TOSHIBA

TOSHIBA Original CMOS 4-Bit Microcontroller

TLCS-47 Series

TMP47P206VMG
TMP47P206VPG

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
TMP47P206VP	P-DIP20-300-2.54A	TMP47P206VPG	DIP20-P-300-2.54A	—
TMP47P206VM	P-SOP20-300-1.27	TMP47P206VMG	SOP20-P-300-1.27	—

*: 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

- The information contained herein is subject to change without notice.
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  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc.
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.).These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in his document shall be made at the customer's own risk.
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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

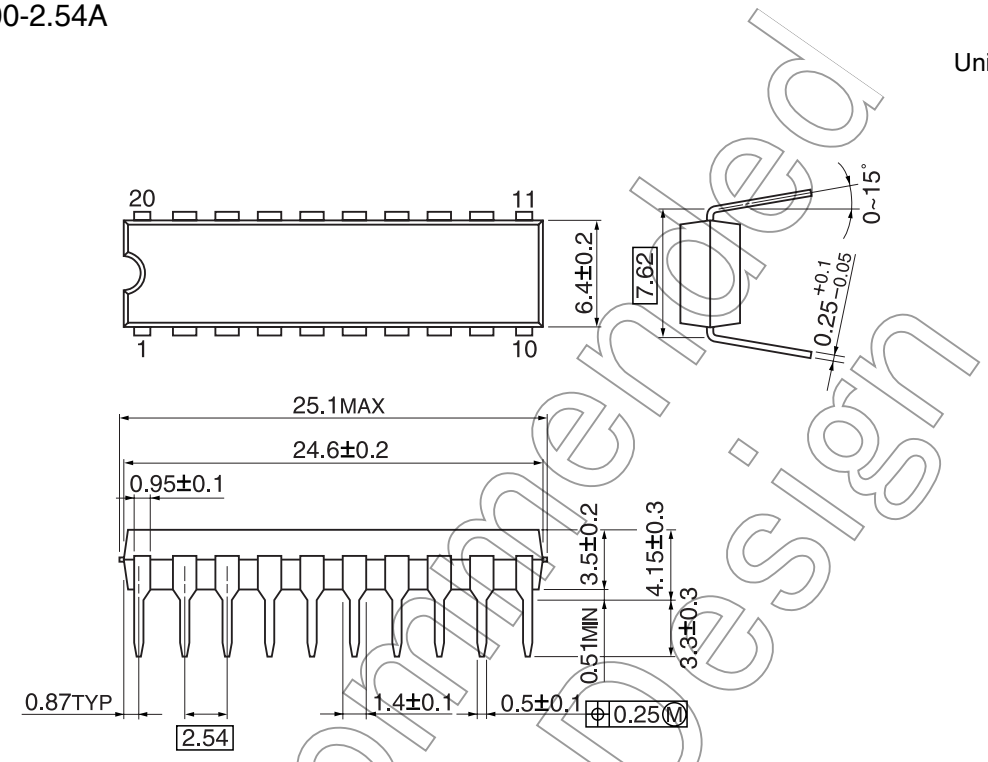
The publication date of this datasheet is printed at the lower right corner of this notification.

(Annex)

