CMOS 8-BIT MICROCONTROLLER

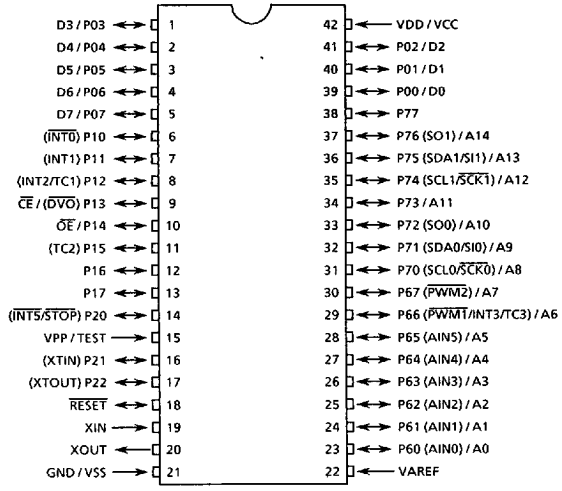
TMP87PK42N

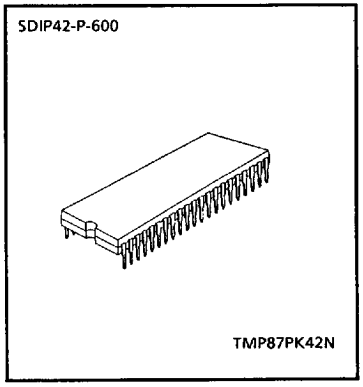
The 87PK42 is a One-Time PROM microcontroller with low-power 192K bits (a 24K bytes program memory) electrically programmable read only memory for the 87CK42 system evaluation. The 87PK42 is pin compatible with the 87CK42. The operations possible with the 87CK42 can be performed by writing programs to PROM. The 87PK42 can write and verify in the same way as the TMM27256AD using an adaptor socket BM1163 and an EPROM programmer.

PART No.	OTP	RAM	PACKAGE
TMP87PK42N	24K × 8-bit	512 × 8-bit	SDIP42-P-600

PIN ASSIGNMENTS (TOP VIEW)

SDIP42-P-600





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PIN FUNCTION

The 87PK42 has two modes: MCU and PROM.

(1) MCU mode

In this mode, the 87PK42 is pin compatible with the 87CK42 (fix the TEST pin at low level).

(2) PROM mode

PIN NAME (PROM mode)	INPUT/OUTPUT	FUNCTIONS	PIN NAME (MCU mode)
A14 ~ A8	Input	PROM address inputs	P76 ~ P70
A7 ~ A0			P67 ~ P60
D7 ~ D0	I/O	PROM data input/outputs	P07 ~ P00
$\overline{CE}$	Input	Chip enable signal input (active low)	P13
$\overline{OE}$		Output enable signal input (active low)	P14
VPP	Power supply	+ 12.5V / 5V (Program supply voltage)	TEST
VCC		+ 5V	VDD
GND		0V	VSS
P11	I/O	PROM mode setting pin. Be fixed at high level.	
P21			
P77			
P12, P10		PROM mode setting pin. Be fixed at low level.	
P17 ~ P15			
P22, P20			
$\overline{RESET}$			
XIN	Input	Connect an 8MHz oscillator to stabilize the internal state.	
XOUT	Output		
VAREF	Power supply	0V (GND)	

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OPERATIONAL DESCRIPTION

The following explains the 87PK42 hardware configuration and operation. The configuration and functions of the 87PK42 are the same as those of the 87CK42, except in that a one-time PROM is used instead of an on-chip mask ROM.

The 87PK42 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 87PK42 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 87CK42 (the TEST / VPP pin cannot be used open because it has no built-in pull-down resistance).

1.1.1 Program Memory

The 87PK42 has a 24K × 8-bit (addresses $A000_H$-$FFFF_H$ in the MCU mode, addresses 2000_H-$7FFF_H$ in the PROM mode) of program memory (OTP).

