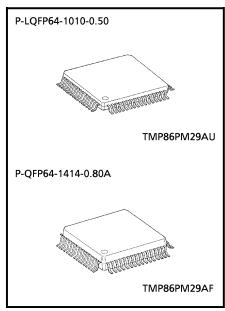
CMOS 8-Bit Microcontroller

TMP86PM29AU/AF

The TMP86PM29A is a OTP type MCU which includes 32-Kbyte One-time PROM. It is a pin compatible with a mask ROM product of the TMP86C829B/H29B/M29B. Writing the program to built-in PROM, the TMP86PM29A operates as the same way as the TMP86C829B/H29B/M29B. Also, this product has upper compatibility for TMP86CH21 and TMP86C420/820 and can be used as an one-time PROM for these products. Please refer to detail "Functional differences of product basis". Using the Adapter socket, you can write and verify the data for the TMP86PM29A with a general-purpose PROM programmer same as TC571000D/AD.

Part No.	ОТР	RAM	Package	Adapter Socket
TMP86PM29AU	22 K 0 hite	1 5 1/ 0 10 14 0	P-LQFP64-1010-0.50	BM11162
TMP86PM29AF	32 K × 8 bits	1.5 K × 8 bits	P-QFP64-1414-0.80A	BM11163



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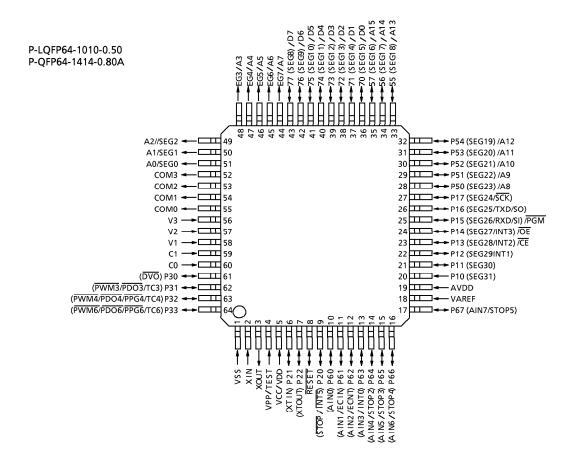
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Functional Differences on Product Basis

	TMP86C829B/H29B/M29B	TMP86CH21	TMP86C420/820				
Input/output ports		39 pins					
Package		P-LQFP64-1010-0.50 P-QFP64-1414-0.80A					
Instruction execution time		0.25 μs (at 16 MHz) 122 μs (at 32.768 kHz)					
Operating voltage	2.	t to 5.5 V at 4.2 MHz/32.768 kH 7 to 5.5 V at 8 MHz/32.768 kH 5 to 5.5 V at 16 MHz/32.768 kH	z				
18-bit timer counter		1 ch (ECIN input is both edge or single edge)					
8-bit timer counter	4 0	h	2 ch				
Time base timer		1 ch					
Watchdog timer		1 ch					
AD converter	10 bits × 8 ch	8 bits	× 8 ch				
UART	10	1 ch					
SIO	(No	(Note) 1 ch					
LCD driver		32 seg × 4 com					
Operating temperature		– 40 to 85°C					

Note: UART and SIO can not use function synchronously because each function pin is shared.

Pin Assignments (Top View)



Pin Functions

The TMP86PM29A has MCU mode and PROM mode.

(1) MCU mode

In the MCU mode, the TMP86PM29A is a pin compatible with the TMP86C420/820, TMP86CH21 and TMP86C829B/H29B/M29B (Make sure to fix the TEST pin to low level). However, TMP86C420/820 have not timer/counter 6 input/ouput and UART input/output.

