CMOS 8-Bit Microcontroller

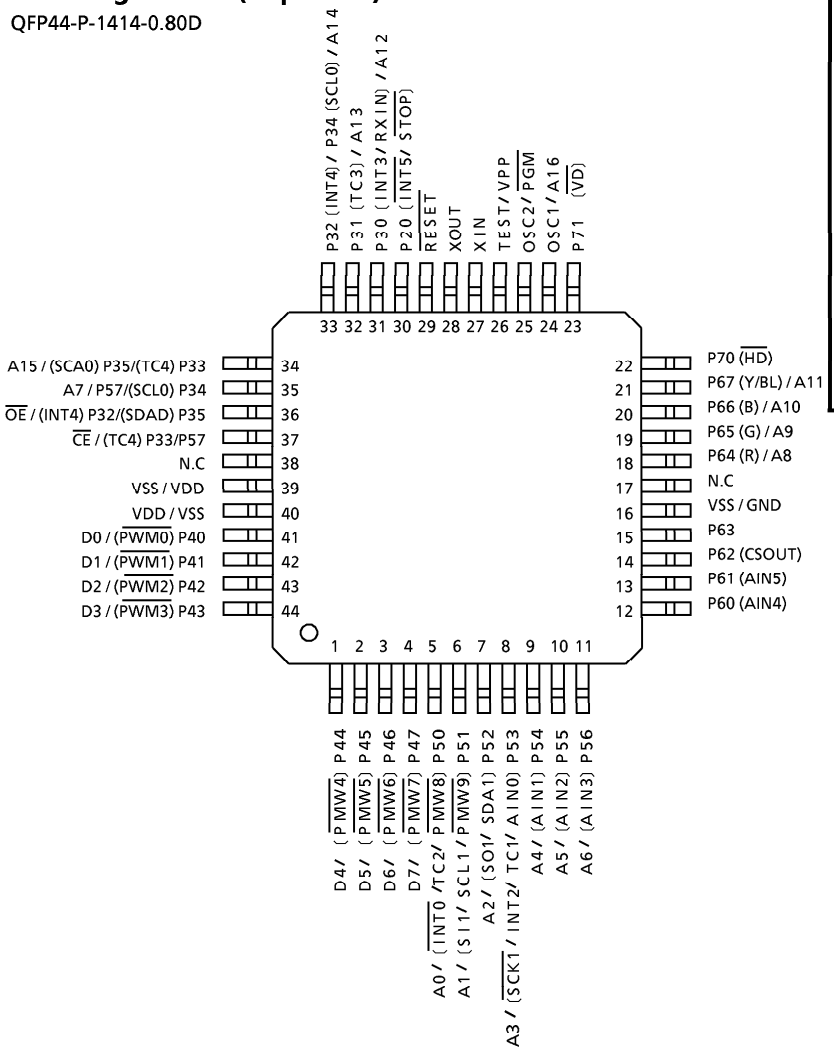
TMP87PS38N / F

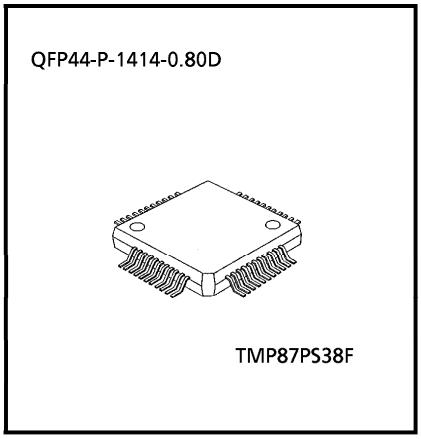
The 87PS38 is a One-Time PROM microcontroller with low-power 541K bits (a 60 Kbytes program memory and a 256 characters OSD font memory) electrically programmable read only memory for the 87CM38/P38/S38 system evaluation. The 87PS38 is pin compatible with the 87CM38/P38/S38. The operations possible with the 87CM38/P38/S38 can be performed by writing programs and OSD font data to PROM (The TMP87PS38's functions are different from the TMP87CH38/K38's in a few functions. Refer to section 1.3 about details.). The 87PS38 can write and verify in the same way as the TC571000 using an adaptor socket (BM11112 or BM11136) and an EPROM programmer.

