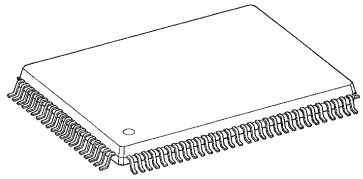
CMOS 8-Bit Microcontroller

TMP86PS64F

The TMP86PS64F is a OTP type MCU which includes 60 Kbytes One-time PROM. It is a pin compatible with a mask ROM product of the TMP86CS64F. Writing the program to built-in PROM, the TMP86PS64F operates as the same way as the TMP86CS64F. Using the Adapter socket, you can write and verify the data for the TMP86PS64F with a general-purpose PROM programmer same as TC571000D/AD.

Product No.	ROM	RAM	Package	Adapter Socket
TMP86PS64F	60 K × 8 bits	2 K × 8 bits	P-QFP100-1420-0.65A	BM11190

P-QFP100-1420-0.65A

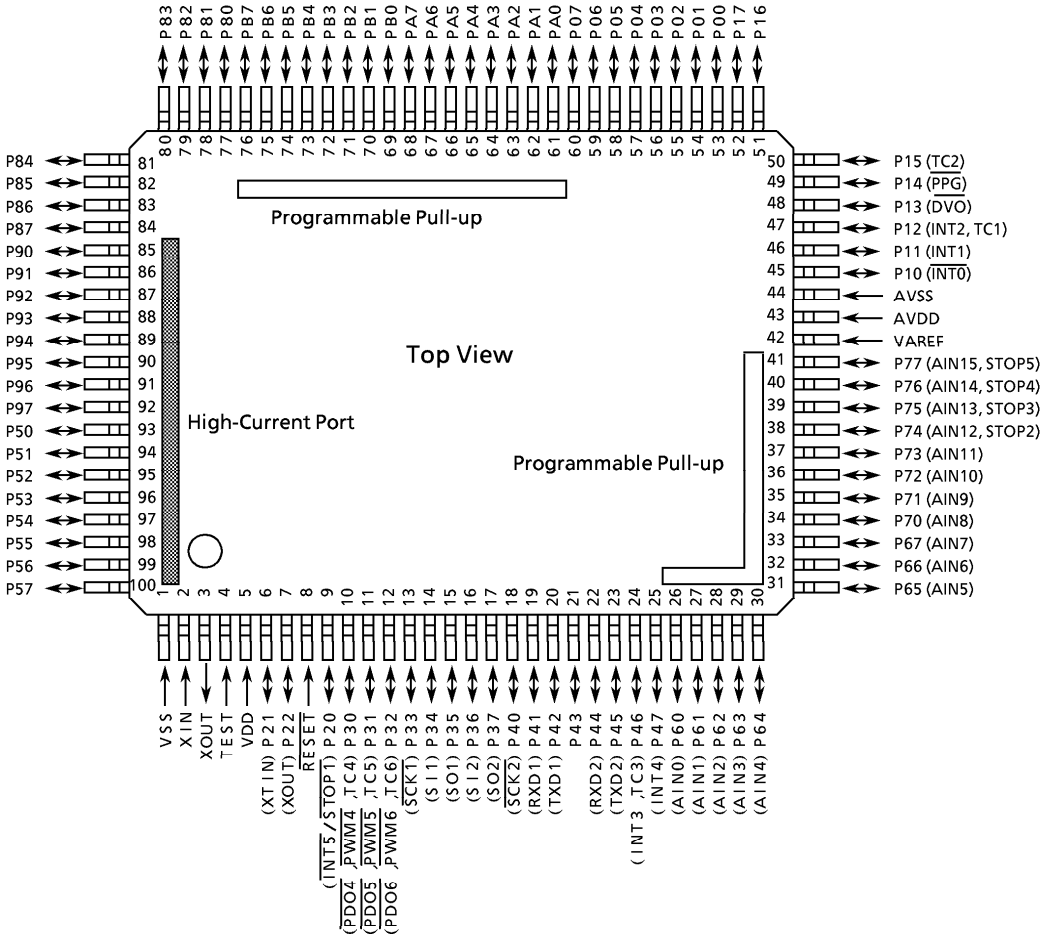


TMP86PS64F

000707EBP1

Pin Assignments (Top View)

P-QFP100-1420-0.65A



Pin Function

The TMP86PS64 has MCU mode and PROM mode.

(1) MCU mode

In the MCU mode, the TMP86PS64F is a pin compatible with the TMP86CS64F (Mask sure to fix the TEST pin to "L" level).