Package Dimensions

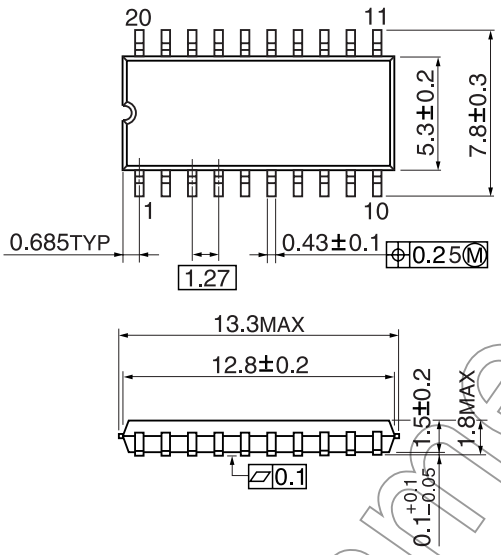
DIP20-P-300-2.54A

Unit: mm



SOP20-P-300-1.27

Unit: mm



CMOS 4-Bit Microcontroller

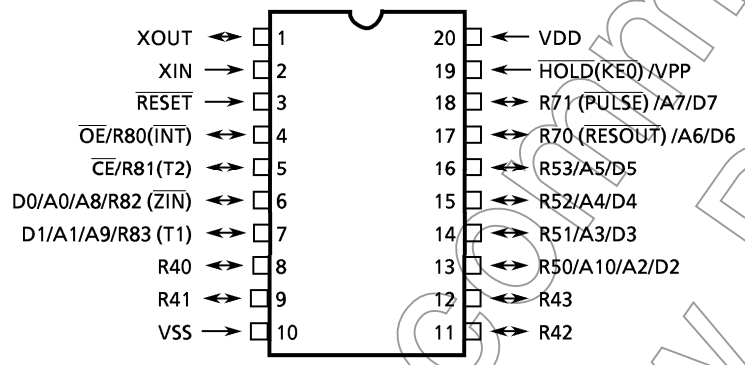
TMP47P206VM/P

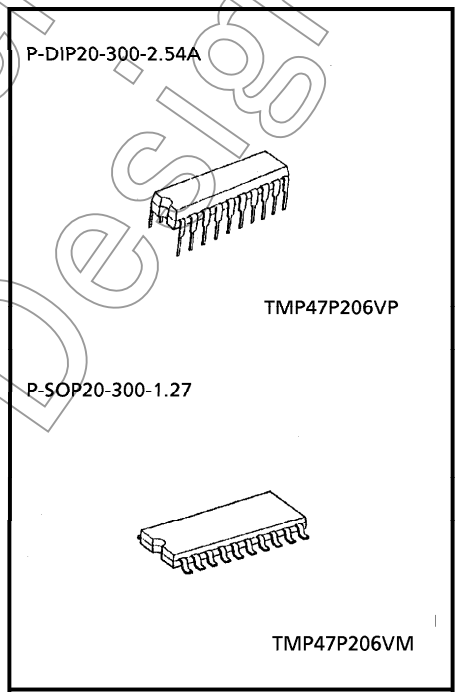
The TMP47P206V is the OTP microcontroller with 16 Kbit PROM. For program operation, the programming is achieved by using with EPROM programmer (TC57256AD type) and adapter socket.
The function of this device is exactly same as the TMP47C206.

Part No.	ROM	RAM	Package	OTP
TMP47P206VP	OTP 2048 × 8-bit	128 × 4-bit	P-DIP20-300-2.54A	BM11125
TMP47P206VM			P-SOP20-300-1.27	BM11126

Pin Assignment (Top View)

P-DIP20-300-2.54A / P-SOP20-300-1.27





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Pin Function

The TMP47P206V has MCU mode and PROM mode.

(1) MCU mode

The TMP47C206 and the TMP47P206V are pin compatible.

(2) PROM mode

Pin Name	Input / Output	Functions	Pin Name (MCU mode)
D0 / A0 / A8	I/O	Data inputs / outputs or Address inputs	R82
D1 / A1 / A9			R83
D2 / A2 / A10			R50
D3 / A3			R51
D4 / A4			R52
D5 / A5			R53
D6 / A6			R70
D7 / A7			R71
$\overline{OE}$	Input	Output Enable input	R80
$\overline{CE}$		Chip Enable input	R81
VPP	Power supply	+ 12.5 V / 5 V (Program supply voltage)	$\overline{HOLD}$
VCC		+ 5 V	VDD
VSS		0 V	VSS
R43 to R40	I/O	Be fixed to low level.	
$\overline{RESET}$	Input	Be fixed to non connection.	
XIN	Input	Input the clock from the external oscillator.	
XOUT	Input	PROM control input	

Operational Description

The following is an explanation of hardware configuration and operation in relation to the TMP47P206V. The TMP47P206V is the same as the TMP47C206 except that an OTP is used instead of a built-in mask ROM.

1. Operation mode

The TMP47P206V 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 TMP47C206. In the TMP47P206V, RC oscillation is impossible.

1.1.1 Program Memory

The program storage area is the same as for the TMP47C206.

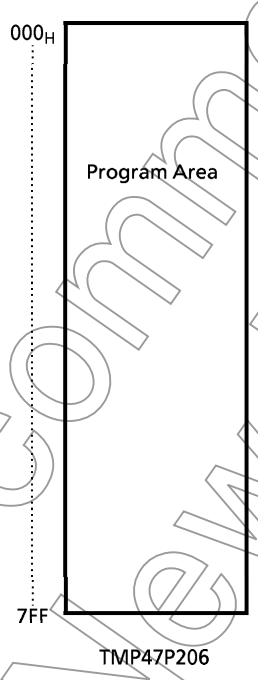


Figure 1-1. Program Area

1.1.2 Data Memory

The TMP47P206V has 128 × 4-bit of data memory (RAM).