Part No.	OTP	RAM	Package	Adaptor Socket
TMP87PS38N	60 Kbytes + 14 × 18 × 256 bits	2 Kbytes	SDIP42-P-600-1.78	BM11112
TMP87PS38F			QFP44-P-1414-0.80D	BM11136

Pin Assignments (Top View)

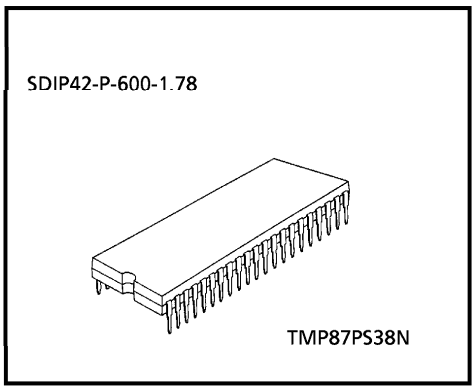
QFP44-P-1414-0.80D





Pin Assignments (Top View)

SDIP42-P-600-1.78



[GND]	VSS	1	42	VDD	[VCC]
[D0]	($\overline{PWM0}$) P40	2	41	P57 / P33 (TC4)	[$\overline{CE}$]
[D1]	($\overline{PWM1}$) P41	3	40	P35 (SDA0) / P32 (INT4)	[$\overline{OE}$]
[D2]	($\overline{PWM2}$) P42	4	39	P34 (SCL0) / P57	[A7]
[D3]	($\overline{PWM3}$) P43	5	38	P33 (TC4) / P35 (SDA0)	[A15]
[D4]	($\overline{PWM4}$) P44	6	37	P32 (INT4) / P34 (SCL0)	[A14]
[D5]	($\overline{PWM5}$) P45	7	36	P31 (TC3)	[A13]
[D6]	($\overline{PWM6}$) P46	8	35	P30 (INT3 / RXIN)	[A12]
[D7]	($\overline{PWM7}$) P47	9	34	P20 ($\overline{INT5}$ / $\overline{STOP}$)	
[A0]	($\overline{INT0}$ / TC2 / $\overline{PWM8}$) P50	10	33	$\overline{RESET}$	
[A1]	(SI1 / SCL1 / $\overline{PWM9}$) P51	11	32	XOUT	
[A2]	(SO1 / SDA1) P52	12	31	XIN	
[A3]	($\overline{SCK1}$ / INT2 / TC1 / AIN0) P53	13	30	TEST	[VPP]
[A4]	(AIN1) P54	14	29	OSC2	[$\overline{PGM}$]
[A5]	(AIN2) P55	15	28	OSC1	[A16]
[A6]	(AIN3) P56	16	27	P71 ($\overline{VD}$)	
	(AIN4) P60	17	26	P70 ($\overline{HD}$)	
	(AIN5) P61	18	25	P67 (Y / BL)	[A11]
	(CSOUT) P62	19	24	P66 (B)	[A10]
	P63	20	23	P65 (G)	[A9]
[GND]	VSS	21	22	P64 (R)	[A8]

Pin Function

The 87PS38 has two modes: MCU and PROM.

(1) MCU mode

In this mode, the 87PS38 is pin compatible with the 87CM38/P38/S38 (fix the TEST pin at low level).

(2) PROM mode

Pin Name (PROM mode)	Input/Output	Functions	Pin Name (MCU mode)
A16	Input	PROM address inputs	OSC1
A15 to A12			P33 to P30
A11 to A8			P67 to P64
A7 to A0			P34, P56 to P50
D7 to D0	I/O	PROM data input/outputs	P47 to P40
$\overline{CE}$	Input	Chip enable signal input (active low)	P57
$\overline{OE}$		Output enable signal input (active low)	P35
$\overline{PGM}$	Input	Program mode signal input (active low)	OSC2
VPP	Power supply	+ 12.75 V / 5 V (Program supply voltage)	TEST
VCC		+ 6.25 V / 5 V	VDD
GND		0 V	VSS
P61	I/O	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		

Operational Description

The following explains the 87PS38 hardware configuration and operation. The configuration and functions of the 87PS38 are the same as those of the 87CM38/P38/S38, except in that a one-time PROM is used instead of an on-chip mask ROM.

