CMOS 8-Bit Microcontroller

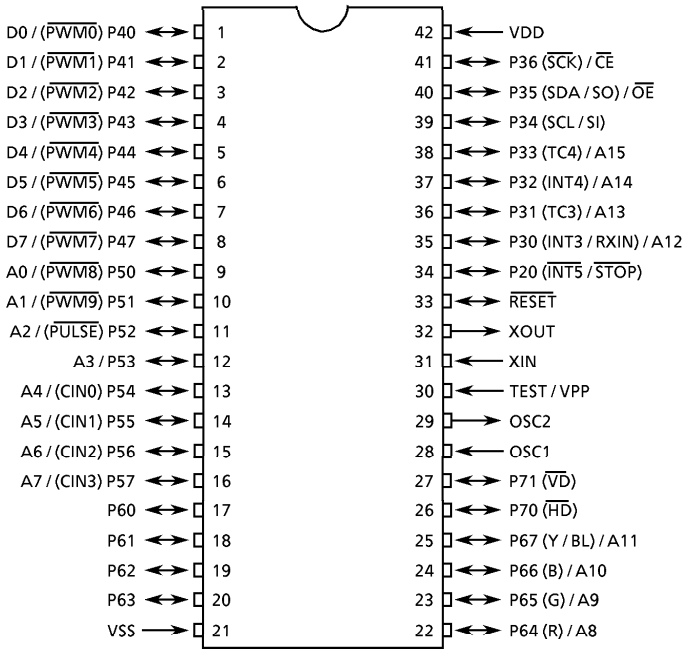
TMP87PM36N

The 87PM36 is a One-Time PROM microcontroller with low-power 287.5 Kbits (a 32 Kbytes program memory and a 128 characters OSD font memory) electrically programmable read only memory for the 87CM36 system evaluation. The 87PM36 is pin compatible with the 87CM36. The operations possible with the 87CM36 can be performed by writing programs and OSD character data to PROM. The 87PM36 can write and verify in the same way as the TC57256AD using an adaptor socket BM1183A and an EPROM programmer.

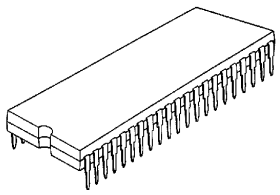
Part No.	OTP	RAM	Package	Adaptor Socket
TMP87PM36N	32 Kbytes + 14 x 18 x 128 bits	1 Kbytes	SDIP42-P-600-1.78	BM1183A

Pin Assignments (Top View)

SDIP42-P-600-1.78



SDIP42-P-600-1.78



TMP87PM36N

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Pin Function

The 87PM36 has two modes: MCU and PROM.

(1) MCU mode

In this mode, the 87PM36 is pin compatible with the 87CM36 (fix the TEST pin at low level).

(2) PROM mode

Pin Name (PROM mode)	Input/Output	Functions	Pin Name (MCU mode)
A15 to A12	Input	PROM address inputs	P33 to P30
A11 to A8			P67 to P64
A7 to A0			P57 to P50
D7 to D0	I/O	PROM data input/outputs	P47 to P40
$\overline{CE}$	Input	Chip enable signal input (active low)	P36
$\overline{OE}$		Output enable signal input (active low)	P35
VPP	Power supply	+ 12.5 V / 5 V (Program supply voltage)	TEST
VCC		+ 5 V	VDD
GND		0V	VSS
P36	I/O	Pull-up with resistance for input processing	
P61		PROM mode setting pin. Be fixed at high level.	
P70			
P20		PROM mode setting pin. Be fixed at low level.	
P63, P62, P60			
P71			
$\overline{RESET}$			
XIN	Input	Connect an 8 MHz oscillator to stabilize the internal state.	
XOUT	Output		
OSC1	Input	Non connection	
OSC2	Output		

Operational Description

The following explains the 87PM36 hardware configuration and operation. The configuration and functions of the 87PM36 are the same as those of the 87CM36, except in that a one-time PROM is used instead of an on-chip mask ROM.

1. Operating Mode

The 87PM36 has two modes: MCU and PROM.

