TOSHIBA

TOSHIBA Original CMOS 4-Bit Microcontroller

TLCS-47 Series

TMP47P241VNG
TMP47P241VMG

TOSHIBA CORPORATION

Semiconductor Company

Document Change Notification

The purpose of this notification is to inform customers about the launch of the Pb-free version of the device. The introduction of a Pb-free replacement affects the datasheet. Please understand that this notification is intended as a temporary substitute for a revision of the datasheet.

Changes to the datasheet may include the following, though not all of them may apply to this particular device.

1. Part number

   Example: TMPxxxxxxF → TMPxxxxxxFG

   All references to the previous part number were left unchanged in body text. The new part number is indicated on the prelims pages (cover page and this notification).

2. Package code and package dimensions

   Example: LQFP100-P-1414-0.50C → LQFP100-P-1414-0.50F

   All references to the previous package code and package dimensions were left unchanged in body text. The new ones are indicated on the prelims pages.

3. Addition of notes on lead solderability

   Now that the device is Pb-free, notes on lead solderability have been added.

4. RESTRICTIONS ON PRODUCT USE

   The previous (obsolete) provision might be left unchanged on page 1 of body text. A new replacement is included on the next page.

5. Publication date of the datasheet

   The publication date at the lower right corner of the prelims pages applies to the new device.

1. Part number

2. Package code and dimensions

Previous Part Number (in Body Text)	Previous Package Code (in Body Text)	New Part Number	New Package Code	OTP
TMP47P241VN	P-SDIP28-400-1.78	TMP47P241VNG	SDIP28-P-400-1.78	—
TMP47P241VM	P-SOP28-450-1.27	TMP47P241VMG	SOP28-P-450-1.27B	—

*: For the dimensions of the new package, see the attached Package Dimensions diagram.

3. Addition of notes on lead solderability

The following solderability test is conducted on the new device.

Lead solderability of Pb-free devices (with the G suffix)

Test	Test Conditions	Remark
Solderability	(1) Use of Lead (Pb) ·solder bath temperature = 230°C ·dipping time = 5 seconds ·the number of times = once ·use of R-type flux (2) Use of Lead (Pb)-Free ·solder bath temperature = 245°C ·dipping time = 5 seconds ·the number of times = once ·use of R-type flux	Leads with over 95% solder coverage till lead forming are acceptable.

4. RESTRICTIONS ON PRODUCT USE

The following replaces the "RESTRICTIONS ON PRODUCT USE" on page 1 of body text.

RESTRICTIONS ON PRODUCT USE 20070701-EN

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- For a discussion of how the reliability of microcontrollers can be predicted, please refer to Section 1.3 of the chapter entitled Quality and Reliability Assurance/Handling Precautions.

