

CMOS 4-Bit Microcontroller

TMP47P441AN
TMP47P441AF

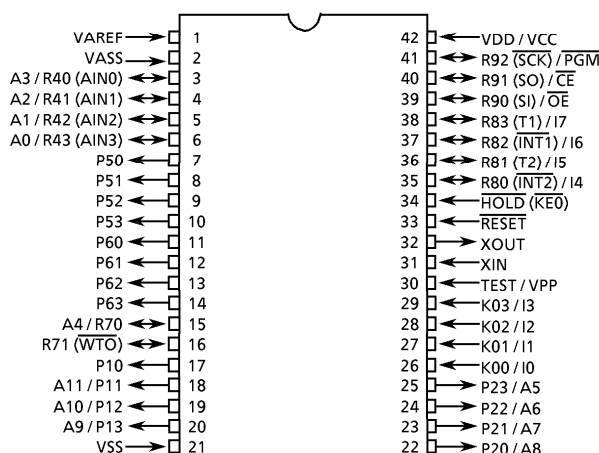
The TMP47P441A is the system evaluation LSI of TMP47C441A with 32K bits one-time PROM. The TMP47P441A programs / verifies using an adapter socket to connect with PROM programmer, as it is in TMM2764D.

In addition, the TMP47P441A and the TMP47C441A are pin compatible. The TMP47P441A operates as the same as the TMP47C441A by programming to the internal PROM.

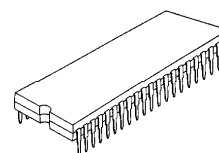
Part No.	ROM	RAM	Package	Adaptor Socket
TMP47P441AN	OTP	256 × 4-bit	P-SDIP42-600-1.78	BM1118
TMP47P441AF	4096 × 8-bit		P-QFP44-1414-0.80D	BM1125

Pin Assignment (Top View)

P-SDIP42-600-1.78



P-SDIP42-600-1.78



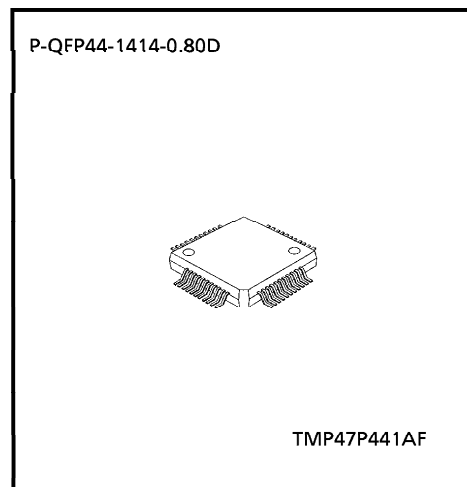
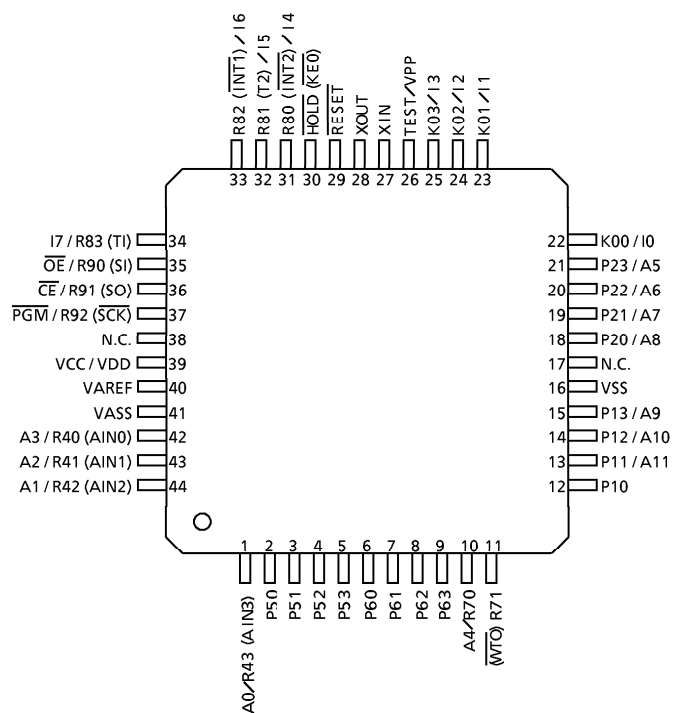
TMP47P441AN

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Pin Assignment (Top View)

P-QFP44-1414-0.80D



Pin Function

The TMP47P441A has MCU mode and PROM mode.

