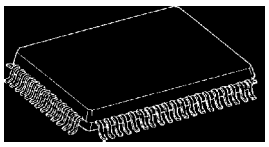
CMOS 8-Bit Microcontroller
TMP87PS39N/F

The TMP87PS39 is a One-Time PROM microcontroller with low-power 543 Kbits (a 60 Kbytes program memory and a 256 characters OSD font memory) electrically programmable read only memory for the TMP87CS39 system evaluation. The TMP87PS39 is pin compatible with the TMP87CS39. The operations possible with the TMP87CS39 can be performed by writing programs and OSD character data to PROM. The TMP87PS39 can write and verify in the same way as the TC571000 using an adaptor socket BM11118/BM11138 and an EPROM programmer.

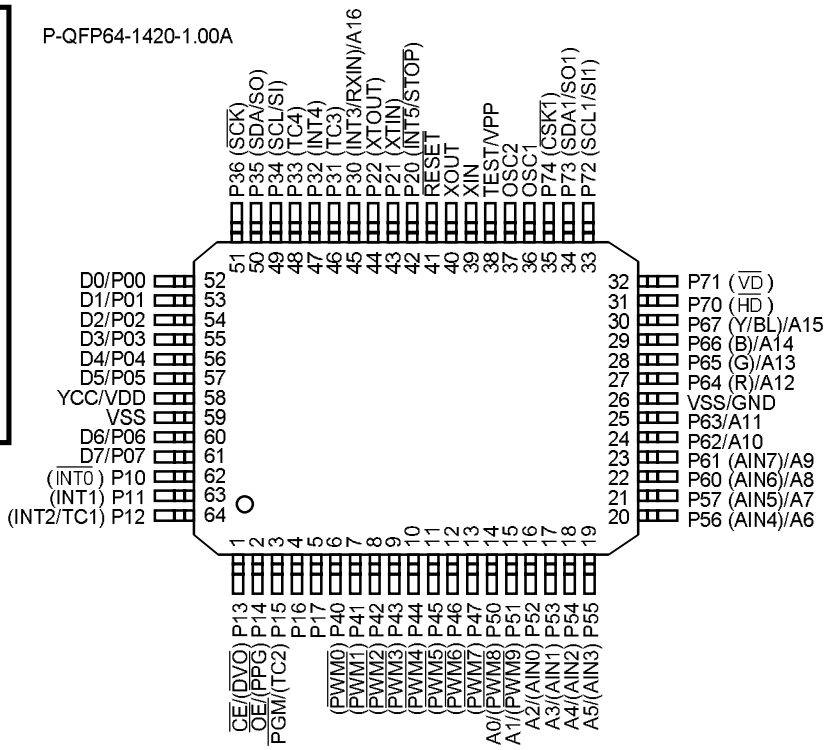
Part No.	OTP	RAM	Package	Adaptor Socket
TMP87PS39N	60 Kbytes + 14 × 18 × 256 bits	2 Kbytes	P-SDIP64-750-1.78	BM11118
TMP87PS39F			P-QFP64-1420-1.00A	BM11138

Pin Assignments (Top View)

P-QFP64-1420-1.00A



TMP87PS39F



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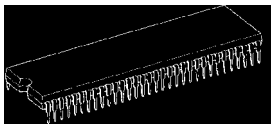
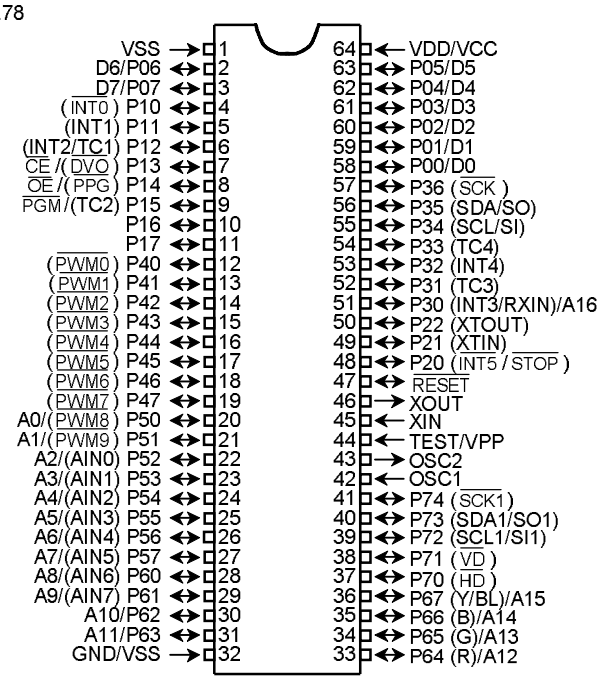


