

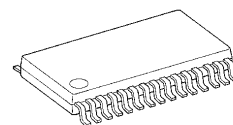
CMOS 8-Bit Microcontroller

TMP86P808DM

The TMP86P808 is a high-speed, high-performance 8-bit single chip microcomputer, which has 8 Kbytes One-Time PROM. The TMP86P808 is pin compatible with the TMP86C408/808. The operations possible with the TMP86C408/808 can be performed by writing programs to PROM. The TMP86P808 can write and verify in the same way as the TC571000D/AD using an adapter socket and a general-purpose PROM programmer.

Product No.	ROM	RAM	Package	Adapter socket
TMP86P808DM	8 K × 8 bits	256 × 8 bits	P-SSOP30-56-0.65	BM11183

P-SSOP30-56-0.65

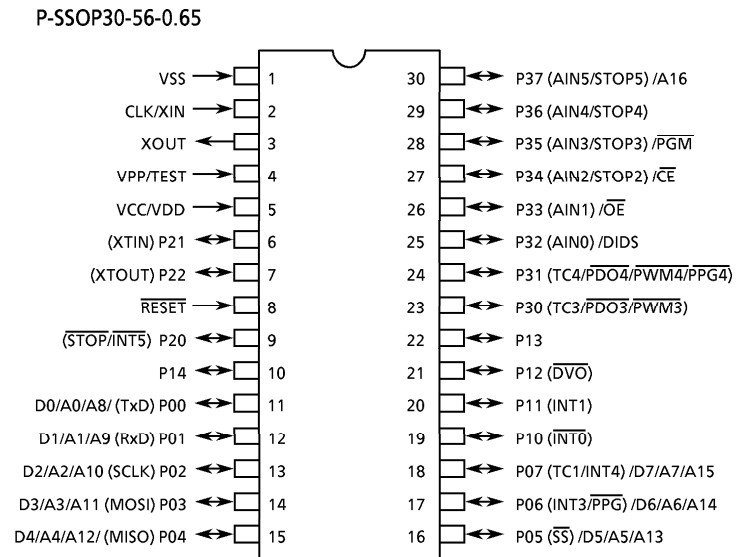


TMP86P808DM

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Pin Assignments (Top View)



Pin Functions

The TMP86P808 has two modes: MCU and PROM.

(1) MCU mode

In this mode, the TMP86P808 is pin compatible with the TMP86C408/808 (fix the TEST pin at low level).

(2) PROM mode

Pin Name (PROM mode)	Input/Output	Functions	Pin name (MCU mode)
A16	Input	Program memory address inputs	P37
A15 to A8			P07 to P00
A7 to A0			P07 to P00
D7 to D0	I/O	Program memory data input/outputs	P07 to P00
\overline{CE}	Input	Chip enable signal input	P34
\overline{OE}		Output enable signal input	P33
\overline{PGM}		Program mode signal input	P35
DIDS		PROM	P32
VPP	Power supply	+ 12.75 V/5 V (Program supply voltage)	TEST
VCC		+ 6.25 V/5 V	VDD
GND		0 V	VSS
P11, P21	I/O	PROM mode setting pins. Be fixed at high level.	
P10, P12, P20, P22, P36		PROM mode setting pins. Be fixed at low level.	
\overline{RESET}			
CLK	Input	Input a clock from the outside.	XIN
XOUT	Output	Open	

Operational Description

The configuration and function of the TMP86P808 are the same as those of the TMP86C408/808, except in that a one-time PROM is used instead of an on-chip mask ROM.

1. Operating Mode

The TMP86P808 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 TMP86C408/808 (TEST/VPP pin cannot be used open because it has no built in pull-down resistance.)

1.1.1 Program Memory

The TMP86P808 have an 8 Kbytes (addresses E000 to FFFF_H in the MCU mode, addresses 0000 to 1FFF_H in the PROM mode) one-time PROM.

When the TMP86P808 is used as a system evaluation of the TMP86C408/808, the data is written to the program storage area shown in Figure 1-1.