1. Operating Mode

The 87PS38 has two modes: MCU and PROM.

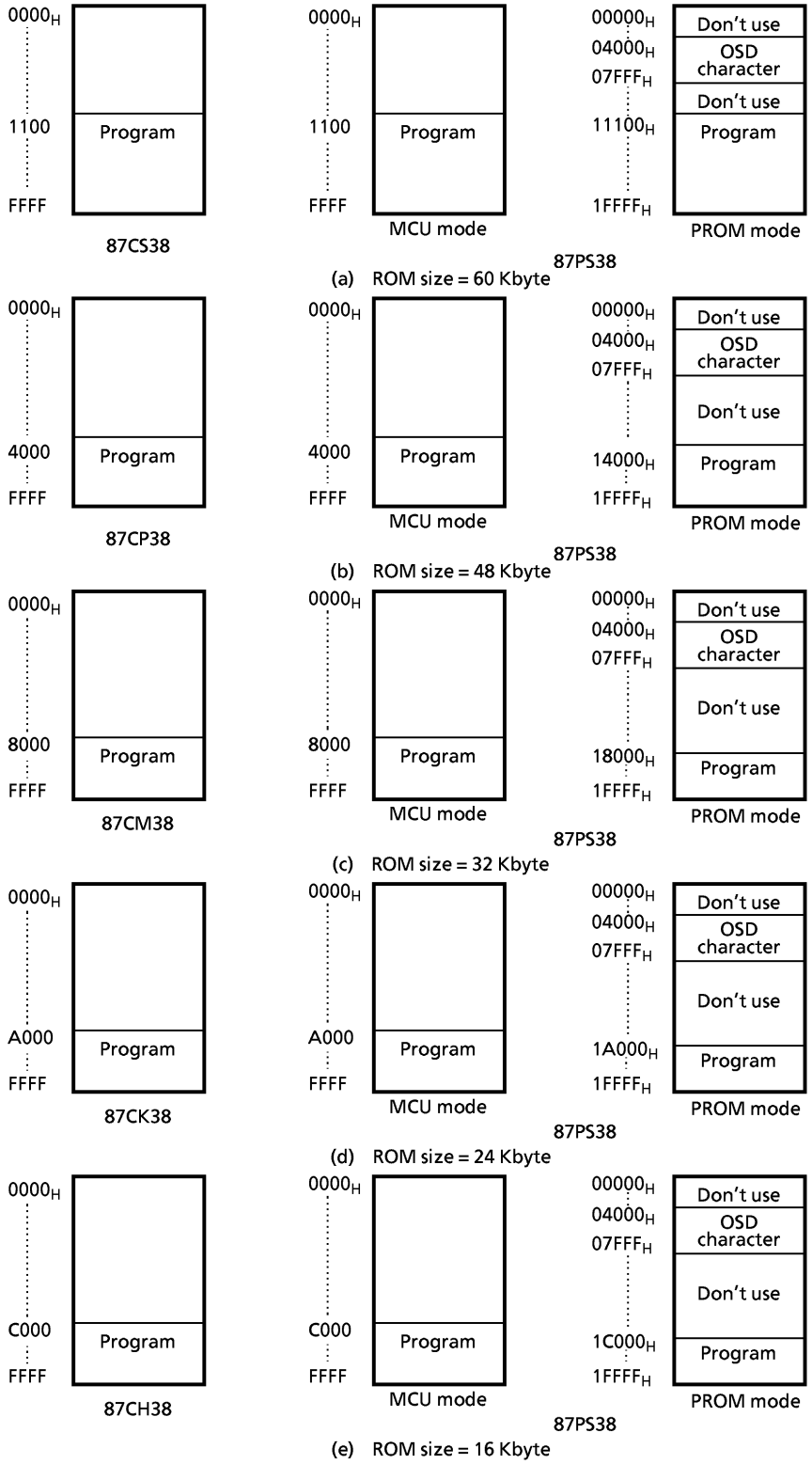
1.1 MCU Mode

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 87CM38/P38/S38. (The TMP87PS38's functions are different from the TMP87CH38/K38's in a few functions. Refer to section 1.3 about details.)

