the bus cycle. The sampling timing differs when the programmable wait state is inserted.
3. i indicates the number of idle states (0 or 1) to be inserted in the read cycle.
4. Be sure to observe at least one of data input hold times t<sub>HKID</sub> (<26>) and t<sub>HDID</sub> (<36>).

(5) Read Timing (2/2): 1 wait



**Note**  $\overline{R/W}$  (output),  $\overline{UBEN}$  (output),  $\overline{LBEN}$  (output)

**Remark** The broken line indicates the high-impedance state.

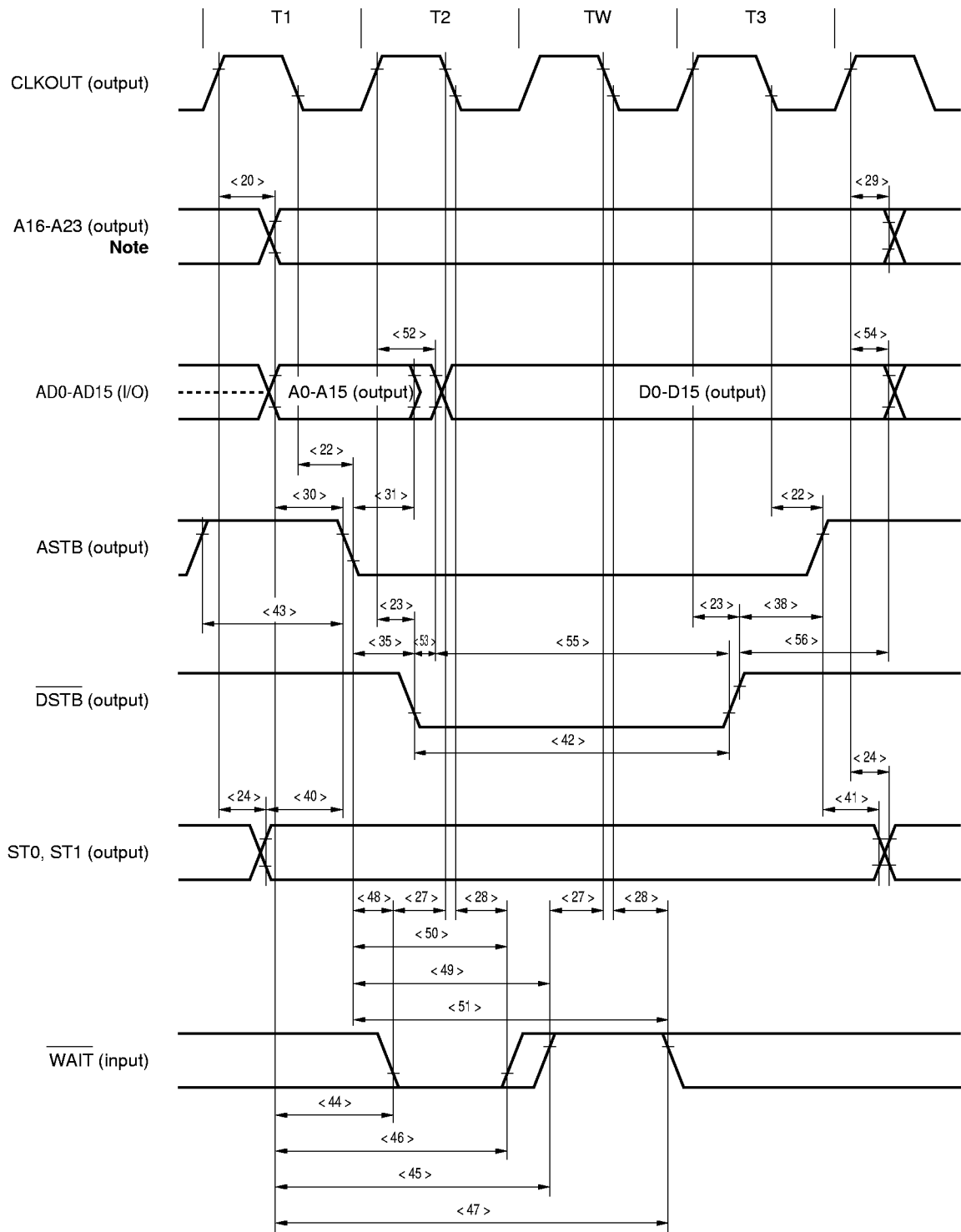
(6) Write timing (1/2)

Parameter	Symbol	Condition	MIN.	MAX.	Unit
CLKOUT ↑→ address delay time	<20> t <sub>DKA</sub>		3	32	ns
CLKOUT ↓→ ASTB delay time	<22> t <sub>DKST</sub>		3	32	ns
CLKOUT ↑→ $\overline{\text{DSTB}}$ delay time	<23> t <sub>DKD</sub>		3	32	ns
CLKOUT ↑→ status delay time	<24> t <sub>DKS</sub>		3	32	ns
$\overline{\text{WAIT}}$ setup time (vs. CLKOUT ↓)	<27> t <sub>SWTK</sub>		7		ns
$\overline{\text{WAIT}}$ hold time (vs. CLKOUT ↓)	<28> t <sub>HKWT</sub>		7		ns
Address hold time (vs. CLKOUT ↑)	<29> t <sub>HKA</sub>		0		ns
Address setup time (vs. ASTB ↓)	<30> t <sub>SAST</sub>		0.5 T – 25		ns
Address hold time (vs. ASTB ↓)	<31> t <sub>HSTA</sub>		0.5 T – 15		ns
ASTB ↓→ $\overline{\text{DSTB}}$ ↓ delay time	<35> t <sub>DSTD</sub>		0.5 T – 15		ns
$\overline{\text{DSTB}}$ ↑→ ASTB ↑ delay time	<38> t <sub>DDSTH</sub>		0.5 T – 15		ns
Status setup time (vs. ASTB ↓)	<40> t <sub>SSST</sub>		0.5 T – 15		ns
Status hold time (vs. ASTB ↑)	<41> t <sub>HSTS</sub>		0.5 T – 20		ns
$\overline{\text{DSTB}}$ width, low	<42> t <sub>WDL</sub>		(1 + n) T – 15		ns
ASTB width, high	<43> t <sub>WSTH</sub>		T – 20		ns
$\overline{\text{WAIT}}$ setup time (vs. address)	<44> t <sub>SAWT1</sub>	n ≥ 1		1.5 T – 50	ns
	<45> t <sub>SAWT2</sub>			(1.5 + n) T – 50	ns
$\overline{\text{WAIT}}$ hold time (vs. address)	<46> t <sub>HAWT1</sub>	n ≥ 1	(0.5 + n) T		ns
	<47> t <sub>HAWT2</sub>		(1.5 + n) T		ns
$\overline{\text{WAIT}}$ setup time (vs. ASTB ↓)	<48> t <sub>SSTWT1</sub>	n ≥ 1		T – 35	ns
	<49> t <sub>SSTWT2</sub>			(1 + n) T – 35	ns
$\overline{\text{WAIT}}$ hold time (vs. ASTB ↓)	<50> t <sub>HSTWT1</sub>	n ≥ 1	nT		ns
	<51> t <sub>HSTWT2</sub>		(1 + n) T		ns
CLKOUT ↑→ data output delay time	<52> t <sub>DKOD</sub>			32	ns
$\overline{\text{DSTB}}$ ↓→ data output delay time	<53> t <sub>DDOD</sub>			20	ns
Data output hold time (vs. CLKOUT ↑)	<54> t <sub>HKOD</sub>		0		ns
Data output setup time (vs. $\overline{\text{DSTB}}$ ↑)	<55> t <sub>SODD</sub>		(1 + n) T – 30		ns
Data output hold time (vs. $\overline{\text{DSTB}}$ ↑)	<56> t <sub>HDOD</sub>		T – 15		ns