TMP87PS39N



Pin Function

The TMP87PS39 has two modes: MCU and PROM.

(1) MCU mode

In this mode, the TMP87PS39 is pin compatible with the TMP87CS39 (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	P30
A15 to A8			P67 to P60
A7 to A0			P57 to P50
D7 to D0	I/O	PROM data input/outputs	P07 to P00
$\overline{CE}$	Input	Chip enable signal input (active low)	P13
$\overline{OE}$		Output enable signal input (active low)	P14
$\overline{PGM}$	Input	Program mode signal input (active low)	P15
VPP	Power supply	+12.5V/5V (Program supply voltage)	TEST
VCC		+5V	VDD
GND		0 V	VSS
P47 to 40	Input	Pull-up with resistance for input processing	
P12			
P74 to P70			
P36 to P32			
P11		PROM mode setting pin. Be fixed at high level.	
P21			
P31			
P17, P16, P10		PROM mode setting pin. Be fixed at low level.	
P22, P20			
$\overline{RESET}$			
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 TMP87PS39 hardware configuration and operation. The configuration and functions of the TMP87PS39 are the same as those of the TMP87CS39, except in that a one-time PROM is used instead of an on-chip mask ROM.

The TMP87PS39 is placed in the single-clock mode during reset. To use the dual-clock mode, the low-frequency oscillator should be turned on by executing [SET (SYSCR2). XTEN] instruction at the beginning of the program.

1. Operating Mode

The TMP87PS39 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 TMP87CS39 (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 TMP87PS39 has a 60 K × 8-bit (addresses 1100H to FFFFH in the MCU mode, addresses 11100H to 1FFFFH in the PROM mode) of program memory and a 14 × 18 × 256 bits (addresses 04000H to 07FFFH in the PROM mode) of OSD character font memory.