Note: 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 87PS38 has a 60 Kbytes (addresses 1100_H to $FFFF_H$ in the MCU mode, address 11100_H to $1FFFF_H$ in the PROM mode) of program memory and a $14 \times 18 \times 256$ bits (addresses 4000_H to $7FFF_H$ in the PROM mode) of OSD character font memory.



Note: Set data of unused area to "FFH".

Figure 1-1. Program memory area

Electrical Characteristics

Absolute maximum ratings (V_{SS} = 0 V)

Parameter	Symbol	Pins	Ratings	Unit
Supply Voltage	V_{DD}		– 0.3 to 6.5	V
Programable Voltage	V_{PP}	TEST / VPP Pin	– 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)	Σ I_{OUT1}	Ports P2, P3, P4, P5, P64 to P67, P7	120	mA
	Σ I_{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}		NORMAL mode	4.5	5.5	V
			IDLE mode			
			STOP mode	2.0		
Input High Voltage	V_{IH1}	Except hysteresis input		V_{DD} × 0.70	V_{DD}	V
	V_{IH2}	Hysteresis input		V_{DD} × 0.75		
Input Low Voltage	V_{IL1}	Except hysteresis input		0	V_{DD} × 0.30	V
	V_{IL2}	Hysteresis input			V_{DD} × 0.25	
Clock Frequency	fc	XIN, XOUT		4.0	8.0	MHz
	f_{OSC}	OSC1, OSC2	Normal frequency mode (FORS = 0, V_{DD} = 4.5 to 5.5 V)	4.0	$f_{OSC} \leqq$ fc × 1.2 $\leqq$ 8.0	
			Double frequency mode (FORS = 1, V_{DD} = 4.5 to 5.5 V)	2.0	$f_{OSC} \leqq$ fc × 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 ; Supply voltage range is specified in NORMAL1/2 mode and IDLE1/2 mode.
Note 3: Smaller value is alternatively specified as the maximum value.

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 / 0 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 ports	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}	Port 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 (Note3) V_{IN} = 5.3 V / 0.2 V	–	14	17	mA
Supply Current in IDLE mode				–	7	10	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_{IN3} ; The current through resistor is not included.

Note 3 : Supply Current I_{DD} ; The current (Typ. 0.5 mA) through ladder resistors of ADC is included in NORMAL mode and IDLE mode.

A/D Conversion Characteristics

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

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Analog Reference Voltage	V_{AREF}	supplied from V_{DD} pin.	–	V_{DD}	–	V
	V_{ASS}	supplied from V_{SS} pin.	–	0	–	
Analog Reference Voltage Range	$\triangle V_{AREF}$	= V_{DD} – V_{SS}	–	V_{DD}	–	
Analog Input Voltage	V_{AIN}		V_{SS}	–	V_{DD}	
Nonlinearity Error			–	–	± 1	LSB
Zero Point Error			–	–	± 2	
Full Scale Error			–	–	± 2	
Total Error			–	–	± 3	

Note: The total error means all error except quanting error.

A.C. characteristics

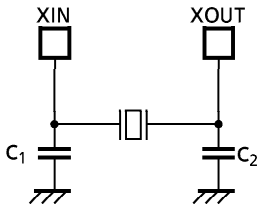
(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, Topr = – 30 to 70°C)

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 = 8 MHz	50	–	–	ns
Low Level Clock Pulse Width	t_{WCL}					

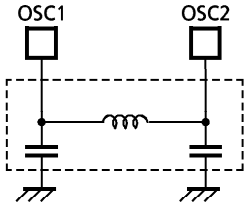
Recommended oscillating conditions

(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	30 pF	30 pF
		4 MHz	KYOCERA KBR4.0MS		
			MURATA CSA4.00MG		
	Crystal Oscillator	8 MHz	TOYOCOM 210B 8.0000	20 pF	20 pF
		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.