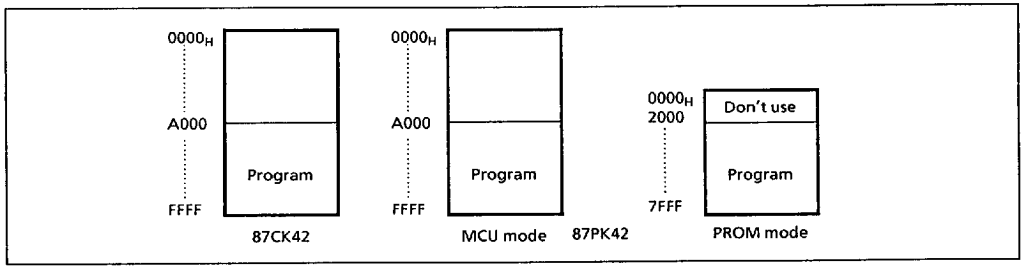

Figure 1-1. Program Memory Area

Either write the data FF_H to the unused area or set the PROM programmer to access only the program storage area.

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1.1.2 Data Memory

The 87PK42 has an on-chip 512 x 8-bit data memory (static RAM).

1.1.3 Input/Output Circuitry

(1) Control pins

The control pins of the 87PK42 are the same as those of the 87CK42 except that the TEST pin has no built-in pull-down resistance.

(2) I/O ports

The I/O circuitries of 87PK42 I/O ports the are the same as those of the 87CK42.

1.2 PROM mode

The PROM mode is activated by setting the TEST, $\overline{\text{RESET}}$ pin and the ports P17-P10, P22-P20, and P77 as shown in Figure 1-3. 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 87PK42 is not supported an *electric signature* mode, so the ROM type must be set to TMM27256AD. Set the adaptor socket switch to "N".

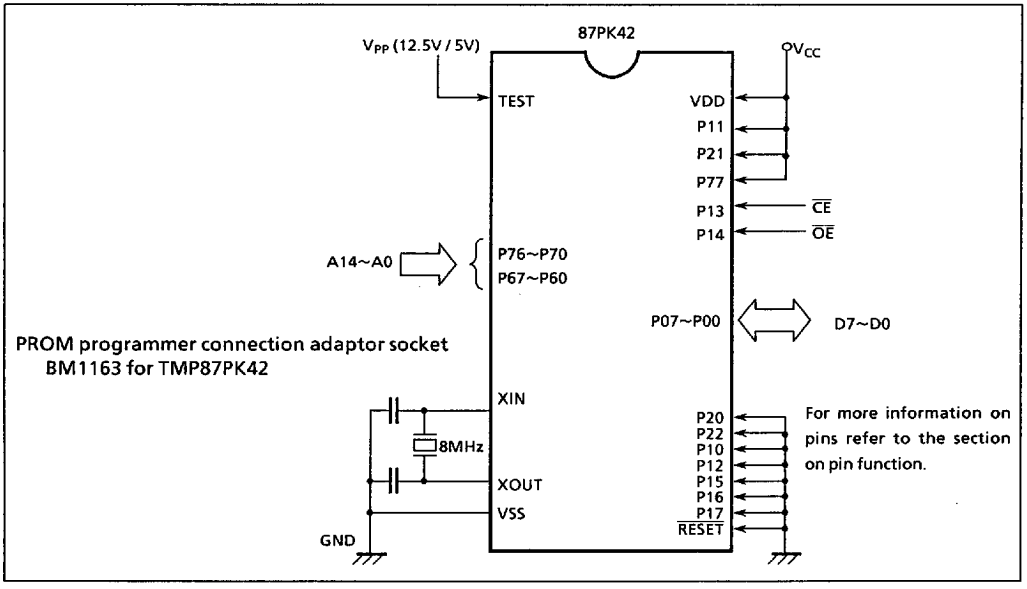

Figure 1-2. Setting for PROM Mode

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1.2.1 Programming Flowchart (High-speed Programming Mode)