5. Publication date of the datasheet

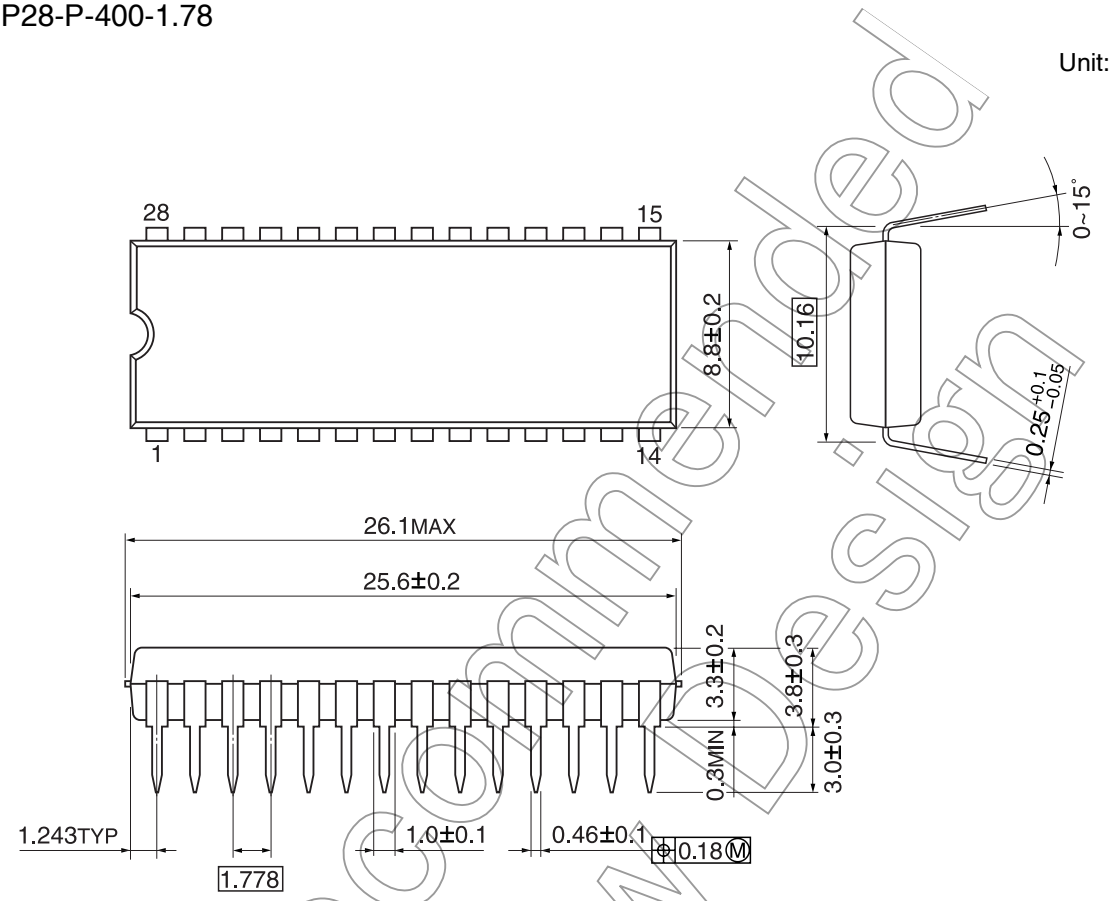
The publication date of this datasheet is printed at the lower right corner of this notification.

(Annex)