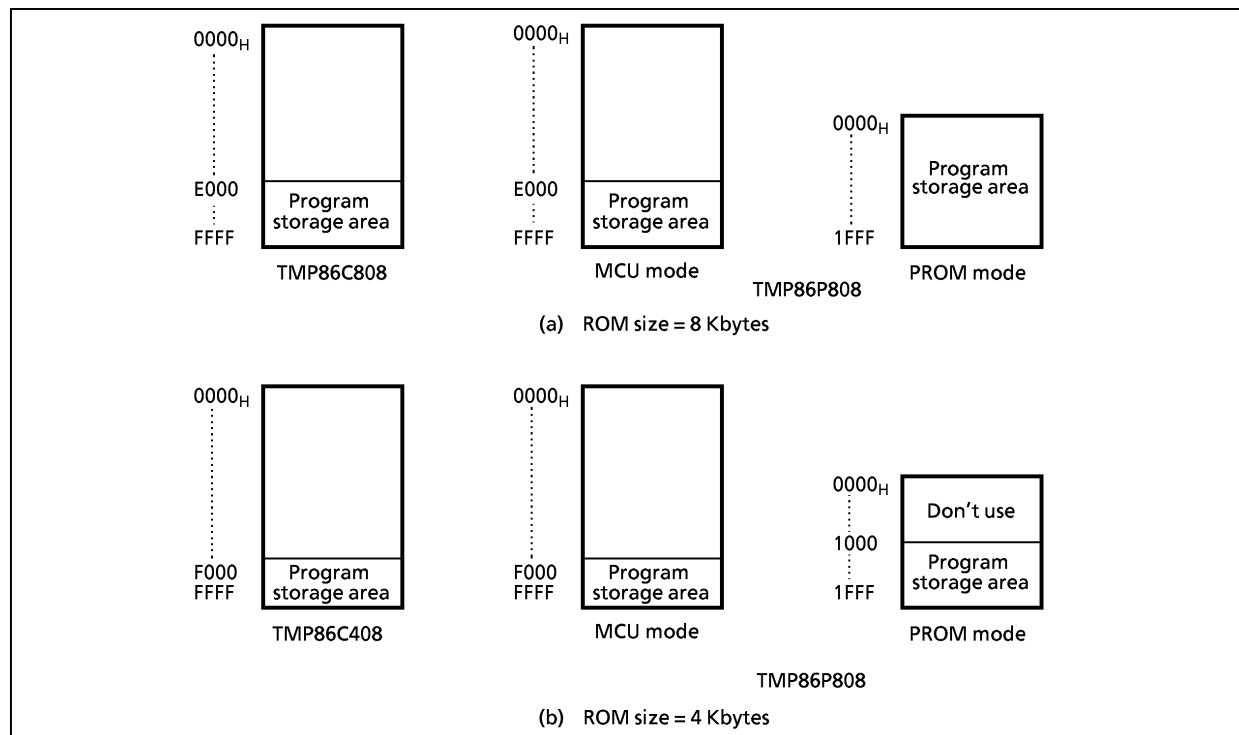


Figure 1-1. Program Memory Area

Note: Either write the data FF_H to the unused area or set the general-purpose PROM programmer to access only the program storage area

1.1.2 Data Memory

The TMP86P808 has an 256 bytes data memory (static RAM).

1.1.3 Input/Output Circuits of Pins**(1) Control pins**

Same as for the TMP86C408/808 except that the TEST pin does not have an internal pull-down resistor.

(2) Input/Output ports

The input/output circuits of the input/output ports on the TMP86P808 are the same as those of the TMP86C408/808.

1.2 PROM Mode

PROM mode is entered by setting the $\overline{\text{RESET}}$ pin, P12 to P10, P22 to P20, and P36 to P32 ports, and TEST as shown in Figure 1-2. In PROM mode, the ROM can be programmed and verified using a general-purpose PROM programmer.

Note: Fast program mode can be used. (Because settings vary with each PROM programmer used, refer to the user's manual for your PROM programmer.) The TMP86P808 does not have an electric signature function, so be sure to set the ROM type in your PROM programmer to TC571000D/AD or equivalent.

When using one of the adapter sockets supported by Toshiba, set its switch to the “N” position.

