

TMP04090FXXXX(ES),JTMP04090XXXXS(ES)

CMOS 4-bit LL Microcontroller (OTP built-in)
(LL: Low power consumption & voltage operation microcontroller)

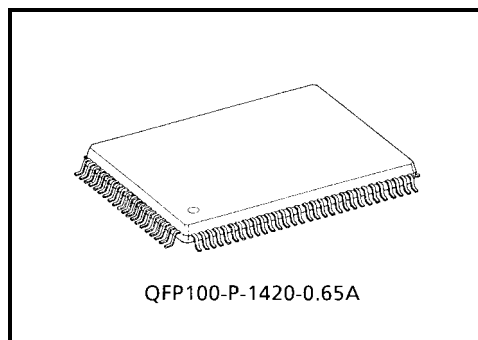
The TMP04090FXXXX and JTMP04090XXXXS are high-performance 4-bit microcontrollers incorporating a 16-Kword (1 word = 16 bits) one-time PROM (OTP). They are pin-compatible with the mask ROM versions of TMP04CH00FXXX and TMP04CH01FXXX. With programs written to their built-in PROMs, the devices operate the same as the mask ROM products. They are therefore optimal for developing software. With an adapter socket, the TMP04090FXXXX can use a general-purpose EPROM programmer for the writing and verification of programs.

Because the TMP04090FXXXX and JTMP04090XXXXS are developed as software development tools for mask ROM versions (TMP04CH00FXXX, TMP04CH01FXXX), they are limited engineering sample versions.

For operations other than writing to OTP, the devices are the same as the mask ROM versions.

For these operations, see the data sheets on the TMP04CH00FXXX and TMP04CH01FXXX.

Note that the OTP-version products do not have STOP mode and HOLD mode. Do not bring these products to the modes. A malfunction may occur.



Weight: 1.65 g (typ.)