(2) PROM mode

Pin Name	Input/Output	Functions	Pin Name (MCU mode)
A16 to A15	Input	Input of Memory address for program	P17 to P16
A14 to A7			P77 to P70
A6 to A0			P67 to P61
D7 to D0	I/O	Input/Output of Memory data for program	P57 to P50
$\overline{CE}$	Input	Chip enable	P13
$\overline{OE}$		Output enable	P14
$\overline{PGM}$		Program control	P15
VPP	Power supply	+ 12.75V/5V (Power supply of program)	TEST
VCC		+ 6.25V/5V	VDD
GND		0V	VSS
P11, P21, AVDD	I/O	PROM mode setting pin. Fix to "H".	
P00, P10, P20, P22, AVSS, VAREF		PROM mode setting pin. Fix to "L".	
$\overline{RESET}$			
P07 to P01	I/O	Open	
P37 to P30			
P47 to P40			
P87 to P80			
P97 to P90			
PA7 to PA0			
PB7 to PB0			
XIN	Input	Self oscillation with resonator (16 MHz).	
XOUT	Output		

Operation

This section describes the functions and basic operational blocks of TMP86PS64F.
The TMP86PS64F has PROM in place of the mask ROM which is included in the TMP86CS64F. The configuration and function are same as the TMP86CS64F. For TMP86CS64F, however, some functions have been partially changed or deleted. For the function of TMP86PS64F in details, see the section of TMP86CS64F
In addition, TMP86PS64F 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 TMP86PS64F has MCU mode and PROM mode.

1.1 MCU Mode

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

1.1.1 Program memory

The TMP86PS64F has a 60 Kbyte built-in one time PROM (addresses 1000 to FFFFH in the MCU mode, addresses 0000 to EFFFH in the PROM mode).
When using TMP86PS64F for evaluation of TMP86CS64F, the program is written in the program storing area shown in Figure 1-1.

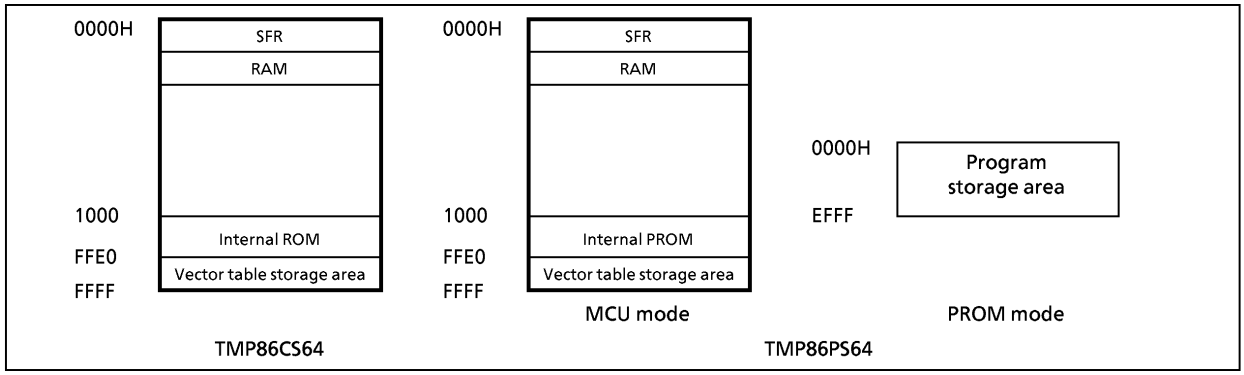


Figure 1-1. Program Memory Area

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.

1.1.2 Data Memory

TMP86PS64 has a built-in 2-Kbyte data memory (static RAM).

1.1.3 Input/Output Circuity

(1) Control pins

The control pins of the TMP86PS64 are the same as those the TMP86CS64 except that the TEST pin does not have a built-in pull-down resistor.

(2) I/O ports

The I/O circuities of TMP86PS64 I/O ports are the same as those of TMP86CS64.