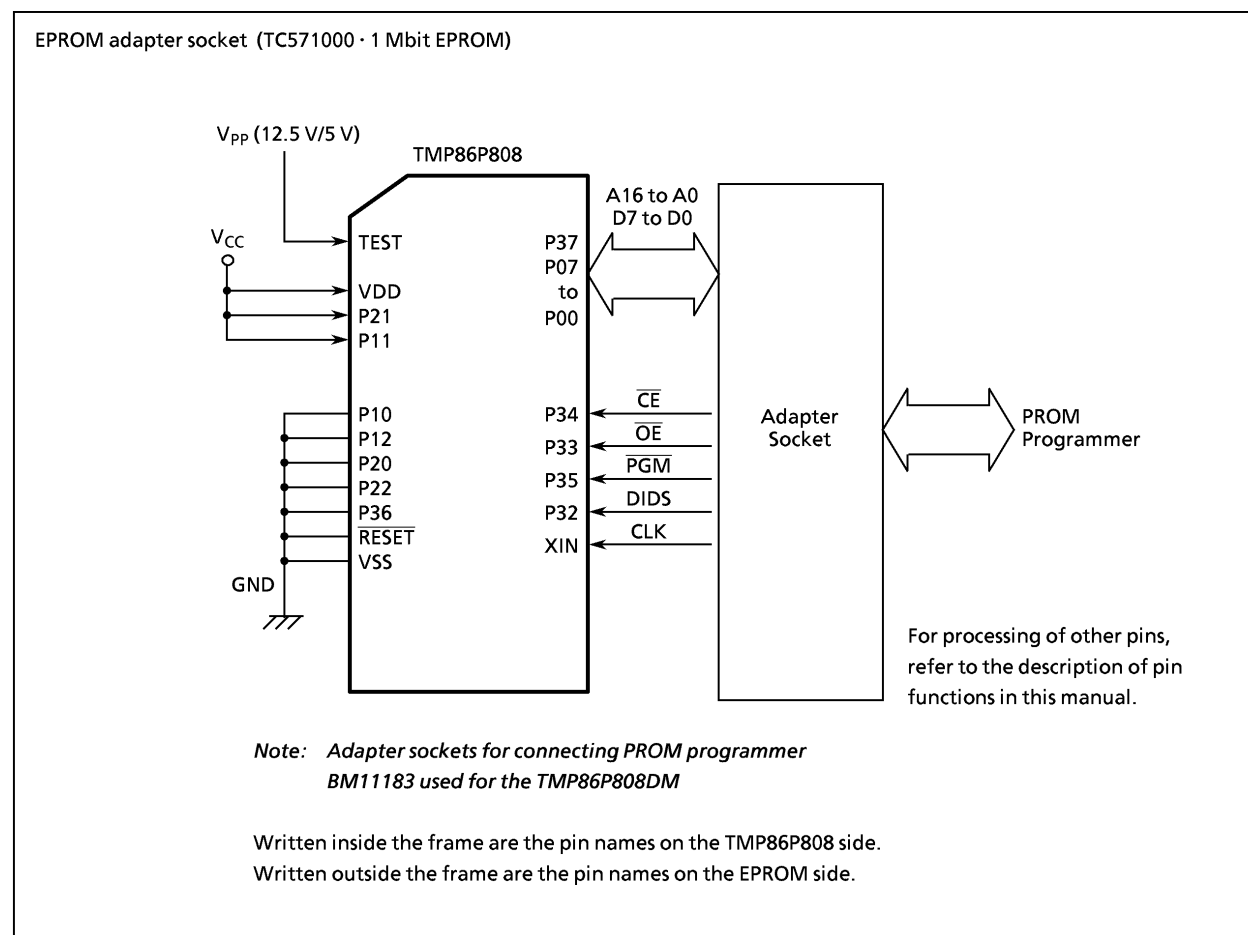


Figure 1-2. Setting Up PROM Mode

1.2.1 Programming Flowchart (Fast Program Mode)

Fast program mode is entered by applying a programming voltage, $V_{PP} = 12.75\text{ V}$, while $V_{CC} = 6.25\text{ V}$. After entering valid address and input data, apply a 0.1 ms programming (single) pulse to $\overline{\text{PGM}}$ input, and the data is written to the ROM. Verify whether the data has been written correctly; if not, apply a 0.1 ms programming pulse again. Repeat this (for up to 25 times) until data is written correctly. When programmed correctly at the set address, increment the address by one and write the next input data to the new address in the same way. When you finished writing data to all addresses, set $V_{CC} = V_{PP} = 5\text{ V}$ and verify all programmed addresses.