1.1.3 Input / Output Circuitry

(1) Control pins
This is the same as I/O code FB of the TMP47C206. In the TMP47P206V, RC oscillator is impossible. Connecting the resonator is required when using as evaluator of I/O code FE.

(2) I/O Ports
The input / output circuit of the TMP47P206V is the same as the TMP47C206.

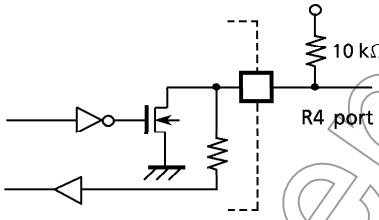


Figure 1-2. I/O code and external circuitry

1.2 PROM mode

The TMP47P206V enters PROM mode by sending external clock signal from XIN pin when XOUT pin is at low level. In PROM mode, programs can be written or verified using a general-purpose PROM writer with an adapter socket being attached.
With the TMP47P206V, the PROM address input and data input/output use the same port. PROM mode control signal (XOUT) is used for switching between two functions. XOUT pin becomes control signal input after PROM mode is completed.

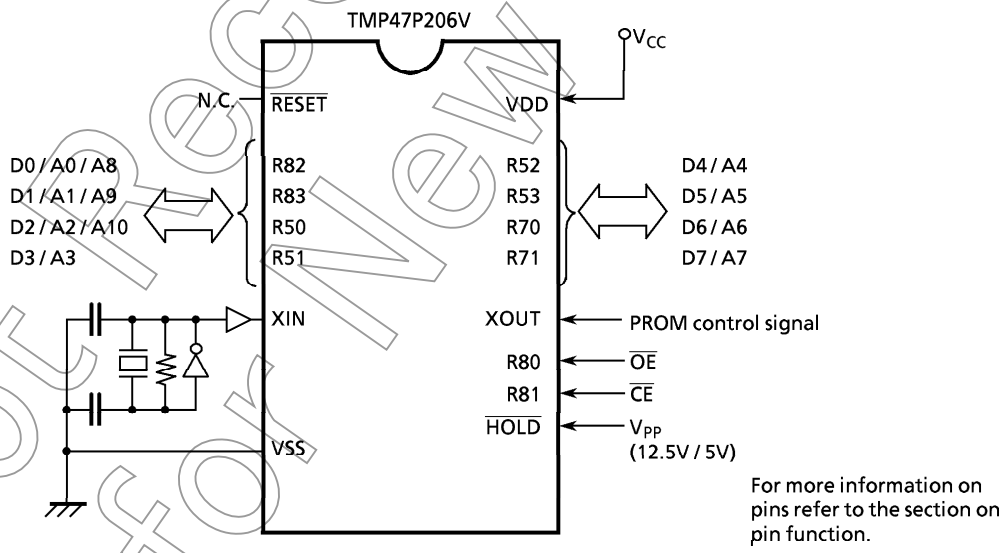


Figure 1-3. Setting for PROM mode

1.2.1 Program Writing

When writing a program, set a ROM type to "TC57256AD" (programming voltage: 12.5 V) . Since the TMP47P206V has a 2048 × 8-bit internal PROM (000 to $7FF_H$) , set a stop address of a PROM writer to "$7FF_H$". Please use a general-purpose PROM writer which does not have an electric signature mode or can release from it.

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.