Electrical Characteristics

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

Parameter	Symbol	Pins	Ratings	Unit
Supply Voltage	V_{DD}		– 0.3 to 6.5	V
Programming Voltage	V_{PP}		– 0.3 to 13	
Input Voltage	V_{IN}		– 0.3 to V_{DD} + 0.3	
Output Voltage	V_{OUT}		– 0.3 to V_{DD} + 0.3	
Output Current (Per 1 pin)	I_{OUTH}	Except Open-drain	– 3.2	mA
	I_{OUT1}	Except Port P5, P9	3.2	
	I_{OUT2}	Port P5	30	
	I_{OUT3}	Port P9		
Output Current (Total)	ΣI_{OUT1}	Except Port P5, P9	60	
	ΣI_{OUT2}	Port P5		
	ΣI_{OUT3}	Port P9		
Power Dissipation [T_{opr} = 85°C]	PD		250	mW
Soldering Temperature (time)	Tsld		260 (10 s)	°C
Storage Temperature	Tstg		– 55 to 125	
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 V, Topr = – 40 to 85°C)

Parameter	Symbol	Pins	Condition		Min	Max	Unit
Supply Voltage	V_{DD}		fc = 1 to 16 MHz	Each operation modes	4.5	5.5	V
			fc = 1 to 8 MHz	Each operation modes	2.7	5.5	
			fs = 32.768 kHz	Each operation modes	2.7	5.5	
			STOP mode		2.0	5.5	
Input high Level	V_{IH1}	Except hysteresis input	$V_{DD} \geqq$ 4.5 V		V_{DD} × 0.70	V_{DD}	
	V_{IH2}	Hysteresis input			V_{DD} × 0.75		
	V_{IH3}		V_{DD} < 4.5 V		V_{DD} × 0.90		
Input low Level	V_{IL1}	Except hysteresis input	$V_{DD} \geqq$ 4.5 V		0	V_{DD} × 0.30	
	V_{IL2}	Hysteresis input				V_{DD} × 0.25	
	V_{IL3}		V_{DD} < 4.5 V			V_{DD} × 0.10	
Clock Frequency	fc	XIN, XOUT	V_{DD} = 4.5 to 5.5 V		1.0	16.0	MHz
			V_{DD} = 2.7 to 5.5 V			8.0	
	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 V, Topr = – 40 to 85°C)

Parameter	Symbol	Pins	Condition	Min	Typ.	Max	Unit
Hysteresis Voltage	V_{HS}	Hysteresis input		–	0.9	–	V
Input Current	I_{IN1}	TEST	V_{DD} = 5.5 V, V_{IN} = 5.5 V/0 V	–	–	± 2	μA
	I_{IN2}	Sink Open Drain, Tri-state port					
	I_{IN3}	$\overline{STOP}$, $\overline{RESET}$					
Input Resistance	R_{IN1}	$\overline{RESET}$		100	220	450	kΩ
	R_{IN2}	Programmable pull up (P6, P7, PA, PB)	V_{DD} = 5.5 V	40	80	200	
OSC. Feedback resistance	Rfx	XIN-XOUT		–	1.2	–	MΩ
	Rfxt	XTIN-XTOUT		–	6	–	
Output Leakage Current	I_{LO1}	Sink Open Drain port	V_{DD} = 5.5 V, V_{OUT} = 5.5 V	–	–	2	μA
	I_{LO2}	Tri-state port	V_{DD} = 5.5 V, V_{OUT} = 5.5 V/0 V	–	–	± 2	
"H" output Voltage	V_{OH}	Tri-state port	V_{DD} = 4.5 V, I_{OH} = – 0.7 mA	4.1	–	–	V
"L" output Voltage	V_{OL3}	Except XOUT, P5, P9	V_{DD} = 4.5 V, I_{OL} = 1.6 mA	–	–	0.4	
"L" output Current	I_{OL1}	Except XOUT, P5, P9	V_{DD} = 4.5 V, V_{OL} = 0.4 V	–	1.6	–	mA
	I_{OL3}	High current port (P5, P9)	V_{DD} = 4.5 V, V_{OL} = 1.0 V	–	20	–	
Supply Current in Normal 1, 2 mode	I_{DD}		V_{DD} = 5.5 V V_{IN} = 5.3 V/0.2 V fc = 16 MHz fs = 32.768 kHz	–	9	10	
Supply Current in IDLE 1, 2 mode				–	5	6	
Supply Current in SLOW 1 mode			V_{DD} = 3.0 V V_{IN} = 2.8 V/0.2 V fs = 32.768 kHz	–	20	30	μA
Supply Current in SLEEP 0, 1 mode				–	10	20	
Supply Current in STOP mode			V_{DD} = 5.5 V V_{IN} = 5.3 V/0.2 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_{IN3}); The current through resistor is not included, when the input resistor (pull-up or pull-down) is contained.

Note 3: I_{DD} ; Except for I_{REF}.