(2) PROM mode

Pin Name	Input/Output	Functions	Pin Name (MCU mode)
A15 to A8	la acut	land of Manager and described and an area	P57 to P50
A7 to A0	Input	Input of Memory address for program	SEG7 to SEG0
D7 to D0	I/O	Input/Output of Memory data for program	P77 to P70
CE		Chip enable	P13
ŌĒ	Input	Output enable	P14
PGM		Program control	P15
VPP		+ 12.75 V/5 V (Power supply of program)	TEST
VCC, AVDD	Power supply	+ 6.25 V/5 V	VDD, AVDD
GND, VAREF		0 V	VSS, VAREF
P11, P21		PROM mode setting pin. Fix to high.	·
P10, P22, P20, P61	1/0		
RESET		PROM mode setting pin. Fix to low.	
P64, P65, P67	Output	Output pin for PROM operation test. Open or release	
P17, P16, P12			
P66, P63 to P62, P60			
P33 to P30	1/0	0.000	
COM3 to COM0	"0	Open	
V3 to V1			
C1, C0			
XIN	Input	Self oscillation with resonator (8 MHz).	
XOUT	Output	j ben oscinación with resonator (o Minz).	

Note: No pin is applied to A16 input.

Operation

This section describes the functions and basic operational blocks of TMP86PM29A.

The TMP86PM29A has PROM in place of the mask ROM which is included in the TMP86C420/820, TMP86CH21 and TMP86C829B/H29B/M29B. The configuration and function are the same as the mask ROM products. For TMP86C420/820 and TMP86CH21, however, some functions have been partially changed or deleted.

In addition, TMP86PM29A operates as the single clock mode when releasing reset.

When using the dual clock mode, oscillate a low-frequency clock by SET. XTEN command at the beginning of program.

1. Operating Mode

The TMP86PM29A has MCU mode and PROM mode.

1.1 MCU Mode

The MCU mode is set by fixing the TEST/VPP pin to the low level. (TEST/VPP pin cannot be used open because it has no built-in pull-down resister).

1.1.1 Program Memory

The TMP86PM29A has a 32 Kbyte built-in one time PROM (addresses 8000 to FFFF $_{\rm H}$ in the MCU mode, addresses 0000 to 7FFF $_{\rm H}$ in the PROM mode).

When using TMP86PM29A for evaluation of mask ROM products, the program is written in the program storing area shown in Figure 1-1.

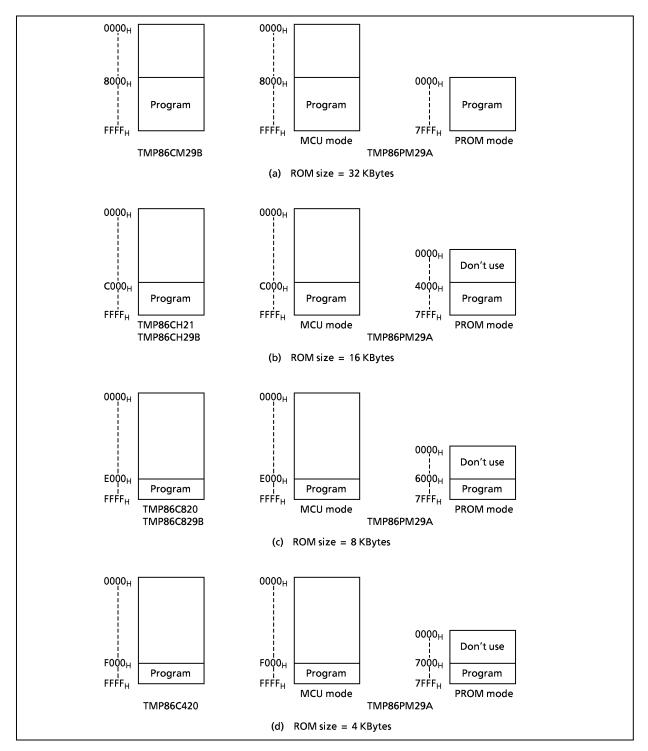


Figure 1-1. Program Memory Area

Note: The area that is not in use should be set data to FFH, or a general-purpose PROM programmer should be set only in the program memory area to access.

