TOSHIBA

TOSHIBA Original CMOS 4-Bit Microcontroller

TLCS-47 Series

TMP47P403VNG
TMP47P403VMG

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
TMP47P403VN	P-SDIP28-400-1.78	TMP47P403VNG	SDIP28-P-400-1.78	—
TMP47P403VM	P-SOP28-450-1.27	TMP47P403VMG	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

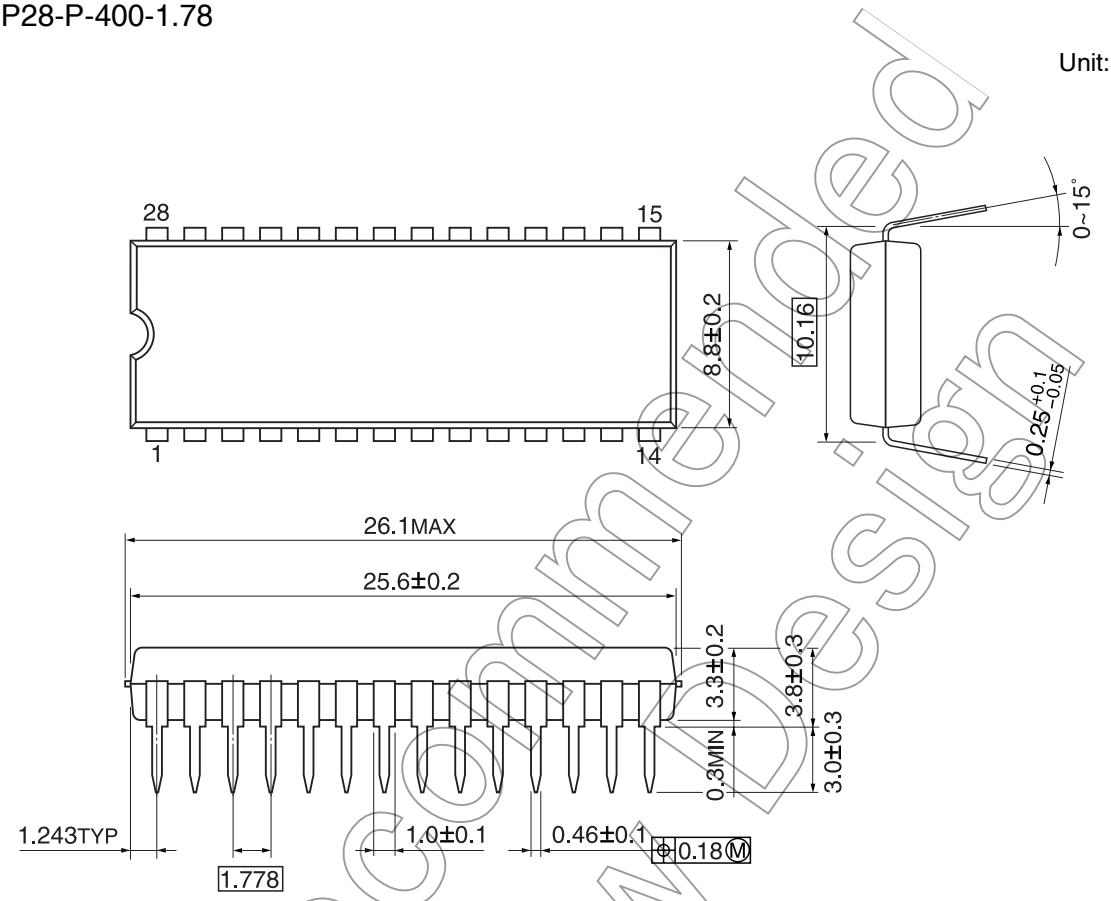
The publication date of this datasheet is printed at the lower right corner of this notification.