(1) MCU mode

The TMP47C441A and the TMP47P441A are pin compatible (TEST pin for out-going test. Be fixed to low level.).

(2) PROM mode

Pin Name	Input / Output	Functions	Pin Name (MCU Mode)
A11 to A9	INPUT	Address inputs	P11 to P13
A8 to A5			P20 to P23
A4			R70
A3 to A0			R40 to R43
I7 to I4	I/O	Data outputs (Inputs)	R83 to R80
I3 to I0			K03 to K00
$\overline{\text{PGM}}$	Input	Program control input	R92
$\overline{\text{CE}}$		Chip Enable input	R91
$\overline{\text{OE}}$		Output Enable input	R90
VPP	Power supply	+ 21 V / 5 V (Program supply voltage)	TEST
VCC		+ 5 V	VDD
VSS		0 V	VSS
P10	Output	Open	
R53 to R50	I/O	Be fixed to Low Level	
R63 to R60			
R71			
$\overline{\text{RESET}}$	Input	PROM mode setting pin. Be fixed to low level.	
$\overline{\text{HOLD}}$	Input		
XIN	Input	Resonator connecting pin	
XOUT	output		
VAREF	Power supply	Be fixed to low level	
VASS			

Operational Description

The following is an explanation of hardware configuration and operation in relation to the TMP47P441A. The TMP47P441A is the same as the TMP47C441A except that an OTP is used instead of a built-in mask ROM.

1. Operation mode

The TMP47P441A has an MCU mode and a PROM mode.

1.1 MCU mode

The MCU mode is set by fixing the TEST/VPP pin at the "L" level. Operation in the MCU mode is the same as for the TMP47C441A, except that the TEST/VPP pin does not have built in pull-down resistor and cannot be used open.

1.1.1 Program Memory

The program storage area is the same as for the TMP47C441A.

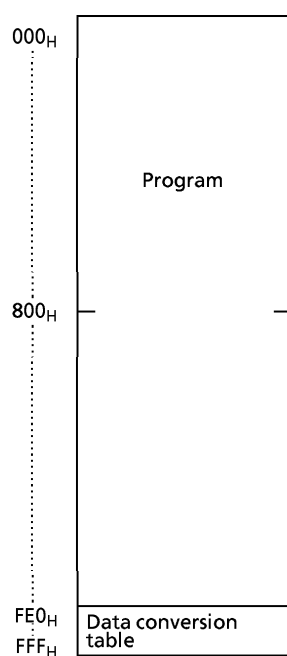


Figure 1-1. Program area

1.1.2 Data Memory

The TMP47P441A has 256 × 4-bit data memory (RAM).

1.1.3 Input/Output Circuitry

(1) Control pins

This is the same as for the TMP47C441A except that there is no built-in pull-down resistance for the TEST pin.

(2) I/O Ports

The input/output circuit of the TMP47P441A is the same as I/O code TA of the TMP47C441A.

External resistance, for example, is required when using as evaluator of other I/O codes (TB, TC), (Refer to Figure 1-2)



Figure 1-2. I/O code and external circuitry

1.2 PROM mode

The PROM mode is set by setting the $\overline{\text{RESET}}$ and $\overline{\text{HOLD}}$ pins to the "L" level. The PROM mode can be used as a general-purpose PROM writer for program writing and verification. (A high-speed program mode is used set the ROM type the same as for the TMM 2764D and an end address of FFF_H).