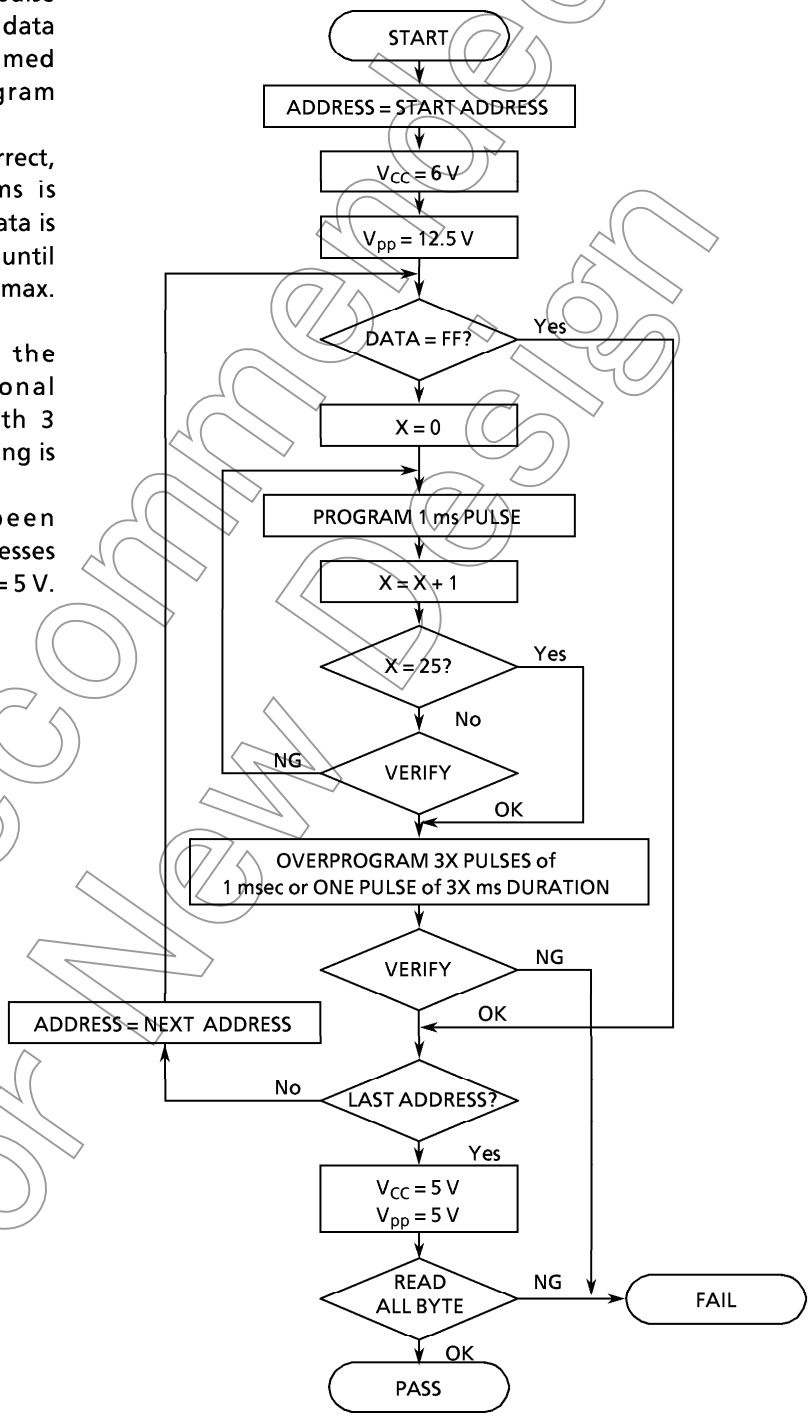


Figure 1-4. Flowchart

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}	$\overline{HOLD}$ / V_{PP}	– 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 R4, R50	30	mA
	I_{OUT2}	Port R51 to 53, R8, R70, R71	3.2	
Output Current (Total)	ΣI_{OUT1}	Port R4, R50	100	mA
	ΣI_{OUT2}	Port R51 to 53, R8, R70, R71	28.8	
Power Dissipation [Topr = 85°C]	PD	SOP	150	mW
		DIP	250	
Soldering Temperature (time)	Tsld		260 (10 s)	°C
Storage Temperature	Tstg		– 55 to 125	°C
Operating Temperature	Topr		– 40 to 85	°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 = – 40 to 85°C)

Parameter	Symbol	Pins	Conditions		Min	Max	Unit
Supply Voltage	V_{DD}	Normal mode	Crystar or ceramic	fc = 8 MHz	4.0 (2.7) *2	5.7	V
				fc = 4.2 MHz	4.0 (2.2) *2		
			RC	fc = 2.5 MHz	4.0 (2.2) *2		
		HOLD mode	–	–	4.0 (2.0) *2		
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 5.7 V		1	8	MHz
			V_{DD} = 2.2 to 5.7 V			4.2	

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: LVD id initially enable and initial Min. V_{DD} is 4.0 V. After LVD is disabled above 4.0 V. Min. V_{DD} will be 2.7 or 2.2 to 2.0 V.