(Annex)

Package Dimensions

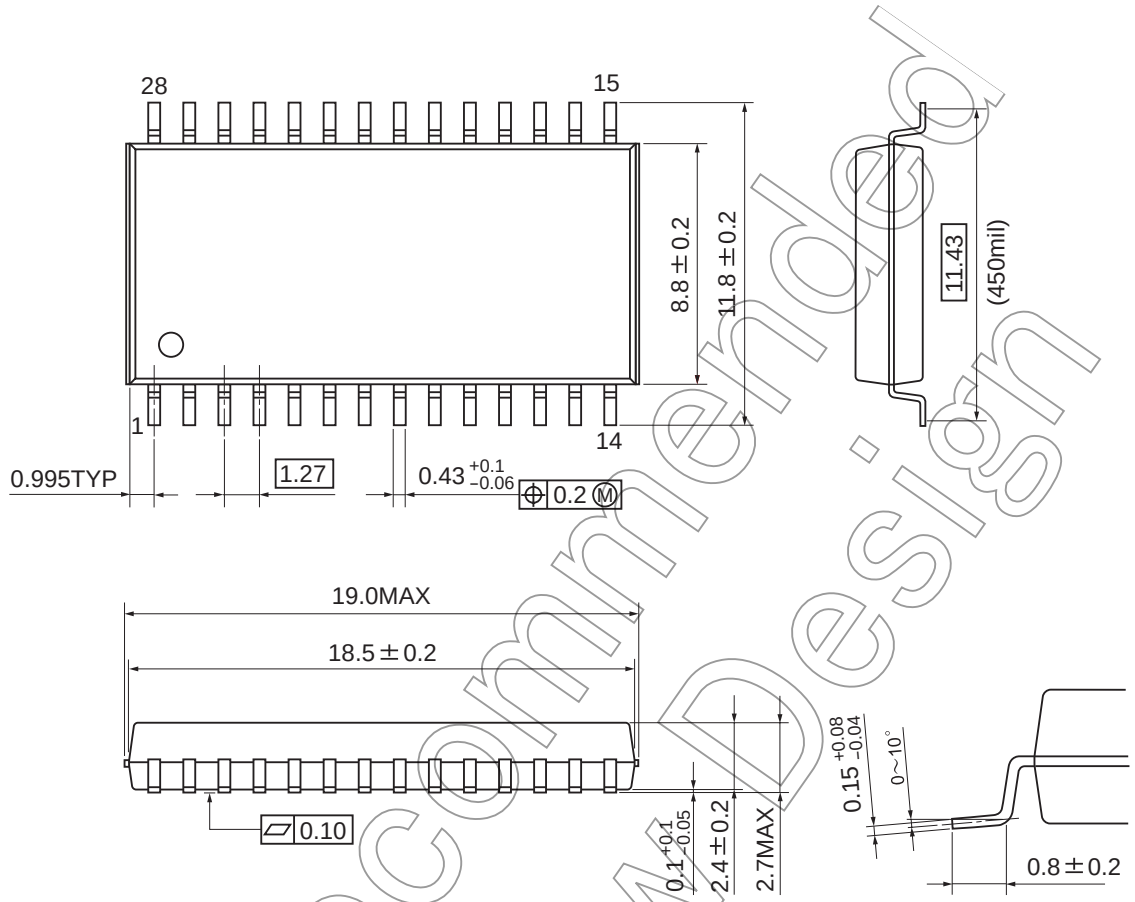
SDIP28-P-400-1.78

Unit: mm



SOP28-P-450-1.27B

Unit: mm



Note: Palladium plated

CMOS 4-Bit Microcontroller

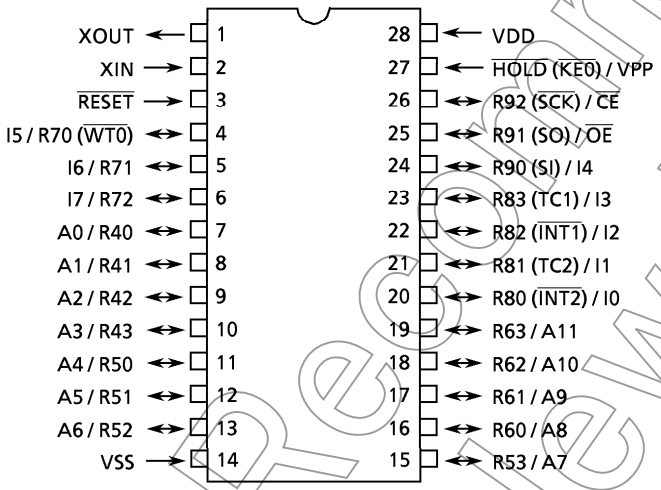
TMP47P403VN
TMP47P403VM

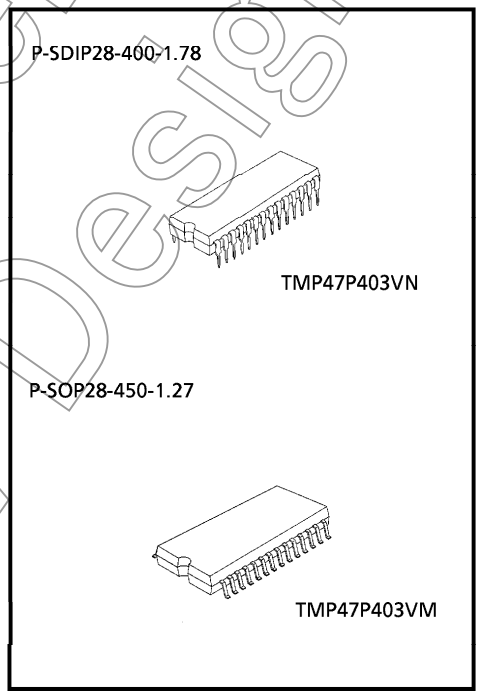
The TMP47P403V is the system evaluation LSI of TMP47C103/203 with a 32-Kbit one-time PROM. The TMP47P403V programs / verifies using an adapter socket to connect with PROM programmer, as it is in TMM27256AD.
In addition, the TMP47P403V and the TMP47C103/203 are pin compatible. The TMP47P403V operates as the same as the TMP47C103/203 by programming to the internal PROM.

Part No.	ROM	RAM	Package	Adaptor Socket
TMP47P403VN	OTP 4096 × 8-bit	128 × 4-bit	P-SDIP28-400-1.78	BM1140
TMP47P403VM			P-SOP28-450-1.27	BM1141

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 TMP47P403V has MCU mode and PROM mode.

(1) MCU mode

The TMP47C103/203 and the TMP47P403V 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)	$\overline{HOLD}$
VCC		+ 5 V	VDD
VSS		0 V	VSS
$\overline{RESET}$	Input	PROM mode setting pin. Be fixed to low level.	
XIN	Input	Input the clock from the external oscillator.	
XOUT	Input	Be pulled up to VCC level. (750 Ω typ.)	

Operational Description

The following is an explanation of hardware configuration and operation in relation to the TMP47P403V. The TMP47P403V is the same as the TMP47C103/203 except that an OTP is used instead of a built-in mask ROM.

1. Operation mode

The TMP47P403V has an 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 TMP47C103/203. In the TMP47P403V, RC oscillation is impossible.

1.1.1 Program Memory

The program storage area are as shown in Figure 1-1. Data conversion tables must be set in two locations when using the TMP47P403V to check TMP47C103/203 operation.