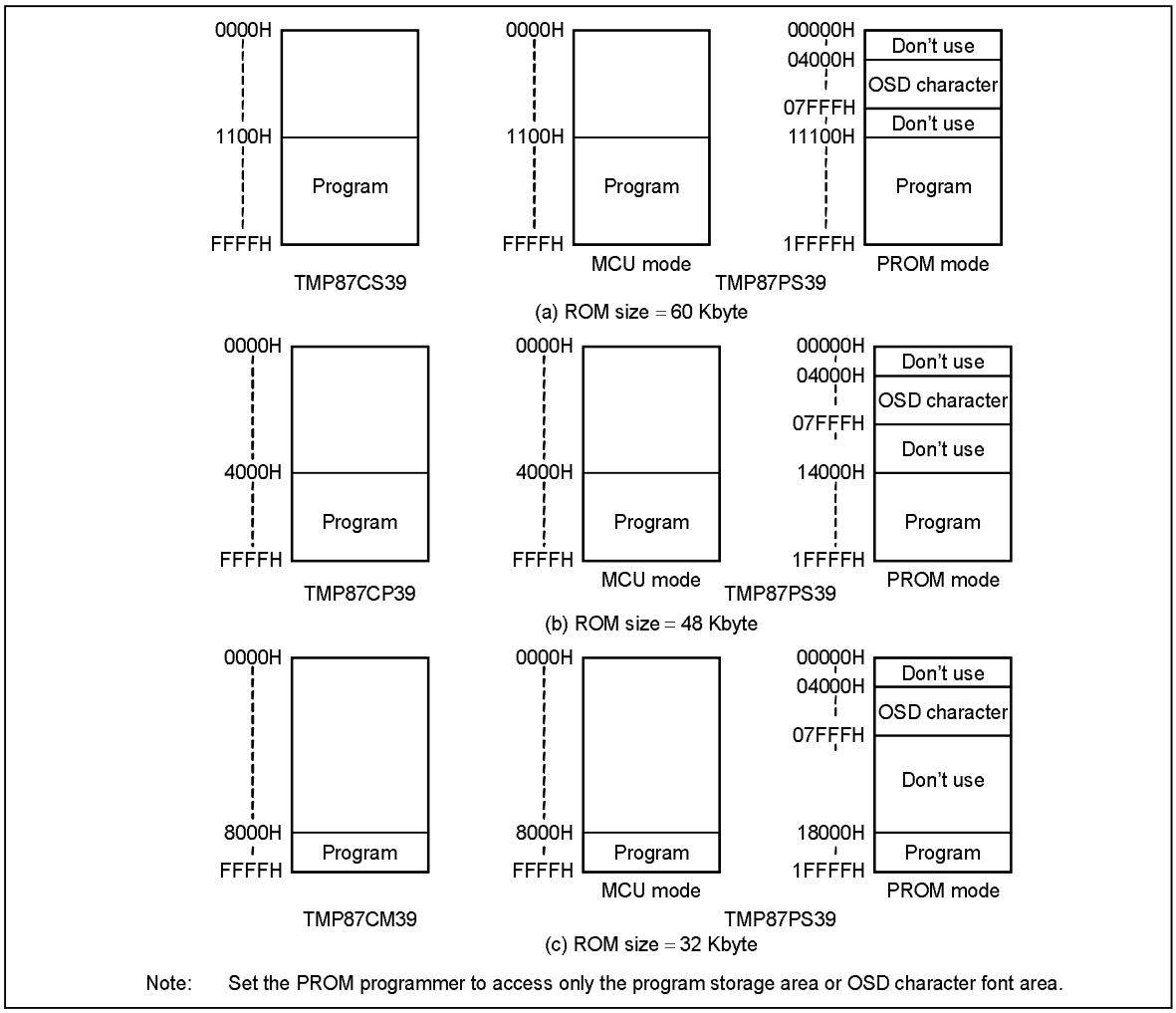


Figure 1.1.1 Program Memory Area

1.1.2 Data Memory

The TMP87PS39 has an on-chip 2 Kbytes data memory (static RAM).

1.1.3 Input/Output Circuitry

(1) Control pins

The control pins of the TMP87PS39 are the same as those of the TMP87CS39 except that the TEST pin has no built-in pull-down resistance.

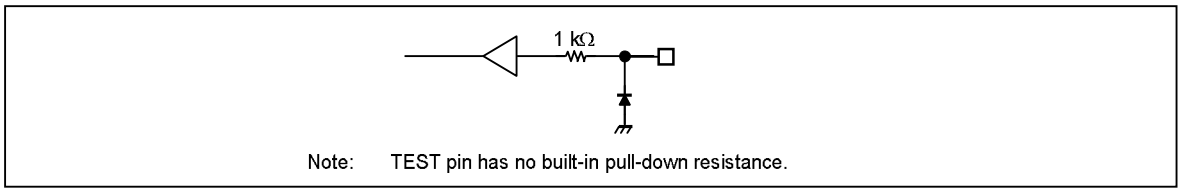


Figure 1.1.2 TEST Pin

(2) I/O ports

The I/O circuitries of TMP87PS39 I/O ports the are the same as those of the TMP87CS39.

1.2 PROM Mode

The PROM mode is activated by setting the TEST, $\overline{\text{RESET}}$ pin and the ports P22 to P20, P17 to P16, P11 to P10 and P31 as shown in Figure 1.1.2. 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 TMP87PS39 is not supported an electric signature mode, so the ROM type must be set to TC571000.

Set the adaptor socket switch to "N".