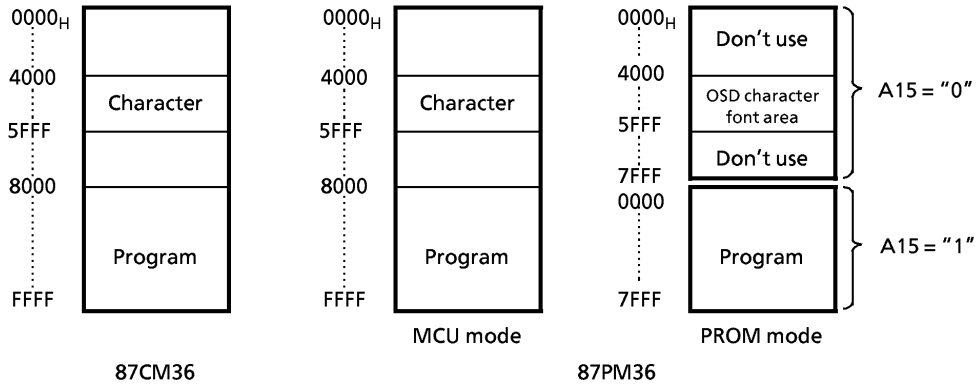
1.1 MCU mode

The MCU mode is activated by fixing the TEST / VPP pin at low level.

In the MCU mode, operation is the same as with the 87CM36 (the TEST / VPP pin cannot be used open because it has no built-in pull-down resistance).

1.1.1 Program memory and OSD character font memory

The 87PM36 has a 32 Kbytes of program memory and a 14 × 18 × 128 bits of OSD character font memory.



Note: Set the PROM programmer to access only the program storage area or OSD character font area.

Figure 1-1. Program Memory Area

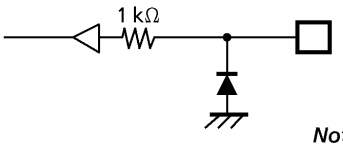
1.1.2 Data memory

The 87PM36 has an on-chip 1 Kbytes data memory (static RAM).

1.1.3 Input/output circuitry

(1) Control pins

The control pins of the 87PM36 are the same as those of the 87CM36 except that the TEST pin has no built-in pull-down resistance.



Note: TEST pin has no built-in pull-down resistance.

Figure 1-2. TEST Pin

(2) I/O ports

The I/O circuitries of 87PM36 I/O ports the are the same as those of the 87CM36.

1.2 PROM mode

The PROM mode is activated by setting the TEST, $\overline{\text{RESET}}$ pin and the ports P71 ot P70, P63 to P60 and P20 as shown in Figure 1-2. The PROM mode is used to write and verify programs with a general-purpose PROM programmer. The high-speed programming mode can be used for program operation.
The 87PM37 is not supported an *electric signature* mode, so the ROM type must be set to TC57256AD.
Set the adaptor socket switch to "N" for the program memory, and to "S" for the OSD character font memory.