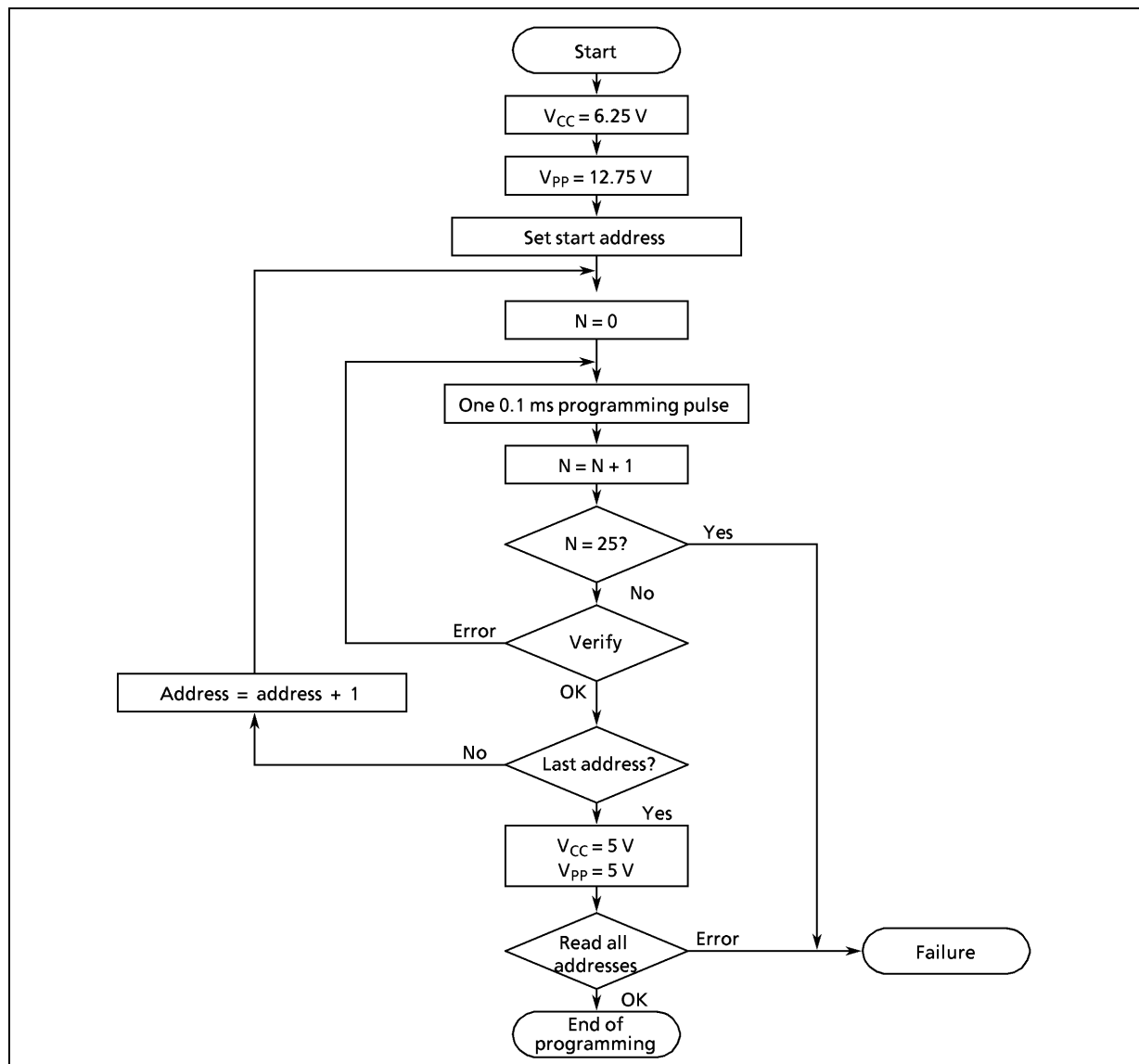


Figure 1-3. Programming Flowchart

1.2.2 Using Toshiba Adapter Socket along with General-purpose PROM Programmer

(1) Preparing the adapter

BM11183 used for the TMP86P808DM

(2) Setting up the adapter

Set the switch (SW1) to the N position.

(3) Setting up the PROM programmer

i) Set the PROM type to TC571000D/AD.

Programming voltage: 12.75 V (fast program mode)

ii) Transferring (or copying) data (Note 1)

The PROM of the TMP86P808 has different addresses to access when in MCU mode and when in PROM mode. Therefore, before the ROM contents to be mounted on the TMP86C408/808 can be written to the PROM of the TMP86P808, the data must be transferred (copied) from the addresses in MCU mode to the addresses in PROM mode. For the relationship of program areas between MCU and PROM modes, see Figure 1-1, "Program Memory Area".

Example: Execute the following in block transfer (copy) mode.