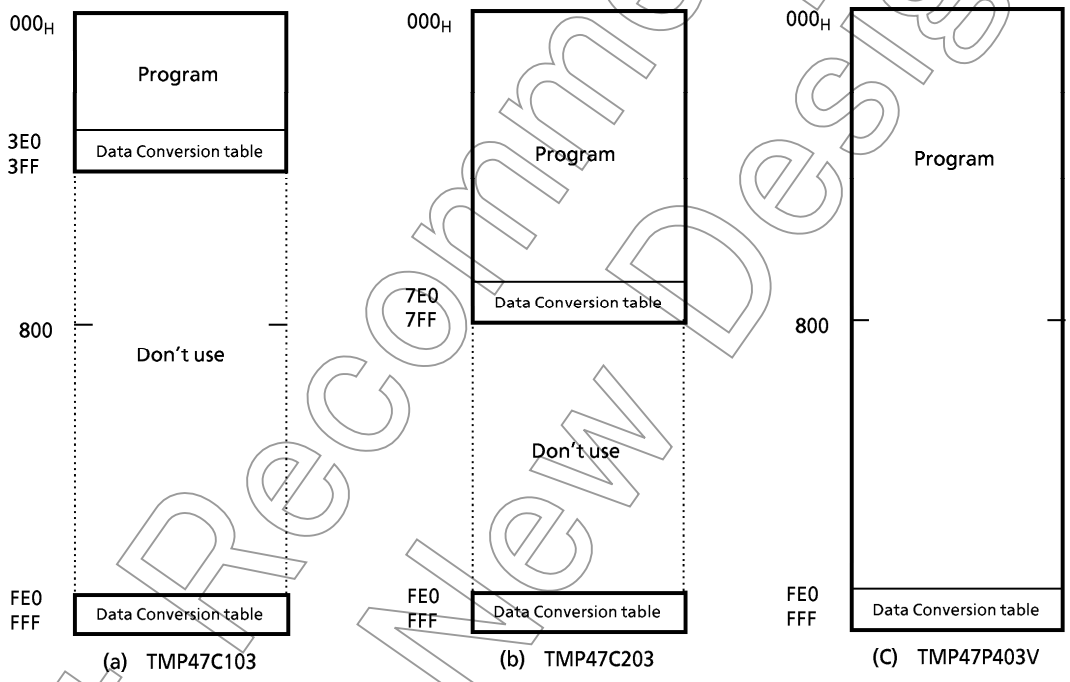


Figure 1-1. Program area

1.1.2 Data Memory

The TMP47P403V has 128 × 4-bit of data memory (RAM). When the TMP47P403V is used as the TMP47C103 evaluator, programming should be performed assuming that the RAM is assigned to addresses 00_H to $0F_H$ and 50_H to $7F_H$ as shown in Figure 1-2 (a).
At the Real time emulator (BM47C203), RAM is assigned to addresses 00_H to FF_H. However, programming should be performed assuming that the RAM is assigned as shown in Figure 1-2 (a).
Further, zero-page (addresses 00_H to $0F_H$) and special function shared area (Stack location 0 to 3) are overlapped on the TMP47C103.

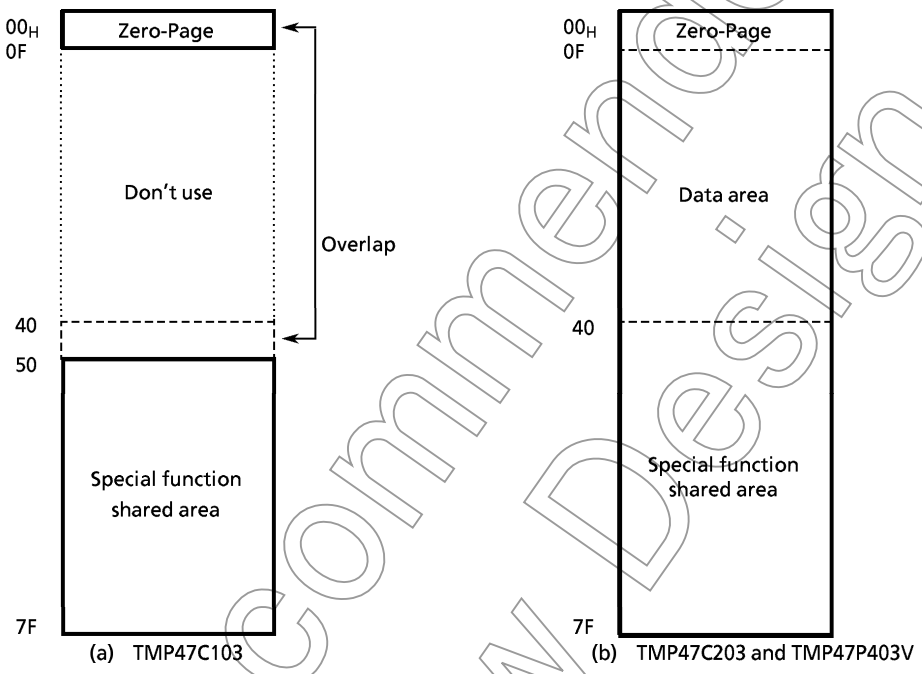


Figure 1-2.