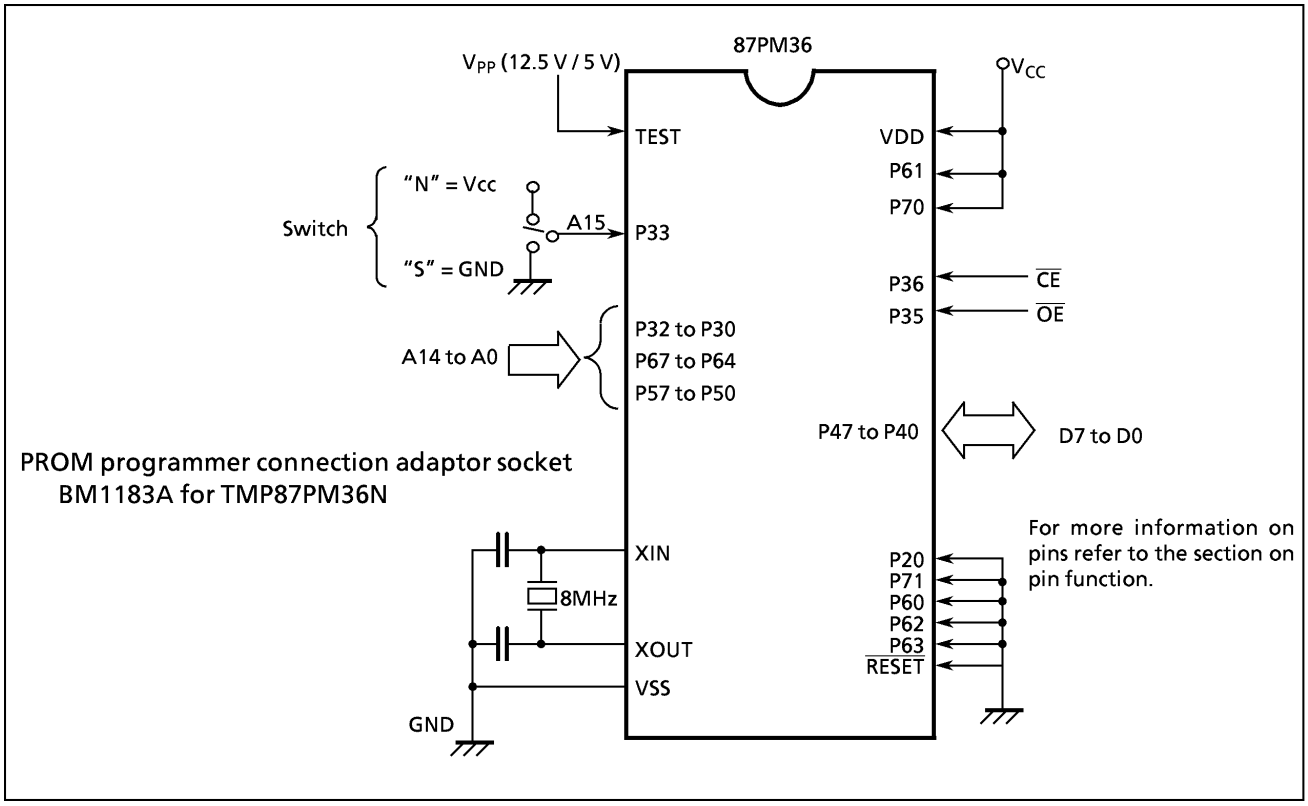


Figure 1-3. Setting for PROM Mode

1.2.1 Programming flowchart (High-speed programming mode-I)

The high-speed programming mode is achieved by applying the program voltage (+ 12.5 V) to the VPP pin when Vcc = 6 V. After the address and input data are stable, the data is programmed by applying a single 1ms program pulse to the $\overline{CE}$ input. The programmed data is verified. If incorrect, another 1ms program pulse is applied and then the programmed data is verified. This process should be repeated (up to 25 times) until the program operates correctly. Programming for one address is ended by applying additional program pulse with width 3 times that needed for initial programming (number of programmed times × 1 ms). After that, change the address and input data, and program as before. When programming has been completed, the data in all addresses should be verified with Vcc = Vpp = 5 V.