Package Dimensions

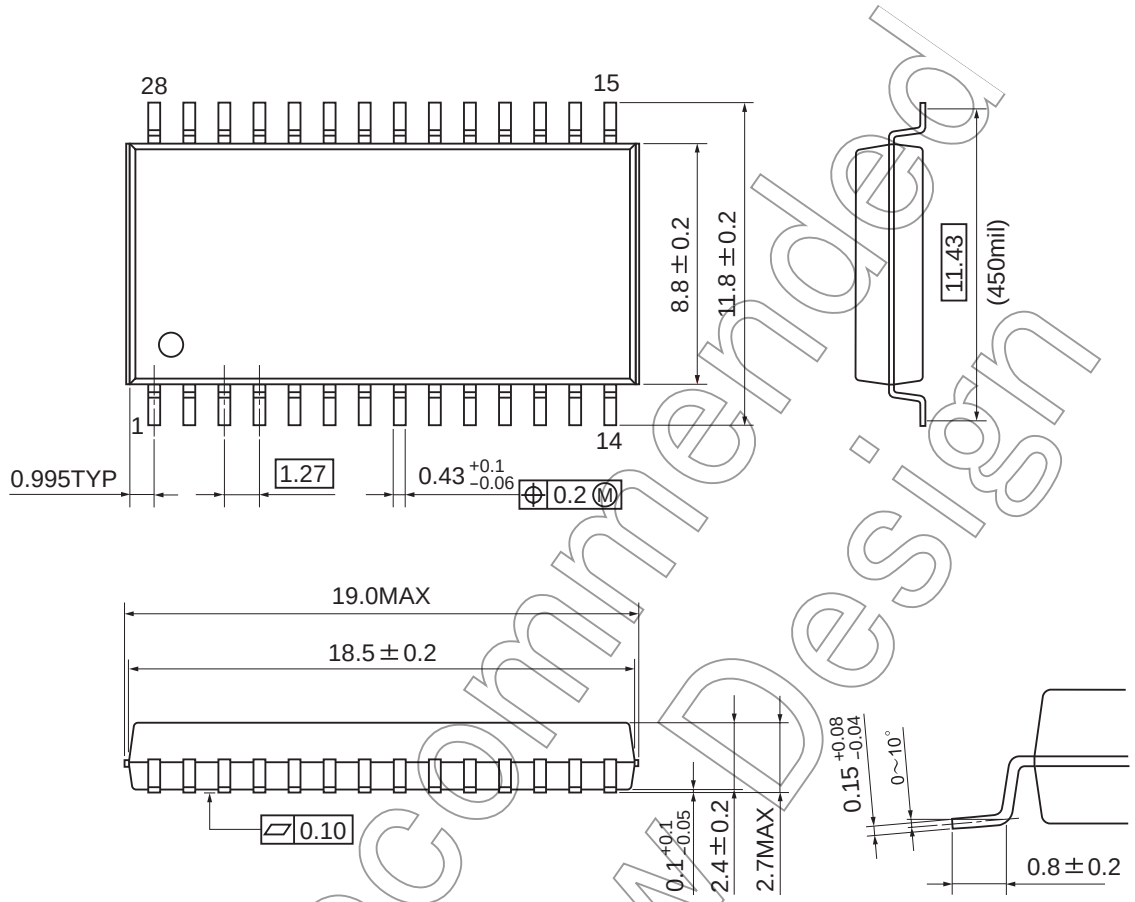
SDIP28-P-400-1.78

Unit: mm



SOP28-P-450-1.27B

Unit: mm



Note: Palladium plated

CMOS 4-Bit Microcontroller

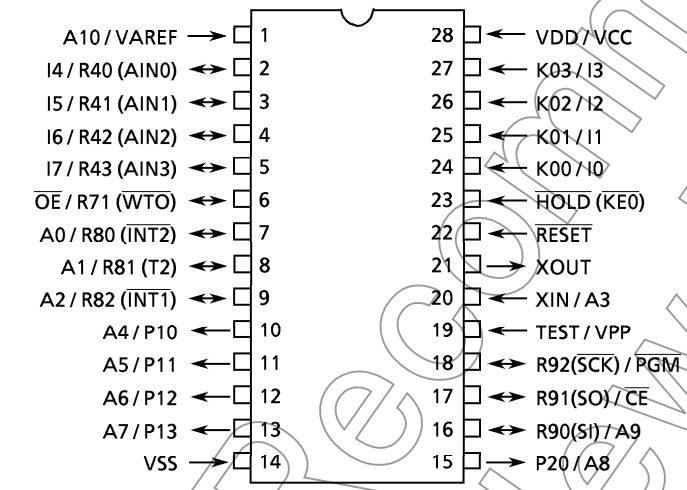
TMP47P241VN
TMP47P241VM

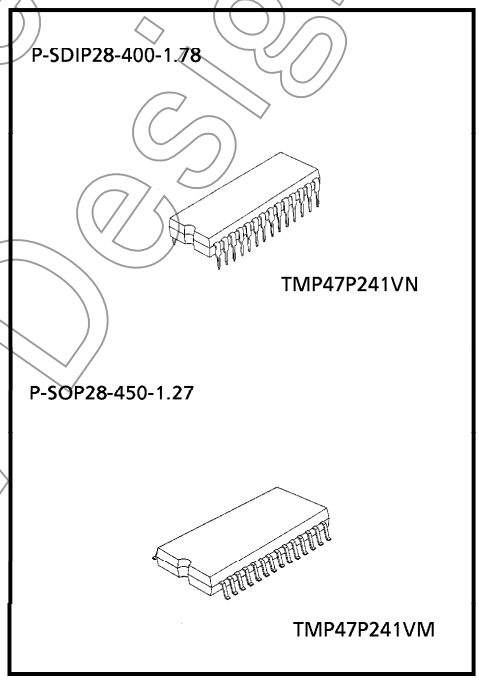
The TMP47P241V is the system evaluation LSI of TMP47C241 with a 16 Kbit one-time PROM. The TMP47P241V programs / verifies using an adapter socket to connect with PROM programmer, as it is in TMM2764AD.
In addition, the TMP47P241V and the TMP47C241 are pin compatible. The TMP47P241V operates as the same as the TMP47C241 by programming to the internal PROM.

Part No.	ROM	RAM	Package	Adaptor Socket
TMP47P241VN	OTP	128 × 4-bit	P-SDIP28-400-1.78	BM1156
TMP47P241VM	2048 × 8-bit		P-SOP28-450-1.27	BM1157

Pin Assignment (Top View)

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





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- For a discussion of how the reliability of microcontrollers can be predicted, please refer to Section 1.3 of the chapter entitled Quality and Reliability Assurance / Handling Precautions.
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Pin Function

The TMP47P241V has MCU mode and PROM mode.