Remarks 1. T = t<sub>CYK</sub>

2. n indicates the number of wait clocks inserted in the bus cycle. The sampling timing differs when the programmable wait state is inserted.

(6) Write timing (2/2): 1 wait



**Note**  $\overline{R/W}$  (output),  $\overline{UBEN}$  (output),  $\overline{LBEN}$  (output)

**Remark** The broken line indicates the high-impedance state.

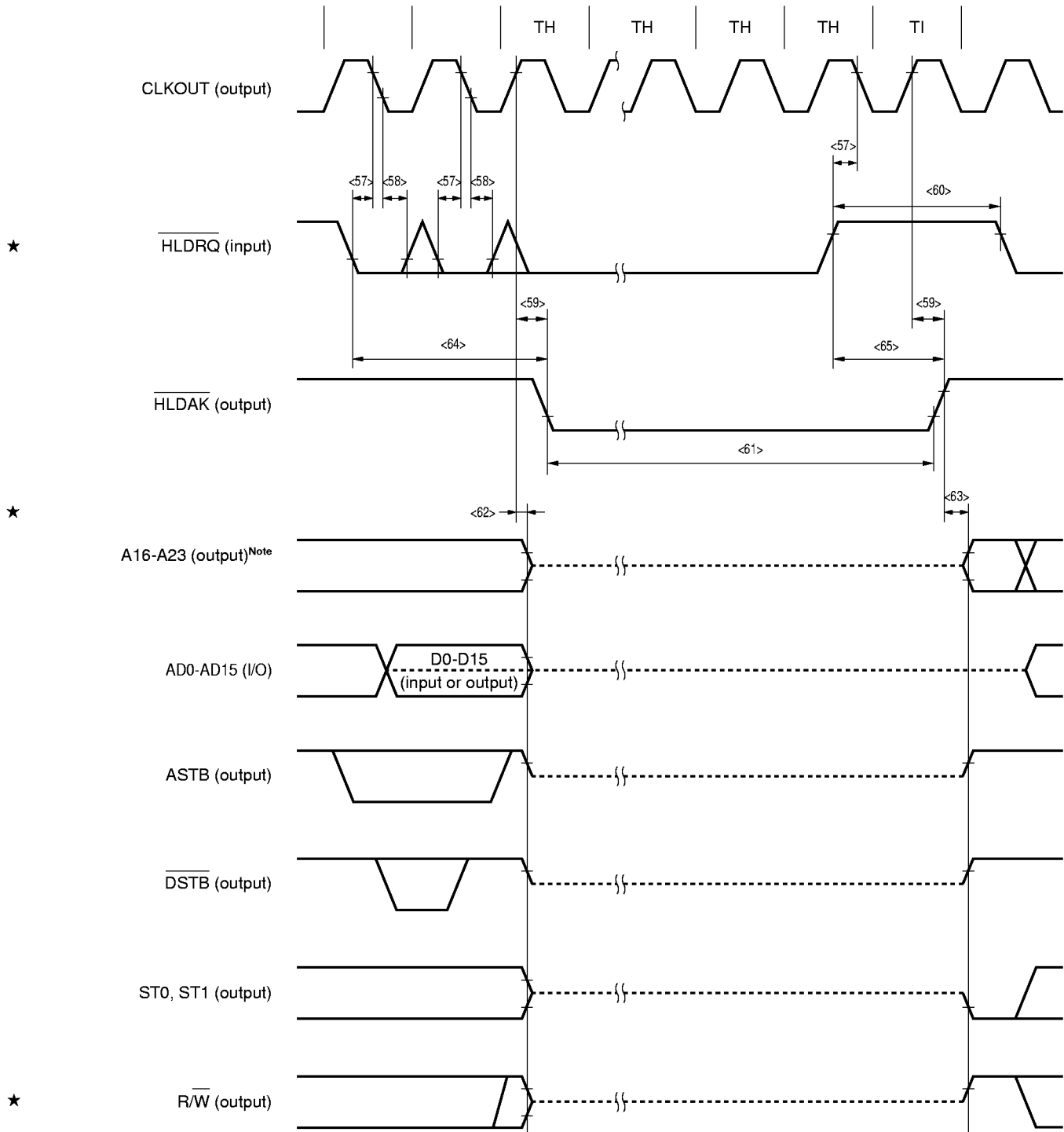
(7) Bus hold timing (1/2)

Parameter	Symbol	Condition	MIN.	MAX.	Unit
$\overline{\text{HLDRQ}}$ setup time (vs. CLKOUT ↓)	<57> $t_{\text{SHOK}}$		7		ns
$\overline{\text{HLDRQ}}$ hold time (vs. CLKOUT ↓)	<58> $t_{\text{HKHO}}$		7		ns
CLKOUT ↑ → $\overline{\text{HLD\!A\!K}}$ delay time	<59> $t_{\text{DKHA}}$			32	ns
$\overline{\text{HLDRQ}}$ width, high	<60> $t_{\text{WHQH}}$		T + 15		ns
$\overline{\text{HLD\!A\!K}}$ width, low	<61> $t_{\text{WHAL}}$		T - 15		ns
★ CLKOUT ↑ → bus float delay time	<62> $t_{\text{DKF}}$			32	ns
$\overline{\text{HLD\!A\!K}}$ ↑ → bus output delay time	<63> $t_{\text{DHAC}}$		-5		ns
$\overline{\text{HLDRQ}}$ ↓ → $\overline{\text{HLD\!A\!K}}$ ↓ delay time	<64> $t_{\text{DHQA1}}$			(2n + 7.5) T + 40	ns
$\overline{\text{HLDRQ}}$ ↑ → $\overline{\text{HLD\!A\!K}}$ ↑ delay time	<65> $t_{\text{DHQA2}}$		0.5 T	1.5 T + 40	ns

**Remarks 1.** T =  $t_{\text{CYK}}$

**2.** n indicates the number of wait clocks inserted in the bus cycle. The sampling timing differs when the programmable wait state is inserted.