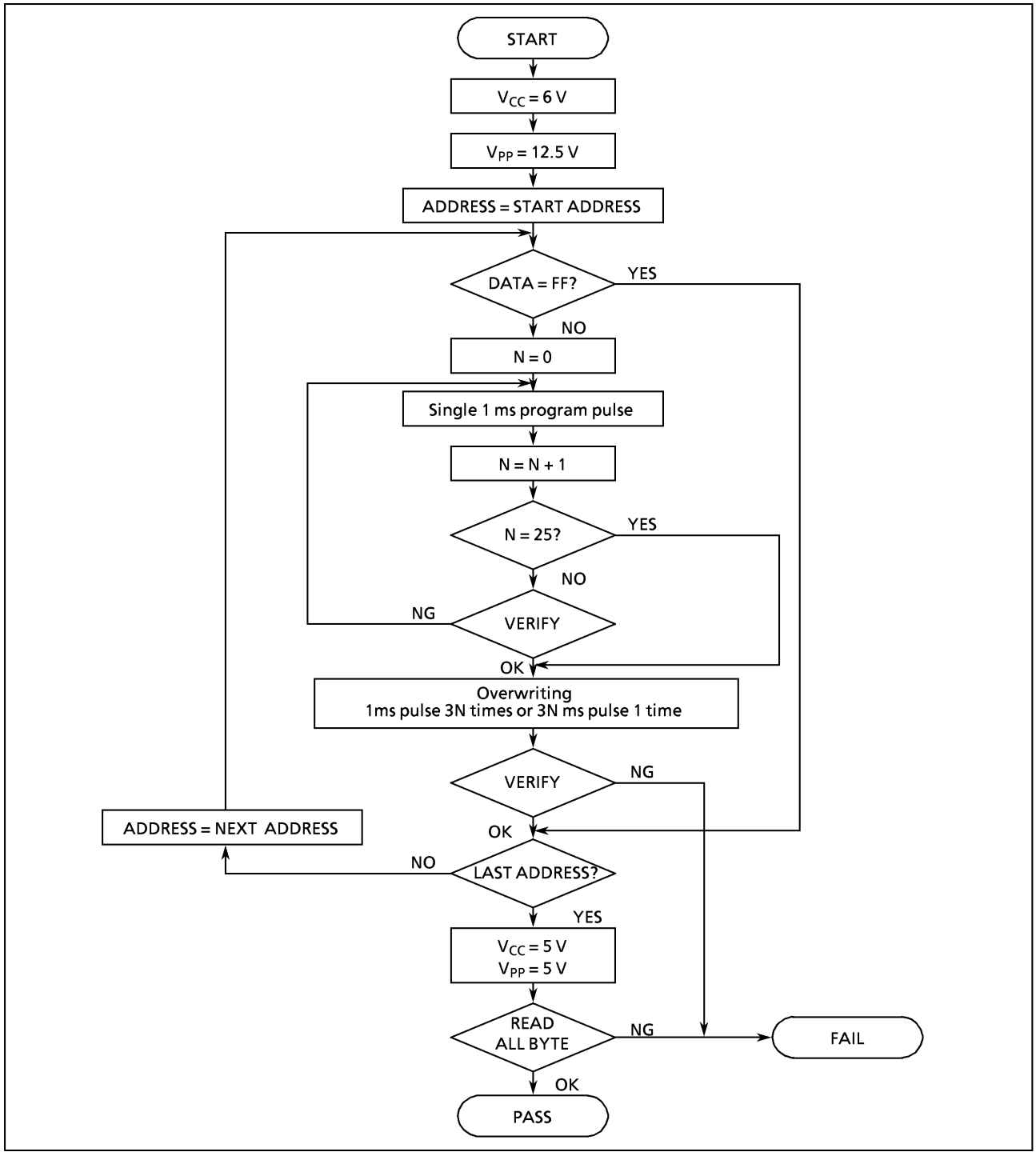


Figure 1-4. Flow Chart of High-Speed Programming Mode- I

1.2.2 Programming Flowchart (High-speed programming mode-II)

The high-speed programming mode is achieved by applying the program voltage (+ 12.75 V) to the Vpp pin when Vcc = 6.25 V. After the address and input data are stable, the data is programmed by applying a single 0.1ms program pulse to the $\overline{CE}$ input. The programmed data is verified. If incorrect, another 0.1ms program pulse is applied and then the programmed data is verified. This process should be repeated (up to 25 times) until the program operates correctly. After that, change the address and input data, and program as before. When programming has been completed, the data in all addresses should be verified with Vcc = Vpp = 5 V.

