CMOS 4-Bit Microcontroller

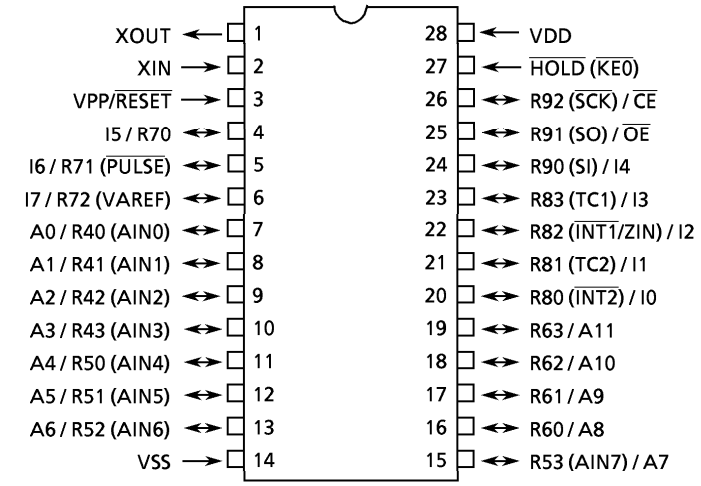
TMP47P443VN
TMP47P443VM
TMP47P443VDM

The TMP47P443V is the system evaluation LSI of TMP47C243/443 with a 32 Kbit one-time PROM. The TMP47P443V programs / verifies using an adapter socket to connect with PROM programmer, as it is in TMM27256AD.
In addition, the TMP47P443V and the TMP47C243/443 are pin compatible. The TMP47P443V operates as the same as the TMP47C243/443 by programming to the internal PROM.

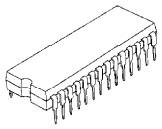
Part No.	ROM	RAM	Rackage	Adapter Socket
TMP47P443VN	OTP 4096 × 8-bit	256 × 4-bit	P-SDIP28-400-1.78	BM11100
TMP47P443VM			P-SOP28-450-1.27	BM11101
TMP47P443VDM			P-SSOP30-56-0.65	BM11115

Pin Assignment (Top View)

P-SDIP28-400-1.78 / P-SOP28-450-1.27

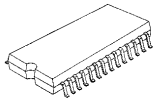


P-SDIP28-400-1.78



TMP47P443VN

P-SOP28-450-1.27



TMP47P443VM

000707EBA1

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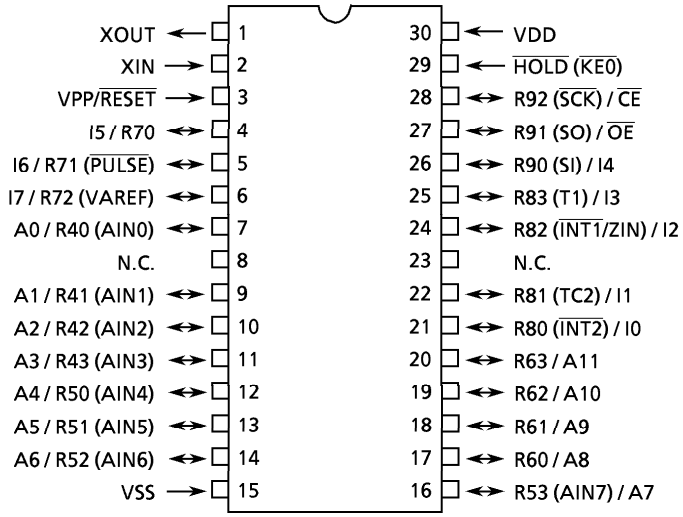
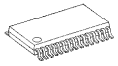
Pin Assignment (Top View)

P-SSOP30-56-0.65



P-SSOP30-56-0.65



TMP47P443VDM

Pin Function

The TMP47P443V has MCU mode and PROM mode.

(1) MCU mode

The TMP47C243/443 and the TMP47P443V are pin compatible.