(7) Bus hold timing (2/2)



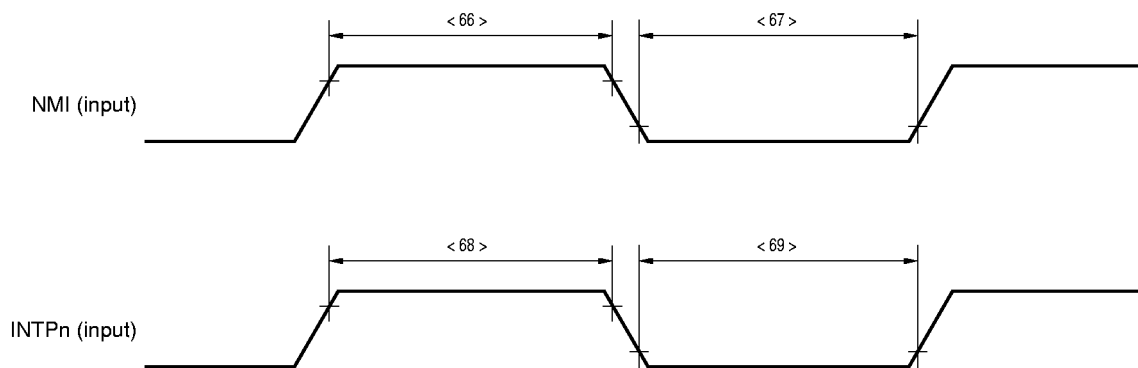
Note  $\overline{UBEN}$  (output) and  $\overline{LBEN}$  (output)

Remark The broken line indicates the high-impedance state.

(8) Interrupt timing

Parameter	Symbol	Condition	MIN.	MAX.	Unit
NMI width, high	<66> $t_{WNIH}$		500		ns
NMI width, low	<67> $t_{WNIL}$		500		ns
INTPn width, high	<68> $t_{WITH}$	n = 00, 01, 02, 03, 10, 11, 12, 13	3 T + 10		ns
INTPn width, low	<69> $t_{WITL}$	n = 00, 01, 02, 03, 10, 11, 12, 13	3 T + 10		ns

Remark T =  $t_{CYC}$



Remark n = 00, 01, 02, 03, 10, 11, 12, 13



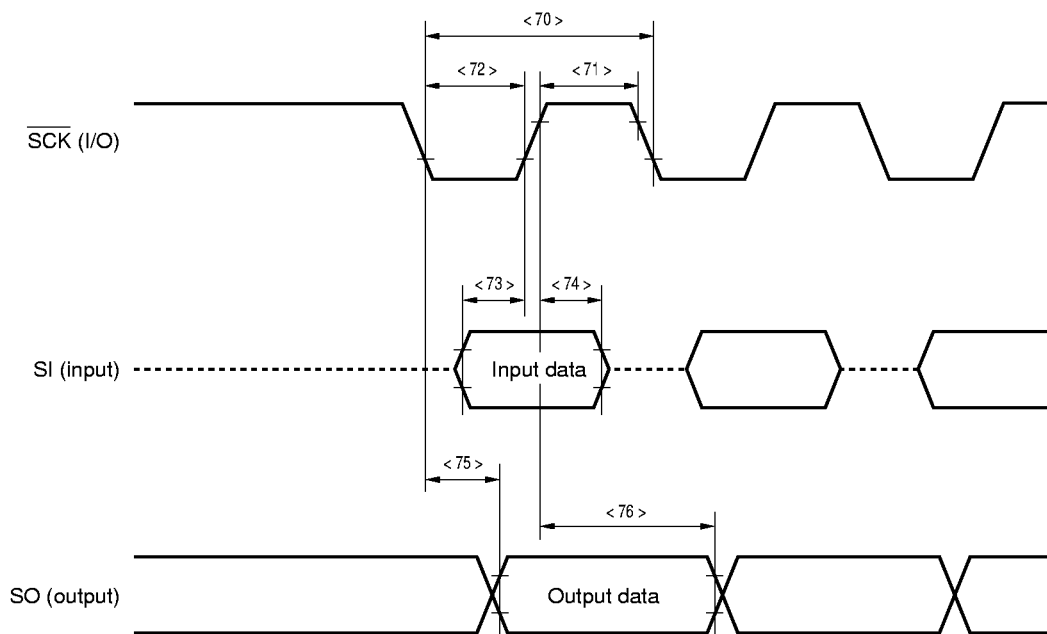
(9) CSI timing

(a) Master mode

Parameter	Symbol	Condition	MIN.	MAX.	Unit
$\overline{\text{SCK}}$ cycle	<70> $t_{\text{CYSK}}$	Output	330		ns
$\overline{\text{SCK}}$ width, high	<71> $t_{\text{WSKH}}$	Output	$0.5 t_{\text{CYSK}} - 40$		ns
$\overline{\text{SCK}}$ width, low	<72> $t_{\text{WSKL}}$	Output	$0.5 t_{\text{CYSK}} - 40$		ns
SI setup time (vs. $\overline{\text{SCK}} \uparrow$ )	<73> $t_{\text{SSISK}}$		60		ns
SI hold time (vs. $\overline{\text{SCK}} \uparrow$ )	<74> $t_{\text{HSKSI}}$		0		ns
SO output delay time (vs. $\overline{\text{SCK}} \downarrow$ )	<75> $t_{\text{DSKSO}}$			40	ns
SO output hold time (vs. $\overline{\text{SCK}} \uparrow$ )	<76> $t_{\text{HSKSO}}$		$0.5 t_{\text{CYSK}} - 15$		ns