DC Characteristics (V_{SS} = 0 V, Topr = – 40 to 85°C)

Parameter	Symbol	Pins	Conditions	Min	Typ.	Max	Unit
Hysteresis Voltage	V_{HS}	Hysteresis Input		–	0.7	–	V
Input Current	I_{IN1} (Note 1)	$\overline{RESET}$, $\overline{HOLD}$	V_{DD} = 5.7 V, V_{IN} = 5.7 V / 0 V	–	–	± 2	μA
	I_{IN2}	Open drain output ports					
Input Resistance	R_{IN}	$\overline{RESET}$		100	220	450	kΩ
Pull down Resistance	R_{PD}	R82		22	70	160	
Input Low Current	I_{IL}	Push-pull output ports	V_{DD} = 5.7 V, V_{IN} = 0.4 V	–	–	– 2	mA
Output Leakage Current	I_{LO}	Open drain output ports	V_{DD} = 5.7 V, V_{OUT} = 5.7 V	–	–	2	μA
Output High Voltage	V_{OH}	Push-pull output ports	V_{DD} = 5 V, I_{OH} = – 100 μA	4.8	–	–	V
			V_{DD} = 4.5 V, I_{OH} = – 200 μA	2.4	–	–	
			V_{DD} = 2.2 V, I_{OH} = – 5 μA	2.0	–	–	
Output Low Voltage	V_{OL1}	Port R8, R7, R51 to 53	V_{DD} = 4.5 V, I_{OL} = 3.3 mA	–	–	1.0	V
			V_{DD} = 4.5 V, I_{OL} = 1.6 mA	–	–	0.4	
			V_{DD} = 2.2 V, I_{OL} = 20 μA	–	–	0.1	
	V_{OL2}	Port R4, R50	V_{DD} = 4.5 V, I_{OL} = 15 mA	–	–	1.0	
			V_{DD} = 4.5 V, I_{OL} = 7 mA	–	–	0.4	
			V_{DD} = 2.2 V, I_{OL} = 50 μA	–	–	0.1	
Output Low Current	I_{OL1}	Port R8, R7, R51 to 53	V_{DD} = 4.5 V, V_{OL} = 0.4 V	1.6	–	–	mA
	I_{OL2}	Port R4, R50	V_{DD} = 4.5 V, V_{OL} = 1.0 V	15	–	–	
			V_{DD} = 4.5 V, V_{OL} = 0.4 V	7	17	–	
Supply Current (in the Normal operating mode) (Note 2)	I_{DD}		V_{DD} = 5.7 V, fc = 8 MHz	–	3	6	mA
			V_{DD} = 5.7 V, fc = 4 MHz	–	2	4	
			V_{DD} = 3.0 V, fc = 4 MHz	–	1	2	
			V_{DD} = 3.0 V, fc = 1 MHz	–	0.6	1.2	
Supply Current (in the HOLD operating mode) (Note 2)	I_{DDH}	LVD always Enable	V_{DD} = 5.7 V	–	50	200	μA
		LVD On and Off	V_{DD} = 5.7 V	–	2.5	20	
Injection Current	I_{ZC}	R82		–	–	1	mA

< General Conditions >

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

Note 1: Input Current I_{IN1}: The current through resistor is not included.

Note 2: Supply Current: V_{IN} = 5.5 V / 0.2 V (V_{DD} = 5.7 V) or 2.8 V / 0.2 V (V_{DD} = 3.0 V)

AC Characteristics

(V_{SS} = 0 V, Topr = – 40 to 85°C)

Parameter	Symbol	Conditions		Min	Typ.	Max	Unit
Instruction Cycle Time	tcy		V_{DD} = 2.7 to 5.7 V	1.0	–	8	μs
			V_{DD} = 2.2 to 5.7 V	1.9			
High level Clock pulse Width	t_{WCH}	For external clock operation	$V_{DD} \geqq 2.7$ 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			
Delay Reset Output Signal	t_{rd}	fc = 1 MHz		–	–	16	μs

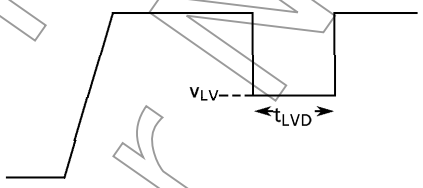
Low Voltage Detector Characteristics

(V_{SS} = 0 V, Topr = – 40 to 85°C)