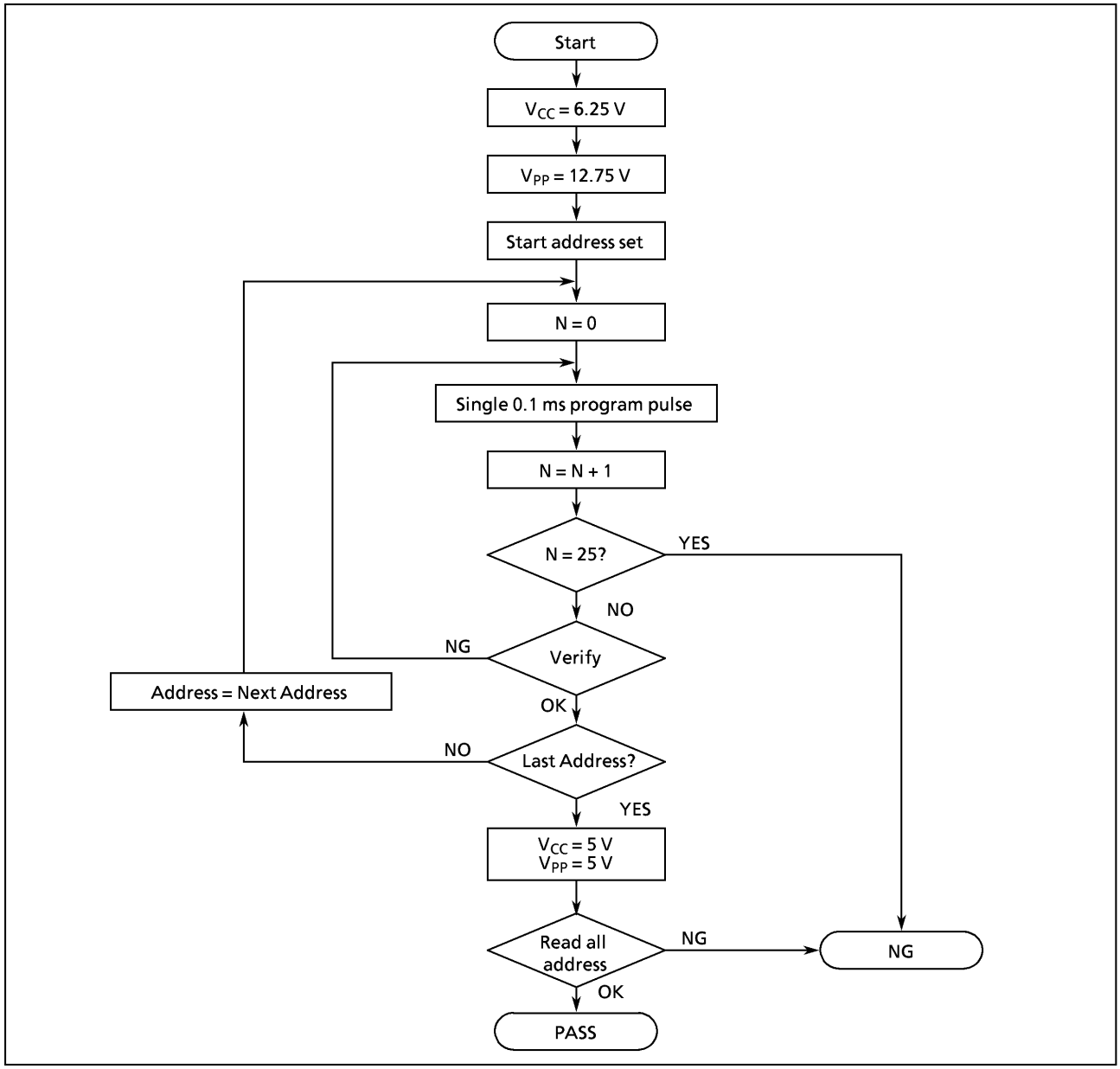


Figure 1-5. Flowchart of High-speed Programming Mode - II

1.2.3 Writing method for general-purpose PROM program

(1) Adapters
BM1183A : TMP87PM36N

(2) Adapter setting
Switch (SW1) is set to side N.

(3) PROM programmer specifying
i) PROM type is specified to TC571000D.
Writing voltage : 12.5 V (high-speed program mode-Ⅰ)
12.75 V (high-speed program mode-Ⅱ)

ii) Data transfer (copy) (note 1)
TMP87PM36 has the programing EPROM (address 0000 to 7FFFH) and the OSD character font EPROM (address 4000 to 5FFFH). The EPROMs are assigned at different addresses, so that they must be separately transferred to the PROM programmer.
SW = "N"
0000 to 7FFFH : programing EPROM
SW = "S"
4000 to 5FFF$_H$: character font EPROM
The program area in MCU mode and PROM mode is referred to "program memory area" in figure 1-1.

iii) Writing address is specified. (Note 1)
programing EPROM
Start address : 0000$_H$
End address : 7FFF$_H$
character font EPROM
Start address : 4000$_H$
End address : 5FFF$_H$

(4) Writing
Writing/Verifying is required to be executed in accordance with PROM programmer operating procedure.

Note 1 : The specifying method is referred to the PROM programmer description. Either write the data FF$_H$ to the unused area or set the PROM programmer to access only the program storage area.

Note 2 : When MCU is set to an adapter or the adapter is set to PROM programmer, a position of pin 1 must be adjusted. If the setting is reversed, MCU, the adapter and PROM program is damaged.

Note 3 : The TMP87PM36 does not support the electric signature mode (hereinafter referred to as "signature"). If the signature is used in PROM program, a device is damaged due to applying 12 V ± 0.5 V to the address pin 9 (A9). The signature must not be used.

Electrical Characteristics

Absolute Maximum Ratings (V_{SS} = 0 V)

Parameter	Symbol	Pins	Ratings	Unit
Supply Voltage	V_{DD}		– 0.3 to 6.5	V
Program Voltage	V_{PP}	TEST / VPP	– 0.3 to 13.0	V
Input Voltage	V_{IN}		– 0.3 to V_{DD} + 0.3	V
Output Voltage	V_{OUT1}		– 0.3 to V_{DD} + 0.3	V
Output Current (Per 1 pin)	I_{OUT1}	Ports P2, P3, P4, P5, P64 to P67, P7	3.2	mA
	I_{OUT2}	Ports P60 to P63	30	
Output Current (Total)	ΣI_{OUT1}	Ports P2, P3, P4, P5, P64 to P67, P7	120	mA
	ΣI_{OUT2}	Ports P60 to P63	120	
Power Dissipation [Topr = 70°C]	PD		600	mW
Soldering Temperature (time)	Tsld		260 (10 s)	°C
Storage Temperature	Tstg		– 55 to 125	°C
Operating Temperature	Topr		– 30 to 70	°C

Note: The absolute maximum ratings are rated values which must not be exceeded during operation, even for an instant. Any one of the ratings must not be exceeded. If any absolute maximum rating is exceeded, a device may break down or its performance may be degraded, causing it to catch fire or explode resulting in injury to the user. Thus, when designing products which include this device, ensure that no absolute maximum rating value will ever be exceeded.