When the ROM size is 8 KB: E000 to FFFF_H → 0000 to 1FFF_H

When the ROM size is 4 KB: F000 to FFFF_H → 1000 to 1FFF_H

iii) Set the write address. (Note 1)

Start address: 0000_H (or 1000_H when the ROM size is 4 KB)

End address: 1FFF_H

(4) Programming

Program and verify the ROM following the operation procedure of your PROM programmer.

Note 1: For details on how to set, refer to the user's manual of your PROM programmer. Always make sure the data in unused address areas are set to FF_H.

Note 2: When attaching the MCU to the adapter or the adapter to the PROM programmer, make sure the No. 1 pin position on both sides are matched. If attached in reverse, the MCU, adapter, and PROM programmer may be damaged.

Note 3: The TMP86P808 does not support electric signature mode. If the PROM programmer is used in signature mode, a voltage of 12 V + 0.5 V is applied to No. 9 address pin (A9), which causes damage to the device. Therefore, do not use signature mode.

Input/Output Circuitry

(1) Control Pins

The input/output circuitries of the TMP86P808 control pins are shown below.

Control Pin	I/O	Input/Output Circuitry	Remarks
XIN XOUT	Input Output		Resonator connecting pins (High-frequency) $R_f = 1.2 \text{ M}\Omega$ (typ.) $R_O = 0.5 \text{ k}\Omega$ (typ.)
XTIN XTOUT	Input Output		Resonator connecting pins (Low-frequency) $R_f = 6 \text{ M}\Omega$ (typ.) $R_O = 220 \text{ k}\Omega$ (typ.)
RESET	Input		Hysteresis input Pull-up resistor $R_{IN} = 220 \text{ k}\Omega$ (typ.) $R = 100 \Omega$ (typ.)
TEST	Input		$R = 100 \Omega$ (typ.)

Note: The TEST pin of the TMP86P808 does not have a pulldown resistor built in it.
Always make sure this pin is fixed low.

(2) Input/Output Ports

Port	I/O	Input/Output Circuitry	Remarks
P0	I/O	<p>Initial High-Z</p> <p>Pch Control</p> <p>Data output</p> <p>Input from output latch</p> <p>High-Z Control</p> <p>Pin input</p> <p>VDD</p> <p>R</p>	<p>Sink open drain output or push-pull output</p> <p>Hysteresis input</p> <p>High current output (Nch) (Programmable port option)</p> <p>$R = 100\ \Omega$ (typ.)</p>
P1	I/O	<p>Data output</p> <p>Disable</p> <p>Pin input</p> <p>VDD</p> <p>R</p>	<p>Tri-state I/O</p> <p>Hysteresis input</p> <p>$R = 100\ \Omega$ (typ.)</p>
P2	I/O	<p>VDD</p> <p>R</p>	<p>Sink open drain output</p> <p>Hysteresis input</p> <p>$R = 100\ \Omega$ (typ.)</p>
P3	I/O	<p>Data output</p> <p>Disable</p> <p>Pin input</p> <p>VDD</p> <p>R</p> <p>* Refer to Figure 2-6</p>	<p>Tri-state I/O</p> <p>Hysteresis input</p> <p>$R = 100\ \Omega$ (typ.)</p>

Note: Input status on pins set for input mode are read in into the internal circuit. Therefore, when using the ports in a mixture of input and output modes, the contents of the output latches for the ports that are set for input mode may be rewritten by execution of bit manipulating instructions.

Electrical Characteristics

Absolute Maximum Ratings

(V_{SS} = 0 V)

Parameter	Symbol	Pins	Rating	Unit
Supply Voltage	V _{DD}		– 0.3 to 6.5	V
Input Voltage	V _{IN}		– 0.3 to V _{DD} + 0.3	
Output Voltage	V _{OUT1}	P21, P22, RESET, Tri-state Port	– 0.3 to V _{DD} + 0.3	
	V _{OUT2}	P20, Sink Open Drain Port	– 0.3 to 5.5	mA
Output Current (Per 1 pin)	I _{OUT1} I _{OH}	P0, P1, P3 Port	– 1.8	
	I _{OUT2} I _{OL}	P1, P2, P3 Port	3.2	
	I _{OUT3} I _{OL}	P0 Port	30	
Output Current (Total)	Σ I _{OUT1}	P0, P1, P3 Port	– 30	
	Σ I _{OUT2}	P1, P2, P3 Port	60	
	Σ I _{OUT3}	P0 Port	80	
Power Dissipation [T _{opr} = 85°C]	PD		145	mW
Soldering Temperature (time)	T _{sld}		260 (10 s)	°C
Storage Temperature	T _{stg}		– 55 to 150	
Operating Temperature	T _{opr}		– 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, T_{opr} = – 40 to 85°C)