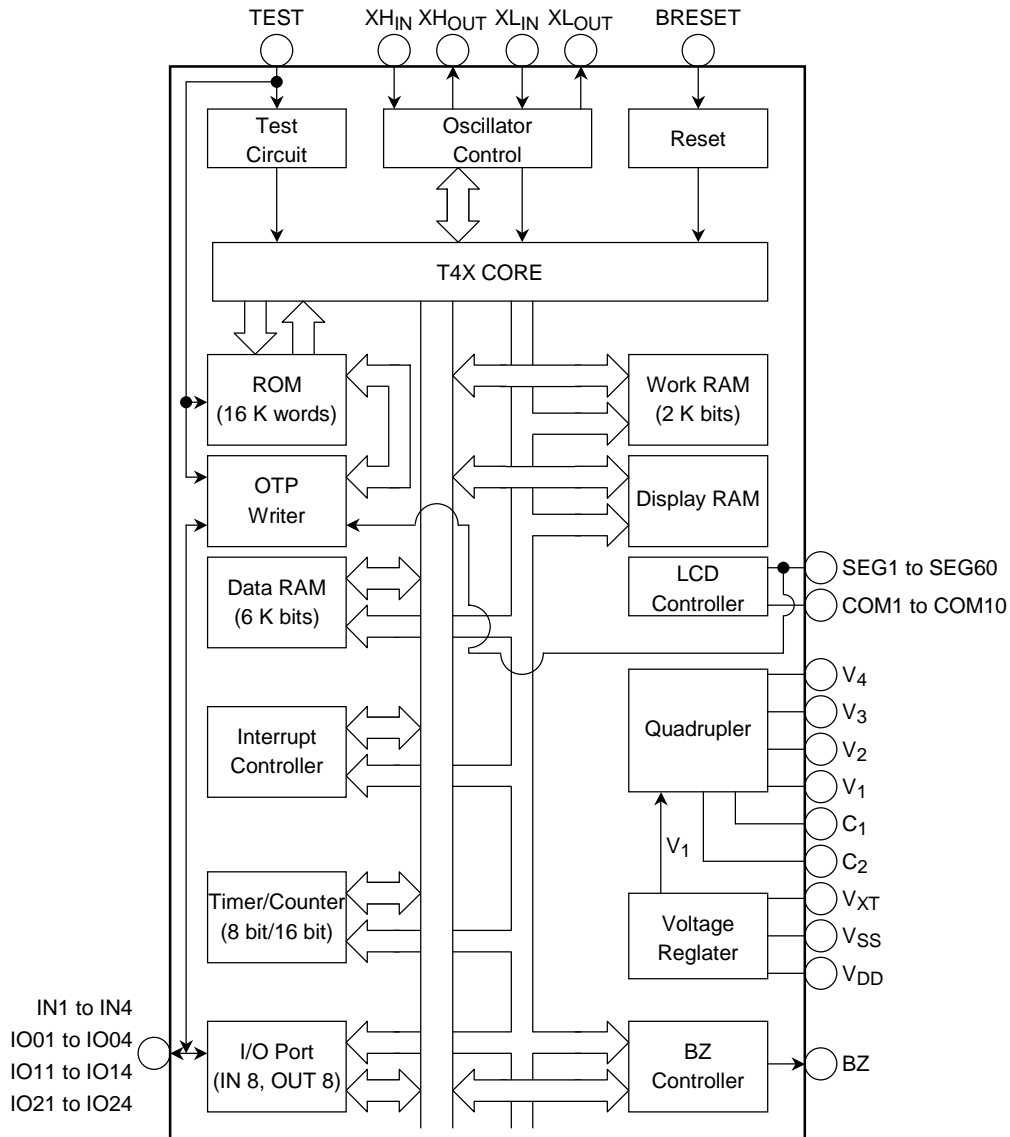
Features

Parameter	Package type device : TMP04090FXXXX (ES) Chip type device : JTMP04090XXXXS (ES) (Note)	Package type device : TMP04090F33F1 (ES) Chip type device : JTMP0409033F1S (ES) (Note)
	OTP version corresponding to mask ROM version TMP04CH00FXXX (T41)	OTP version corresponding to mask ROM version TMP04CH01FXXX (T42)
Input pins	8 (IN1 to IN4, IO01 to IO04) Interrupt: 8 (IN1 to IN4, IO01 to IO04)	4 (IN1 to IN4) Interrupt: 4 (IN1 to IN4)
Input/output pins	8 (IO11 to IO14, IO21 to IO24) Interrupt: none	12 (IO01 to IO04, IO11 to IO14, IO21 to IO04) Interrupts: 4 (IO01 to IO04)
Buzzer output pin	1 drive pattern: 7	1 drive pattern: 6 + 1 V _{DD} fixed type
LCD driver controller	60 SEG × 8 COM/58 SEG × 10 COM Mask option	52 SEG × 16 COM
Operating voltage in MCU mode	3.0 V (typ.)	3.0 V (typ.)
Built-in RAM size	Data RAM: 6 Kbits	Data RAM: none
	Work RAM: 512 × 4-bit	
Built-in ROM size	16 K word (1 word = 16 bits)	
No. of basic instructions	56	
Minimum instruction execution time	61 μs (32.768 kHz) 1 μs (2 MHz)	
Oscillator circuit	Low-speed crystal oscillator (32.768 kHz) High-speed crystal oscillator (2 MHz/3.0 V)/external CR (2 MHz/3.0 V) Mask option	
Interrupts	2 external (input pin, general-purpose input/output pin) 2 internal (timer/counter, timings)	
Timer	8-bit × 2-ch/16-bit × 1-ch (selectable by software)	
Watchdog timer	Timer/counter can be used as watchdog timer	
PROM writing method	8-bit parallel	
No. of writes	1 (for chip or Package type device)	

Note: For product names, see page 14.

Block Diagram of TMP04090

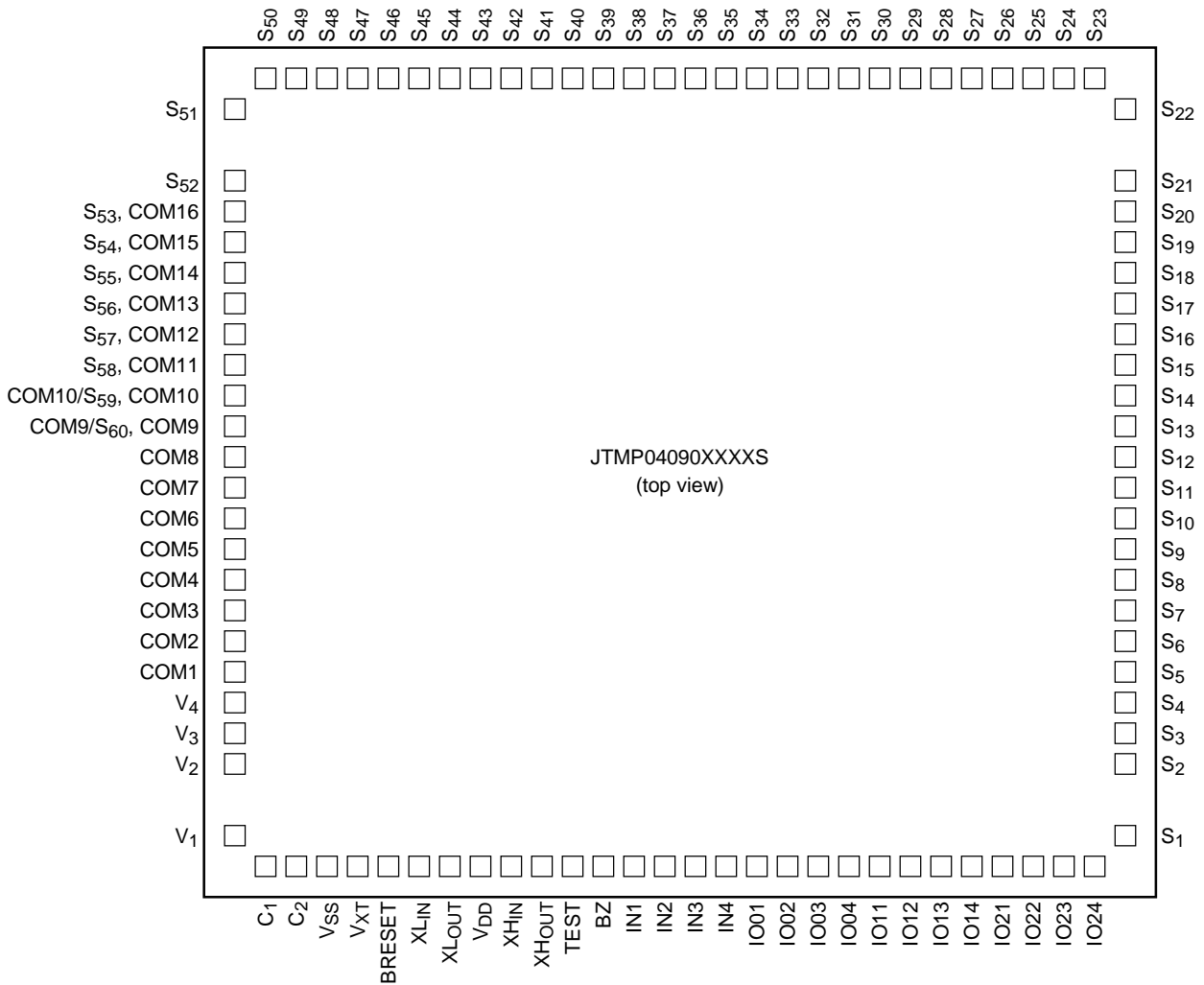
(OTP version corresponding to mask ROM versions, TMP04CH00FXXX and JTMP04CH00XXXXS)



Note: The OTP version corresponding to the mask ROM versions, TMP04CH01FXXX and JTMP04CH01XXXXS (T42), does not include data RAM.