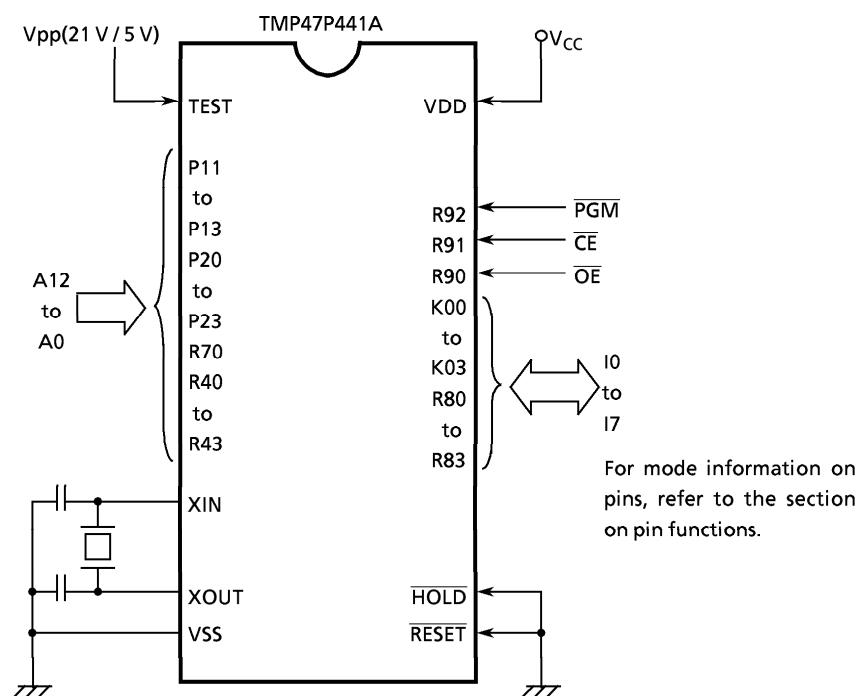


Figure 1-3. Setting for PROM mode

When writing a program, set a ROM type to 2764 (programming voltage: 21 V).

Since the TMP47P441A has 4096 × 8 bit internal PROM (000 to FFF_H), set a stop address of a PROM writer to "FFF_H", or store the same data or "FF_H" to the latter half addresses 1000 to 1FFF_H.

1.2.1 High Speed Programming Mode

The device is set up in the high speed programming mode when the programming voltage (21.0 V) is applied to the Vpp pin with Vcc = 6 V and $\overline{\text{PGM}} = V_{IH4}$. The programming is achieved by applying a single TTL low level 1 ms, pulse the $\overline{\text{PGM}}$ input after addresses and data are stable. Then the programmed data is verified by using Program Verify mode. If the programmed data is not correct, another program pulse of 1 ms is applied and then programmed data is verified. This should be repeated until the program operates correctly (max 25 times) After correctly programming the selected address, one additional program pulse with pulse width 3 times that needed for programming is applied. When programming has been completed, the data in all addresses should be verified with Vcc = Vpp = 5 V.