(b) Slave mode

Parameter	Symbol	Condition	MIN.	MAX.	Unit
$\overline{\text{SCK}}$ cycle	<70> $t_{\text{CYSK}}$	Input	330		ns
$\overline{\text{SCK}}$ width, high	<71> $t_{\text{WSKH}}$	Input	110		ns
$\overline{\text{SCK}}$ width, low	<72> $t_{\text{WSKL}}$	Input	110		ns
SI setup time (vs. $\overline{\text{SCK}} \uparrow$ )	<73> $t_{\text{SSISK}}$		20		ns
SI hold time (vs. $\overline{\text{SCK}} \uparrow$ )	<74> $t_{\text{HSKSI}}$		20		ns
SO output delay time (vs. $\overline{\text{SCK}} \downarrow$ )	<75> $t_{\text{DSKSO}}$			60	ns
SO output hold time (vs. $\overline{\text{SCK}} \uparrow$ )	<76> $t_{\text{HSKSO}}$		$t_{\text{WSKH}}$		ns

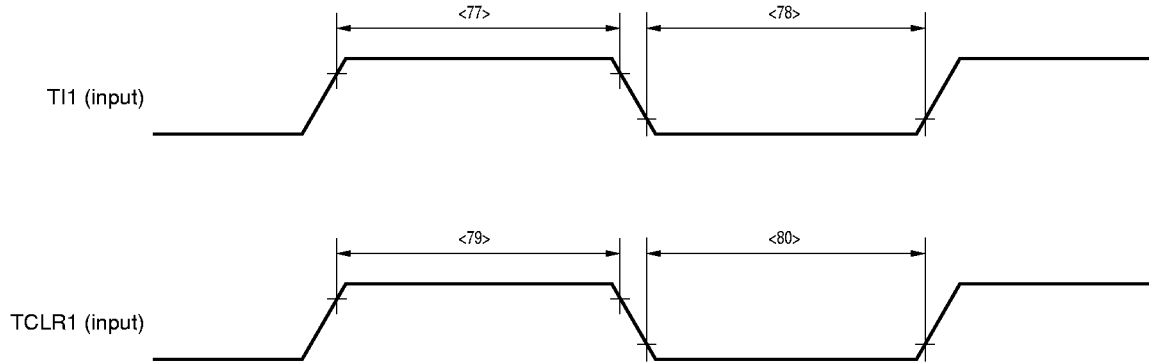


**Remark** The broken line indicates the high-impedance state.

(10) RPU timing

Parameter	Symbol	Condition	MIN.	MAX.	Unit
TI1 width, high	<77> $t_{WTIH}$		$3 T + 10$		ns
TI1 width, low	<78> $t_{WTIL}$		$3 T + 10$		ns
TCLR1 width, high	<79> $t_{WTCH}$		$3 T + 10$		ns
TCLR1 width, low	<80> $t_{WTCL}$		$3 T + 10$		ns

**Remark**  $T = t_{CYK}$



## 6.2 PROM Programming Mode

### DC Programming Characteristics

**PROM write mode ( $T_A = 25 \pm 5 \text{ }^\circ\text{C}$ ,  $V_{DD} = 6.5 \pm 0.25 \text{ V}$ ,  $V_{PP} = 12.5 \pm 0.3 \text{ V}$ )**

Parameter	Symbol	Symbol <sup>Note</sup>	Condition	MIN.	TYP.	MAX.	Unit
Input voltage, high	$V_{IH}$	$V_{IH}$		$0.7 V_{DD}$		$V_{DD}$	V
Input voltage, low	$V_{IL}$	$V_{IL}$		0		$0.3 V_{DD}$	V
Output voltage, high	$V_{OH}$	$V_{OH}$	$I_{OH} = -1 \text{ mA}$	$V_{DD} - 1.0$			V
Output voltage, low	$V_{OL}$	$V_{OL}$	$I_{OL} = 1.6 \text{ mA}$			0.4	V
Input leakage current	$I_{LI}$	$I_{LI}$	$0 \leq V_{IN} \leq V_{DD}$	-10		+10	μA
$V_{PP}$ supply voltage	$V_{PP}$	$V_{PP}$		12.2	12.5	12.8	V
$V_{DD}$ supply voltage	$V_{DD}$	$V_{CC}$		6.25	6.5	6.75	V
$V_{PP}$ supply current	$I_{PP}$	$I_{PP}$	$\overline{\text{PGM}} = V_{IL}$			50	mA
$V_{DD}$ supply current	$I_{DD}$	$I_{CC}$				50	mA

**Note** Symbol of corresponding μPD27C1001A

**PROM read mode ( $T_A = 25 \pm 5 \text{ }^\circ\text{C}$ ,  $V_{DD} = 5.0 \pm 0.5 \text{ V}$ ,  $V_{PP} = V_{DD} \pm 0.6 \text{ V}$ )**

Parameter	Symbol	Symbol <sup>Note</sup>	Condition	MIN.	TYP.	MAX.	Unit
Input voltage, high	$V_{IH}$	$V_{IH}$		$0.7 V_{DD}$		$V_{DD}$	V
Input voltage, low	$V_{IL}$	$V_{IL}$		0		$0.3 V_{DD}$	V
Output voltage, high	$V_{OH1}$	$V_{OH1}$	$I_{OH} = -1 \text{ mA}$	$V_{DD} - 1.0$			V
	$V_{OH2}$	$V_{OH2}$	$I_{OH} = -100 \text{ } \mu\text{A}$	$V_{DD} - 0.5$			V
Output voltage, low	$V_{OL}$	$V_{OL}$	$I_{OL} = 1.6 \text{ mA}$			0.4	V
Input leakage current	$I_{LI}$	$I_{LI}$	$0 \leq V_{IN} \leq V_{DD}$	-10		+10	μA
Output leakage current	$I_{LO}$	$I_{LO}$	$0 \leq V_{OUT} \leq V_{DD}$ , $\overline{\text{OE}} = V_{IH}$	-10		+10	μA
$V_{PP}$ supply voltage	$V_{PP}$	$V_{PP}$		$V_{DD} - 0.6$	$V_{DD}$	$V_{DD} + 0.6$	V
$V_{DD}$ supply voltage	$V_{DD}$	$V_{CC}$		4.5	5.0	5.5	V
$V_{PP}$ supply current	$I_{PP}$	$I_{PP}$	$V_{PP} = V_{DD}$			100	μA
$V_{DD}$ supply current	$I_{DD}$	$I_{CCA1}$	$\overline{\text{CE}} = V_{IL}$ , $V_{IN} = V_{IH}$			50	mA