Pad/Pin Assignment

1. Pad Assignment



Chip size 6.16 × 5.98 (mm)

Chip thickness 450 ± 30 (μm)

Substrate voltage V_{SS}

Note 1: Pin specifications differ between the OTP versions corresponding to TMP04CH00FXXX and TMP04CH01FXXX.

Example: COM9/S60,	COM9
OTP version corresponding	OTP version corresponding
to TMP04CH00FXXX	to TMP04CH01FXXX

Note 2: Chip size differs from that of the mask ROM version.

2. JTMP04090XXXXS (ES) Pad Layout

($\times 10^{-3}$ mm)

No.	Name	X Point	Y Point
1	V ₁	-2901	-2505
2	C ₁	-2576	-2855
3	C ₂	-2350	-2855
4	V _{SS}	-2141	-2855
5	V _{XT}	-1952	-2855
6	BRESET	-1764	-2855
7	XL _{IN}	-1614	-2855
8	XL _{OUT}	-1464	-2855
9	V _{DD}	-1314	-2855
10	XH _{IN}	-1164	-2855
11	XH _{OUT}	-1014	-2855
12	TEST	-596	-2855
13	BZ	-223	-2855
14	IN1	-44	-2855
15	IN2	106	-2855
16	IN3	256	-2855
17	IN4	406	-2855
18	IO01	557	-2855
19	IO02	707	-2855
20	IO03	857	-2855
21	IO04	1007	-2855
22	IO11	1157	-2855
23	IO12	1307	-2855
24	IO13	1457	-2855
25	IO14	1645	-2855
26	IO21	1852	-2855
27	IO22	2078	-2855
28	IO23	2324	-2855
29	IO24	2588	-2855
30	S ₁	2901	-2505
31	S ₂	2901	-1540
32	S ₃	2901	-1314
33	S ₄	2901	-1126
34	S ₅	2901	-976
35	S ₆	2901	-826
36	S ₇	2901	-676

No.	Name	X Point	Y Point
37	S ₈	2901	-526
38	S ₉	2901	-375
39	S ₁₀	2901	-225
40	S ₁₁	2901	-75
41	S ₁₂	2901	75
42	S ₁₃	2901	225
43	S ₁₄	2901	375
44	S ₁₅	2901	525
45	S ₁₆	2901	675
46	S ₁₇	2901	825
47	S ₁₈	2901	975
48	S ₁₉	2901	1126
49	S ₂₀	2901	1314
50	S ₂₁	2901	1540
51	S ₂₂	2901	2505
52	S ₂₃	2539	2855
53	S ₂₄	2256	2855
54	S ₂₅	1992	2855
55	S ₂₆	1747	2855
56	S ₂₇	1521	2855
57	S ₂₈	1314	2855
58	S ₂₉	1126	2855
59	S ₃₀	976	2855
60	S ₃₁	826	2855
61	S ₃₂	675	2855
62	S ₃₃	525	2855
63	S ₃₄	375	2855
64	S ₃₅	225	2855
65	S ₃₆	75	2855
66	S ₃₇	-75	2855
67	S ₃₈	-225	2855
68	S ₃₉	-375	2855
69	S ₄₀	-525	2855
70	S ₄₁	-675	2855
71	S ₄₂	-826	2855
72	S ₄₃	-976	2855

Note: Pad X and Y point values differ from those of the mask ROM version.

No.	Name	X Point	Y Point
73	S ₄₄	-1126	2855
74	S ₄₅	-1314	2855
75	S ₄₆	-1521	2855
76	S ₄₇	-1747	2855
77	S ₄₈	-1992	2855
78	S ₄₉	-2256	2855
79	S ₅₀	-2539	2855
80	S ₅₁	-2901	2505
81	S ₅₂	-2901	1540
82	S ₅₃ , COM16	-2901	1314
83	S ₅₄ , COM15	-2901	1126
84	S ₅₅ , COM14	-2901	975
85	S ₅₆ , COM13	-2901	825
86	S ₅₇ , COM12	-2901	675

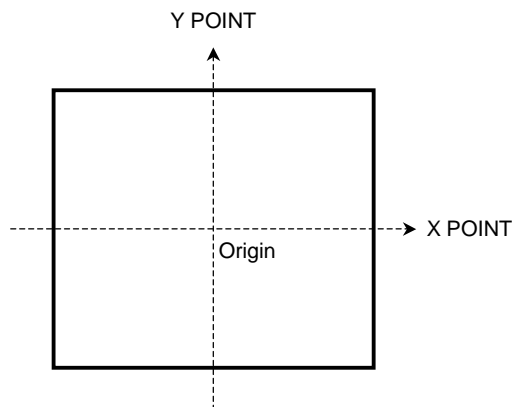
No.	Name	X Point	Y Point
87	S ₅₈ , COM11	-2901	525
88	COM10/S ₅₉ , COM10	-2901	375
89	COM9/S ₆₀ , COM9	-2901	225
90	COM8	-2901	75
91	COM7	-2901	-75
92	COM6	-2901	-225
93	COM5	-2901	-375
94	COM4	-2901	-526
95	COM3	-2901	-676
96	COM2	-2901	-826
97	COM1	-2901	-976
98	V ₄	-2901	-1126
99	V ₃	-2901	-1314
100	V ₂	-2901	1540

Note: Pad X and Y point values differ from those of the mask ROM version.

(Supplementary)

Definition of pad X and Y points

As shown below, X and Y points are determined with the center of the chip as the origin.