(1) MCU mode

The TMP47C241 and the TMP47P241V 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)
A10	INPUT	Address inputs	VAREF
A9			R90
A8			P20
A7 to A4			P13 to P10
A3			XIN
A2 to A0			R82 to R80
I7 to I4	I/O	Data outputs (Inputs)	R43 to R40
I3 to I0			K03 to K00
$\overline{PGM}$	Input	Program control input	R92
$\overline{CE}$		Chip Enable input	R91
$\overline{OE}$		Output Enable input	R71
VPP	Power supply	+ 12.5 V / 5 V (Program supply voltage)	TEST
VCC		+ 5 V	VDD
VSS		0 V	VSS
$\overline{RESET}$	Input	PROM mode setting pin. Be fixed to low level.	
$\overline{HOLD}$	Input		
XOUT	Input	Input the clock from the external oscillator.	

Operational Description

The following is an explanation of hardware configuration and operation in relation to the TMP47P241V. The TMP47P241V is the same as the TMP47C241 except that an OTP is used instead of a built-in mask ROM.

1. Operation mode

The TMP47P241V 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 TMP47C241, except that the TEST/VPP pin does not have built in pull-down resistor and cannot be used open. In the TMP47P241V, RC oscillation is impossible.

1.1.1 Program Memory

The program storage area is the same as for the TMP47C241.

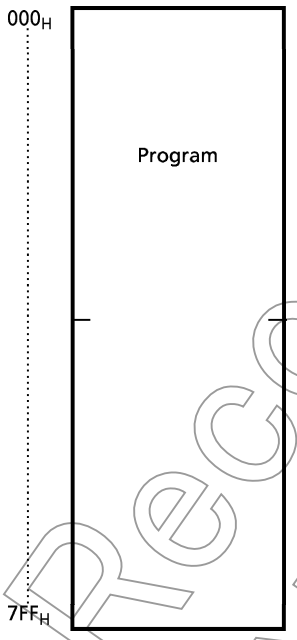


Figure 1-1. Program area (ROM)

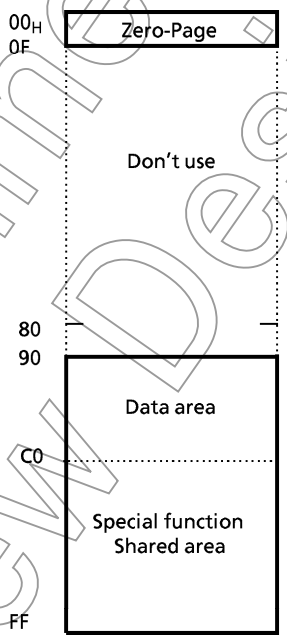


Figure 1-2. RAM addressing

1.1.2 Data Memory

The TMP47P241V has 128 × 4-bit of data memory (RAM).

When the TMP47C940A is used as evaluator of the TMP47C241V, programming should be performed assuming that the RAM is assigned to addresses 00 to $7F_H$ and 90 to FF_H as show in Figure 1-2 by considering the application software evaluation. When the BM47214A (emulator) is used as the TMP47C241 evaluator, it is same.

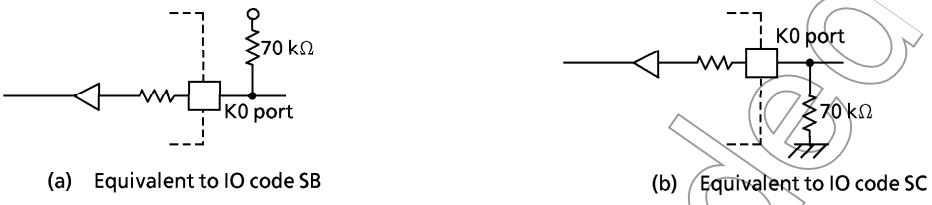
1.1.3 Input / Output Circuitry

(1) Control pins

This is the same as for the TMP47C241 except that there is no built-in pull-down resistance for the TEST pin. In the TMP47P241V, RC oscillation is impossible. Connecting the resonator is required when using as evaluator of I/O code SG.

(2) I/O Ports

The input/output circuit of the TMP47P241V is the same as I/O code SA of the TMP47C241.
External resistance, for example, is required when using as evaluator of other I/O codes (SB, SC).