Parameter	Symbol	Pins	Condition		Min	Max	Unit
Supply Voltage	V _{DD}		fc = 16 MHz	NORMAL1, 2 mode	4.5	5.5	V
				IDLE0, 1, 2 mode			
			fc = 8 MHz	NORMAL1, 2 mode	2.7		
				IDLE0, 1, 2 mode			
			fs = 32.768 kHz	SLOW1, 2 mode			
				SLEEP0, 1, 2 mode			
	STOP mode						
Input high Level	V _{IH1}	Except Hysteresis input	V _{DD} ≥ 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} ≥ 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} = 2.7 to 5.5 V		1.0	8.0	MHz
			V _{DD} = 4.5 to 5.5 V			16.0	
	fs	XTIN, XTOUT	V _{DD} = 2.7 to 5.5 V		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 Standard

DC Characteristics

(V_{SS} = 0 V, T_{opr} = – 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}	RESET, STOP					
Input Resistance	R _{IN}	RESET Pull-Up		100	220	450	kΩ
Output Leakage Current	I _{LO}	Sink Open Drain, Tri-state Port	V _{DD} = 5.5 V, V _{OUT} = 5.5 V/0 V	–	–	± 2	μA
Output High Voltage	V _{OH}	P0, P1, P3 Port	V _{DD} = 4.5 V, I _{OH} = – 0.7 mA	4.1	–	–	V
Output Low Voltage	V _{OL}	P1, P2, P3 Port	V _{DD} = 4.5 V, I _{OL} = 1.6 mA	–	–	0.4	
Output Low Current	I _{OL}	High Current Port (P0 Port)	V _{DD} = 4.5 V, V _{OL} = 1.0 V	–	20	–	mA
Supply Current in NORMAL 1, 2 mode	I _{DD}		V _{DD} = 5.5 V V _{IN} = 5.3/0.2 V f _c = 16.0 MHz f _s = 32.768 kHz	–	7.5	9.0	
Supply Current in IDLE 0, 1, 2 mode				–	5.5	6.5	
Supply Current in SLOW 1 mode			V _{DD} = 3.0 V V _{IN} = 2.8 V/0.2 V f _s = 32.768 kHz	–	14.0	25.0	μA
Supply Current in SLEEP 1 mode				–	7.0	15.0	
Supply Current in SLEEP 0 mode				–	6.0	15.0	
Supply Current in STOP mode			V _{DD} = 5.5 V V _{IN} = 5.3 V/0.2 V	–	0.5	10.0	

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

Note 2: Input current (I_{IN1}, I_{IN3}); The current through pull-up or pull-down resistor is not included.

Note 3: I_{DD} does not include I_{REF} current.

Note 4: The power supply current in STOP2 and SLEEP2 modes each are the same as in IDLE0, 1, and 2 modes.

AD Conversion Characteristics

(V_{SS} = 0.0 V, 4.5 V ≤ V_{DD} ≤ 5.5 V, T_{opr} = –40 to 85°C)

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Analog Input Voltage	V _{AIN}		V _{SS}	–	V _{DD}	V
Power Supply Current of Analog Reference Voltage	I _{REF}	V _{DD} = 5.5 V V _{SS} = 0.0 V	–	0.6	1.0	mA
Non linearity Error		V _{DD} = 5.0 V, V _{SS} = 0.0 V	–	–	± 1	LSB
Zero Point Error			–	–	± 1	
Full Scale Error			–	–	± 1	
Total Error			–	–	± 2	

(V_{SS} = 0.0 V, 2.7 V ≤ V_{DD} < 4.5 V, T_{opr} = –40 to 85°C)

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Analog Input Voltage	V _{AIN}		V _{SS}	–	V _{DD}	V
Power Supply Current of Analog Reference Voltage	I _{REF}	V _{DD} = 4.5 V V _{SS} = 0.0 V	–	0.5	0.8	mA
Non linearity Error		V _{DD} = 2.7 V, V _{SS} = 0.0 V	–	–	± 1	LSB
Zero Point Error			–	–	± 1	
Full Scale Error			–	–	± 1	
Total Error			–	–	± 2	

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 Configuration".