3. Pin Assignment of TMP04090FXXXX



Pin No.	Pin Name
1	V ₁
2	C ₁
3	C ₂
4	V _{SS}
5	V _{XT}
6	BRESET
7	XL _{IN}
8	XL _{OUT}
9	V _{DD}
10	XH _{IN}
11	XH _{OUT}
12	TEST
13	BZ
14	IN1
15	IN2
16	IN3
17	IN4
18	IO01
19	IO02
20	IO03
21	IO04
22	IO11
23	IO12
24	IO13
25	IO14

Pin No.	Pin Name
26	IO21
27	IO22
28	IO23
29	IO24
30	S ₁
31	S ₂
32	S ₃
33	S ₄
34	S ₅
35	S ₆
36	S ₇
37	S ₈
38	S ₉
39	S ₁₀
40	S ₁₁
41	S ₁₂
42	S ₁₃
43	S ₁₄
44	S ₁₅
45	S ₁₆
46	S ₁₇
47	S ₁₈
48	S ₁₉
49	S ₂₀
50	S ₂₁

Pin No.	Pin Name
51	S ₂₂
52	S ₂₃
53	S ₂₄
54	S ₂₅
55	S ₂₆
56	S ₂₇
57	S ₂₈
58	S ₂₉
59	S ₃₀
60	S ₃₁
61	S ₃₂
62	S ₃₃
63	S ₃₄
64	S ₃₅
65	S ₃₆
66	S ₃₇
67	S ₃₈
68	S ₃₉
69	S ₄₀
70	S ₄₁
71	S ₄₂
72	S ₄₃
73	S ₄₄
74	S ₄₅
75	S ₄₆

Pin No.	Pin Name
76	S ₄₇
77	S ₄₈
78	S ₄₉
79	S ₅₀
80	S ₅₁
81	S ₅₂
82	S ₅₃ /COM16
83	S ₅₄ /COM15
84	S ₅₅ /COM14
85	S ₅₆ /COM13
86	S ₅₇ /COM12
87	S ₅₈ /COM11
88	S ₅₉ /COM10
89	S ₆₀ /COM9
90	COM8
91	COM7
92	COM6
93	COM5
94	COM4
95	COM3
96	COM2
97	COM1
98	V ₄
99	V ₃
100	V ₂

Note 1: In the OTP version corresponding to TMP04CH00FXXX, pins 82 to 87 are S53 to S58.

Note 2: In the OTP version corresponding to TMP04CH01FXXX, pins 82 to 87 are COM16 to COM9.

4. Pin Description

4.1 Pin Description of OTP Version Corresponding to TMP04CH00FXXX

Pin Name	Function
V _{DD}	Power supply
V _{SS}	GND
V _{XT}	Voltage regulator1 output
V ₁	Voltage regulator2 output
V ₂ to V ₄	Boosted voltage output
C ₁ to C ₂	Capacitor pin for LCD booster
XH _{IN} to XH _{OUT}	Crystal/resister connection pin for high speed oscillator
XL _{IN} to XL _{OUT}	Crystal connection pin for low speed oscillator
IN1 to IN4	Input port (with interruption)
IO01 to IO04	I/O port (with interruption)
IO11 to IO14	I/O port
IO21 to IO24	I/O port
SEG1 to SEG60	LCD segment output (mask option 58 SEG/60 SEG selectable)
COM1 to COM10	LCD common output (mask option 10 COM/8 COM selectable)
BZ	Buzzer output
BRESET	Reset input (low active)
TEST	Test input (connect to V _{SS})

4.2 Pin Description of OTP Version Corresponding to TMP04CH01FXXX

Pin Name	Function
V _{DD}	Power supply
V _{SS}	GND
V _{XT}	Voltage regulator 1 output
V ₁	Voltage regulator 2 output
V ₂ to V ₄	Boosted voltage output
C ₁ to C ₂	Capacitor pin for LCD booster
XH _{IN} to XH _{OUT}	Crystal / resister connection pin for high speed oscillator
XL _{IN} to XL _{OUT}	Crystal connection pin for low speed oscillator
IN1 to IN4	Input port (with interruption)
IO01 to IO04	I/O port (with interruption)
IO11 to IO14	I/O port
IO21 to IO24	I/O port
SEG1 to SEG52	LCD segment output
COM1 to COM16	LCD common output
BZ	Buzzer output
BRESET	Reset input (low active)
TEST	Test input (connect to V _{SS})

5. Operation

The TMP04090FXXXX is a one-time PROM version of the TMP04CH00FXXXX and TMP04CH01FXXXX which incorporate mask ROM. Other than the ROM, the configuration and functions of the TMP04090FXXXX are the same as those of the TMP04CH00FXXXX and TMP04CH01FXXXX.

5.1 Operating Mode

The TMP04090FXXXX supports MCU and PROM modes.

5.2 MCU Mode

Fixing the TEST pin to L level puts the device in MCU mode. In MCU mode, operation is the same as that for the mask ROM versions, TMP04CH00FXXXX and TMP04CH01FXXXX. For the function of MCU mode, refer to the T4X Series Users' Manual.

5.3 PROM Mode

Connect a 2-MHz oscillator to the XHIN and XHOUT pins, set the BRESET pin = VSS and the IN1 pin = VDD. Then, setting the TEST pin (VPP) to H level sets PROM mode. Definition of the ROM area in MCU mode is as shown in Figure 1 because 1 word = 16 bits. Write to ROM in PROM mode is performed in 8 bits, divided into two as shown in Figure 2. In PROM mode, programs can be written or verified using a general-purpose EPROM writer.