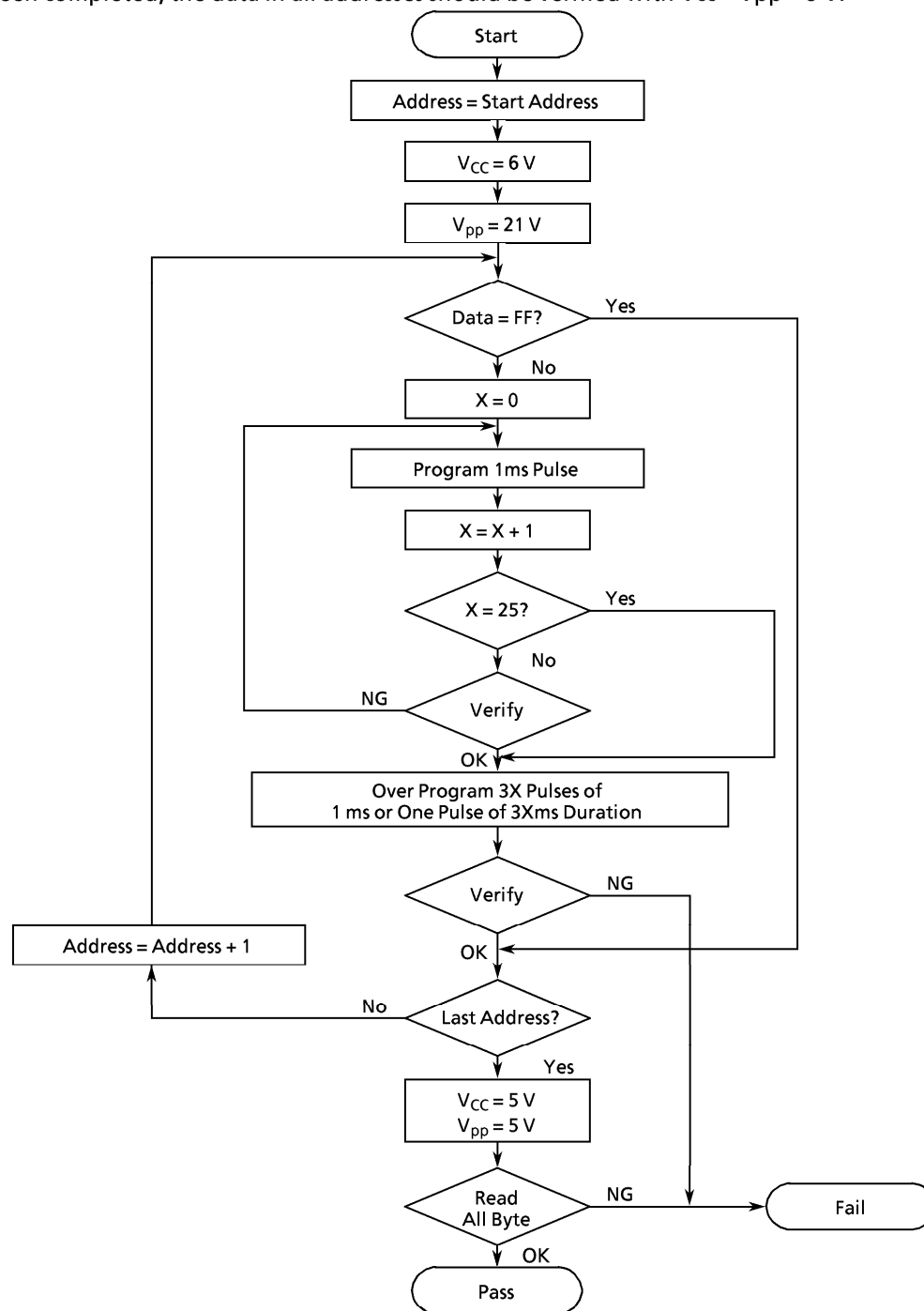


Figure1-4. Flowchart

Electrical Characteristics

Absolute Maximum Ratings

(V_{SS} = 0 V)

Parameter	Symbol	Pins	Ratings	Unit
Supply Voltage	V _{DD}		– 0.3 to 7	V
Programming Voltage	V _{PP}	TEST / VPP pin	– 0.3 to 22.0	V
Input Voltage	V _{IN}		– 0.3 to V _{DD} + 0.3	V
Output Voltage	V _{OUT1}	Except open drain pin	– 0.3 to V _{DD} + 0.3	V
	V _{OUT2}	Ports R7, R8, R9	– 0.3 to 10	
	V _{OUT3}	Analog input pin	– 0.3 to V _{DD} + 0.3	
	V _{OUT4}	Source open drain pin	– 35 to V _{DD} + 0.3	
Output Current (Per 1 pin)	I _{OUT1}	Ports P1, P2	– 10	mA
	I _{OUT2}	Ports P5, P6	– 25	
	I _{OUT3}	Ports R4 (Analog inputs) and R8	3.2	
Output Current (Total)	Σ I _{OUT}	Ports P5, P6	– 100	mA
Power Dissipation [Topr = 70°C]	PD		600	mW
Soldering Temperature (time)	Tsld		260 (10 s)	°C
Storage Temperature	Tstg		– 55 to 125	°C
Operating Temperature	Topr		– 30 to 70	°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 = – 30 to 70°C)

Parameter	Symbol	Pins	Conditions	Min	Max	Unit
Supply Voltage	V _{DD}		In the Normal mode	4.5	6.0	V
			In the HOLD mode	2.0		
Input High Voltage	V _{IH1}	Except Hysteresis Input	V _{DD} ≥ 4.5 V	V _{DD} × 0.7	V _{DD}	V
	V _{IH2}	Hysteresis Input		V _{DD} × 0.75		
	V _{IH3}		V _{DD} < 4.5 V	V _{DD} × 0.9		
Input Low Voltage	V _{IL1}	Except Hysteresis Input	V _{DD} ≥ 4.5 V	0	V _{DD} × 0.3	V
	V _{IL2}	Hysteresis Input			V _{DD} × 0.25	
	V _{IL3}		V _{DD} < 4.5 V		V _{DD} × 0.1	
Clock Frequency	fc			0.4	4.2	MHz

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: Input voltage V_{IH3}, V_{IL3}: In the SLOW or HOLD mode.