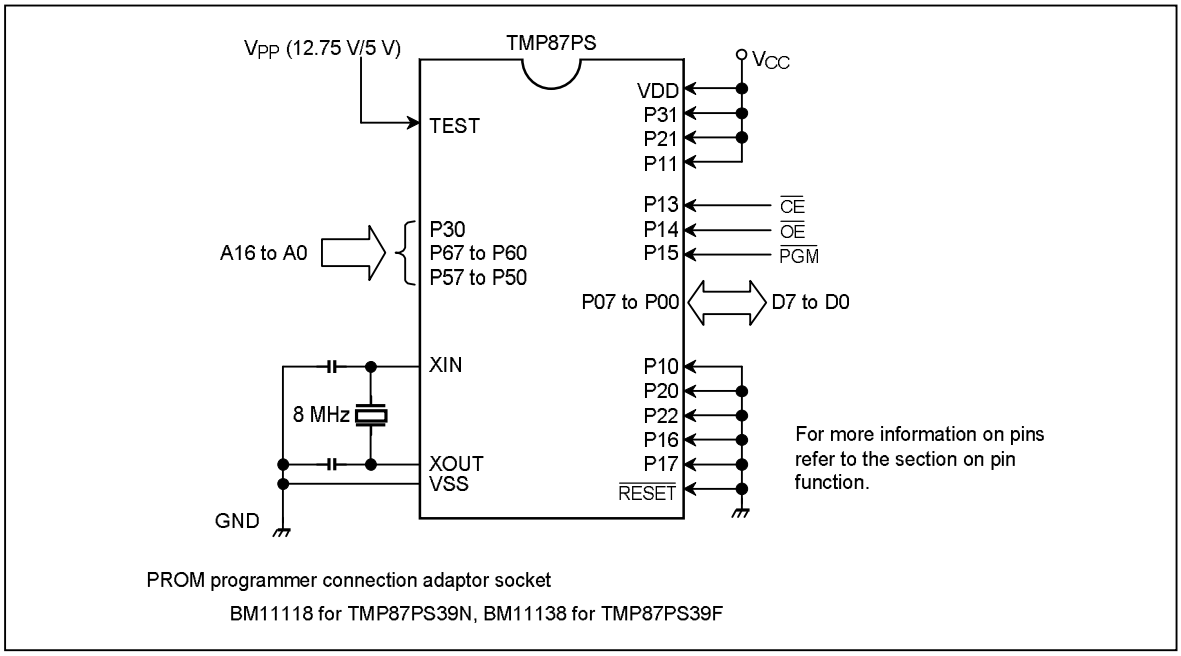


Figure 1.2.1 Setting for PROM Mode

1.2.1 Programming Flowchart (High-speed Programming Mode)

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 0.1 ms program pulse to the $\overline{\text{PGM}}$ input. The programmed data is verified. If incorrect, another 0.1 ms program pulse is applied. 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.