The high-speed programming mode is achieved by applying the program voltage (+ 12.5V) to the VPP pin when Vcc = 6V. After the address and input data are stable, the data is programmed by applying a single 1ms program pulse to the $\overline{CE}$ input. The programmed data is verified. If incorrect, another 1ms program pulse is applied and then the programmed data is verified. This process should be repeated (up to 25 times) until the program operates correctly. Programming for one address is ended by applying additional program pulse with width 3 times that needed for initial programming (number of programmed times x 1ms). 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 = 5V.

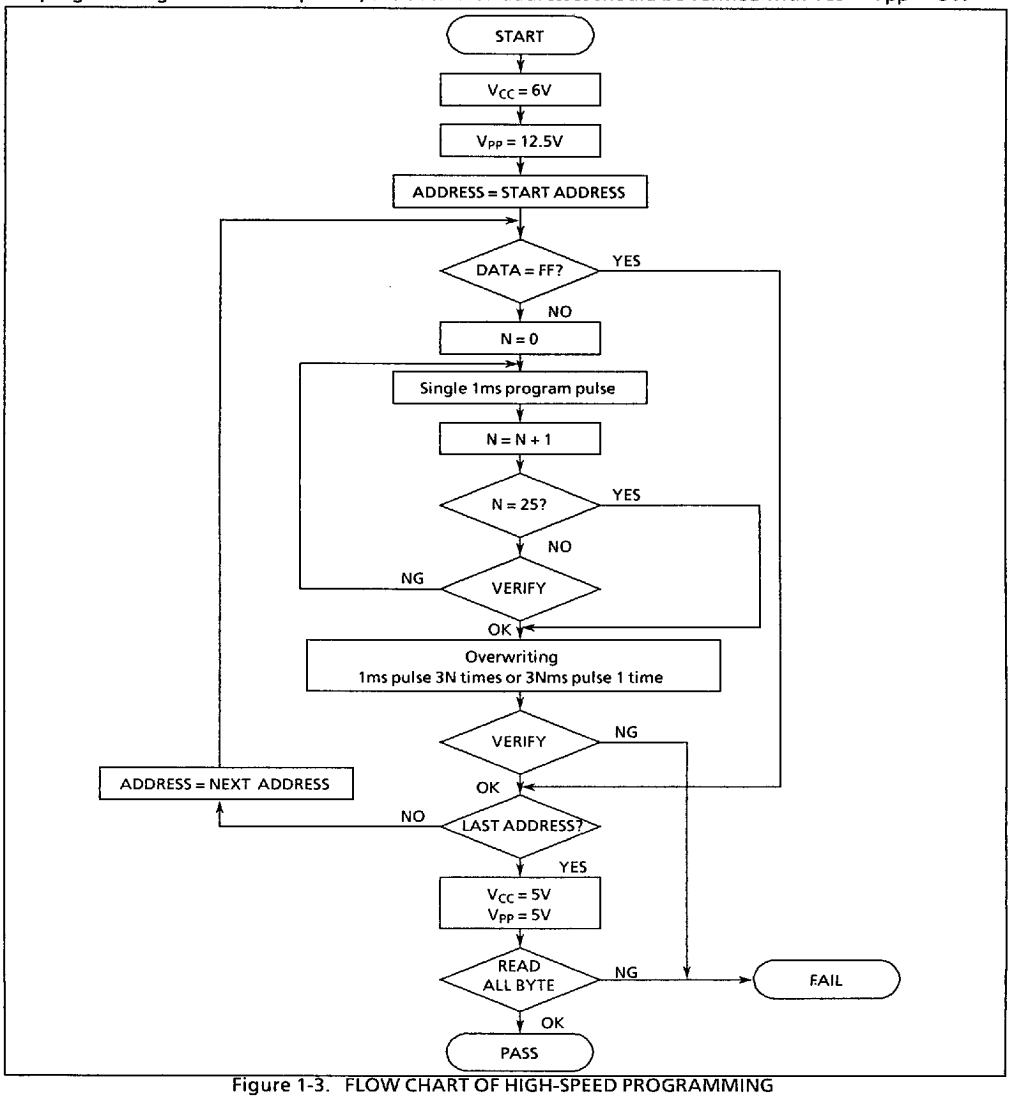

Figure 1-3. FLOW CHART OF HIGH-SPEED PROGRAMMING

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ELECTRICAL CHARACTERISTICS

ABSOLUTE MAXIMUM RATINGS (V_{SS} = 0V)

PARAMETER	SYMBOL	PINS	RATINGS	UNIT
Supply Voltage	V_{DD}		− 0.3~7	V
Program Voltage	V_{PP}	TEST / VPP	− 0.3~13.0	V
Input Voltage	V_{IN}		− 0.3~V_{DD} + 0.3	V
Output Voltage	V_{OUT1}	P0, P1, P21, P22, P60~65, $\overline{RESET}$, XOUT	− 0.3~V_{DD} + 0.3	V