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Electrical Characteristics

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

Parameter	Symbol	Pins	Rating	Unit
Supply Voltage	V _{DD}		- 0.3 to 6.5	
Program Voltage	V _{PP}	TEST/V _{PP}	- 0.3 to 13.0] ,
Input Voltage	V _{IN}		- 0.3 to V _{DD} + 0.3] '
Output Voltage	V _{OUT1}		- 0.3 to V _{DD} + 0.3	
	I _{OUT1}	P3, P6 Port	- 1.8	
Output Current (Per 1 pin)	I _{OUT2}	P1, P2, P5, P6, P7 Port	3.2	
	I _{OUT3}	P3 Port	30	mA
Output Current (Total)	ΣI _{OUT2}	P1, P2, P5, P6, P7 Port	60	
Output Current (Total)	ΣI _{OUT3}	P3 Port	80	
Power Dissipation [T _{opr} = 85℃]	PD		350	mW
Soldering Temperature (time)	Tsld		260 (10 μ)	
Storage Temperature	Tstg		– 55 to 125	°c
Operating Temperature	Topr		- 40 to 85	

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 Condition

 $(V_{SS} = 0 \text{ V, Topr} = -40 \text{ to } 85^{\circ}\text{C})$

Parameter	Symbol	Pins	(Condition	Min	Max	Unit
				NORMAL1, 2 modes	4.5		
			fc = 16 MHz IDLE0, 1, 2 modes		4.5		
				NORMAL1, 2 modes	2.7		
			fc = 8 MHz	IDLE0, 1, 2 modes	2.7		
Supply Voltage	V _{DD}			NORMAL1, 2 modes		5.5	
			fc = 4.2 MHz	IDLE0, 1, 2 modes			
			1.00 7.00 1.11	SLOW1, 2 modes	1.8		
				SLEEP0, 1, 2 modes]		
				STOP mode			V
	V _{IH1}	Except Hysteresis input	V _{DD} ≧ 4.5 V		$V_{DD} \times 0.70$		
Input high Level	V _{IH2}	Hysteresis input			$V_{DD} \times 0.75$	V_{DD}	
	V _{IH3}		V	V _{DD} < 4.5 V			
	V_{IL1}	Except Hysteresis input] ,,	_{DD} ≧ 4.5 V		$V_{DD} \times 0.30$	
Input low Level	V_{IL2}	Hysteresis input	V	DD ≅ 4.3 V	0	$V_{DD} \times 0.25$	
	V _{IL3}		V	_{DD} < 4.5 V		$V_{DD} \times 0.10$	
			V_{DD}	= 1.8 to 5.5 V		4.2	
Clock Frequency fc	fc	XIN, XOUT	V_{DD}	= 2.7 to 5.5 V	1.0	8.0	MHz
Clock Frequency			V_{DD}	$V_{DD} = 4.5 \text{ to } 5.5 \text{ V}$		16.0	
	fs	XTIN, XTOUT			30.0	34.0	kHz

Note: 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.

DC Characteristics

 $(V_{SS} = 0 \text{ V, Topr} = -40 \text{ to } 85^{\circ}\text{C})$

Parameter	Symbol	Pins	Condition	Min	Тур.	Max	Unit
Hysteresis voltage	V _{HS}	Hysteresis input		-	0.9	-	V
	I _{IN1}	TEST					
Input current	I _{IN2}	Sink Open Drain, Tri-state	$V_{DD} = 5.5 \text{ V}, V_{IN} = 5.5 \text{ V}/0 \text{ V}$	_	_	± 2	μA
	I _{IN3}	RESET, STOP					
Input resistance	R _{IN2}	RESET Pull-Up		100	220	450	kΩ
Output leakage current	I _{LO}	Sink Open Drain, Tri-state	$V_{DD} = 5.5 \text{ V}, V_{OUT} = 5.5 \text{ V}/0 \text{ V}$	-	-	± 2	μA
Output high voltage	V _{OH2}	C-MOS, Tri-st Port	$V_{DD} = 4.5 \text{ V}, I_{OH} = -0.7 \text{ mA}$	4.1	_	_	
Output low voltage	V _{OL}	Except XOUT and P3 Port	V _{DD} = 4.5 V, I _{OL} = 1.6mA	-	_	0.4	V
Output low current	l _{OL}	High Current Port (P3 Port)	$V_{DD} = 4.5 \text{ V}, V_{OL} = 1.0 \text{ V}$	-	20	-	
Supply current in NORMAL 1, 2 modes			V _{DD} = 5.5 V V _{IN} = 5.3/0.2 V	-	7.5	9	mA
Supply current in IDLE 0, 1, 2 modes			fc = 16 MHz fs = 32.768 kHz	_	5.5	6.5	
Supply current in SLOW 1 mode]			_	18	42	
Supply current in SLEEP 1 mode	V _{DD}		$V_{DD} = 3.0 \text{ V}$ $V_{IN} = 2.8 \text{ V}/0.2 \text{ V}$ $fs = 32.768 \text{ kHz}$	-	16	25	
Supply current in SLEEP 0 mode			LCD driver is not enable.	-	12	20	μΑ
Supply current in STOP mode			$V_{DD} = 5.5 \text{ V}$ $V_{IN} = 5.3 \text{ V}/0.2 \text{ V}$	-	0.5	10	