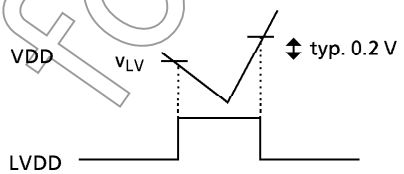
Parameter		Symbol	Conditions	Min	Typ.	Max	Unit
LVD interval time	(Note 1)	t_{int}		8.5	–	128	ms
LVD Enable time	(Note 1)	t_{en}		100	–	–	μs
LVD pulse width	(Note 1, 2)	t_{LVD}		50	–	–	μs
Detection Voltage	(Note 3)	V_{LV}	LVDDTY = 0 LVDD = 0	2.7	3.3	3.8	V
			LVDDTY = 1 LVDD = 0	2.2	2.7	3.3	
LVD Operating Voltage	(Note 1)	V_{LVD}		2.0	–	–	V

Note 1: These parameters are characterized but not tested.

Note 2: Less than Min. t_{LVD}, CPU will not be reset.



Note 3: Detection voltage has typ. 0.2 V hysteresis.



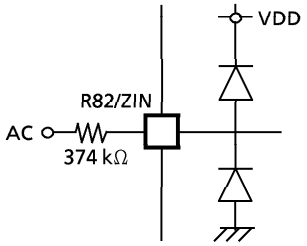
(Low voltage detect)

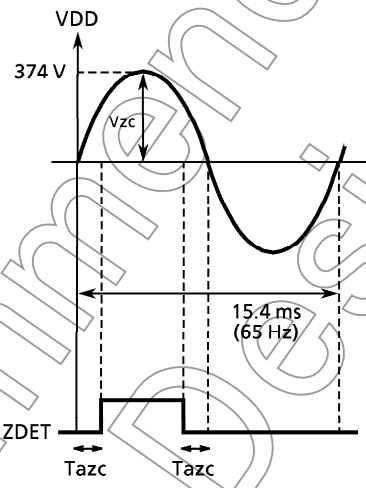
Zero-Cross Detection Characteristics

(V_{SS} = 0 V, Topr = – 40 to 85°C)

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Zero-cross Accuracy	Tazc	fzc = 45 to 65 Hz (*)			90	μs
Injection Current	Izc				1	mA
Pull-down resistance	R_{PD}		22	70	160	kΩ

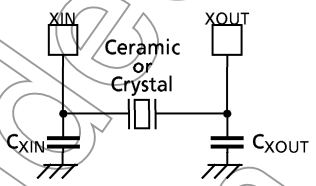
(*) Measurement conditions





Recommended Oscillating Conditions	(V_{SS} = 0 V, V_{DD} = 2.2 to 5.7 V, Topr = – 40 to 85°C)

Recommended oscillating conditions of the TMP47P206V are equal to the TMP47C206's but RC oscillation is impossible.



(1) 8 MHz
Ceramic Resonator

CSA8.00MGU	(MURATA)	$C_{XIN} = C_{XOUT}$ = 30pF
KBR-8.00MS	(KYOCERA)	$C_{XIN} = C_{XOUT}$ = 30pF
EFOEC8004A4	(NATIONAL)	$C_{XIN} = C_{XOUT}$ = 30pF

(2) 6 MHz
Ceramic Resonator

CSA6.00MGU	(MURATA)	$C_{XIN} = C_{XOUT}$ = 30pF
KBR-6.00MS	(KYOCERA)	$C_{XIN} = C_{XOUT}$ = 30pF
EFOEC6004A4	(NATIONAL)	$C_{XIN} = C_{XOUT}$ = 30pF

(3) 4 MHz
Ceramic Resonator

CSA4.00MGU	(MURATA)	$C_{XIN} = C_{XOUT}$ = 30pF
KBR-4.00MS	(KYOCERA)	$C_{XIN} = C_{XOUT}$ = 30pF
EFOEC4004A4	(NATIONAL)	$C_{XIN} = C_{XOUT}$ = 30pF