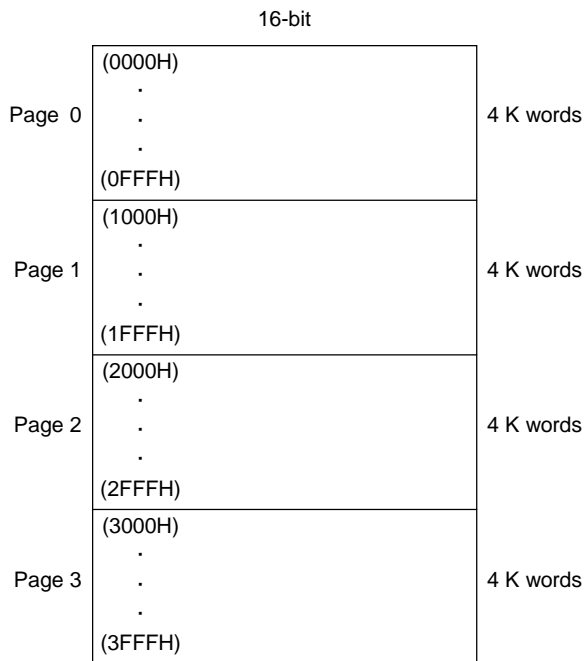


Figure 1 Addresses in MCU mode

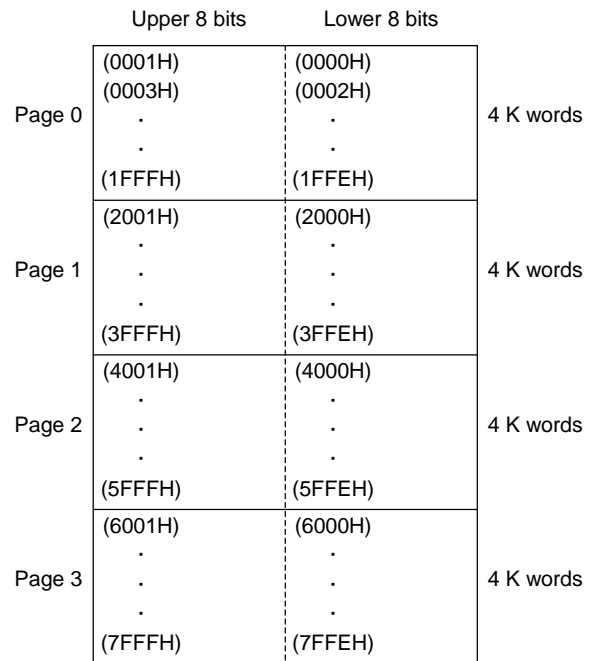


Figure 2 Addresses in PROM mode

5.4 Table of PROM Mode Setting Pins

Listed Below are The Pins Required in PROM Mode.

Pin Name	No. of Pins	Pin Specification		Pin Name in PROM Mode	Function in PROM Mode
		MCU Mode	PROM Mode		
IO11 to IO14	4	Input/output	Input/output	PDB0 to PDB3	Program memory data input/output (8-bit)
IO21 to IO24	4			PDB4 to PDB7	
S ₂₅ to S ₃₉	15	Output	Input	EPAD0 to EPAD14	Program memory address input (0000H to 7FFFH)
S ₄₀	1	Output	Input	EPCE (/CE)	Chip enable signal input
S ₄₁	1	Output	Input	EPOE (/OE)	Output enable signal input
BRESET	1	Input	Input	BRESET	Input for setting PROM mode (V _{SS} level fixed)
IN1	1	Input	Input	IN1	Input for setting PROM mode (V _{DD} level fixed)
TEST	1	Input	Power supply	V _{PP}	Program voltage input (12.75 V/5 V)
XH _{IN}	1	High-speed oscillation		XH _{IN}	High-speed oscillation (input)
XH _{OUT}	1	High-speed oscillation		XH _{OUT}	High-speed oscillation (output)
XL _{IN}	1	Low-speed oscillation	Unused	—	Unused (V _{SS} level fixed)
V _{DD}	1	Power supply		V _{CC}	+5 V supply input (5 V/6.25 V)
V ₄	1	Booster output	Unused	—	Unused (V _{DD} level fixed)
V _{SS}	1	GND		GND	+0 V supply input

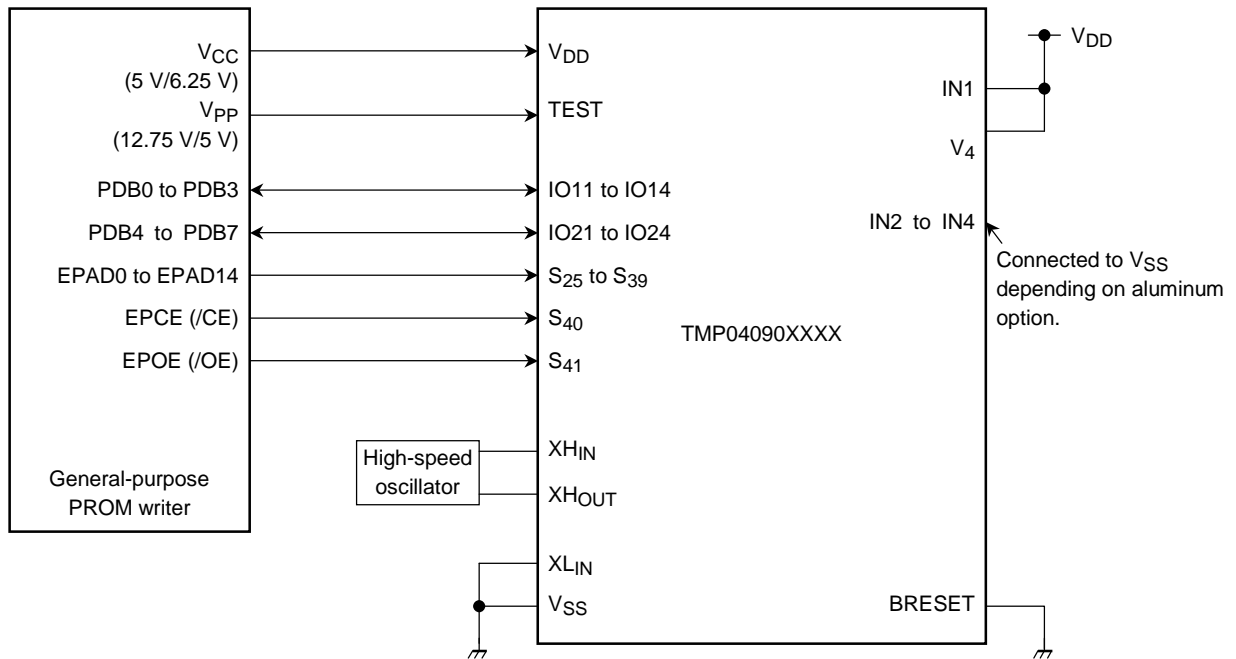
Handling of pins not listed above may differ depending on aluminum option. Handle by referring to the table below.