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

Note 2: Input current (I_{IN1} , I_{IN2}); The current through pull-up or pull-down resistor is not included.

Note 3: IDD does not include IREF current.

Note 4: The supply currents of SLOW 2 and SLEEP 2 modes are equivalent to IDLE 0, 1, 2.

AD Conversion Characteristics

$(V_{SS} = 0.0 \text{ V}, 4.5 \text{ V} \le V_{DD} \le 5.5 \text{ V}, Topr = -40 \text{ to } 85^{\circ}\text{C})$

Parameter	Symbol	Condition	Min	Тур.	Max	Unit
Analog Reference Voltage	V _{AREF}		A _{VDD} - 1.0	-	A _{VDD}	
Power Supply Voltage of Analog Control Circuit	A _{VDD}			V_{DD}		$\Big]_{V}$
Analog Reference Voltage Range (Note 4)	$\triangle V_{AREF}$		3.5	-	_]
Analog Input Voltage	V _{AIN}		V _{SS}	-	V _{AREF}]
Power Supply Current of Analog Reference Voltage	I _{REF}	$V_{DD} = A_{VDD} = V_{AREF} = 5.5 \text{ V}$ $V_{SS} = 0.0 \text{ V}$	-	0.6	1.0	mA
Non linearity Error			_	_	± 2	
Zero Point Error		$V_{DD} = A_{VDD} = 5.0 \text{ V},$	_	-	± 2	
Full Scale Error		$V_{SS} = 0.0 \text{ V}$ $V_{AREF} = 5.0 \text{ V}$	_	-	± 2	LSB
Total Error		ANEI	_	_	± 2	1

$(V_{SS} = 0.0 \text{ V}, 2.7 \text{ V} \le V_{DD} < 4.5 \text{ V}, \text{Topr} = -40 \text{ to } 85^{\circ}\text{C})$

Parameter	Symbol	Condition	Min	Тур.	Max	Unit
Analog Reference Voltage	V _{AREF}		A _{VDD} - 1.0	-	A _{VDD}	
Power Supply Voltage of Analog Control Circuit	A _{VDD}			V_{DD}] ,
Analog Reference Voltage Range (Note 4)	$\triangle V_{AREF}$		2.5	-	_	1
Analog Input Voltage	V _{AIN}		V _{SS}	-	V _{AREF}	
Power Supply Current of Analog Reference Voltage	I _{REF}	$V_{DD} = A_{VDD} = V_{AREF} = 4.5 \text{ V}$ $V_{SS} = 0.0 \text{ V}$	_	0.5	0.8	mA
Non linearity Error			-	-	± 2	
Zero Point Error		$V_{DD} = A_{VDD} = 2.7 \text{ V},$	-	-	± 2	LSB
Full Scale Error		$V_{SS} = 0.0 \text{ V}$ $V_{AREF} = 2.7 \text{ V}$	-	-	± 2	1 138
Total Error		ANLI	_	-	± 2	

