CMOS 4-bit Microcontroller
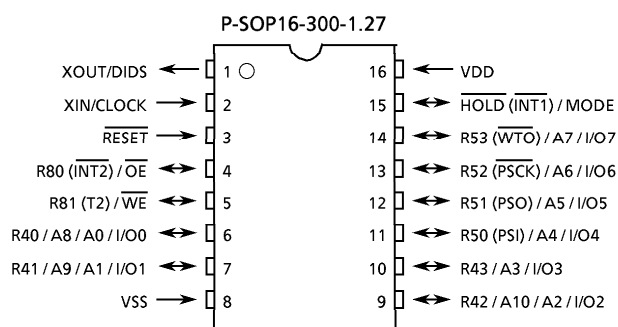
TMP47P186M
TMP47P187M

The TMP47P186M/187M is a system evaluation LSI with a built-in 1 Kbyte E^2PROM as ROM. Like the MBM28C64, The TMP47P186M/187M can write / verify data using a PROM writer connection adaptor socket.
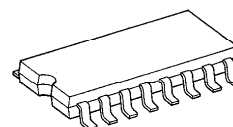
The TMP47P186M/187M is pin-compatible with mask ROM product TMP47E186M/187M. Writing a program to the built-in E^2PROM enables the TMP47P186M/187M to operate the same as TMP47E186M/187M.

Part No.	ROM	RAM	E^2PROM	Package	Adaptor socket	Oscillator
TMP47P186M	E^2PROM	64×4 bit	16×8 bit	P-SOP16-300-1.27	BM11114	CR oscillator
TMP47P187M	1024×8 bit					crystal/ceramic oscillator

Pin Assignment (Top View)

P-SOP16-300-1.27

Pin		Pin	
XOUT/DIDS ←	1 ○	16	→ VDD
XIN/CLOCK →	2	15	↔ HOLD ($\overline{INT1}$) / MODE
$\overline{RESET}$ →	3	14	↔ R53 ($\overline{WTO}$) / A7 / I/O7
R80 ($\overline{INT2}$) / $\overline{OE}$ ↔	4	13	↔ R52 ($\overline{PSCK}$) / A6 / I/O6
R81 (T2) / $\overline{WE}$ ↔	5	12	↔ R51 (PSO) / A5 / I/O5
R40 / A8 / A0 / I/O0 ↔	6	11	↔ R50 (PSI) / A4 / I/O4
R41 / A9 / A1 / I/O1 ↔	7	10	↔ R43 / A3 / I/O3
VSS →	8	9	↔ R42 / A10 / A2 / I/O2

P-SOP16-300-1.27

TMP47P186M
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000707EBA1

Pin Functions

The TMP47P186M/187M supports MCU and E^{2}PROM modes.

(1)   MCU mode

Pin-compatible with TMP47E186M/187M.

(2)   E^{2}PROM mode

Pin Name	Input / Output	Function	Pin Name (In MCU Mode)
A10 to A8	Input	Inputs program memory addresses.	R42 to R40 (Note 1)
A7 to A4			R53 to R50 (Note 1)
A3 to A0			R43 to R40 (Note 1)
I/O7 to I/O4	Input / Output	Inputs / outputs program memory data.	R53 to R50 (Note 1)
I/O3 to I/O0			R43 to R40 (Note 1)
$\overline{OE}$	Input	Inputs output enable signal.	R80
$\overline{WE}$		Inputs write enable signal.	R81
$\overline{CE}$		Inputs chip enable signal.	$\overline{HOLD}$ (MODE) (Note 2)
CLOCK (Note 3)	Input	Oscillator connecting pin	XIN
DIDS (Note 3)	Input	Inputs address input timing control signal.	XOUT
VCC	Power supply	+ 5 V (or other voltage)	VDD
VSS		0 V (GND)	VSS

Note 1:   R43 to R40 and R53 to R50 are used in time sharing mode for input of program memory address and program memory data.

Note 2:   The MODE signal is processed by the adaptor socket. The MODE signal, not the CE signal, is input to the HOLD pin.

Note 3:   Generated by the adaptor socket.