DC Characteristics

(V_{SS} = 0 V, T_{opr} = – 30 to 70°C)

Parameter	Symbol	Pins	Conditions	Min	Typ.	Max	Unit
Hysteresis Voltage	V _{HS}	Hysteresis Input		—	0.7	—	V
Input Current	I _{IN1}	Port K0, TEST, RESET, HOLD	V _{DD} = 5.5 V, V _{IN} = 5.5 V / 0 V	—	—	± 2	μA
	I _{IN2}	Ports R (open drain)					
Input Resistance	R _{IN1}	Port K0 with pull-up/pull-down		30	70	150	kΩ
	R _{IN2}	RESET		100	220	450	
Output Leakage Current	I _{LO1}	Ports R (Sink open drain)	V _{DD} = 5.5 V, V _{OUT} = 5.5 V	—	—	2	μA
	I _{LO2}	Ports P (Source open drain)	V _{DD} = 5.5 V, V _{OUT} = – 32 V	—	—	– 2	
Output High Voltage	V _{OH1}	Ports P1, P2	V _{DD} = 4.5 V, I _{OH} = – 4 mA	2.4	—	—	V
Output Low Voltage	V _{OL2}	Except XOUT, ports P	V _{DD} = 4.5 V, I _{OL} = 1.6 mA	—	—	0.4	V
High output Current	I _{OH2}	Ports P5, P6	V _{DD} = 4.5 V, V _{OH} = 2.4 V	—	– 10	—	mA
Supply Current (in the Normal mode)	I _{DD}		V _{DD} = 5.5 V, f _c = 4 MHz	—	5	10	mA
Supply Current (in the HOLD mode)	I _{DDH}		V _{DD} = 5.5 V	—	0.5	10	μA

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

Note 2: Input Current I_{IN1} ; The current through resistor is not included, when the input resistor (pull-up/pull-down) is contained.

Note 3: Supply Current I_{DD}, I_{DDH} ; V_{IN} = 5.3 V / 0.2 V

The K0 port is open when the input resistor is contained. The voltage applied to the R port is within the valid range.

AD Conversion Characteristics

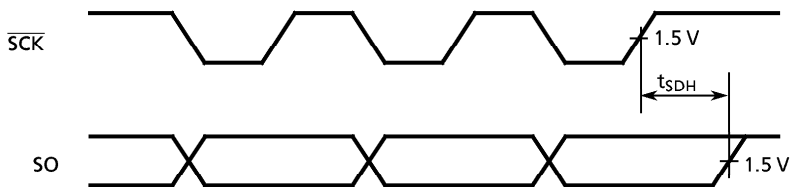
(T_{opr} = – 30 to 70°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Analog Reference Voltage	V _{AREF}		V _{DD} – 1.5	—	V _{DD}	V
	V _{ASS}		V _{SS}	—	1.5	
Analog Reference Voltage Range	ΔV _{AREF}	V _{AREF} – V _{ASS}	2.5	—	—	V
Analog Input Voltage	V _{AIN}		V _{ASS}	—	V _{AREF}	V
Analog Supply Current	I _{REF}		—	0.5	1.0	mA
Nonlinearity Error		V _{DD} = 5.0 V, V _{SS} = 0.0 V V _{AREF} = 5.000 V V _{ASS} = 0.000 V	—	—	± 1	LSB
Zero Point Error			—	—	± 1	
Full Scale Error			—	—	± 1	
Total Error			—	—	± 2	

(V_{SS} = 0 V, V_{DD} = 4.5 to 6.0 V, T_{opr} = -30 to 70°C)

Note: *Shift Data Hold Time*

Serial port (completion of transmission)



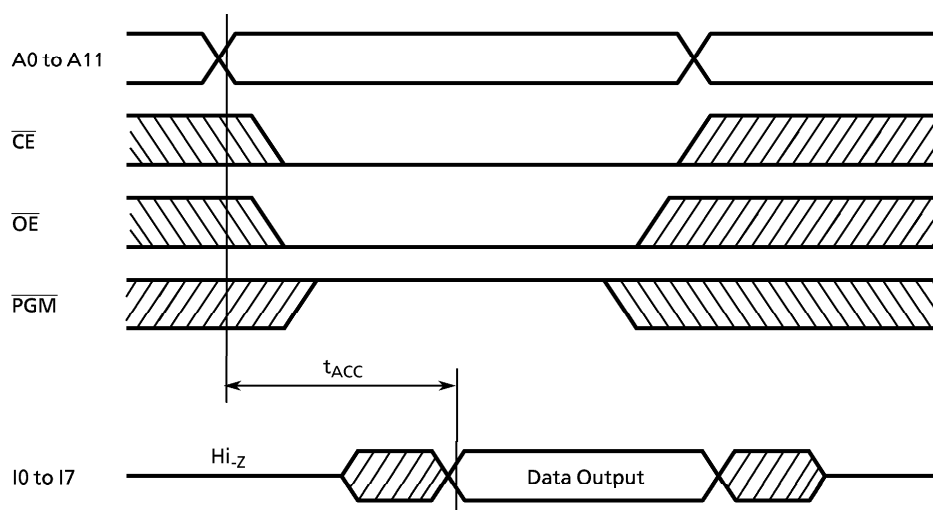
($V_{SS} = 0\text{ V}$, $V_{DD} = 4.5\text{ to }6.0\text{ V}$, $T_{opr} = -30\text{ to }70^{\circ}\text{C}$)

Recommended oscillating conditions of the TMP47P441A are equal to the TMP47C441A's.