(V_{SS} = 0.0 V, 2.0 V \leqq V_{DD} <2.7 V, Topr = -40 to 85°C) Note 5 (V_{SS} = 0.0 V, 1.8 V \leqq V_{DD} <2.0 V, Topr = -10 to 85°C) Note 5

Parameter	Symbol	Condition	Min	Тур.	Max	Unit
Analog Reference Voltage	V _{AREF}		A _{VDD} - 0.9	-	A _{VDD}	
Power Supply Voltage of Analog Control Circuit	A _{VDD}			V_{DD}] ,
Analog Reference Voltage Range (Note 4)	$\triangle V_{AREF}$	$1.8 \text{ V} \le \text{V}_{DD} < 2.0 \text{ V}$	1.8	-	_] ' [
Arialog Reference Voltage Range (Note 4)	AREF	$2.0 \text{ V} \le \text{V}_{DD} < 2.7 \text{ V}$	2.0	-	-	
Analog Input Voltage	V _{AIN}		V _{SS}	-	V _{AREF}	
Power Supply Current of Analog Reference Voltage	I _{REF}	$V_{DD} = A_{VDD} = V_{AREF} = 2.7 \text{ V}$ $V_{SS} = 0.0 \text{ V}$	-	0.3	0.5	mA
Non linearity Error			_	_	± 4	
Zero Point Error		$V_{DD} = A_{VDD} = 1.8 \text{ V},$	_	-	± 4	LSB
Full Scale Error		$V_{SS} = 0.0 \text{ V}$ $V_{ARFF} = 1.8 \text{ V}$	_	-	± 4	LJB
Total Error		ANE	_	-	± 4	

- Note 1: The total error includes all errors except a quantization error, and is defined as a maximum deviation from the ideal conversion line.
- Note 2: Conversion time is different in recommended value by power supply voltage.

 About conversion time, please refer to "2.10.2 Register Framing".

 Note 3: Please use input voltage to AIN input Pin in limit of V_{AREF} V_{SS}.

- When voltage of range outside is input, conversion value becomes unsettled and gives affect to other channel conversion value.
- Note 4: Analog Reference Voltage Range: $\triangle V_{AREF} = V_{AREF} V_{SS}$ Note 5: When AD is used with $V_{DD} < 2.7 V$, the guaranteed temperature range varies with the operating voltage. Note 6: The A_{VDD} pin should be fixed on the V_{DD} level even though AD convertor is not used.

AC Characteristics

 $(V_{SS} = 0 \text{ V}, V_{DD} = 4.5 \text{ to } 5.5 \text{ V}, Topr = -40 \text{ to } 85^{\circ}\text{C})$

Parameter	Symbol	Condition	Min	Тур.	Max	Unit
		NORMAL 1, 2 modes				
Machine Cycle Time	tcy	IDLE 1, 2 modes	0.25	_	4	
		SLOW 1, 2 modes	117.6	5 –	133.3	μS
		SLEEP 1, 2 modes	117.6			
High Level Clock Pulse Width	twcH	For external clock operation (XIN input)				ns
Low Level Clock Pulse Width	twcL	fc = 16 MHz	_	31.25	-	113
High Level Clock Pulse Width	twcH	For external clock operation (XTIN input)		45.00		
Low Level Clock Pulse Width	twcL	fc = 32.768 kHz	-	15.26	-	μS

$(V_{SS} = 0 \text{ V}, V_{DD} = 2.7 \text{ to } 4.5 \text{ V}, Topr = -40 \text{ to } 85^{\circ}\text{C})$

Parameter	Symbol	Condition	Min	Тур.	Max	Unit
		NORMAL 1, 2 modes			_	
Machine Cycle Time	tcy	IDLE 1, 2 modes	0.5	_	4	
		SLOW 1, 2 modes	117.6		422.2	μS
		SLEEP 1, 2 modes	117.6 –		133.3	
High Level Clock Pulse Width	twcH	For external clock operation (XIN input)				ns
Low Level Clock Pulse Width	twcL	fc = 8 MHz	_	62.5	-	113
High Level Clock Pulse Width	twcH	For external clock operation (XTIN input)		45.26		
Low Level Clock Pulse Width	twcL	fc = 32.768 kHz	ı	15.26	-	μS