Crystal Oscillator

204B-6F 4.0000	(TOYOCOM)	$C_{XIN} = C_{XOUT}$ = 20pF

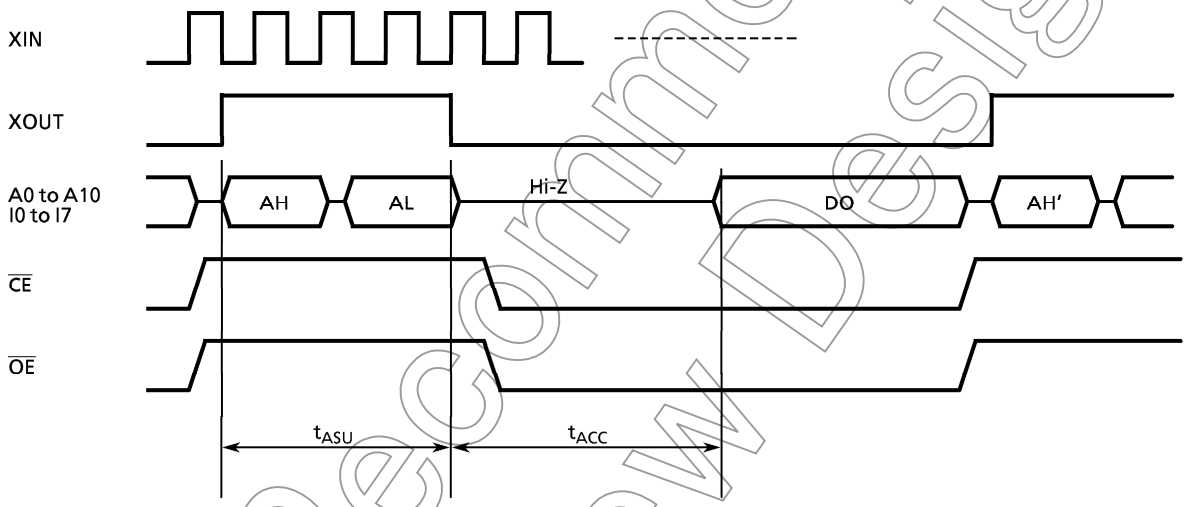
(4) 1 MHz
Ceramic Resonator

CSA1.00MGU	(MURATA)	$C_{XIN} = C_{XOUT}$ = 30pF
KBR-1.00MS	(KYOCERA)	$C_{XIN} = C_{XOUT}$ = 30pF
EFOEC1004A4	(NATIONAL)	$C_{XIN} = C_{XOUT}$ = 30pF

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

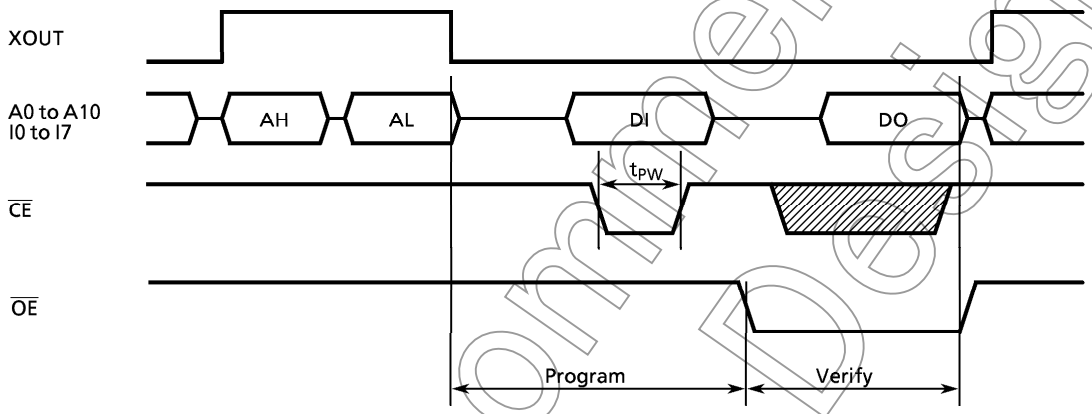
(1) Read Operation

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 Set-up Time	t_{ASU}		350	–	–	ns
Address Access Time	t_{ACC}	V_{CC} = 5.0 ± 0.25 V	–	–	300	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}		12.25	12.50	12.75	V
Programming Pulse Width	t_{PW}	V_{CC} = 6.0 ± 0.25 V	0.095	0.1	0.105	ms



Note: DO; Data output (I0 to I7), AL; Address input (A0 to A7)
DI; Data input (I0 to I7), AH; Address input (A8 to A10)