(a) Equivalent to IO code SB (b) Equivalent to IO code SC

Figure 1-3. I/O code and external circuitry

1.2 PROM mode

The PROM mode is set by setting the $\overline{\text{RESET}}$, $\overline{\text{HOLD}}$ pins to the "L" level. In PROM mode, programs can be written or verified using a general-purpose PROM writer with an adapter socket being attached.
(A high-speed program mode is used is used set the ROM type the same as for the TMM2764AD.)

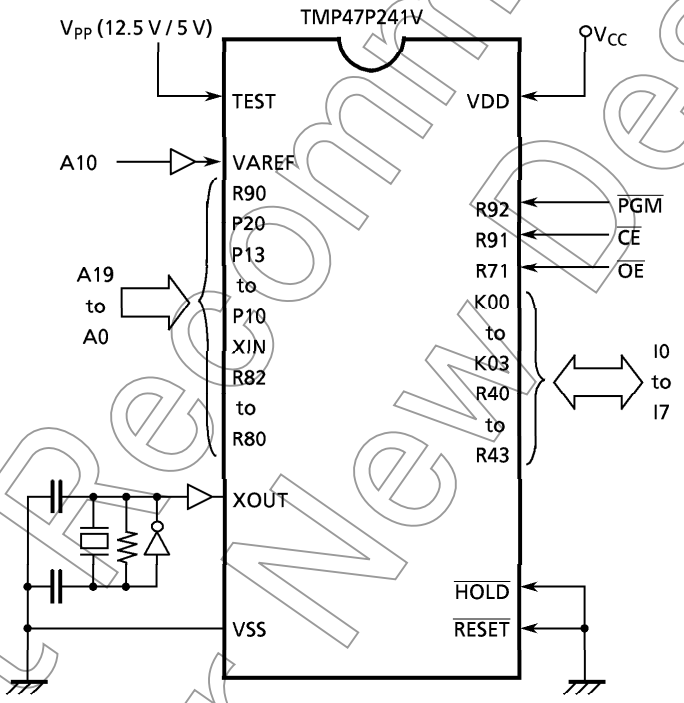


Figure 1-4. Setting for PROM mode

1.2.1 Program Writing

When writing a program, set a ROM type to "2764A" (programming voltage: 12.5 V) . Since the TMP47P241V has a 2048×8-bit internal PROM (000 to $7FF_H$) , set a stop address of a PROM writer to "$7FF_H$" . For a general-purpose PROM writer, use the writer which does not have or can release an electric signature mode.

1.2.2 High Speed Programming Mode

The program time can be greatly decreased by using this high speed programming mode. The device is set up in the high speed programming mode when the programming voltage (+ 12.5 V) is applied to the V_{PP} terminal with V_{CC} = 6 V and $\overline{PGM}$ = V_{IH}.

The programming is achieved by applying a single low level 1ms pulse the $\overline{PGM}$ 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 1ms 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 V_{CC} = V_{PP} = 5 V.