**Note** Symbol of corresponding μPD27C1001A

AC Programming Characteristics

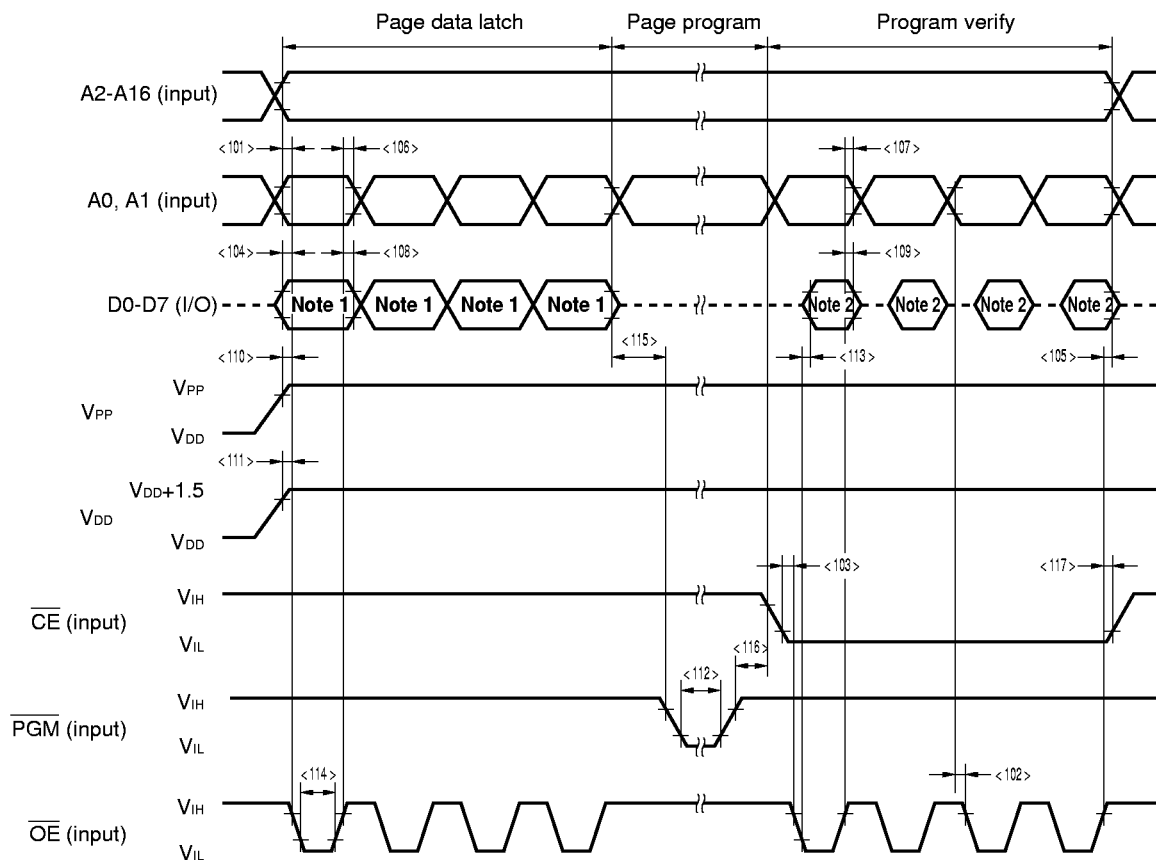
(1) PROM write mode timing (page program mode)

(T<sub>A</sub> = 25 ± 5 °C, V<sub>DD</sub> = 6.5 ± 0.25 V, V<sub>PP</sub> = 12.5 ± 0.3 V) (1/2)

Parameter	Symbol	Symbol <sup>Note</sup>	Condition	MIN.	TYP.	MAX.	Unit
Address setup time (vs. $\overline{OE} \downarrow$ )	<101> t <sub>AS</sub>	t <sub>AS</sub>		2			μs
$\overline{OE}$ setup time	<102> t <sub>oES</sub>	t <sub>oES</sub>		2			μs
$\overline{CE}$ setup time (vs. $\overline{OE} \downarrow$ )	<103> t <sub>CES</sub>	t <sub>CES</sub>		2			μs
Input data setup time (vs. $\overline{OE} \downarrow$ )	<104> t <sub>DS</sub>	t <sub>DS</sub>		2			μs
Address hold time (vs. $\overline{OE} \uparrow$ )	<105> t <sub>AH</sub>	t <sub>AH</sub>		2			μs
	<106> t <sub>AHL</sub>	t <sub>AHL</sub>		2			μs
	<107> t <sub>AHV</sub>	t <sub>AHV</sub>		0			μs
Input data hold time (vs. $\overline{OE} \uparrow$ )	<108> t <sub>DH</sub>	t <sub>DH</sub>		2			μs
$\overline{OE} \uparrow \rightarrow$ data output float delay time	<109> t <sub>DF</sub>	t <sub>DF</sub>		0		250	ns
V <sub>PP</sub> setup time (vs. $\overline{OE} \downarrow$ )	<110> t <sub>VPS</sub>	t <sub>VPS</sub>		1.0			ms
V <sub>DD</sub> setup time (vs. $\overline{OE} \downarrow$ )	<111> t <sub>VDS</sub>	t <sub>VCS</sub>		1.0			ms
Program pulse width	<112> t <sub>PW</sub>	t <sub>PW</sub>		0.095	0.1	0.105	ms
$\overline{OE} \downarrow \rightarrow$ valid data delay time	<113> t <sub>OE</sub>	t <sub>OE</sub>				1	μs
$\overline{OE}$ pulse width in data latch	<114> t <sub>LW</sub>	t <sub>LW</sub>		1			μs
$\overline{PGM}$ setup time	<115> t <sub>PGMS</sub>	t <sub>PGMS</sub>		2			μs
$\overline{CE}$ hold time	<116> t <sub>CEH</sub>	t <sub>CEH</sub>		2			μs
$\overline{OE}$ hold time	<117> t <sub>OEH</sub>	t <sub>OEH</sub>		2			μs

**Note** Symbol of corresponding μPD27C1001A

(1) PROM write mode timing (page program mode) (2/2)



- Notes 1. D0-D7 (input)
- 2. D0-D7 (output)