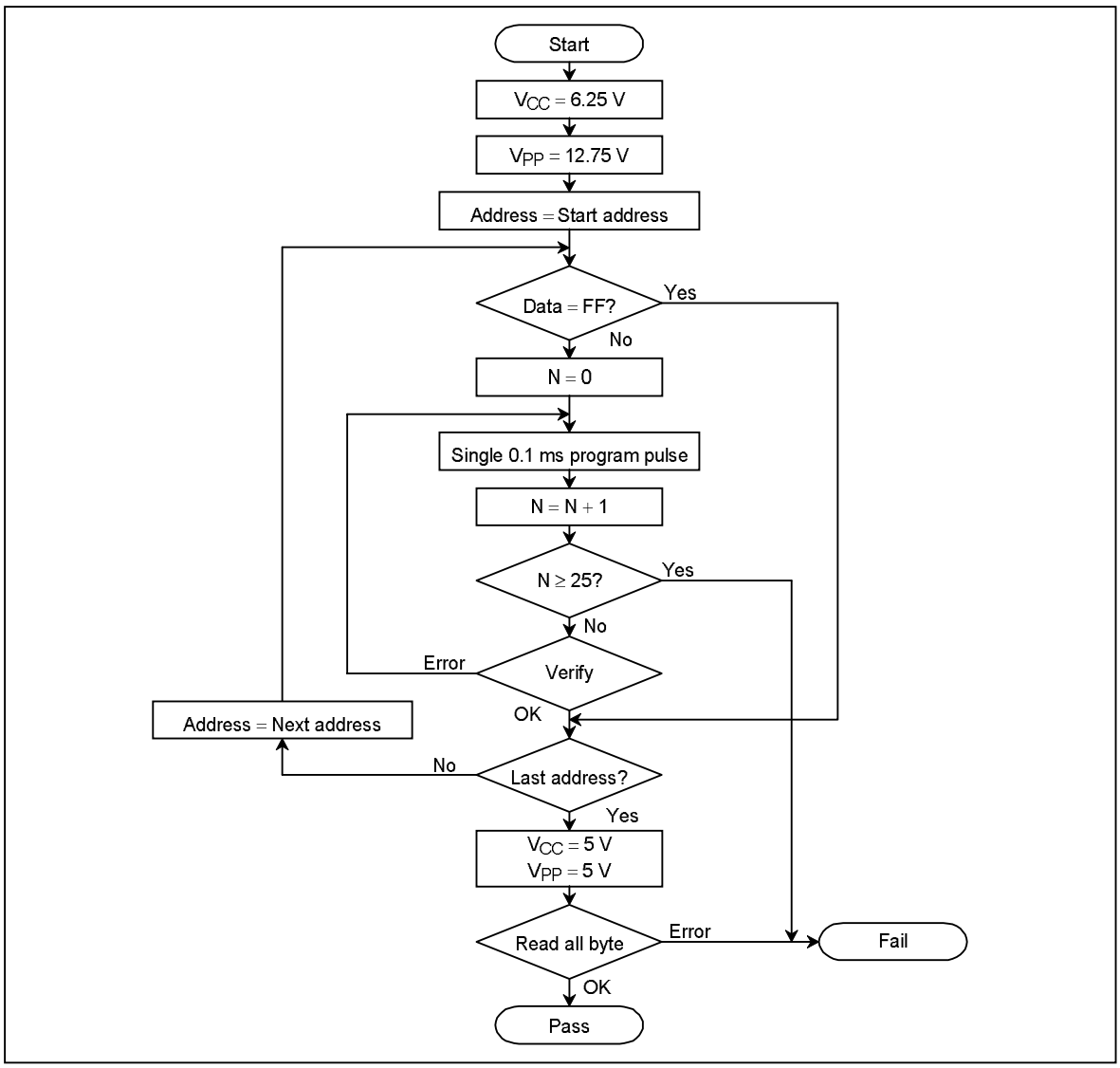


Figure 1.2.2 Flow Chart of High-speed Programming

1.2.2 Writing Method for General-purpose PROM Program

(1) Adapters

BM11118: TMP87PS39N

BM11138: TMP87PS39F

(2) Adapter setting

Switch (SW1) is set to side N.

(3) PROM programmer specifying

i) PROM type is specified to TC571000D.

Writing voltage: 12.75 V (high-speed program mode)

ii) Data transfer (copy) (Note 1)

In the TMP87PS39, EPROM is within the addresses 04000H to 07FFFH, and 11100H to 1FFFFH. Data is required to be transferred (copied) to the addresses where it is possible to write. The program area in MCU mode and PROM mode is referred to "Program memory area" in Figure 1.1.1.

iii) Writing address is specified. (Note 1)

Start address: 04000H

End address: 1FFFFH

(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 FFH 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 TMP87PS39 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	
Input voltage	V_{IN}		–0.3 to V_{DD} + 0.3	
Output voltage	V_{OUT1}		–0.3 to V_{DD} + 0.3	
Output current (Per 1 pin)	I_{OUT1}	Ports P0, P1, P2, P3, P4, P5, P64 to P67, P7	3.2	mA
	I_{OUT2}	Ports P60 to P63	30	
Output current (Total)	ΣI_{OUT1}	Ports P0, P1, P2, P3, P4, P5, P64 to P67, P7	120	
	ΣI_{OUT2}	Ports P60 to P63	120	
Power dissipation [Topr = 70°C]	P_D		600	mW
Soldering temperature (time)	Tsld		260 (10 s)	°C
Storage temperature	Tstg		–55 to 125	
Operating temperature	Topr		–30 to 70	