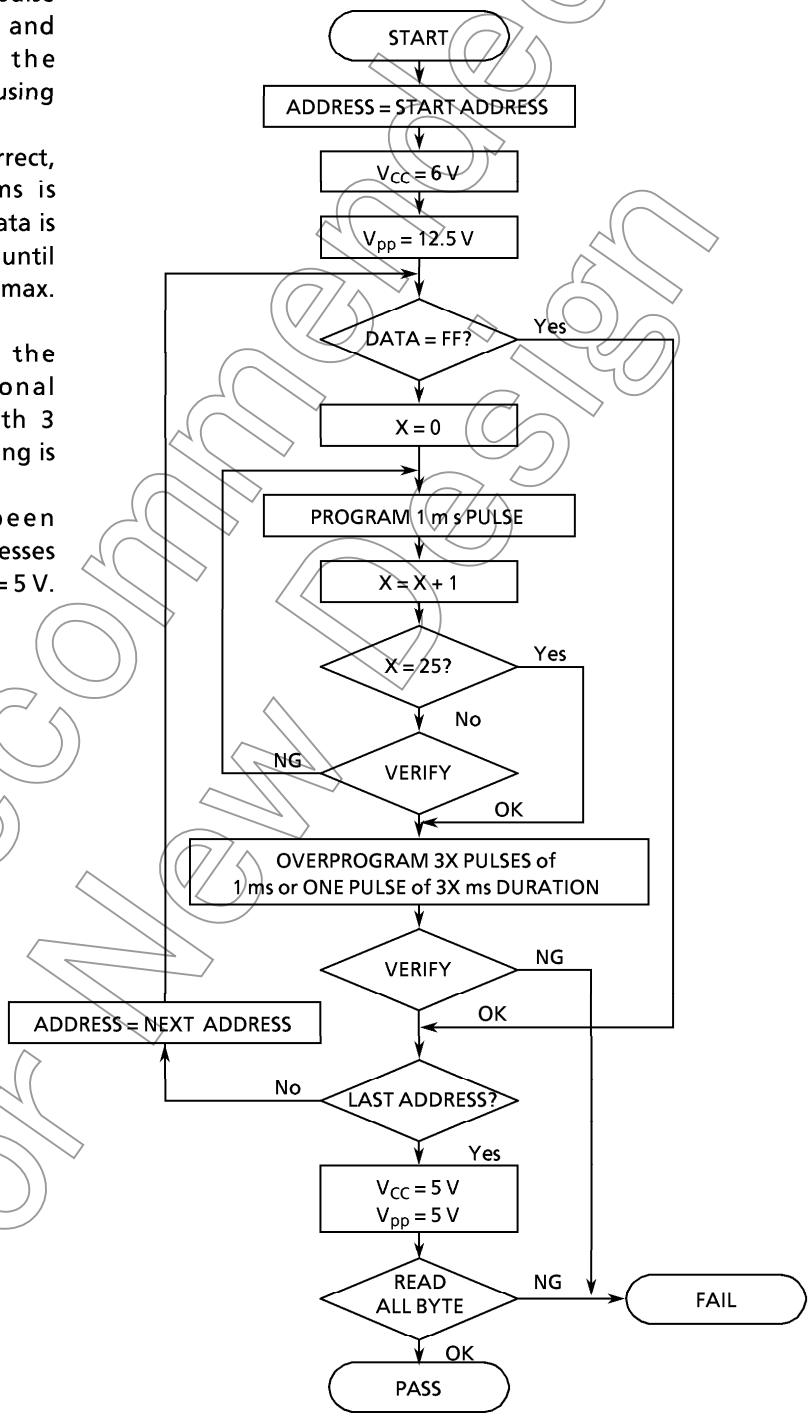


Figure 1-5. Flowchart

Electrical Characteristics

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

Parameter	Symbol	Pins	Ratings	Unit
Supply Voltage	V_{DD}		– 0.3 to 7	V
Program Voltage	V_{PP}	$\overline{HOLD}$/VPP pin	– 0.3 to 14.0	V
Input Voltage	V_{IN}		– 0.3 to V_{DD} + 0.3	V
Output Voltage	V_{OUT1}	Except sink open drain pin	– 0.3 to V_{DD} + 0.3	V
	V_{OUT2}	Ports P1, P2, R7 to R9	– 0.3 to 10	
	V_{OUT3}	Port R4 (Analog inputs)	– 0.3 to V_{DD} + 0.3	
Output Current (Per 1 pin)	I_{OUT1}	Ports P1, P2	30	mA
	I_{OUT2}	Port R9	15	
	I_{OUT3}	Ports R4, R7, R8	3.2	
Output Current (Total)	ΣI_{OUT1}	Ports P1, P2, R9	120	mA
Power Dissipation [Topr = 70℃]	PD		300	mW
Soldering Temperature (time)	Tsld		260 (10 s)	℃
Storage Temperature	Tstg		– 55 to 125	℃
Operating Temperature	Topr		– 30 to 70	℃