1.1.3 Input / Output Circuitry

(1) Control pins
This is the same as for the TMP47C103/203. In the TMP47P403V, RC oscillation is impossible. Connecting the resonator or inputting the external check to XIN pin are required when using as evaluator of I/O code FD, FE.

(2) I/O Ports
The input / output circuit of the TMP47P403V is the same as I/O code FA, FD of the TMP47C103/203. External resistance, for example, is required when using as evaluator of other I/O codes (FB, FE).

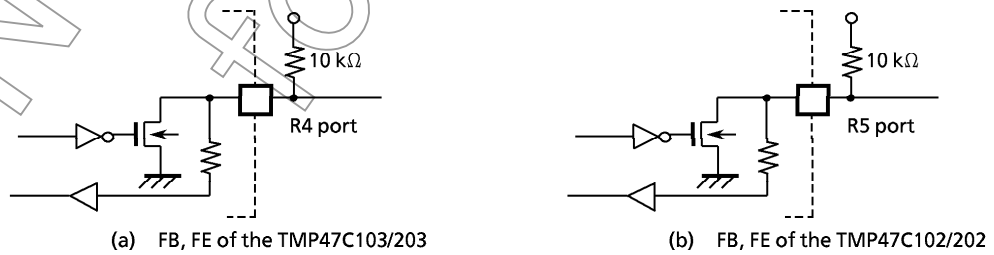


Figure 1-3. I/O code and external circuitry

1.2 PROM mode

The PROM mode is set by inputting the external clock to the XIN pin when XOUT pin is pulled up to the VCC level. In PROM mode, programs can be written or verified using a general-purpose PROM writer with an adapter socket being attached.

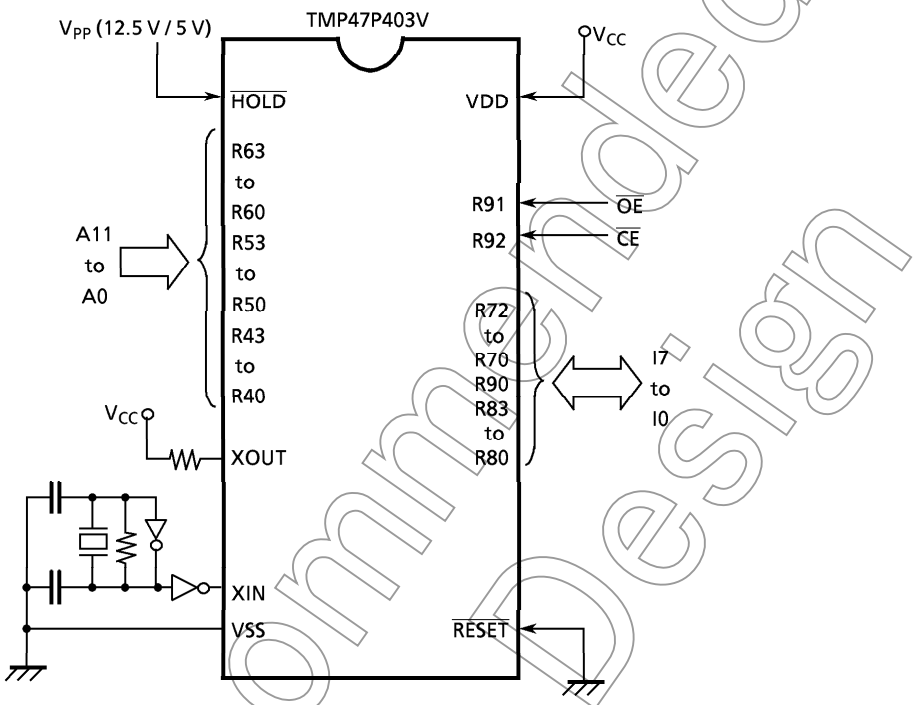


Figure 1-4. Setting for PROM mode

1.2.1 Program Writing

When writing a program, set a ROM type to "27256A" (programming voltage: 12.5 V) . Since the TMP47P403V has a 4096 × 8-bit internal PROM (000 to FFF_H) , set a stop address of a PROM writer to "FFF_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 $\overline{CE}$ = V_{IH}.