Recommended Operating Conditions (V_{SS} = 0 V, Topr = – 30 to 70°C)

Parameter	Symbol	Pins	Conditions		Min	Max	Unit
Supply Voltage	V_{DD}		fc = 8MHz	NORMAL mode	4.5	5.5	V
				IDLE mode			
				STOP mode	2.0		
Input High Voltage	V_{IH1}	Except hysteresis input			$V_{DD} \times 0.70$	V_{DD}	V
	V_{IH2}	Hysteresis input			$V_{DD} \times 0.75$		
Input Low Voltage	V_{IL1}	Except hysteresis input			0	$V_{DD} \times 0.30$	V
	V_{IL2}	Hysteresis input				$V_{DD} \times 0.25$	
Clock Frequency	fc	XIN, XOUT	V_{DD} = 4.5 to 5.5 V		4.0	8.0	MHz
	f_{OSC}	OSC1, OSC2	Normal frequency mode (FORS = 0, V_{DD} = 4.5 to 5.5 V)		4.0	$f_{OSC} \leqq f_C \times 1.2 \leqq 8.0$	
			Double frequency mode (FORS = 1, V_{DD} = 4.5 to 5.5 V)		2.0	$f_{OSC} \leqq f_C \times 0.6 \leqq 4.0$	

Note 1: The recommended operating conditions for a device are operating conditions under which it can be guaranteed that the device will operate as specified. If the device is used under operating conditions other than the recommended operating conditions (supply voltage, operating temperature range, specified AC/DC values etc.), malfunction may occur. Thus, when designing products which include this device, ensure that the recommended operating conditions for the device are always adhered to.

Note 2: Clock frequency fc ; The condition of supply voltage range is the value in NORMAL and IDLE modes.

D.C. Characteristics

(V_{SS} = 0 V, Topr = – 30 to 70°C)

Parameter	Symbol	Pins	Conditions	Min	Typ.	Max	Unit
Hysteresis Voltage	V_{HS}	Hysteresis inputs		–	0.9	–	V
Input Current	I_{IN1}	TEST	V_{DD} = 5.5 V, V_{IN} = 5.5 V / 0 V	–	–	± 2	μA
	I_{IN2}	Open drain ports	V_{DD} = 5.5 V, V_{IN} = 5.5 V	–	–	2	
	I_{IN3}	Tri-state ports	V_{DD} = 5.5 V, V_{IN} = 5.5 V / 0 V	–	–	± 2	
	I_{IN4}	$\overline{RESET}$, $\overline{STOP}$	V_{DD} = 5.5 V, V_{IN} = 5.5 V / 0 V	–	–	± 2	
Input Resistance	R_{IN2}	$\overline{RESET}$		100	220	450	kΩ
Output Leakage Current	I_{LO1}	Sink open drain ports	V_{DD} = 5.5 V, V_{OUT} = 5.5 V	–	–	2	μA
	I_{LO2}	Tri-state ports	V_{DD} = 5.5 V, V_{OUT} = 5.5 V / 0 V	–	–	± 2	
Output High Voltage	V_{OH2}	Tri- state port	V_{DD} = 4.5 V, I_{OH} = – 0.7 mA	4.1	–	–	V
Output Low Voltage	V_{OL}	Except XOUT, OSC2 and ports P60 to P63	V_{DD} = 4.5 V, I_{OL} = 1.6 mA	–	–	0.4	V
Output Low Current	I_{OL3}	Ports P60 to P63	V_{DD} = 4.5 V, V_{OL} = 1.0 V	–	20	–	mA
Supply Current in NORMAL mode	I_{DD}		V_{DD} = 5.5 V fc = 8 MHz V_{IN} = 5.3 V / 0.2 V	–	10	16	mA
Supply Current in IDLE mode				–	6	8	mA
Supply Current in STOP mode			V_{DD} = 5.5 V V_{IN} = 5.3 V / 0.2 V	–	0.5	10	μA

Note 1 : Typical values show those at Topr = 25°C , V_{DD} = 5 V.

Note 2 : Input Current I_{IN4} ; The current through pull-up resistor is not included.

Note 3 : Typical current consumption during A/D conversion is 1.2mA.

A/D Conversion Characteristics

(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, Topr = – 30 to 70°C)

Parameter	Symbol	Pins	Conditions	Min	Typ.	Max	Unit
Analog Input Voltage Range	V_{AIN}	CIN3 to CIN0		V_{SS}	–	V_{DD}	V
Conversion Error			V_{DD} = 5.0 V	–	–	± 1.5	LSB

A.C. Characteristics

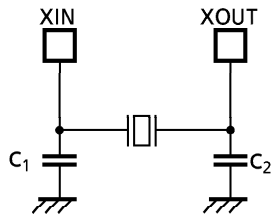
(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, Topr = – 30 to 70°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Machine Cycle Time	t_{cy}	In NORMAL mode	0.5	–	1.0	μs
		In IDLE mode				
High Level Clock Pulse Width	t_{WCH}	For external clock operation (XIN input), fc = 8MHz	50	–	–	ns
Low Level Clock Pulse Width	t_{WCL}					