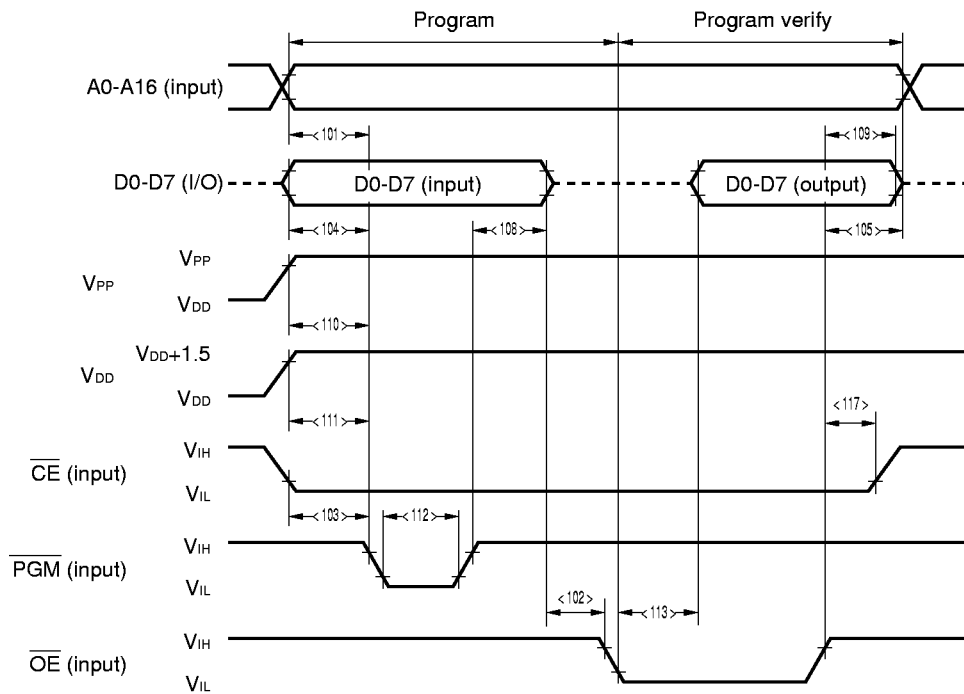
Remark The broken line indicates the high-impedance state.

(2) PROM write mode timing (byte program mode)

( $T_A = 25 \pm 5 \text{ }^\circ\text{C}$ ,  $V_{DD} = 6.5 \pm 0.25 \text{ V}$ ,  $V_{PP} = 12.5 \pm 0.3 \text{ V}$ )

Parameter	Symbol	Symbol <sup>Note</sup>	Condition	MIN.	TYP.	MAX.	Unit
Address setup time (vs. $\overline{\text{PGM}} \downarrow$ )	<101> $t_{AS}$	$t_{AS}$		2			$\mu\text{s}$
$\overline{\text{OE}}$ setup time	<102> $t_{OES}$	$t_{OES}$		2			$\mu\text{s}$
$\overline{\text{CE}}$ setup time (vs. $\overline{\text{PGM}} \downarrow$ )	<103> $t_{CES}$	$t_{CES}$		2			$\mu\text{s}$
Input data setup time (vs. $\overline{\text{PGM}} \downarrow$ )	<104> $t_{DS}$	$t_{DS}$		2			$\mu\text{s}$
Address hold time (vs. $\overline{\text{OE}} \uparrow$ )	<105> $t_{AH}$	$t_{AH}$		2			$\mu\text{s}$
Input data hold time (vs. $\overline{\text{PGM}} \uparrow$ )	<108> $t_{DH}$	$t_{DH}$		2			$\mu\text{s}$
$\overline{\text{OE}} \uparrow \rightarrow$ data output float delay time	<109> $t_{DF}$	$t_{DF}$		0		250	ns
$V_{PP}$ setup time (vs. $\overline{\text{PGM}} \downarrow$ )	<110> $t_{VPS}$	$t_{VPS}$		1.0			ms
$V_{DD}$ setup time (vs. $\overline{\text{PGM}} \downarrow$ )	<111> $t_{VDS}$	$t_{VDS}$		1.0			ms
Program pulse width	<112> $t_{PW}$	$t_{PW}$		0.095	0.1	0.105	ms
$\overline{\text{OE}} \downarrow \rightarrow$ valid data delay time	<113> $t_{OE}$	$t_{OE}$				1	$\mu\text{s}$
$\overline{\text{OE}}$ hold time	<117> $t_{OEH}$	—		2			$\mu\text{s}$

**Note** Symbol of the corresponding μPD27C1001A



**Cautions 1.** Apply  $V_{DD}$  before  $V_{PP}$ , and turn off  $V_{DD}$  after  $V_{PP}$ .

**2.** Keep  $V_{PP}$  to less than +13.5 V including overshoot.

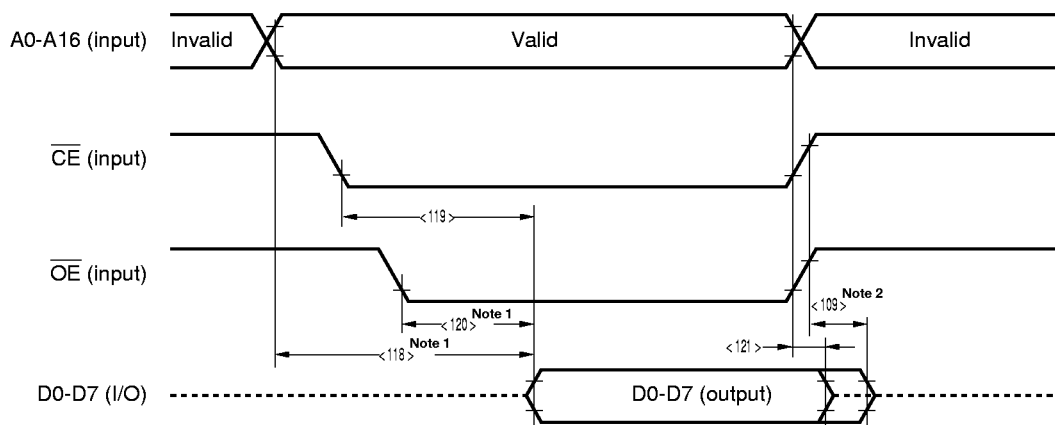
**3.** If the device is pulled out of the socket while +12.5 V is applied to  $V_{PP}$ , the reliability may be degraded.