Pin Name	No. of Pins	Aluminum Option Code	Pin Specification	Pin Handling
IN2 to IN4	3	A3081	With pull-down resistor	Open
		A30A1		
		A3480	Without pull-down resistor	Connect to V _{SS}
		A34A0		
		A5082	With pull-down resistor	Open
		A50A2		
		A33F1	With pull-down resistor	Open

For details of aluminum specifications, see the Aluminum Specification Table.

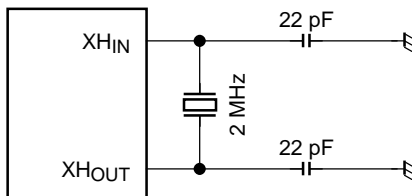
5.5 PROM Mode Setting Diagram

Setting the TMP04090FXXXX pins as shown in the figure below sets PROM mode. In PROM mode, programs can be written or verified using a general-purpose PROM writer. Since the TMP04090FXXXX does not support an electric signature function, set the PROM writer ROM type to TC57256AD or equivalent.

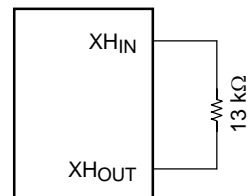


Note: The TMP04090FXXXX can select a high-speed oscillator depending on the mask option, thus the structure of the high-speed oscillator circuit changes according to the mask option specification (figures below). Set the oscillator frequency to 2 MHz (typ.)

(1) Crystal oscillator



(2) CR oscillator



(Supplementary)

With package type devices, the pins necessary for setting PROM mode are handled on the adapter socket, thus the above setting is unnecessary.

5.6 How to Write Using General-Purpose PROM Programmer**[1] Package type device (TMP04090FXXXX)**

- (1) Prepare adapter
Adapter socket: PN004103
- (2) Set PROM programmer
 - (i) Set the PROM type to TC57256AD or equivalent.
Write voltage: 12.75 V
 - (ii) Set write address
Start address: 0000H
End address: 7FFFH
- (3) Write
Write or verify a program according to the operation steps of the PROM programmer.

Note 1: For settings, refer to the PROM programmer instruction manual.

Note 2: When installing the MCU on the adapter or installing the adapter on the PROM programmer, match pin 1 of the one device to the corresponding pin 1 of the other. If the orientations do not match, the MCU, adapter, or PROM programmer will be damaged.

Note 3: The TMP04090FXXXX does not support Electric Signature mode (Signature). Therefore, if Signature is used by the PROM programmer, 12.5 V \pm 0.5 V is applied to pin 9 of the address (EPAD9), damaging the device. Do not use Signature.

[2] Chip type device (JTMP04090XXXXS)

- (1) Mounting chip type device
Write program on the chip before mounting peripherals. For how to set PROM mode or how to connect to a general-purpose PROM writer, see 5.5, PROM Mode Setting Diagram.
- (2) Set PROM programmer
 - (i) Set the PROM type to TC57256AD or equivalent.
Write voltage: 12.75 V
 - (ii) Set write address
Start address: 0000H
End address: 7FFFH
- (3) Write
Write or verify a program according to the operation steps of the PROM programmer.

(Supplementary)

- (1) Program Memory Security (PMS), which inhibits reading program after writing, is not supported.
- (2) Gang writer (simultaneous multiple writes) is not supported.
- (3) Program write service is not supported.

5.7 Write Flow Chart (High-speed program mode II)

With $V_{CC} = 6.25\text{ V}$, applying program voltage of $V_{PP} = 12.75\text{ V}$ puts the device in High-Speed Program mode II. After entering the address and input data, applying a single program pulse of 0.1 ms to $/CE$ input writes data. Verify whether data are written correctly. If not written correctly, apply a 0.1 ms program pulse again. Repeat until data are written correctly (up to 25 times). Afterwards, change address and input data, and continue writing in the same way. When all writes are complete, set $V_{CC} = V_{PP} = 5\text{ V}$ and verify data from all addresses.