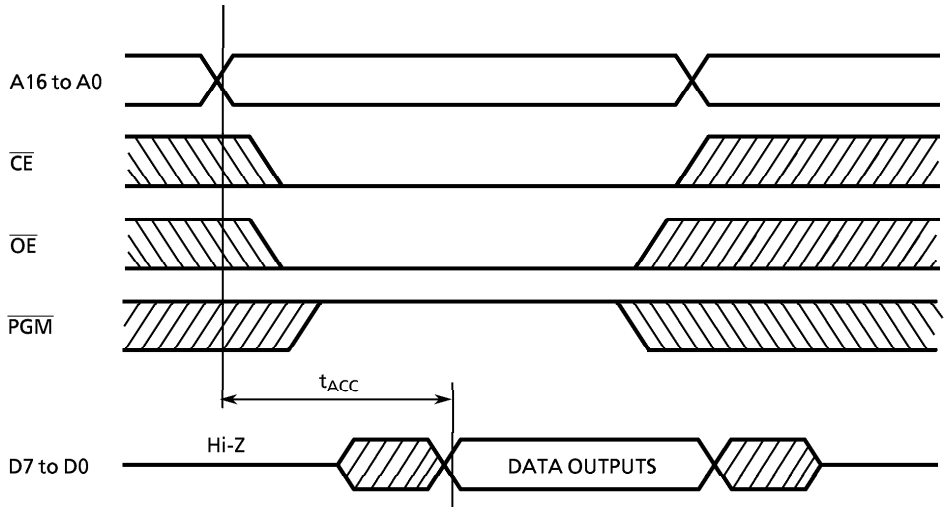
Note: To keep reliable operation, shield the device electrically with the metal plate on its package mold surface against the high electric field, for example, by CRT (Cathode Ray Tube) .

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

(1) Read operation

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
Power Supply Voltage	V_{CC}		4.75	5.0	5.25	V
Program Power Supply Voltage	V_{PP}					
Address Access Time	t_{ACC}	V_{CC} = 5.0 ± 0.25 V	–	1.5tcyc + 300	–	ns

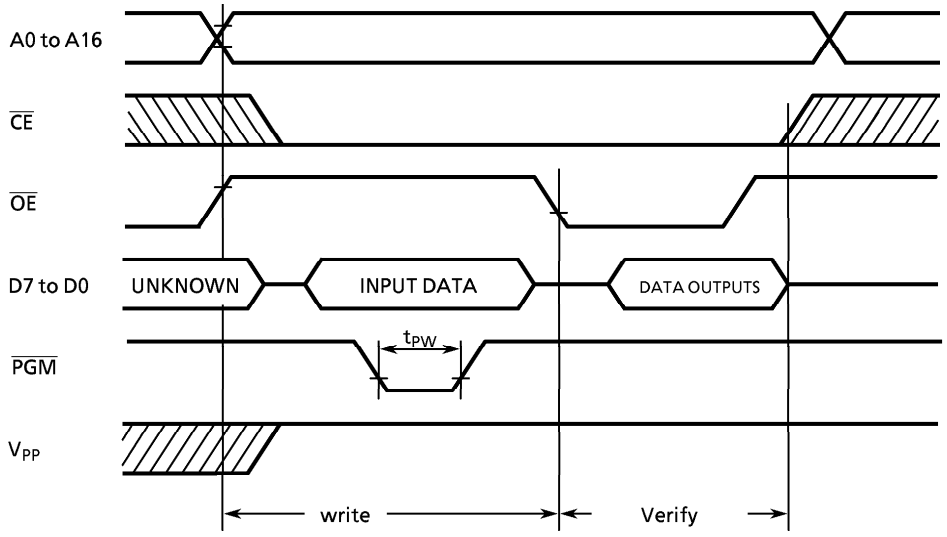
Note : tcyc = 500 ns at 8 MHz



(2) High-speed programming operation (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
Power Supply Voltage	V_{CC}		6.0	6.25	6.5	V
Program Power Supply Voltage	V_{PP}		12.5	12.75	13.0	V
Initial Program Pulse Width	t_{PW}	V_{CC} = 6.0 V	0.095	0.1	0.105	ms

High-Speed Programing Timing



Note1:	*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.*
Note2:	*The device must not be set to the EPROM programmer or picked op from it under applying the program voltage (12.75 V ± 0.25 V = V) to the V_{pp} pin as the device is damaged.*
Note3:	*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.*