	V_{OUT2}	P20, P66, P67, P7	− 0.3~10	
Output Current (Per 1 pin)	I_{OUT1}	P0, P1, P2, P6, P7	3.2	mA
Output Current (Total)	ΣI_{OUT1}	P0, P1, P2, P6, P7	120	mA
Power Dissipation [Topr = 70°C]	PD		600	mW
Soldering Temperature (time)	Tsld		260 (10s)	°C
Storage Temperature	Tstg		− 55~125	°C
Operating Temperature	Topr		− 30~70	°C

RECOMMENDED OPERATING CONDITIONS (V_{SS} = 0V, Topr = − 30 to 70°C)

PARAMETER	SYMBOL	PINS	CONDITIONS		Min.	Max.	UNIT
Supply Voltage	V_{DD}		fc = 8MHz	NORMAL1, 2 mode	4.5	6.0	V
				IDLE1, 2 mode			
			fc = 4.2MHz	NORMAL1, 2 mode	2.7		
				IDLE1, 2 mode			
			fs = 32.768kHz	SLOW mode			
				SLEEP mode			
				STOP mode	2.0		
Input High Voltage	V_{IH1}	Except hysteresis input	$V_{DD} \geqq 4.5V$		$V_{DD} \times 0.70$	V_{DD}	V
	V_{IH2}	Hysteresis input			$V_{DD} \times 0.75$		
	V_{IH3}		$V_{DD} < 4.5V$		$V_{DD} \times 0.90$		
Input Low Voltage	V_{IL1}	Except hysteresis input	$V_{DD} \geqq 4.5V$		0	$V_{DD} \times 0.30$	V
	V_{IL2}	Hysteresis input				$V_{DD} \times 0.25$	
	V_{IL3}		$V_{DD} < 4.5V$			$V_{DD} \times 0.10$	
Clock Frequency	fc	XIN, XOUT	V_{DD} = 4.5 to 6V		0.4	8.0	MHz
			V_{DD} = 2.7 to 6V			4.2	
	fs	XTIN, XTOUT			30.0	34.0	kHz