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 = 8 MHz	NORMAL1	4.5	5.5	V
				IDLE1, 2 modes			
			fc = 32.768 kHz	SLOW mode	2.7		
				SLEEP mode			
				STOP mode	2.0		
Input high voltage	V_{IH1}	Except hysteresis input	$V_{DD} \geq 4.5$ V		$V_{DD} \times 0.70$	V_{DD}	
	V_{IH2}	Hysteresis input			$V_{DD} \times 0.75$		
	V_{IH3}		$V_{DD} < 4.5$ V		$V_{DD} \times 0.90$		
Input low voltage	V_{IL1}	Except hysteresis input	$V_{DD} \geq 4.5$ V		0	$V_{DD} \times 0.30$	
	V_{IL2}	Hysteresis input				$V_{DD} \times 0.25$	
	V_{IL3}		$V_{DD} < 4.5$ V			$V_{DD} \times 0.10$	
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	$f_{OSC} \leq fc \times 1.2 \leq 8.0$	
			Doublel frequency mode (FORS = 1, V_{DD} = 4.5 to 5.5 V)		2.0	$f_{OSC} \leq fc \times 0.6 \leq 4.0$	
	fs	XTIN, XTOUT			30.0	34.0	kHz

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 NORMAL 1/2 mode and IDLE 1/2 mode.

Note 3: When using test video signal circuit, high frequency must be 8 MHz.

Note 4: When the OSD circuit is used, the supply voltage must be from 4.5 V to 5.5 V.

DC 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 P63 to P60	V_{DD} = 4.5 V, I_{OL} = 1.6 mA	–	–	0.4	
Output low current	I_{OL3}	Ports P63 to P60	V_{DD} = 4.5 V, V_{OL} = 1.0 V	–	20	–	mA
Supply current in NORMAL 1, 2 modes	I_{DD}		V_{DD} = 5.5 V fc = 8 MHz fs = 32.768 kHz V_{IN} = 5.3 V/0.2 V	–	13	20	
Supply current in IDLE 1, 2 modes				–	6.5	10	
Supply current in SLOW mode			V_{DD} = 3.0 V fs = 32.768 kHz V_{IN} = 2.8 V/0.2 V	–	30	70	μA
Supply current in SLEEP mode				–	15	35	
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_{IN3}; The current through pull-up 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.

AD Conversion 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
Analog reference voltage	V_{DD}	Supplied from V_{DD} pin	–	V_{DD}	–	V
	V_{SS}	Supplied from V_{SS} pin	–	0	0	
Analog reference voltage range	ΔV_{AREF}	= V_{DD} – V_{SS}	–	V_{DD}	–	
Analog input voltage	V_{AIN}		V_{SS}	–	V_{DD}	
Nonlinearity error		V_{DD} = 4.5 to 5.5V	–	–	±1	LSB
Zero point error			–	–	±2	
Full scale error			–	–	±2	
Total error			–	–	±3	

AC Characteristics

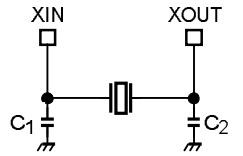
(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, Topr = –30 to 70°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Machine cycle time	t_{cy}	In NORMAL1, 2 modes	0.5	–	1.0	μs
		In IDLE1, 2 modes				
		In SLOW mode	117.6	–	133.3	
		In SLEEP 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}					
High level clock pulse width	t_{WSH}	For external clock operation (XTIN input), fs = 32.768kHz	14.7	–	–	μs
Low level clock pulse width	t_{WSL}					