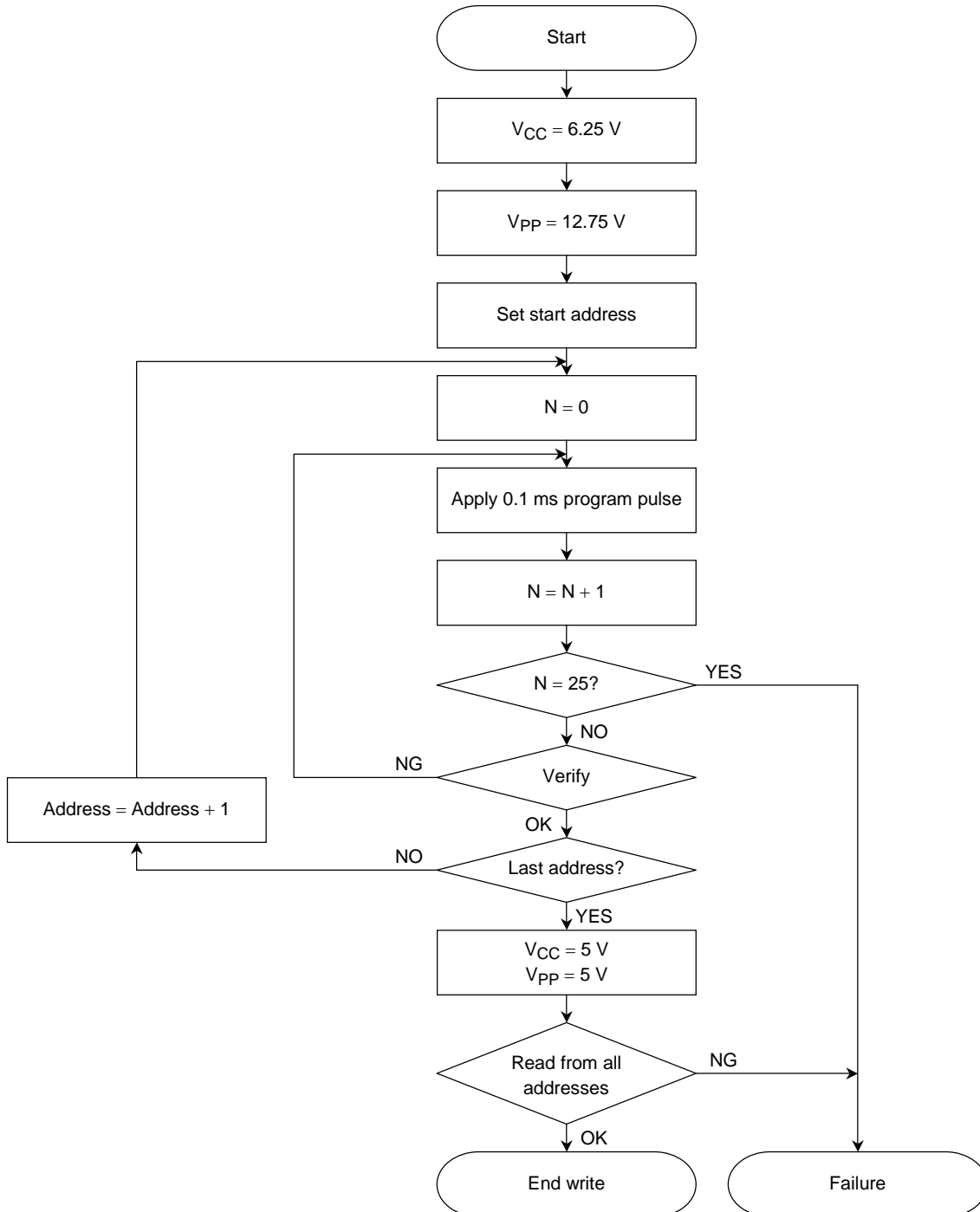


Figure 3 Write flow chart in High-speed program mode II

6. Mask Option and Pin Equivalent Circuit

6.1 List of Mask Option Specifications

(1) OTP version corresponding to TMP04CH00FXXX

(T41)

MASK Code	Supply Voltage	LCD Duty	No. of Segments	High-Speed Oscillation	Low-Speed Oscillation	Input Port Status		Supply Type	Product Name	
						IN1 to IN4 IO01 to IO04	IO11 to IO14 IO21 to IO24		OTP Version	MASK ROM Version
A3081	3.0 V (typ.)	1/8	60	CR	X'tal	With pull-down resistor	With pull-down resistor	Chip type device	JTMP040903081S (ES)	JTMP04CH00XXXXS (PI)
								Package type device	TMP04090F3081 (ES)	TMP04CH00FXXX (BH, D)
A30A1	3.0 V (typ.)	1/10	58	CR	X'tal	With pull-down resistor	With pull-down resistor	Chip type device	JTMP0409030A1S (ES)	JTMP04CH00XXXXS (PI)
								Package type device	TMP04090F30A1 (ES)	TMP04CH00FXXX (BH, D)
A3480	3.0 V (typ.)	1/8	60	X'tal	X'tal	Without pull-down resistor	With pull-down resistor	Chip type device	JTMP040903480S (ES)	JTMP04CH00XXXXS (PI)
								Package type device	TMP04090F3480 (ES)	TMP04CH00FXXX (BH, D)
A34A0	3.0 V (typ.)	1/10	58	X'tal	X'tal	Without pull-down resistor	With pull-down resistor	Chip type device	JTMP0409034A0S (ES)	JTMP04CH00XXXXS (PI)
								Package type device	TMP04090F34A0 (ES)	TMP04CH00FXXX (BH, D)

(2) OTP version corresponding to TMP04CH01FXXX

(T42)

MASK Code	Supply Voltage	LCD Duty	No. of Segments	High-Speed Oscillation	Low-Speed Oscillation	Input Port Status		Supply Type	Product Name	
						IN1 to IN4 IO01 to IO04	IO11 to IO14 IO21 to IO24		OTP Version	MASK ROM Version
A33F1	3.0 V (typ.)	1/16	52	CR	X'tal	With pull-down resistor	With pull-down resistor	Chip type device	JTMP0409033F1S (ES)	JTMP04CH01XXXXS (PI)
								Package type device	TMP04090F33F1 (ES)	TMP04CH01FXXX (BH, D)

6.2 Input/output Circuit for Pins

(1) Control pin

Shown below is an equivalent circuit of the TMP04090FXXXX control pins.