Operation

The following sections describe the configuration and operation of TMP47P186M/187M hardware. The TMP47P186M/187M uses the mask ROM built into TMP47E186M/187M as E²PROM. In every other respect, TMP47P186M/187M configuration and functions are identical to those of TMP47E186M/187M.

1.   Operation modes

The TMP47P186M/187M supports MCU and E²PROM modes.

Table 1-1. Operating Mode Setting

Mode\Pin	XIN	XOUT	R80
MCU	Oscillator connected.		*
E²PROM	Clock input	L	H

L: 0 V
H: 5 V
*: Don't care

1.1   MCU Mode

Operation in MCU mode is the same as that of TMP47E186M/187M.

1.1.1 Program Memory

The program area is the same as that of TMP47E186M/187M.

```
0000H ┌─────────────┐
      ┆             │
      ┆             │
      ┆ Program area│
      ┆             │
      ┆             │
03FFH └─────────────┘
```
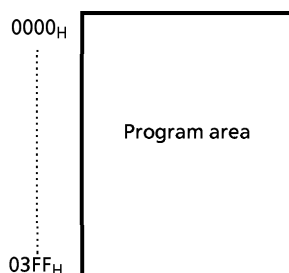
Figure 1-1. Program Area

1.1.2 Data Memory

The TMP47P186M/187M incorporates a 64 × 4-bit data memory (RAM, equivalent to TMP47E186M/187M).

1.1.3 Pin I/O Circuit

The pin I/O circuit is the same as that of TMP47E186M/187M.

Electrical Characteristics

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

Parameter	Symbol	Pin	Specifications	Unit
Power supply voltage	V_{DD}		– 0.3 to 6.5	V
Input voltage	V_{IN}		– 0.3 to V_{DD} + 0.3	V
Output voltage	V_{OUT}		– 0.3 to V_{DD} + 0.3	V
Output current (per pin)	I_{OUT}		3	mA
Output current (total for all pins)	$\Sigma\, I_{OUT}$		12	mA
Power dissipation	PD		88	mW
Soldering temperature (time)	Tsld		260 (10 s)	°C
Storage temperature	Tstg		– 55 to 125	°C
Operating temperature	T_{OPR}		– 40 to 85	°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 = – 40 to 85°C)

Parameter	Symbol	Pins		Conditions		Min	Max	Unit
Power supply voltage	V_{DD}		At normal operation	Crystar or ceramic (Note 2)	fc = 6.0 MHz	4.5	5.5	V
					fc = 4.2 MHz	2.7		
				RC (Note 3)	fc = 2.5 MHz	2.2		
					fc = 1 MHz	2.0		
			In hold mode	–	–	2.0		
High-level input voltage	V_{IH1}	Excluding hysteresis input		VDD ≧ 4.5 V		$V_{DD} \times 0.7$	VDD	V
	V_{IH2}	Hysteresis input				$V_{DD} \times 0.75$		
	V_{IH3}			VDD < 4.5 V		$V_{DD} \times 0.9$		
Low-level input voltage	V_{IL1}	Excluding hysteresis input		VDD ≧ 4.5 V		0	$V_{DD} \times 0.3$	V
	V_{IL2}	Hysteresis input					$V_{DD} \times 0.25$	
	V_{IL3}			VDD < 4.5 V			$V_{DD} \times 0.1$	
Clock frequency	fc	XIN, XOUT		VDD = 4.5 to 5.5 V		0.4	0.6	MHz
				VDD = 2.7 to 5.5 V			4.2	
				VDD = 2.2 to 5.5 V (CR)			2.5	
				VDD = 2.0 to 5.5 V (CR)			1.0	