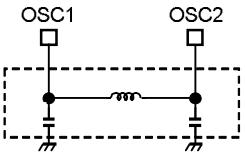
Recommended Oscillating Conditions

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

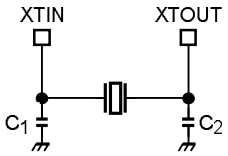
Parameter	Oscillator	Oscillation Frequency	Recommended Oscillator	Recommended Constant C_1	Recommended Constant C_2
High-frequency oscillation	Ceramic resonator	8 MHz	KYOCERA KBR8.0M	30 pF	30 pF
		4 MHz	KYOCERA KBR4.0MS		
			MURATA CSA4.00MG		
	Crystal oscillator	8 MHz	TOYOCOM 210B 8.0000	20 pF	20 pF
		4 MHz	TOYOCOM 204B 4.0000		
OSD	LC resonator	8 MHz	TOKO A285TNIS-11695	–	–
		7 MHz	TOKO TBEKSES-30375FBY		
Low-frequency oscillation	Crystal oscillator	32.768 kHz	NDK MX-38T	15 pF	15 pF



(1) High-frequency oscillation



(2) LC resonator for OSD



(3) Low-frequency oscillation

Note 1: 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 33 μH.

Note 2: To keep reliable operation, shield the device electrically with the metal plate on its package mold surface against the high electric field, for example, be CRT (Cathode Ray Tube).

Note 3: 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:

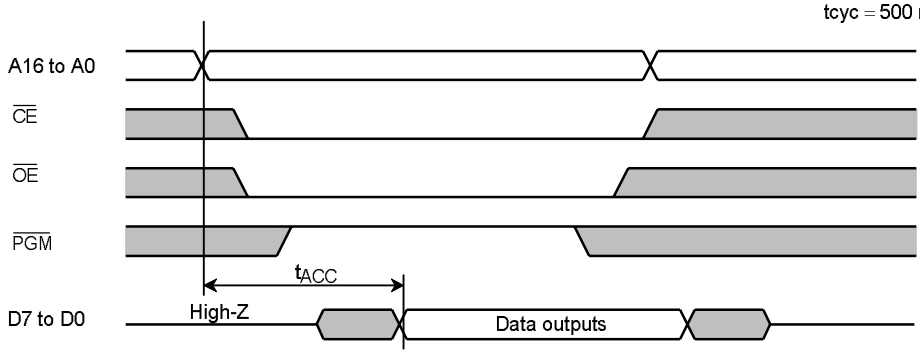
http://www.murata.co.jp/search/index.html

DC/AC 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	–	$V_{CC} \times 0.12$	
Power supply voltage	V_{CC}		4.75	5.0	5.25	
Program power supply voltage	V_{PP}					
Address access time	t_{ACC}	V_{CC} = 5.0 ± 0.25 V	–	1.5tcyc + 300	–	ns

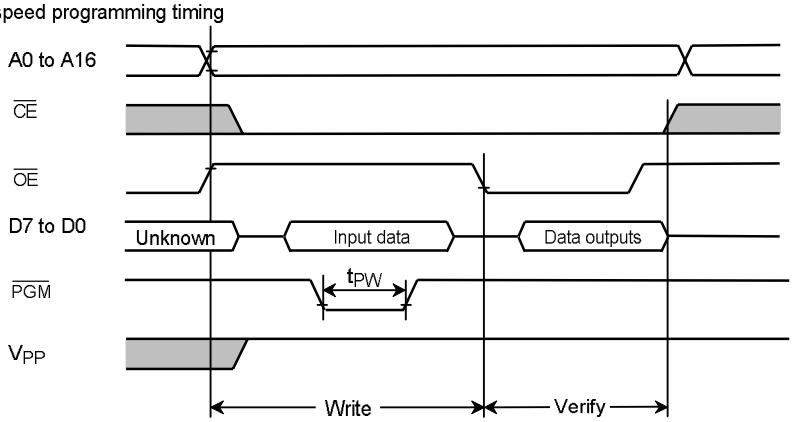
tcyc = 500 ns at 8 MHz



(2) High-Speed Programming 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	–	$V_{CC} \times 0.12$	
Power supply voltage	V_{CC}		6.0	6.25	6.5	
Program power supply voltage	V_{PP}		12.5	12.75	13.0	
Initial program pulse width	t_{PW}	V_{CC} = 6.0 V	0.095	0.1	0.105	ms

High-speed programming 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.