(2) PROM mode

Pin Name	Input / Output	Functions	Pin Name (MCU mode)
A11 to A8	Input	Address inputs	R63 to R60
A7 to A4			R53 to R50
A3 to A0			R43 to R40
I7 to I5	I/O	Data inputs / outputs	R72 to R70
I4			R90
I3 to I0			R83 to R80
$\overline{CE}$	Input	Chip Enable input	R92
$\overline{OE}$		Output Enable input	R91
VPP	Power supply	+ 12.5 V / 5 V (Program supply voltage)	$\overline{RESET}$
VCC		+ 5 V	VDD
VSS		0 V	VSS
$\overline{HOLD}$	Input	PROM mode setting pin. Be fixed to low level.	
XIN	Input	Input the clock from the external oscillator. (6 MHz typ.)	
XOUT	Input	Be pulled down to VSS level. (750 Ω typ.)	

Operational Description

The following is an explanation of hardware configuration and operation in relation to the TMP47P443V. The TMP47P443V is the same as the TMP47C243/443 except that an OTP is used instead of a built-in mask ROM.

1. Operation mode

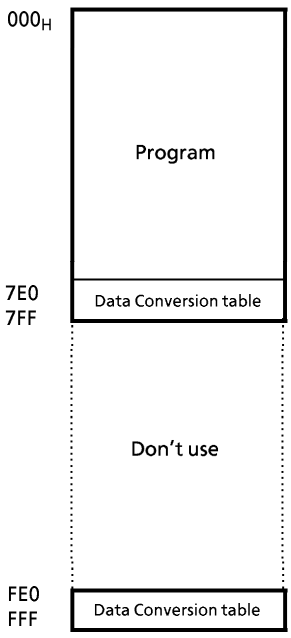
The TMP47P443V has a MCU mode and a PROM mode.

1.1 MCU mode

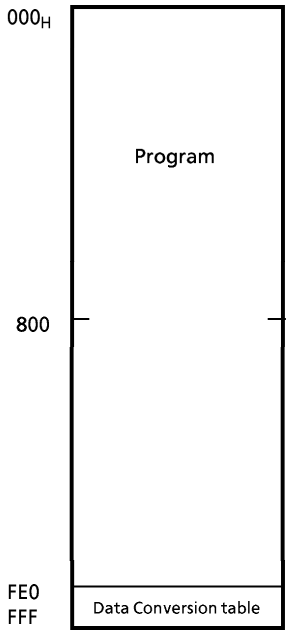
The MCU mode is set by attaching a resonator between the XIN and Xout pins. Operation in the MCU mode is the same as for the TMP47C243/443. In the TMP47P443V, RC oscillation is impossible.

1.1.1 Program Memory

The program storage area is the same as for the TMP47C443. Data conversion tables must be set in two locations when using the TMP47P443V to check TMP47C243 operation.

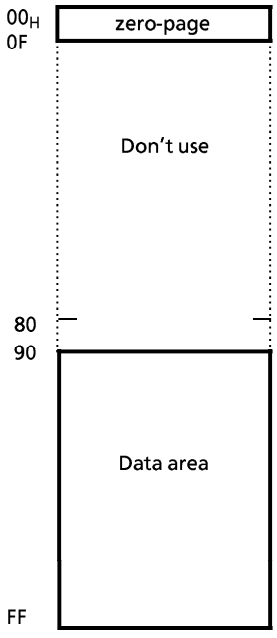


(a) TMP47C243



(b) TMP47C443

Figure 1-1. Program area (ROM)



(in case of TMP47C243)

Figure 1-2. RAM addressing

1.1.2 Data Memory

The TMP47P443V has 256 × 4-bit of data memory (RAM). When the TMP47P443V is used as the TMP47C243 evaluator, programming should be performed assuming that the RAM is assigned to address 00 to $0F_H$ and 90 to FF_H as show in Figure 1-2. When the BM47C443 (emulator) is used as the TMP47C243 evaluator, it is same.