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: *TMP47E187M*

Note 3: *TMP47E186M*

DC Characteristics $(V_{SS} = 0 \text{ V}, \text{ Topr} = -40 \text{ to } 85°C)$

Parameter	Symbol	Pin	Condition	Min	Typ.	Max	Unit
Hysteresis voltage	V_{HS}	Hysteresis input		–	0.7	–	V
Input current	I_{IN1}	$\overline{RESET}, \overline{HOLD}$	$V_{DD} = 5.5 \text{ V}, V_{IN} = 5.5 \text{ V} / 0 \text{ V}$	–	–	± 2	μA
Input resistance	R_{IN}	$\overline{RESET}$		100	220	450	kΩ
High-level output current	V_{OH}	Push-pull output portH	VDD = 4.5 V, IOH = – 1.6 mA	2.4	–	–	V
			VDD = 2.2 V, IOH = – 20 μA	2.0	–	–	
Low-level output voltage	V_{OL}	Excluding XOUT	VDD = 4.5 V, IOL = 1.6 mA	–	–	0.4	V
			VDD = 2.2 V, IOL = 20 μA	–	–	0.1	
Power supply current at normal operation	I_{DD}	Except for E²PROM Erase / write	$V_{DD} = 5.5 \text{ V}$, fc = 4 MHz	–	2	4	mA
			$V_{DD} = 3.0 \text{ V}$, fc = 4 MHz	–	1	2	
			$V_{DD} = 3.0 \text{ V}$, fc = 400 kHz	–	0.5	1	
		During E²PROM Erase / write	$V_{DD} = 5.5 \text{ V}$, fc = 4 MHz	–	5	7	
Power supply current in hold mode	I_{DDH}		$V_{DD} = 5.5 \text{ V}$	–	0.5	10	μA
			$V_{DD} = 3.0 \text{ V}$	–	0.3	1	

Note 1: *Typ. values are for when Topr = 25°C, V_{DD} = 5 V.*
Note 2: *Input current: IIN1 excludes current due to built-in pull-up resistors.*
Note 3: *VIN = 5.3 V / 0.2 V (V_{DD} = 5 V) or VIN = 2.8 V / 0.2 V (V_{DD} = 3.0 V)*

## Data (16 × 8 bit) E²PROM Characteristics $(V_{SS} = 0 \text{ V}, \text{ Topr} = -40 \text{ to } 85°C)$

Parameter	Symbol	Conditions		Unit
Programming time	t_{PW}		4.1 (Typ.)	ms
Erase time	t_{EW}		4.1 (Typ.)	
Number of overwrites		Topr = T_H, V_{DD} = 5 V	10^4 (Min)	Cycle
Data hold characteristics		After overwriting 10^4 times, Ta = 55°C.	10 (Min)	Year

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AC Characteristics	(V_{SS} = 0 V, Topr = − 40 to 85°C)

Parameter	Symbol	Condition		Min	Typ.	Max	Unit
Instruction cycle time	tcy		V_{DD} = 4.5 to 5.5 V	1.3	−	20	μs
			V_{DD} = 2.7 to 5.5 V	1.9			
			VDD = 2.2 to 5.5 V	3.2			
			VDD = 2.0 to 5.5 V	8.0			
High-level clock pulse width	t_{WCH}	External clock (XIN input)	$V_{DD} \geqq 2.7$ V	80	−	−	ns
			$V_{DD} < 2.7$ V	160			
Low-level clock pulse width	t_{WCL}		$V_{DD} \geqq 2.7$ V	80			
			$V_{DD} < 2.7$ V	160			
Shift data storage time	t_{SDH}			0.5tcy − 0.3	−	−	μs

Note: *Shift data hold time:*
$\overline{PSCK}$, PSO pin, External circuit   Serial port (end of transmission)
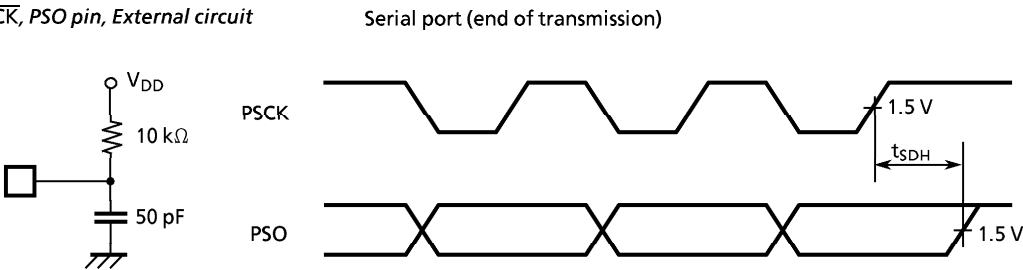
Recommended Oscillation Conditions	(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, Topr = − 40 to 85°C)

Same as those for TMP47E186M/187M.