AD Conversion Characteristics (V_{SS} = 0 V, 4.5 V ≦ V_{DD} ≦ 5.5 V, Topr = – 40 to 85°C)

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Analog Reference Voltage	V_{AREF}		A_{VDD} – 1.0	–	A_{VDD}	V
Power Supply Voltage of Analog Control Circuit	A_{VDD}		V_{DD}			
	A_{VSS}		V_{SS}			
Analog Reference of Voltage Range (Note 4)	$\triangle V_{AREF}$		3.5	–	V_{DD}	
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 V $V_{SS} = A_{VSS}$ = 0.0 V	–	0.6	1.0	mA
Non linearity Error		$V_{DD} = A_{VDD}$ = 5.0 V $V_{SS} = A_{VSS}$ = 0.0 V V_{AREF} = 5.0 V	–	–	± 2	LSB
Zero Point Error			–	–	± 2	
Full Scale Error			–	–	± 2	
Total Error			–	–	± 4	

(V_{SS} = 0 V, 2.7 V ≦ V_{DD} < 4.5 V, Topr = – 40 to 85°C)

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Analog Reference Voltage	V_{AREF}		A_{VDD} – 1.0	–	A_{VDD}	V
Power Supply Voltage of Analog Control Circuit	A_{VDD}		V_{DD}			
	A_{VSS}		V_{SS}			
Analog Reference of Voltage Range (Note 4)	$\triangle V_{AREF}$		2.5	–	V_{DD}	
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 V $V_{SS} = A_{VSS}$ = 0.0 V	–	0.5	0.8	mA
Non linearity Error		$V_{DD} = A_{VDD}$ = 2.7 V $V_{SS} = A_{VSS}$ = 0.0 V V_{AREF} = 2.7 V	–	–	± 2	LSB
Zero Point Error			–	–	± 2	
Full Scale Error			–	–	± 2	
Total Error			–	–	± 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 "2.14.2 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: $\triangle V_{AREF} = V_{AREF} - A_{VSS}$

AC Characteristics (V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, Topr = – 40 to 85°C)

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Machine Cycle Time	tcy	NORMAL 1, 2 mode	0.25	–	4	μs
		IDLE 0, 1, 2 mode				
		SLOW 1, 2 mode	117.6	–	133.3	
		SLEEP 0, 1, 2 mode				
High Level Clock Pulse Width	t_{WCH}	For external clock operation (XIN input) fc = 16 MHz	–	31.25	–	ns
Low Level Clock Pulse Width	t_{WCL}					
High Level Clock Pulse Width	t_{WSH}	For external clock operation (XTIN input) fs = 32.768 kHz	–	15.26	–	μs
Low Level Clock Pulse Width	t_{WSL}					

(V_{SS} = 0 V, V_{DD} = 2.7 to 4.5 V, Topr = – 40 to 85°C)

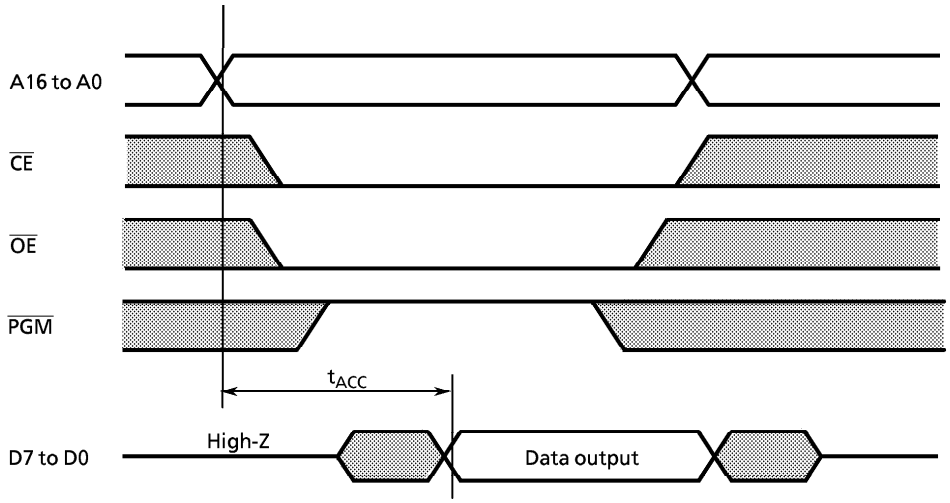
Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Machine Cycle Time	tcy	NORMAL 1, 2 mode	0.5	–	4	μs
		IDLE 0, 1, 2 mode				
		SLOW 1, 2 mode	117.6	–	133.3	
		SLEEP 0, 1, 2 mode				
High Level Clock Pulse Width	t_{WCH}	For external clock operation (XIN input) fc = 8 MHz	–	62.5	–	ns
Low Level Clock Pulse Width	t_{WCL}					
High Level Clock Pulse Width	t_{WSH}	For external clock operation (XTIN input) fs = 32.768 kHz	–	15.26	–	μs
Low Level Clock Pulse Width	t_{WSL}					