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D.C. CHARACTERISTICS

(V_{SS} = 0V, 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} = 5.5V, V_{IN} = 5.5V / 0V	–	–	± 2	μA
	I_{IN2}	Open drain ports	V_{DD} = 5.5V, V_{IN} = 5.5V	–	–	2	
		Tri-state ports	V_{DD} = 5.5V, V_{IN} = 5.5V / 0V	–	–	± 2	
	I_{IN3}	$\overline{RESET}$, $\overline{STOP}$					
Input Resistance	R_{IN2}	$\overline{RESET}$		100	220	450	kΩ
Output Leakage Current	I_{LO}	Sink open drain ports	V_{DD} = 5.5V, V_{OUT} = 5.5V	–	–	2	μA
Output High Voltage	V_{OH2}	Tri-state ports	V_{DD} = 4.5V, I_{OH} = – 0.7mA	4.1	–	–	V
Output Low Voltage	V_{OL}	Except XOUT	V_{DD} = 4.5V, I_{OL} = 1.6mA	–	–	0.4	V
Supply Current in NORMAL 1, 2 modes	I_{DD}		V_{DD} = 5.5V fc = 8MHz	–	12	18	mA
Supply Current in IDLE 1, 2 modes			fs = 32.768kHz V_{IN} = 5.3V/0.2V	–	4.5	6	
Supply Current in SLOW mode			V_{DD} = 3.0V fs = 32.768kHz	–	30	60	μA
Supply Current in SLEEP mode			V_{IN} = 2.8V/0.2V	–	15	30	
Supply Current in STOP mode			V_{DD} = 5.5V V_{IN} = 5.3V/0.2V	–	0.5	10	μA

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

Note 2 : Input Current I_{IN1}, I_{IN3} ; The current through resistor is not included.

A / D CONVERSION CHARACTERISTICS

(V_{SS} = 0V, V_{DD} = 4.5 to 6.0V, Topr = – 30 to 70°C)

PARAMETER	SYMBOL	CONDITIONS	Min.	Typ.	Max.	UNIT
Analog Reference Voltage	V_{AREF}	$V_{DD} \geqq 4.5V$, V_{SS} = 0V	V_{DD} – 1.5	–	V_{DD}	V
Analog Reference Voltage Range	ΔV_{AREF}		3.0	–	–	V
Analog Input Voltage	V_{AIN}		V_{SS}	–	V_{AREF}	V
Analog Supply Current	I_{REF}		–	0.5	1.0	mA
Nonlinearity Error		V_{DD} = 5.0V, V_{SS} = 0.0V V_{AREF} = 5.000V	–	–	± 1	LSB
Zero Point Error			–	–	± 1	
Full Scale Error			–	–	± 1	
Total Error			–	–	± 2	

Note : $\Delta V_{AREF} = V_{AREF} - V_{SS}$

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A.C. CHARACTERISTICS

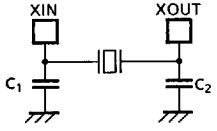
(V_{SS} = 0V, V_{DD} = 4.5 to 6.0V, Topr = – 30 to 70°C)

PARAMETER	SYMBOL	CONDITIONS	Min.	Typ.	Max.	UNIT
Machine Cycle Time	t_{cy}	In NORMAL1, 2 modes	0.5	–	10	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 = 8MHz	62.5	–	–	ns
Low Level Clock Pulse Width	t_{WCL}					
High Level Clock Pulse Width	t_{WSH}	For external clock operation (XTIN input), fs = 32.768kHz	14.7	–	–	μs
Low Level Clock Pulse Width	t_{WSL}					

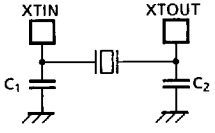
RECOMMENDED OSCILLATING CONDITIONS

(V_{SS} = 0V, V_{DD} = 4.5 to 6.0V, Topr = – 30 to 70°C)

PARAMETER	Oscillator	Oscillation Frequency	Recommended Oscillator	Recommended Constant C_1	Recommended Constant C_2
High-frequency Oscillation	Ceramic Resonator	8MHz	KYOCERA KBR8.0M	30pF	30pF
		4MHz	KYOCERA KBR4.0MS		
			MURATA CSA4.00MG		
	Crystal Oscillator	8MHz	TOYOCOM 210B 8.0000	20pF	20pF
		4MHz	TOYOCOM 204B 4.0000		
Low-frequency Oscillation	Crystal Oscillator	32.768kHz	NDK MX-38T	15pF	15pF



(1) High-frequency Oscillation



(3) Low-frequency Oscillation

Note : An electrical shield by metal shield plate on the surface of the IC package should be recommendable in order to prevent the device from the high electric fieldstress applied from CRT (Cathode Ray Tube) for continuous reliable operation.