The programming is achieved by applying a single low level 1ms pulse the $\overline{CE}$ 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.

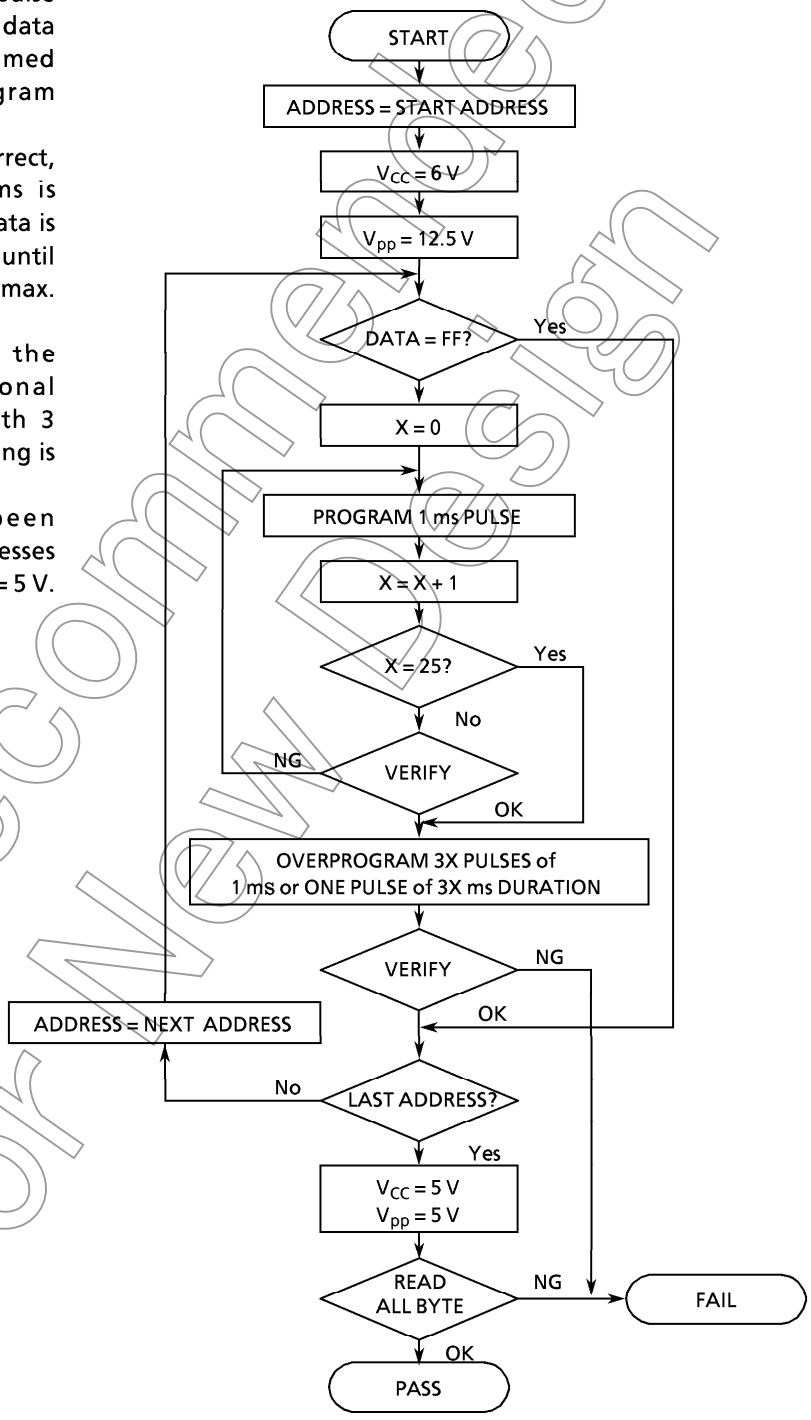


Figure 1-5. Flowchart

Electrical Characteristics

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

Parameter	Symbol	Pins		Ratings	Unit
Supply Voltage	V_{DD}			– 0.3 to 6.5	V
Program Voltage	V_{PP}	$\overline{HOLD}$ / 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		15	
	I_{OUT3}	Ports R7, R8, R9		3.2	
Output Current (Total)	ΣI_{OUT}	Port R4, R5, R6		120	mA
Power Dissipation [Topr = 70°C]	PD		DIP	300	mW
			SOP	180	
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 = 6.0 MHz	4.5	5.5	V
			fc = 4.2 MHz	2.7		
			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} = 4.5 to 5.5 V	0.4	6.0	MHz
			V_{DD} = 2.7 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
Input Low Current	I_{IL}	Push-pull output ports	V_{DD} = 5.5 V, V_{IN} = 0.4 V	–	–	– 2	mA
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 R7, R8, R9	V_{DD} = 4.5 V, I_{OL} = 1.6 mA	–	–	0.4	V