DC Characteristics, AC Characteristics (PROM Mode) (V_{SS} = 0 V, Topr = 25 ± 5°C)

(1) Read operation in PROM mode

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
High level input voltage (TTL)	V_{IH4}		2.2	–	V_{CC}	V
Low leve input voltage (TTL)	V_{IL4}		0	–	0.8	
Power supply	V_{CC}		4.75	5.0	5.25	
Power supply of program	V_{PP}					
Address access time	t_{ACC}	V_{CC} = 5.0 ± 0.25 V	–	1.5tcyc + 300	–	ns

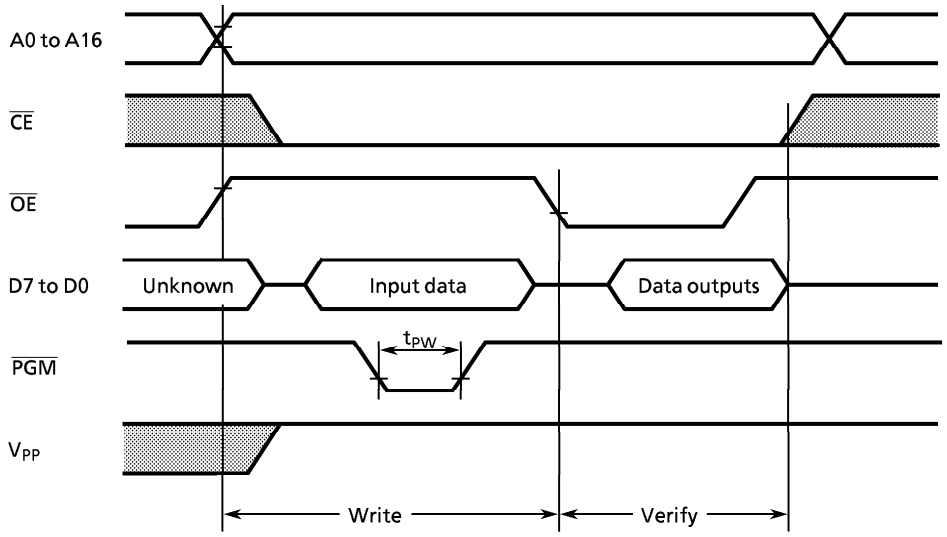
Note: tcyc = 250 ns at 16 MHz



(2) Program operation (High-speed) (Topr = 25 ± 5°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
High level input voltage (TTL)	V_{IH4}		2.2	–	V_{CC}	V
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



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}.

Note 2: The pulling up/down device on the condition of V_{PP} = 12.75 V ± 0.25 V causes a damage for the device. Do not pull up/down at programming.

Note 3: 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.

Recommended Oscillating Conditions-1

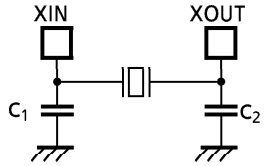
(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, Topr = – 40 to 85°C)

Parameter	Oscillator	Oscillation Frequency	Recommended Oscillator		Recommended Constant C_1	Recommended Constant C_2
High-frequency Oscillation	Ceramic Resonator	16 MHz	MURATA	CSA16.00MXZ040	10 pF	10 pF
		8 MHz	MURATA	CSA8.00MTZ	30 pF	30 pF
				CST8.00MTW	30 pF (built-in)	30 pF (built-in)
		4.19 MHz	MURATA	CSA4.19MG	30 pF	30 pF
				CST4.19MGW	30 pF (built-in)	30 pF (built-in)
Low-frequency Oscillation	Crystal Oscillator	32.768 kHz	SII	VT-200	6 pF	6 pF

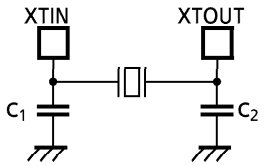
Recommended Oscillating Conditions-2

(V_{SS} = 0 V, V_{DD} = 2.7 to 5.5 V, Topr = – 40 to 85°C)

Parameter	Oscillator	Oscillation Frequency	Recommended Oscillator		Recommended Constant C_1	Recommended Constant 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)
		4.19 MHz	MURATA	CSA4.19MG	30 pF	30 pF
				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