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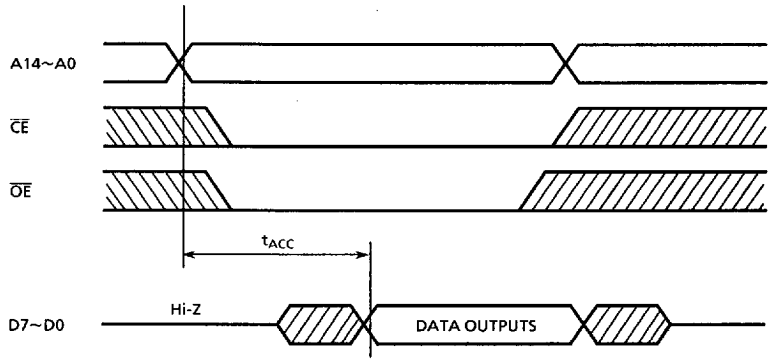
D.C./A.C. CHARACTERISTICS (PROM mode) (V_{SS} = 0V)

(1) Read Operation

PARAMETER	SYMBOL	CONDITIONS	Min.	Typ.	Max.	UNIT
Input High Voltage	V_{IH4}		V_{CC} × 0.7	–	V_{CC}	V
Input Low Voltage	V_{IL4}		0	–	V_{CC} × 0.12	V
Power Supply Voltage	V_{CC}		4.75	–	6.0	V
Program Power Supply Voltage	V_{PP}					
Address Access Time	t_{ACC}	V_{CC} = 5.0 ± 0.25V	–	1.5tcyc + 300	–	ns

Note : tcyc = 500ns at 8MHz



TIMING WAVEFORMS OF READ OPERATION

(2) High-Speed Programming Operation

PARAMETER	SYMBOL	CONDITIONS	Min.	Typ.	Max.	UNIT
Input High Voltage	V_{IH4}		V_{CC} × 0.7	–	V_{CC}	V
Input Low Voltage	V_{IL4}		0	–	V_{CC} × 0.12	V
Power Supply Voltage	V_{CC}		5.75	–	6.0	V
Program Power Supply Voltage	V_{PP}		12.0	12.5	13.0	V
Initial Program Pulse Width	t_{PW}	V_{CC} = 6.0V	0.95	1.0	1.05	ms

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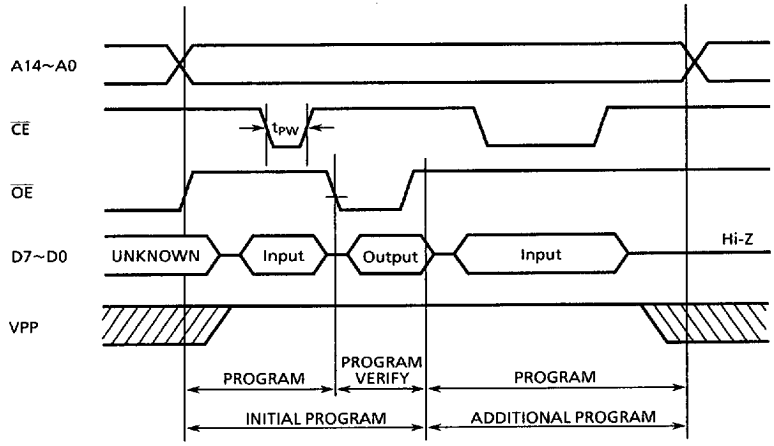

TIMING WAVEFORMS OF PROGRAMMING OPERATION

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