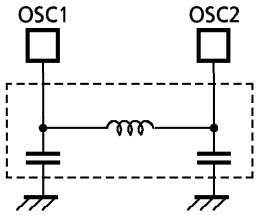
Recommended Oscillating Conditions

(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, Topr = – 30 to 70°C)

Parameter	Oscillator	Oscillation Frequency	Recommended Oscillator	Recommended Constant C_1	Recommended Constant C_2
High-frequency Oscillation	Ceramic Resonator	8 MHz	KYOCERA KBR8.0M	30pF	30pF
		4 MHz	KYOCERA KBR4.0MS		
			MURATA CSA4.00MG		
	Crystal Oscillator	8 MHz	TOYOCOM 210B 8.0000	20pF	20pF
		4 MHz	TOYOCOM 204B 4.0000		
OSD	LC Resonator	8 MHz	TOKO A285TNIS-11695	–	–
		7 MHz	TOKO TBEKSES-30375FBY		



(1) High-frequency Oscillation



(2) LC Resonator for OSD

Note : On our OSD circuit, the horizontal display start position is determined by counting the clock from LC oscillator. So, the unstable start of oscillation after the rising edge of Horizontal Sync. Signal will be cause the OSD distortion.
Generally, smaller C and larger L make clearer wave form at the beginning of oscillation.
We recommend that the value of LC oscillator should be equal and bigger than 33μH.

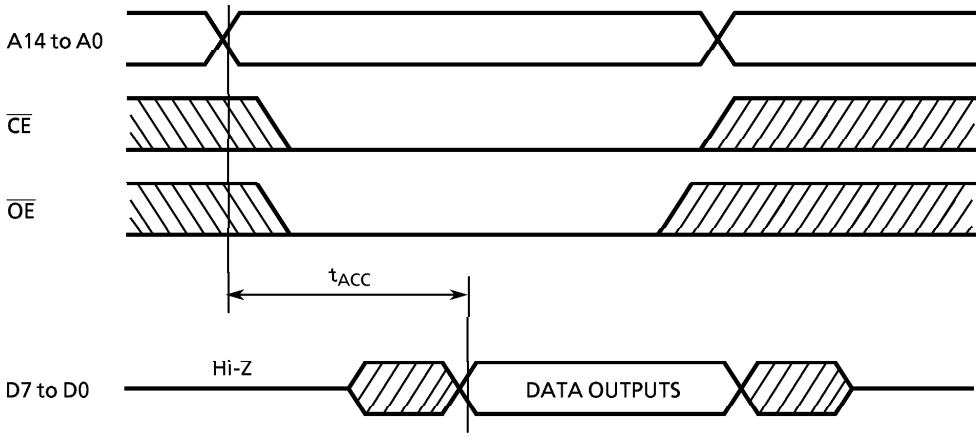
Note : To keep reliable operation, shield the device electrically with the metal plate on its package mold surface against the high electric field, for example, by CRT (Cathode Ray Tube).

D.C./A.C. Characteristics (PROM mode) (V_{SS} = 0 V)

(1) Read Operation (Ta = 25 ± 5°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input High Voltage	V_{IH4}		V_{CC} × 0.7	–	V_{CC}	V
Input Low Voltage	V_{IL4}		0	–	V_{CC} × 0.12	V
Power Supply Voltage	V_{CC}		4.75	5.00	5.25	V
Program Power Supply Voltage	V_{PP}		V_{CC} – 0.6	V_{CC}	V_{CC} + 0.6	
Address Access Time	t_{ACC}	V_{CC} = 5.0 ± 0.25 V	–	1.5 tcyc + 300	–	ns