$(V_{SS} = 0 \text{ V}, V_{DD} = 1.8 \text{ to } 2.7 \text{ V}, Topr = -40 \text{ to } 85^{\circ}\text{C})$

Parameter	Symbol	Condition	Min	Тур.	Max	Unit
		NORMAL 1, 2 modes			_	
Machine Cycle Time	tcy	IDLE 1, 2 modes	0.95	-	4	
		SLOW 1, 2 modes	117.6	-	133.3	μS
		SLEEP 1, 2 modes	117.6			
High Level Clock Pulse Width	twcH	For external clock operation (XIN input)				ns
Low Level Clock Pulse Width	twcL	fc = 4.2 MHz	_	119.05	_	115
High Level Clock Pulse Width	twcH	For external clock operation (XTIN input)		45.26		
Low Level Clock Pulse Width	twcL	fc = 32.768 kHz	I	15.26	ı	μ\$

Timer Counter 1 input (ECIN) Characteristics $(V_{SS} = 0 \text{ V}, \text{Topr} = -40 \text{ to } 85^{\circ}\text{C})$

Parameter	Symbol	Condition			Тур.	Max	Unit
TC1 input (ECIN input)		Frequency measurement mode V _{DD} = 4.5 to 5.5 V	Single edge count	-	-	16	
			Both edge count	-	-		MHz
	+	Frequency measurement mode $V_{DD} = 2.7 \text{ to } 4.5 \text{ V}$	Single edge count	-	-	- 8	
	t _{TC1}		Both edge count	-	-		
		Frequency measurement mode V _{DD} = 1.8 to 2.7 V	Single edge count	-	-	4.2	
			Both edge count	_	-		

Recommended Oscillating Conditions - 1

$$(V_{SS} = 0 \text{ V}, V_{DD} = 4.5 \text{ to } 5.5 \text{ V}, \text{ Topr} = -40 \text{ to } 85^{\circ}\text{C})$$

PARAMETER	0.331.4	Oscillation	Recommended Oscillator		Recommended Constant		
	Oscillator	Frequency			C ₁	C ₂	
High-frequency Oscillation		16 MHz	MURATA	CSA16.00MXZ040	10 pF	10 pF	
	Ceramic Resonator	0.0411-	MURATA	CSA8.00MTZ	30 pF	30 pF	
		8 MHz		CST8.00MTW	30 pF (built-in)	30 pF (built-in)	
		4.19 MHz	MURATA	CSA4.19MG	30 pF	30 pF	
		4. 19 IVID2		CST4.19MGW	30 pF (built-in)	30 pF (built-in)	
Low-frequency	Crystal Oscillator	32.768 kHz	SII	VT-200	6 pF	6 pF	
Oscillation	Crystal Oscillator	32.700 KHZ	311	V 1-200	o pr	брг	

Recommended Oscillating Conditions - 2

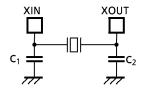
$$(V_{SS} = 0 \text{ V}, V_{DD} = 2.7 \text{ to } 5.5 \text{ V}, \text{ Topr} = -40 \text{ to } 85^{\circ}\text{C})$$

PARAMETER	Oscillator	Oscillation	Recommended Oscillator		Recommended Constant		
PARAIVIETER	Oscillator	Frequency			C ₁	C ₂	
High-frequency Oscillation	Ceramic Resonator	8 MHz	MURATA	CSA8.00MTZ	30 pF	30 pF	
				CST8.00MTW	30 pF (built-in)	30 pF (built-in)	
		4 40 0411-	MURATA	CSA4.19MG	30 pF	30 pF	
		4.19 MHz		CST4.19MGW	30 pF (built-in)	30 pF (built-in)	