Note 3: Please use input voltage to AIN input Pin in limit of V_{DD} - V_{SS}.
When voltage of range outside is input, conversion value becomes unsettled and gives affect to other channel conversion value.

Note 4: The relevant pin for I_{REF} is V_{DD}, so that the current flowing into V_{DD} is the power supply current I_{DD} + I_{REF}.

SEI Operating Conditions (Slave mode)

(V_{SS} = 0.0 V, 2.7 V ≤ V_{DD} ≤ 5.5 V, T_{opr} = –40 to 85°C)

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Transfer Rate			15.625 k	–	fc/4	bps

AC Characteristics

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

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Machine Cycle Time	tcy	NORMAL 1, 2 mode	0.25	–	4	μ s
		IDLE 0, 1, 2 mode				
		SLOW 1, 2 mode	117.6	–	133.3	
		SLEEP 0, 1, 2 mode				
High Level Clock Pulse Width	twcH	For external clock operation (XIN input) fc = 16 MHz	25	–	–	ns
Low Level Clock Pulse Width	twcL					
High Level Clock Pulse Width	twcH	For external clock operation (XTIN input) fs = 32.768 kHz	14.7	–	–	μ s
Low Level Clock Pulse Width	twcL					

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

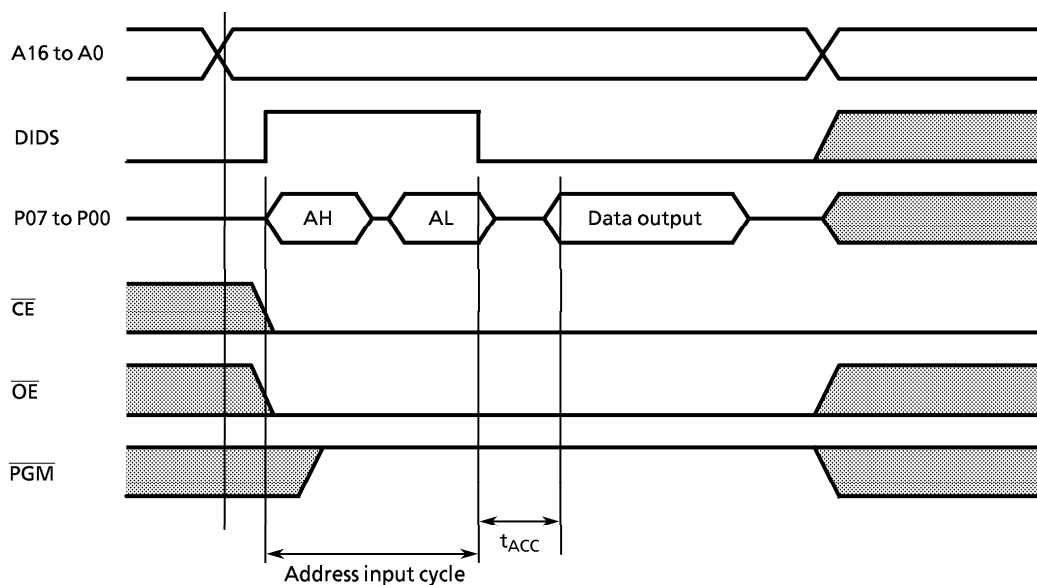
Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Machine Cycle Time	tcy	NORMAL 1, 2 mode	0.5	–	4	μ s
		IDLE 0, 1, 2 mode				
		SLOW 1, 2 mode	117.6	–	133.3	
		SLEEP 0, 1, 2 mode				
High Level Clock Pulse Width	twcH	For external clock operation (XIN input) fc = 8 MHz	50	–	–	ns
Low Level Clock Pulse Width	twcL					
High Level Clock Pulse Width	twcH	For external clock operation (XTIN input) fs = 32.768 kHz	14.7	–	–	μ s
Low Level Clock Pulse Width	twcL					

DC Characteristics, AC Characteristics (PROM mode)

(V_{SS} = 0 V, Topr = – 40 to 85°C)

(1) Read operation in PROM mode

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
High level input voltage	V _{IH4}		V _{CC} × 0.75	–	V _{CC}	V
Low level input voltage	V _{IL4}		0	–	V _{CC} × 0.25	V
Power supply	V _{CC}		4.75	5.0	5.25	V
Power supply of program	V _{PP}					
Address access time	t _{ACC}	V _{CC} = 5.0 ± 0.25 V	–	–	1.5t _{cy} + 300	ns
Address input cycle	–		–	t _{cy}	–	ns