$(V_{SS} = 0 \text{ V})$

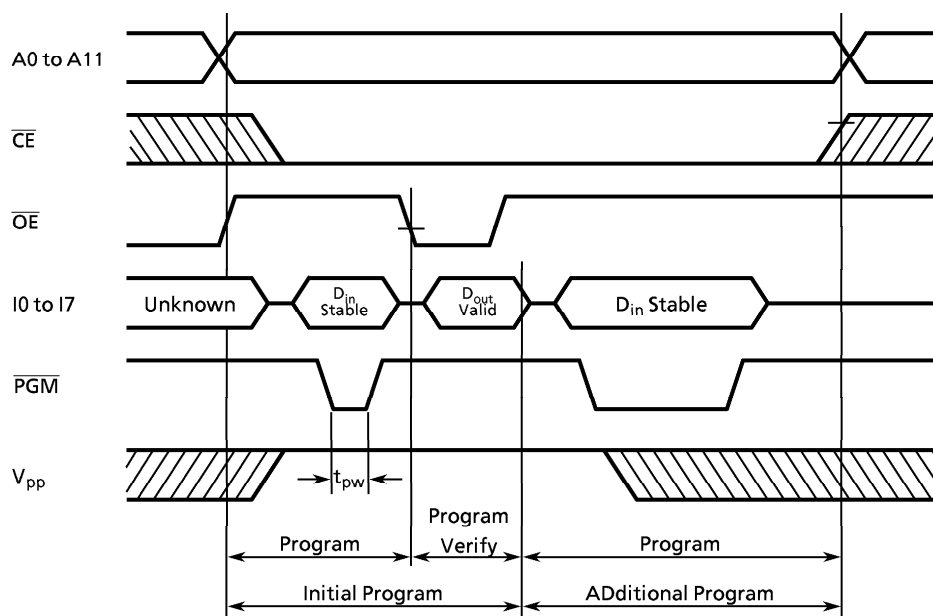
(1) ReAD Operation

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Output Level High Voltage	V_{IH4}		$V_{CC} \times 0.8$	–	V_{CC}	V
Output Level Low Voltage	V_{IL4}		0	–	$V_{CC} \times 0.1$	V
Supply Voltage	V_{CC}		4.75	–	6.0	V
Programming Voltage	V_{PP}					
Address Access Time	t_{ACC}	$V_{CC} = 5.0 \pm 0.25$ V	–	–	350	ns



(2) High Speed Programming Operation

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Input High Voltage	V_{IH4}		$V_{CC} \times 0.8$	–	V_{CC}	V
Input Low Voltage	V_{IL4}		0	–	$V_{CC} \times 0.1$	V
Supply Voltage	V_{CC}		4.75	–	6.0	V
V_{PP} Power Supply Voltage	V_{PP}		20.5	21.0	21.5	V
Programming Pulse Width	t_{PW}	$V_{CC} = 6.0 \pm 0.25$ V	0.95	1.0	1.05	ms



- * Difference compared with the TMPTMP47C441A
The TMP47P441A is different from the TMP47C441A with respect to the following spec points.

Absolute Maximum Ratings

(V_{SS} = 0 V)

Parameter	Symbol	Pins		Rating	Unit
		TMP47C441A	TMP47P441A		
Output Voltage	V _{OUT2}	Ports P7, P8, R9	Ports R7, R9	– 0.3 to 10	V
	V _{OUT3}	Analog inputs	Ports R4 (Analog inputs) and R8	– 0.3 to V _{DD} + 0.3	

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.

DC Characteristics

(V_{SS} = 0 V, T_{opr} = – 30 to 70°C)

Parameter	Symbol	Conditions	TMP47C441A			TMP47P441A			Unit
			Min	Typ.	Max	Min	Typ.	Max	
Supply Current	I _{DD}	In the Normal mode	—	3	6	—	5	10	mA

*Note: Be fixed low level at MCU mode because of TEST pin does not have pull-down resistor.
Input/output circuitry of I/O port as the same as the code TA of the TMP47C441A.*

Typical Characteristics