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}	$\overline{RESET}$ / VPP pin		– 0.3 to 13.0	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 1 pin)	I_{OUT1}	Port R5, R6		30	mA
	I_{OUT2}	Port R4, R7, R8, R9		3.2	
Output Current (Total)	ΣI_{OUT}	Port R4, R5, R6, R7, R8, R9		120	mA
Power Dissipation [Topr = 70°C]	PD		DIP	300	mW
			SOP	180	
			SSOP	145	
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}		fc = 8.0 MHz	2.7	5.5	V
			fc = 4.2 MHz	2.2		
			In the HOLD mode	2.0		
Input High Voltage	V_{IH1}	Except Hysteresis Input	In the normal operating area	V_{DD} × 0.7	V_{DD}	V
	V_{IH2}	Hysteresis Input		V_{DD} × 0.75		
	V_{IH3}		In the HOLD mode	V_{DD} × 0.9		
Input Low Voltage	V_{IL1}	Except Hysteresis Input	In the normal operating area	0	V_{DD} × 0.3	V
	V_{IL2}	Hysteresis Input			V_{DD} × 0.25	
	V_{IL3}		In the HOLD mode		V_{DD} × 0.1	
Clock Frequency	fc	XIN, XOUT	V_{DD} = 2.7 to 5.5 V	0.4	8.0	MHz
			V_{DD} = 2.2 to 5.5 V		4.2	

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 Characteristics

(V_{SS} = 0 V, Topr = – 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}	$\overline{RESET}$, $\overline{HOLD}$	V_{DD} = 5.5 V, V_{IN} = 5.5 V / 0 V	–	–	± 2	μA
	I_{IN2}	Open drain output ports					
Input Resistance	R_{IN}	$\overline{RESET}$		100	220	450	kΩ
Output Leakage Current	I_{LO}	Open drain output ports	V_{DD} = 5.5 V, V_{OUT} = 5.5 V	–	–	2	μA
Output Low Voltage	V_{OL}	Port R4, R7, R8, R9	V_{DD} = 4.5 V, I_{OL} = 1.6 mA	–	–	0.4	V
			V_{DD} = 2.2 V, I_{OL} = 20 μA	–	–	0.1	
Output Low Current	I_{OL1}	Port R5, R6	V_{DD} = 4.5 V, V_{OL} = 1.0 V	7	20	–	mA
Supply Current (in the Normal operating mode)	I_{DD}		V_{DD} = 5.5 V, fc = 4 MHz	–	2	4	mA
			V_{DD} = 3.0 V, fc = 4 MHz	–	1	2	
			V_{DD} = 3.0 V, fc = 400 kHz	–	0.5	1	
Supply Current (in the HOLD operating mode)	I_{DDH}		V_{DD} = 5.5 V	–	0.5	10	μA

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

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

Note 3: Supply Current: The analog supply current (I_{REF}) is not included.

Note 4: Supply Current: V_{IN} = 5.3 V / 0.2 V (V_{DD} = 5.5 V), 2.8 V / 0.2 V (V_{DD} = 3.0 V)

AD Conversion Characteristics

(Topr = – 30 to 70°C)

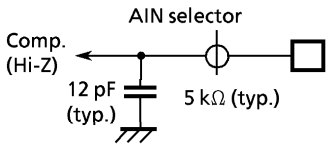
Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Analog Reference Voltage	V_{AREF}		V_{DD} – 1.5	—	V_{DD}	V
Analog Reference Voltage Range	ΔV_{AREF}	V_{AREF} – V_{SS}	2.7	—	—	V
Analog Input Voltage	V_{AIN}		V_{SS}	—	V_{DD}	V
Analog Supply current	I_{REF}		—	0.5	1.0	mA
Nonlinearity Error		V_{DD} = 2.7 to 5.5 V, V_{AREF} = V_{DD} ± 0.001 V, V_{SS} = ± 0.001 V	—	—	± 1	LSB
Zero Point Error			—	—	± 1	
Full Scale Error			—	—	± 1	
Total Error			—	—	± 2	