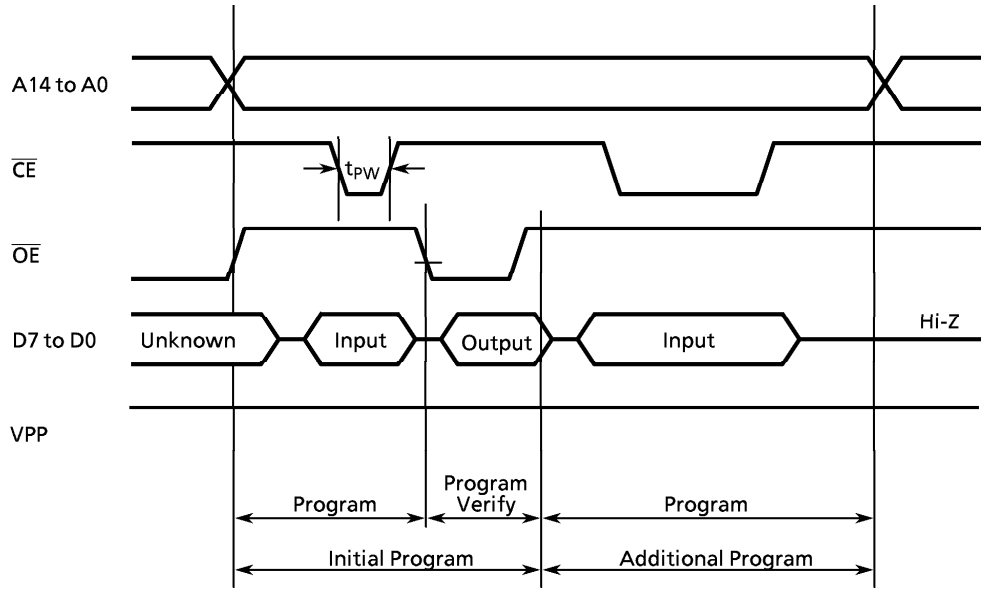
Note : tcyc = 500 ns at 8 MHz



Timing Waveforms of Read operation

(2) High-Speed Programming Operation (High speed write mode-Ⅰ) (Ta = 25 ± 5°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input High Voltage	V_{IH4}		V_{CC} × 0.7	–	V_{CC}	V
Input Low Voltage	V_{IL4}		0	–	V_{CC} × 0.12	V
Power Supply Voltage	V_{CC}		5.75	6.0	6.25	V
Program Power Supply Voltage	V_{PP}		12.0	12.5	13.0	V
Initial Program Pulse Width	t_{PW}	V_{CC} = 6.0 ± 0.25 V, V_{PP} = 12.5 ± 0.25 V	0.95	1.0	1.05	ms



Timing Waveforms of Programming Operation

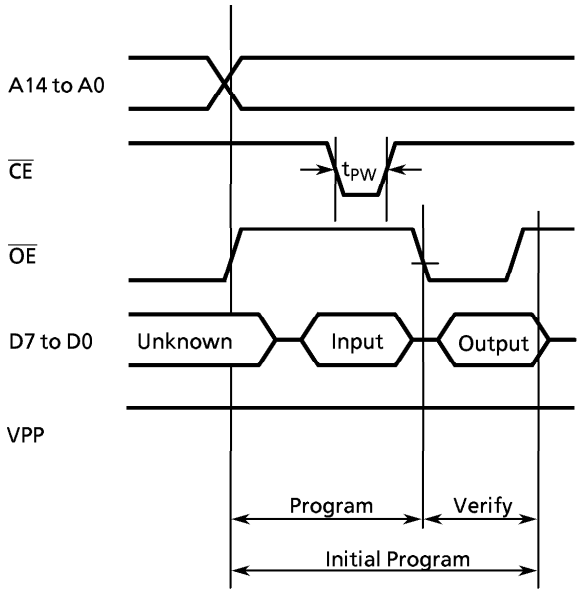
Note 1: When V_{cc} power supply is turned on or after, V_{pp} must be increased.
When V_{cc} power supply is turned off or before, V_{pp} must be increased.

Note 2: he device must not be set to the EPROM programmer or picked op from it under applying the program voltage (12.5 V ± 0.5 V = V) to the V_{pp} pin as the device is damaged.

Note 3: Be sure to execute the recommended programing mode with the recommended programing adaptor. If a mode or an adaptor except the above, the misoperation sometimes occurs.

(3) PROGRAM OPERATION (High speed write mode - II) (Topr = 25 ± 5°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input High Voltage	V_{IH4}		$V_{CC} \times 0.7$	–	V_{CC}	V
Input Low Voltage	V_{IL4}		0	–	$V_{CC} \times 0.12$	V
Supply Voltage	V_{CC}		6.00	6.25	6.50	V
Program Supply Voltage	V_{PP}		12.50	12.75	13.0	V
Initial Program Pulse Width	t_{PW}	V_{CC} = 6.25 V ± 0.25 V, V_{PP} = 12.75 V ± 0.25 V	0.095	0.1	0.105	ms



Note 1: When V_{cc} power supply is turned on or after, V_{pp} must be increased.
When V_{cc} power supply is turned off or before, V_{pp} must be decreased.

Note 2: The device must not be set to the EPROM programmer or picked up from it under applying the program voltage (12.75 V ± 0.5 V) to the V_{pp} pin as the device is damaged.

Note 3: Be sure to execute the recommended programing mode with the recommended programing adaptor. If a mode or an adaptor except the above, the misoperation sometimes occurs.