Note: t_{cy} = 250 ns at f_{CLK} = 16 MHz

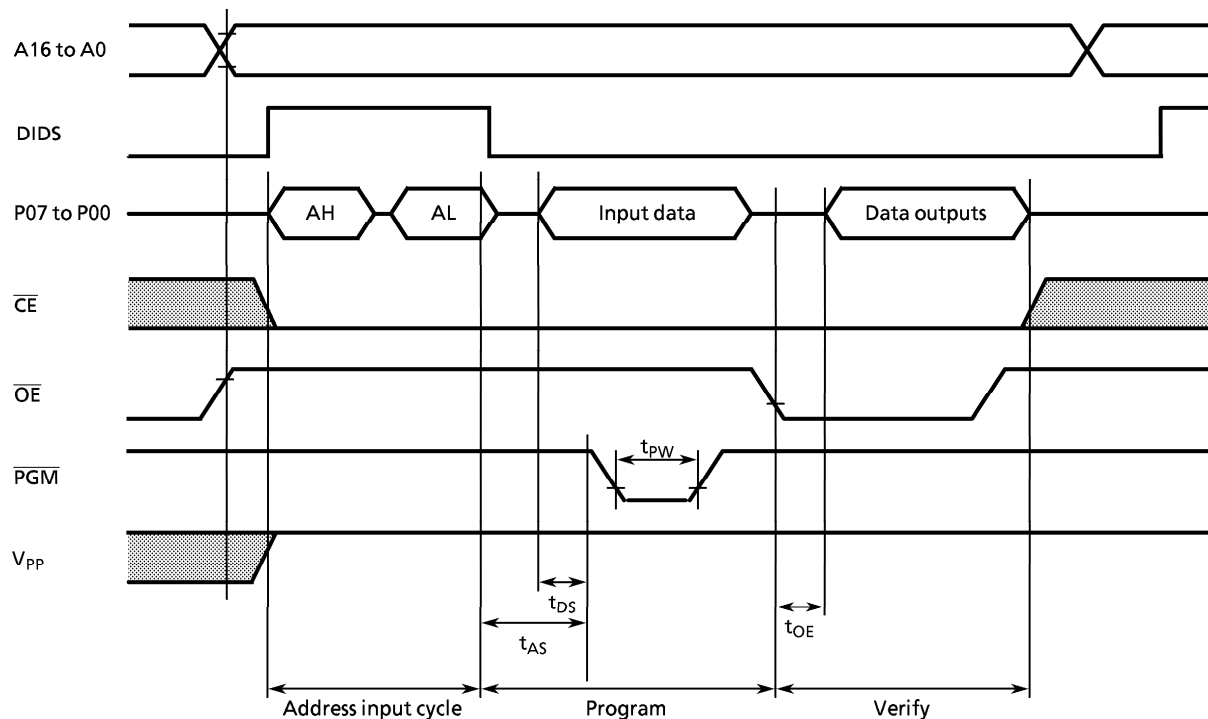
Note: DIDS and P07 to P00 are the signals for the TMP86P808.
 All other signals are EPROM programmable.
 AL: Address input (A0 to A7)
 AH: Address input (A8 to A15)

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

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
High level input voltage	V_{IH4}		$V_{CC} \times 0.75$	–	V_{CC}	V
Low level input voltage	V_{IL4}		0	–	$V_{CC} \times 0.25$	V
Power supply	V_{CC}		6.0	6.25	6.5	V
Power supply of program	V_{PP}		12.5	12.75	13.0	V
Pulse width of initializing program	t_{PW}	$V_{CC} = 6.0\text{ V}$	0.095	0.1	0.105	ms
Address set up time	t_{AS}		$0.5tcyc$	–	–	ns
Address input cycle	–		–	$tcyc$	–	ns
Data set up time	t_{DS}		$1.5tcyc$	–	–	ns
\overline{OE} to valid output data	t_{OE}		–	–	$1.5tcyc + 300$	ns

Note: $tcyc = 250\text{ ns}$ at $f_{CLK} = 16\text{ MHz}$

High-speed program writing



Note: DIDS and P07 to P00 are the signals for the TMP86P808.

All other signals are EPROM programmable.

AL: Address input (A0 to A7)

AH: Address input (A8 to A15)

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 $V_{PP} = 12.75\text{ V} \pm 0.25\text{ V}$ 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.

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