**Remark** The broken line indicates the high-impedance state.

(3) PROM read mode timing ( $T_A = 25 \pm 5 \text{ }^\circ\text{C}$ ,  $V_{DD} = 5.0 \pm 0.5 \text{ V}$ ,  $V_{PP} = V_{DD} \pm 0.6 \text{ V}$ )

Parameter	Symbol	Symbol <sup>Note</sup>	Condition	MIN.	TYP.	MAX.	Unit
Address → data output delay time	<118>	$t_{ACC}$	$\overline{CE} = \overline{OE} = V_{IL}$			1	μs
$\overline{CE} \downarrow \rightarrow$ data output delay time	<119>	$t_{CE}$	$\overline{OE} = V_{IL}$			1	μs
$\overline{OE} \downarrow \rightarrow$ data output delay time	<120>	$t_{OE}$	$\overline{CE} = V_{IL}$			1	μs
$\overline{OE} \uparrow \rightarrow$ data output float delay time	<109>	$t_{DF}$	$\overline{CE} = V_{IL}$	0		60	ns
Address → data hold time	<121>	$t_{OH}$	$\overline{CE} = \overline{OE} = V_{IL}$	0			ns

**Note** Symbol of the corresponding μPD27C1001A



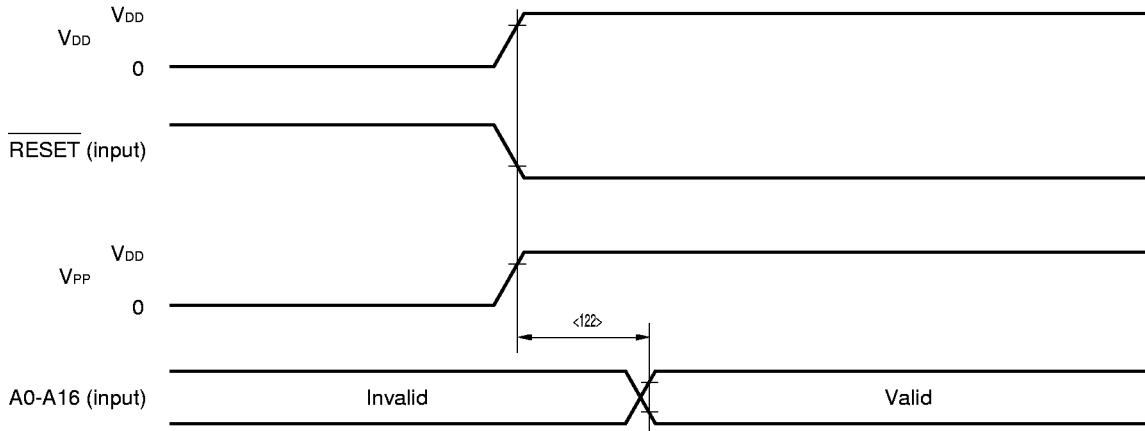
**Notes 1.** To read within the range of  $t_{ACC}$  (< 118 >), the delay time of  $\overline{OE}$  input from the falling of  $\overline{CE}$  must be  $t_{ACC} - t_{OE}$  (< 118 > - < 120 >) max.

**2.**  $t_{DF}$  (< 109 >) is the time after either  $\overline{OE}$  or  $\overline{CE}$  first reaches  $V_{IH}$ .

**Remark** The broken line indicates the high-impedance state.

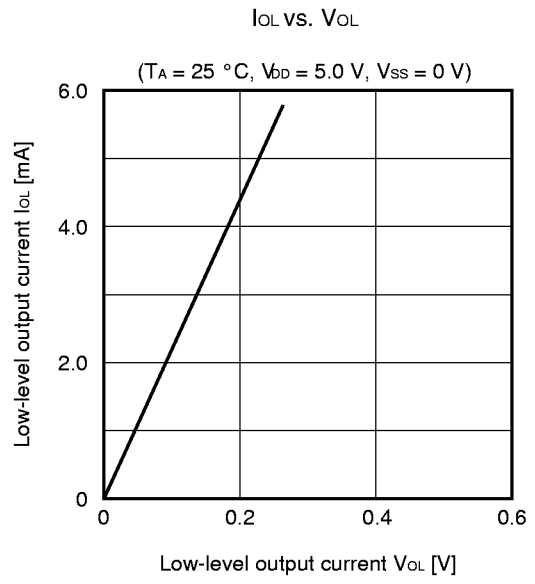
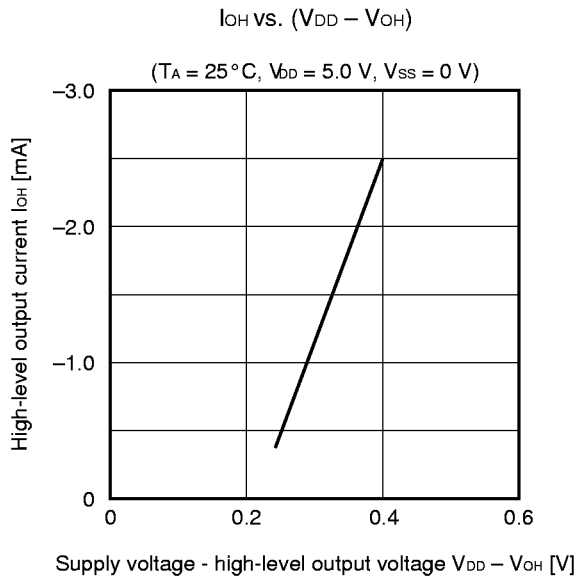
(4) PROM programming mode setting timing (T<sub>A</sub> = 25 °C, V<sub>SS</sub> = 0 V)

Parameter	Symbol	Condition	MIN.	TYP.	MAX.	Unit
PROM programming mode setup time	<122> t <sub>SMA</sub>		10			μs



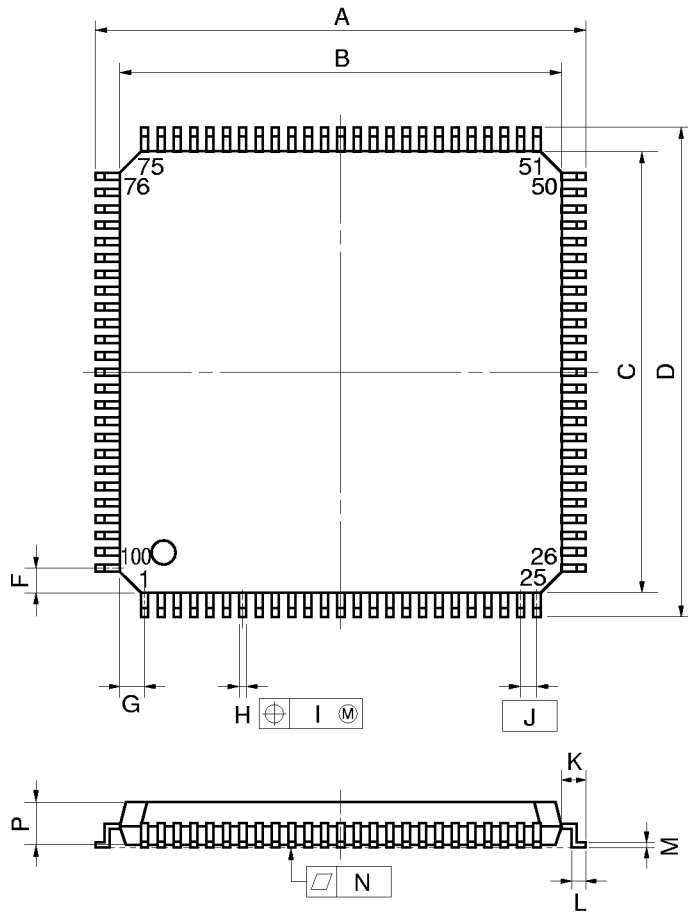


7. CHARACTERISTICS CURVES (reference)



8. PACKAGE DRAWINGS

100 PIN PLASTIC QFP (FINE PITCH) (□14)



NOTE

Each lead centerline is located within 0.10 mm (0.004 inch) of its true position (T.P.) at maximum material condition.