AC Characteristics

(V_{SS} = 0 V, Topr = – 30 to 70°C)

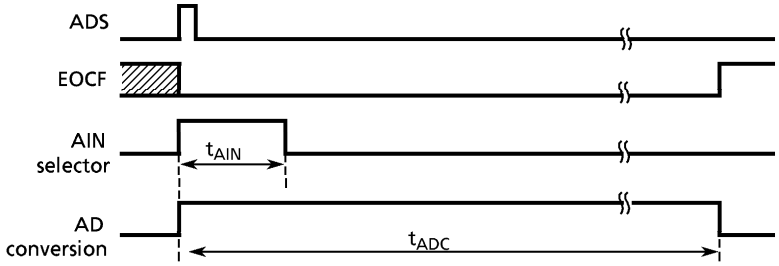
Parameter	Symbol	Conditions		Min	Typ.	Max	Unit
Instruction Cycle Time	tcy		V_{DD} = 2.7 to 5.5 V	1.0	–	20	μs
			V_{DD} = 2.2 to 5.5 V	1.9			
High level clock pulse width	t_{WCH}	For external clock (XIN input)	$V_{DD} \geqq 2.7$ V	60	–	–	ns
			$V_{DD} < 2.7$ V	120			
Low level clock pulse width	t_{WCL}		$V_{DD} \geqq 2.7$ V	60			
			$V_{DD} < 2.7$ V	120			
AD Conversion Time	t_{ADC}			–	24 tcy	–	μs
AD Sampling Time	t_{AIN}			–	2 tcy	–	
Shift data Hold Time	t_{SDH}			0.5 tcy – 0.3	–	–	μs

Note 1: AD conversion timing:
Internal circuit for pins AIN0 to 7

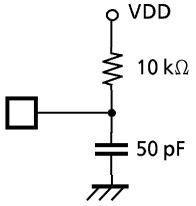


* Electrical change inust be loaded into the buit-in condensen during t_{AIN} for normal AD conversion.

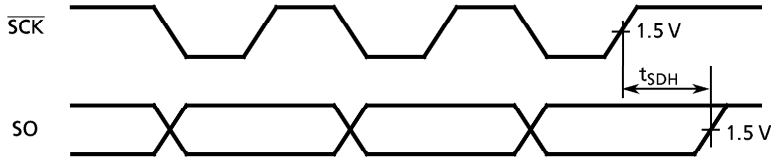
AD conversion timing



Note 2: Shift data Hold Time:
External circuit for pins
$\overline{SCK}$ and SO



Serial port (completed of transmission)



Zero-Cross Detection Characteristics

(V_{SS} = 0 V, Topr = – 30 to 70℃)

Characteristics are equivalent to the TMP47C243/443's.

Recommended Oscillating Conditions

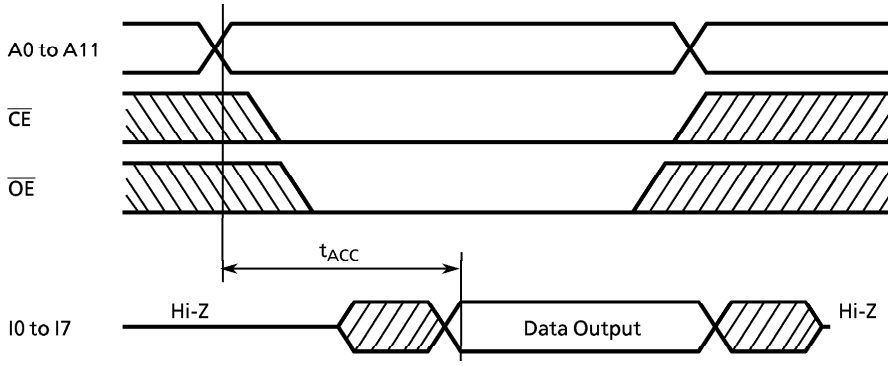
(V_{SS} = 0 V, V_{DD} = 2.2 to 5.5 V, Topr = – 30 to 70℃)

Recommended oscillating conditions of the TMP47P443V are equal to the TMP47C243/443's but RC oscillation is impossible.