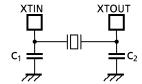
Recommended Oscillating Conditions - 3

$$(V_{SS} = 0 \text{ V}, V_{DD} = 1.8 \text{ to } 5.5 \text{ V}, \text{ Topr} = -40 \text{ to } 85^{\circ}\text{C})$$

PARAMETER	O Water	Oscillation	Recommended Oscillator		Recommended Constant		
PARAIVIETER	Oscillator	Frequency			C ₁	C ₂	
High-frequency	Coromic Bosonator	4.40.8411-	MURATA	CSA4.19MG	30 pF	30 pF	
Oscillation	Ceramic Resonator	4.19 MHz		CST4.19MGW	30 pF (built-in)	30 pF (built-in)	



(1) High-frequency Oscillation



(2) Low-frequency Oscillation

Note 1: An electrical shield by metal shield plate on the surface of IC package is recommended in order to protect the device from the high electric field stress applied from CRT (Cathodic Ray Tube) for continuous reliable operation.

Note 2: The product numbers and specifications of the resonators by Murata Manufacturing Co., Ltd. are subject to change. For up-to-date information, please refer to the following URL: http://www.murata.co.jp/search/index.html

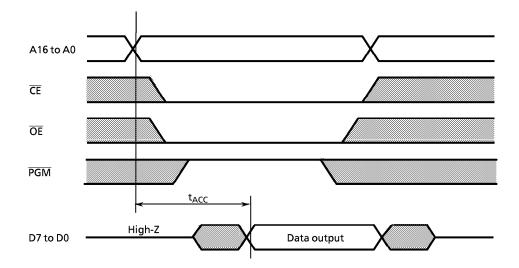
DC Characteristics, AC Characteristics (PROM Mode)

 $(V_{SS} = 0 \text{ V, Topr} = -40 \text{ to } 85^{\circ}\text{C})$

(1) Read operation in PROM mode

Parameter	Symbol	Conditions	Min	Тур.	Max	Unit
High level input voltage (TTL)	V _{IH4}		2.2	-	V _{CC}	
Low leve input voltage (TTL)	V _{IL4}		0	-	0.8] _v
Power supply	V _{CC}		4.75	5.0	5.25	
Power supply of program	V_{PP}		4.73	3.0	3.23	
Address access time	t _{ACC}	$V_{CC} = 5.0 \pm 0.25 \text{ V}$	_	1.5tcyc + 300	_	ns

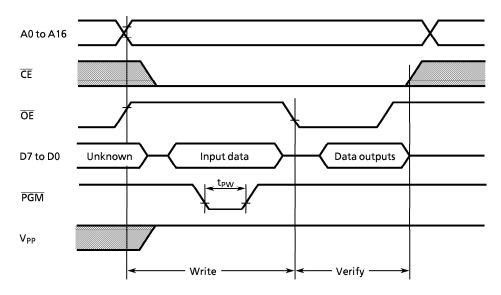
Note: tcyc = 500 ns at 8 MHz



(2) Program operation (High-speed) (Topr = $25 \pm 5^{\circ}$ C)

Parameter	Symbol	Conditions	Min	Тур.	Max	Unit
High level input voltage (TTL)	V _{IH4}		2.2	-	V _{CC}	
Low leve input voltage (TTL)	V _{IL4}		0	_	0.8	
Power supply	V _{CC}		6.0	6.25	6.5	\ \
Power supply of program	V _{PP}		12.5	12.75	13.0	
Pulse width of initializing program	t _{PW}	V _{CC} = 6.0 V	0.095	0.1	0.105	ms

High-speed program writing



- Note 1: The power supply of V_{PP} (12.75 V) must be set power-on at the same time or the later time for a power supply of V_{CC} and must be clear power-on at the same time or early time for a power supply of V_{CC} .
- Note2: The pulling up/down device on the condition of $V_{PP} = 12.75 \text{ V } \pm 0.25 \text{ V}$ causes a damage for the device. Do not pull up/down at programming.
- Note3: Use the recommended adapter (see 1.2.2 (1)) and mode (see 1.2.2 (3) i).

 Using other than the above condition may cause the trouble of the writting.