ITEM	MILLIMETERS	INCHES
A	16.0±0.2	0.630±0.008
B	14.0±0.2	0.551 <sup>+0.009</sup> <sub>-0.008</sub>
C	14.0±0.2	0.551 <sup>+0.009</sup> <sub>-0.008</sub>
D	16.0±0.2	0.630±0.008
F	1.0	0.039
G	1.0	0.039
H	0.22 <sup>+0.05</sup> <sub>-0.04</sub>	0.009±0.002
I	0.10	0.004
J	0.5 (T.P.)	0.020 (T.P.)
K	1.0±0.2	0.039 <sup>+0.009</sup> <sub>-0.008</sub>
L	0.5±0.2	0.020 <sup>+0.008</sup> <sub>-0.009</sub>
M	0.17 <sup>+0.03</sup> <sub>-0.07</sub>	0.007 <sup>+0.001</sup> <sub>-0.003</sub>
N	0.10	0.004
P	1.45	0.057
Q	0.125±0.075	0.005±0.003
R	5°±5°	5°±5°
S	1.7 MAX.	0.067 MAX.

P100GC-50-7EA-2

**9. RECOMMENDED SOLDERING CONDITIONS**

Solder this product under the following recommended conditions.

For the details of the recommended soldering conditions, refer to Information Document “**Semiconductor Device Mounting Technology Manual**” (C10535E).

For soldering methods and soldering conditions other than those recommended, consult NEC.

**Table 9-1. Soldering Conditions of Surface Mount Type**

Soldering Method	Soldering Condition	Symbol of Recommended Condition
Infrared reflow	Package peak temperature: 235 °C, Time: 30 seconds max. (210 °C min.), Number of times: 2 max., Number of days: 7 <sup>Note</sup> (after that, prebaking is necessary at 125 °C for 10 hours) <Precaution> Products other than those supplied in thermal-resistant tray (magazine, taping, and non-thermal-resistant tray) cannot be baked in their packs.	IR35-107-2
VPS	Package peak temperature: 215 °C, Time: 40 seconds max. (200 °C min.), Number of times: 2 max., Number of days: 7 <sup>Note</sup> (after that, prebaking is necessary at 125 °C for 10 hours) <Precaution> Products other than those supplied in thermal-resistant tray (magazine, taping, and non-thermal-resistant tray) cannot be baked in their packs.	VP15-107-2
Partial heating	Pin temperature: 300 °C max., Time: 3 seconds (per side of device)	—

**Note** The number of days during which the product can be stored at 25 °C, 65 % RH max. after the dry pack has been opened.

**Caution** Do not use two or more soldering methods in combination (except partial heating).

**APPENDIX PROM WRITING TOOLS**

**(1) Hardware tools**

Product	Product Name	Description
★ PROM programmer	PG-1500	NEC PROM programmer. The NEC PROM programmer can program PROM-contained single-chip microcontrollers in stand-alone mode or under control of a host machine when connected with an optional PROM programmer adapter. This programmer can also program representative PROMs from 256K-bit to 4M-bit models.
	UNISITE	Data I/O Japan Co., Ltd. PROM programmers
	2900	
	3900	
	MODEL1890A	Minato Electronics Inc. PROM programmers
★ AF-9705 Rev.01.37 or higher Algorithm Rev.02.40 or higher	Ando Electric Co., Ltd. PROM programmers	
★ PROM programmer adapter	PA-70P3000GC	PROM programmer adapter to write program to μPD70P3000 on general-purpose PROM programmer such as PG-1500

**(2) Software tools**

Product	Host Machine	OS	Supply Medium	Part Number	Description
PG-1500 controller	PC-9800 series	MS-DOS	3.5" FD	μS5A13PG1500	Controls PG-1500 on host machine by connecting PG-1500 and host machine with serial or parallel interface.
			5" FD	μS5A10PG1500	
	IBM PC/AT™ and compatible machines	PC DOS	3.5" FD	μS7B13PG1500	
			5" FD	μS7B10PG1500	

**Remark** The operations of the PG-1500 controller are guaranteed only on the above host machine and OS.

[MEMO]

## NOTES FOR CMOS DEVICES

### ① PRECAUTION AGAINST ESD FOR SEMICONDUCTORS

**Note:** Strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and quickly dissipate it once, when it has occurred. Environmental control must be adequate. When it is dry, humidifier should be used. It is recommended to avoid using insulators that easily build static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work bench and floor should be grounded. The operator should be grounded using wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with semiconductor devices on it.

### ② HANDLING OF UNUSED INPUT PINS FOR CMOS

**Note:** No connection for CMOS device inputs can be cause of malfunction. If no connection is provided to the input pins, it is possible that an internal input level may be generated due to noise, etc., hence causing malfunction. CMOS device behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using a pull-up or pull-down circuitry. Each unused pin should be connected to  $V_{DD}$  or GND with a resistor, if it is considered to have a possibility of being an output pin. All handling related to the unused pins must be judged device by device and related specifications governing the devices.

### ③ STATUS BEFORE INITIALIZATION OF MOS DEVICES

**Note:** Power-on does not necessarily define initial status of MOS device. Production process of MOS does not define the initial operation status of the device. Immediately after the power source is turned ON, the devices with reset function have not yet been initialized. Hence, power-on does not guarantee out-pin levels, I/O settings or contents of registers. Device is not initialized until the reset signal is received. Reset operation must be executed immediately after power-on for devices having reset function.

## Regional Information

Some information contained in this document may vary from country to country. Before using any NEC product in your application, please contact the NEC office in your country to obtain a list of authorized representatives and distributors. They will verify:

- Device availability
- Ordering information
- Product release schedule
- Availability of related technical literature
- Development environment specifications (for example, specifications for third-party tools and components, host computers, power plugs, AC supply voltages, and so forth)
- Network requirements

In addition, trademarks, registered trademarks, export restrictions, and other legal issues may also vary from country to country.

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