DC/AC Characteristics (V_{SS} = 0 V)

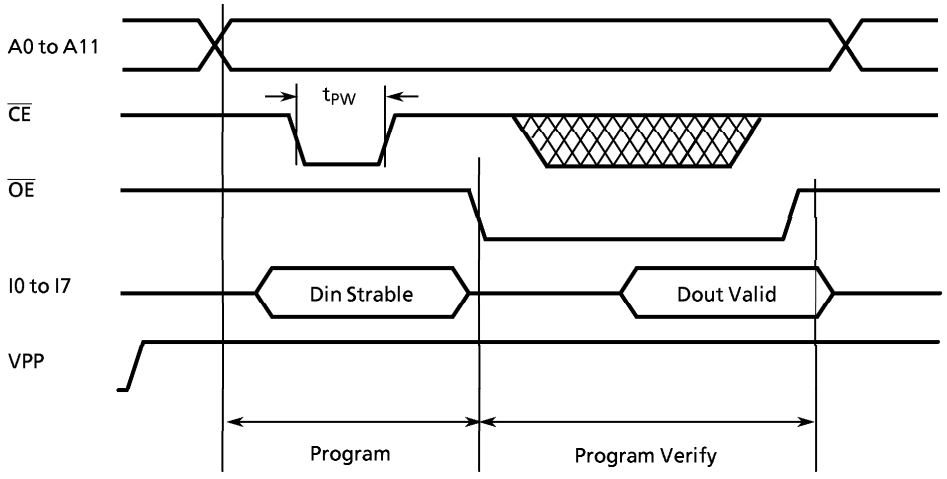
(1) Read Operation

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Output Level High Voltage	V_{IH4}		$V_{CC} \times 0.7$	–	V_{CC}	V
Output Level Low Voltage	V_{IL4}		0	–	$V_{CC} \times 0.3$	V
Supply Voltage	V_{CC}		4.75	–	6.0	V
Programming Voltage	V_{PP}					
Address Access Time	t_{ACC}	V_{CC} = 5.0 ± 0.25 V	0	–	350	ns

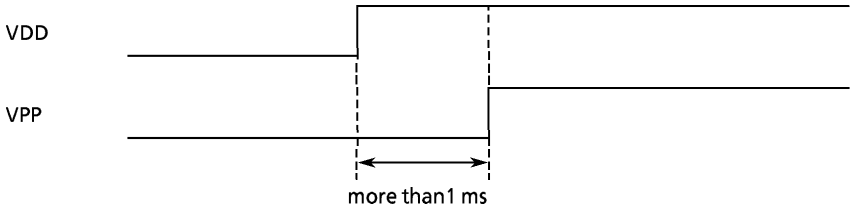


(2) High Speed Programming Operation

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Input High Voltage	V_{IH4}		$V_{CC} \times 0.7$	–	V_{CC}	V
Input Low Voltage	V_{IL4}		0	–	$V_{CC} \times 0.3$	V
Supply Voltage	V_{CC}		4.75	–	6.0	V
V_{PP} Power Supply Voltage	V_{PP}		12.0	12.5	13.0	V
Programming Pulse Width	t_{PW}	V_{CC} = 6.0 ± 0.25 V	0.95	1.0	1.05	ms



Note: There are some PROM programmer types which cannot program OTP.
In TMP47P443V, VPP pin is also used as RESET pin. To set a mode, REST/VPP pin must be set to "low" during 1 ms and more after the rising of power-on and the rising of VDD electrical power.



Recommended EPROM programmer

TYPE	
R4945	(ADVANTEST)
UNISITE	(DATA I/O)
AF – 9706	(ANDO)
PECKER – 11	(AVAL DATA)