Output Low Current	I_{OL1}	Port R5, R6	V_{DD} = 4.5 V, V_{OL} = 1.0 V	–	20	–	mA
	I_{OL2}	Port R4		–	7	–	
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: V_{IN} = 5.3 V / 0.2 V (V_{DD} = 5.5 V), 2.8 V / 0.2 V (V_{DD} = 3.0 V)

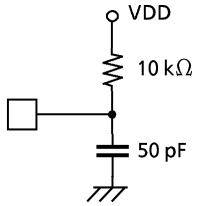
AC Characteristics

(V_{SS} = 0 V, Topr = – 30 to 70°C)

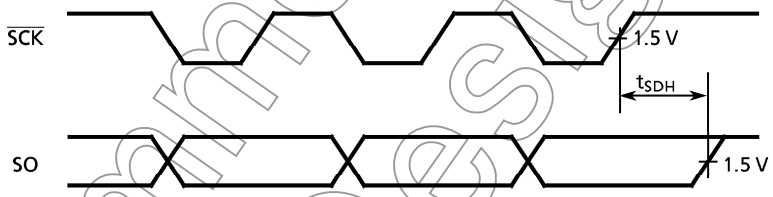
Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Instruction Cycle Time	t_{cy}	V_{DD} = 4.5 to 5.5 V	1.3	–	20	μs
		V_{DD} = 2.7 to 5.5 V	1.9			
High level Clock pulse Width	t_{WCH}	For external clock operation	80	–	–	ns
Low level Clock pulse Width	t_{WCL}					
Shift data Hold Time	t_{SDH}		0.5 t_{cy} – 0.3	–	–	μs

Note: Shift data Hold Time:

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



Serial port (completed of transmission)



Recommended Oscillating Conditions

(V_{SS} = 0 V, V_{DD} = 4.5 to 5.5 V, Topr = – 30 to 70℃)

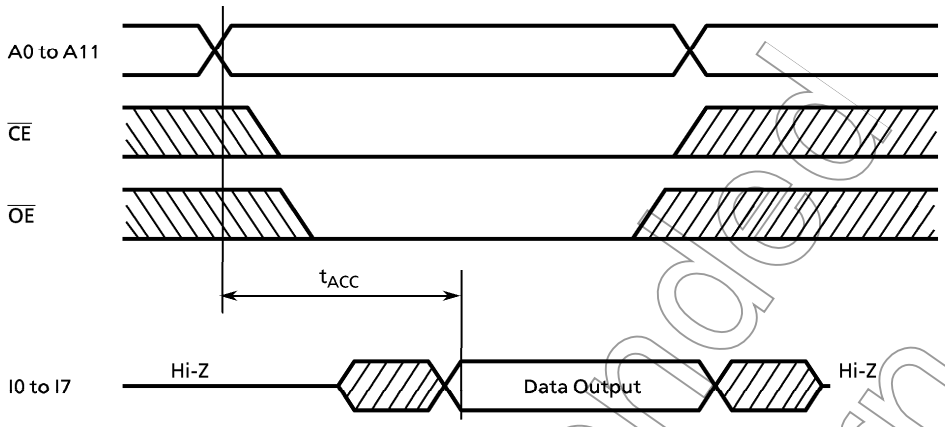
Recommended oscillating conditions of the TMP47P403V are equal to the TMP47C103/203's but RC oscillation is impossible.

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