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 = 6.0 MHz	4.5	6.0	V
			fc = 4.2 MHz	2.7		
			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		V_{DD} = 4.5 to 6.0 V	0.4	6.0	MHz
			V_{DD} = 2.7 to 6.0 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}	Port K0, TEST, $\overline{RESET}$, $\overline{HOLD}$	V_{DD} = 5.5 V, V_{IN} = 5.5 V / 0 V	—	—	± 2	μA
	I_{IN2}	Ports R (open drain)					
Input Registance	R_{IN1}	Port K0 with pull-up/pull-down		30	70	150	kΩ
	R_{IN2}	$\overline{RESET}$		100	220	450	
Output Leakage Current	I_{LO}	Ports R, P (open drain)	V_{DD} = 5.5 V, V_{OUT} = 5.5 V	—	—	2	μA
Output Low Voltage	V_{OL2}	Except XOUT, ports P	V_{DD} = 4.5 V, I_{OL} = 1.6 mA	—	—	0.4	V
Low Output Current	I_{OL1}	Ports P1, P2	V_{DD} = 4.5 V, V_{OL} = 1.0 V	—	20	—	mA
	I_{OL2}	Port R9		—	7	—	
Supply Current (in the Normal 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 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} = 5 V.

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

(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_{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	

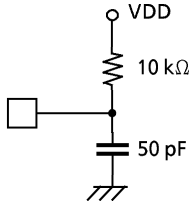
AC Characteristics

(V_{SS} = 0 V, Topr = – 30 to 70°C)

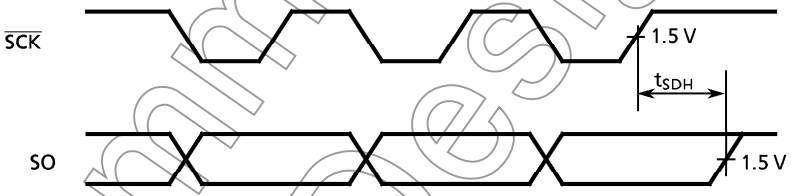
Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Instruction Cycle Time	t_{cy}	V_{DD} = 4.5 to 6.0 V	1.3	—	20	μs
		V_{DD} = 2.7 to 6.0 V	1.9			
High level Clock pulse Width	t_{WCH}	External clock mode	80	—	—	ns
Low level Clock pulse Width	t_{WCL}					
AD Sampling Time	t_{AIN}	fc = 4 MHz	—	4	—	μs
Shift Data Hold Time	t_{SDH}		0.5 t_{cy} – 0.3	—	—	μs

Note: Shift Data Hold Time

External circuit for $\overline{SCK}$ pin and SO pin



Serial port (completion of transmission)



Recommended Oscillating Conditions

(V_{SS} = 0 V, V_{DD} = 4.5 to 6.0 V, Topr = – 40 to 70℃)

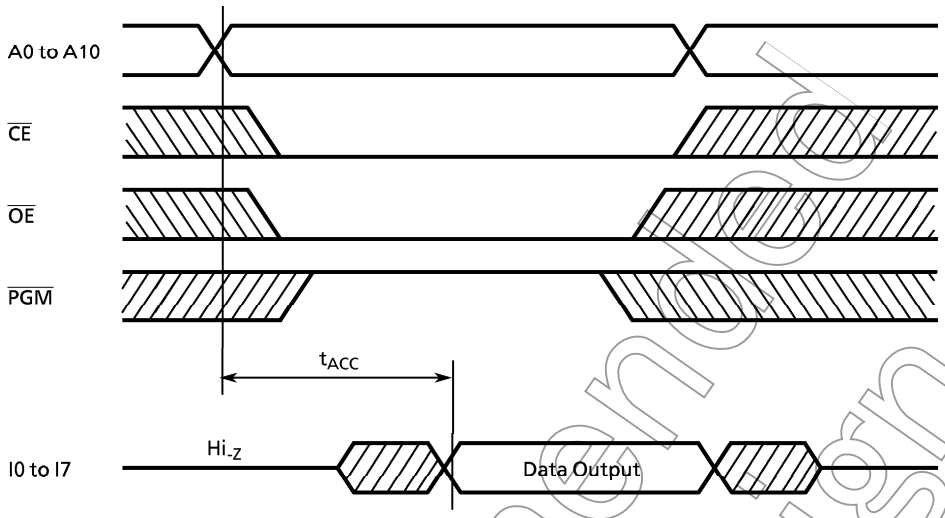
Recommended oscillating conditions of the TMP47P241V are equal to the TMP47C241's but RC oscillation is impossible.

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} × 0.7	–	V_{CC}	V
Output Level Low Voltage	V_{IL4}		0	–	V_{CC} × 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}		12.00	12.50	13.00	V
Programming Pulse Width	t_{PW}	$V_{CC} = 6.0 \pm 0.25$ V	0.95	1.0	1.05	ms