Control Pin	Input/Output	Circuit	Remarks
XH _{IN} XH _{OUT}	Input/Output		<p>High-speed oscillator connection pin (Mask option: X'tal) $R_f = 3\text{ M}\Omega$ (typ.)</p>
			<p>Resistor connection pin for high-speed oscillation (Mask option: CR) $C = 10\text{ pF}$ (typ.)</p>
XL _{IN} XL _{OUT}	Input/Output		<p>Low-speed oscillator connection pin (Mask option: X'tal) $R_f = 10\text{ M}\Omega$ (min)</p>
BRESET	Input		<p>$R_1 = 500\text{ k}\Omega$ (typ.) $R_2 = 55.5\text{ k}\Omega$ (typ.) $R_3 = 150\text{ }\Omega$ (typ.)</p>
TEST (V _{PP})	Input		<p>$R_1 = 10\text{ k}\Omega$ (typ.) $R_2 = 150\text{ }\Omega$ (typ.)</p>
BZ	Output		<p>CMOS output</p>

(2) Input/output ports

Shown below is an equivalent circuit of the TMP04090FXXXX input/output ports.

Control Pin	Input/Output	Circuit	Remarks
IN1 to IN4	Input		Pull-down input $R_2 = 400\text{ k}\Omega$ (typ.) Mask option specified With/without pull-down resistor $R_1 = 150\ \Omega$ (typ.)
IO11 to IO14 IO21 to IO24	Input/Output		Key strobe input/output $R_2 = 400\text{ k}\Omega$ (typ.) $R_1 = 150\ \Omega$ (typ.)
IO01 to IO04	Input		Pull-down input $R_2 = 400\text{ k}\Omega$ (typ.) $R_1 = 150\ \Omega$ (typ.)

Note: For the OTP version corresponding to the TMP040CH01FXXX (A33F1), IO01 to IO04 are as shown below

Control Pin	Input/Output	Circuit	Remarks
IO01 to IO04	Input/Output		Key strobe input/output $R_2 = 400\text{ k}\Omega$ (typ.) $R_1 = 150\ \Omega$ (typ.)

7. Maximum Ratings

7.1 Absolute Maximum Ratings ($V_{SS} = 0\text{ V}$, $T_a = 25^\circ\text{C} \pm 1.5^\circ\text{C}$)

(1) TMP04090FXXXX (Package type device)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{DD}	-0.3 to 6.0	V
Program supply voltage	V_{PP}	-0.3 to 13.0	V
Input voltage	V_{IN}	-0.3 to $V_{DD} + 0.3$	V
Power dissipation (Note)	P_D	1.0	W
Solder temperature	T_{sol}	260/10	$^\circ\text{C}/\text{S}$
Storage temperature	T_{stg}	-55 to 125	$^\circ\text{C}$
Operating temperature	T_{opr}	0 to 40	$^\circ\text{C}$

Note: Power dissipation decreases by about 12 mW per 1°C .

(2) JTMP04090XXXXS (Chip type device)

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{DD}	-0.3 to 6.0	V
Program supply voltage	V_{PP}	-0.3 to 13.0	V
Input voltage	V_{IN}	-0.3 to $V_{DD} + 0.3$	V
Storage temperature	T_{stg}	-55 to 125	$^\circ\text{C}$
Operating temperature	T_{opr}	0 to 40	$^\circ\text{C}$

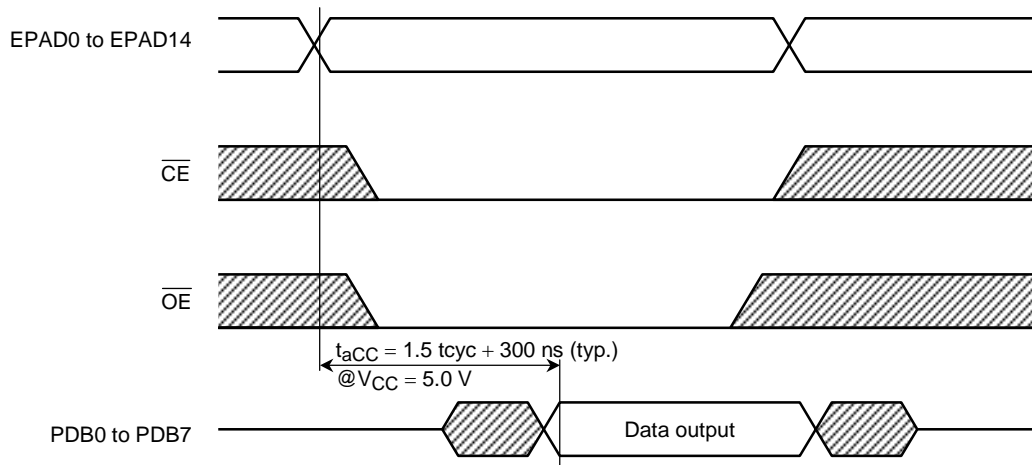
8. Electrical Characteristics

8.1 Electrical Characteristics in PROM Mode

(1) Read operating ($T_{opr} = 25^{\circ}\text{C} \pm 1.5^{\circ}\text{C}$, $V_{SS} = 0\text{ V}$)

Characteristics		Symbol	Pin Name	Test Condition	Min	Typ.	Max	Unit
Input voltage	High level	V_{IH1}	S ₂₅ to S ₄₁ IN1 to IN4	—	0.7 V_{CC}	—	V_{CC}	V
	Low level	V_{IL1}		—	V_{SS}	—	0.12 V_{CC}	
Operating voltage		V_{CC}	V_{DD}	—	4.75	5.00	5.25	V
Program supply voltage		V_{PP}	TEST	—	V_{CC} -0.6	V_{CC}	V_{CC} +0.6	V

Read Timing Diagram

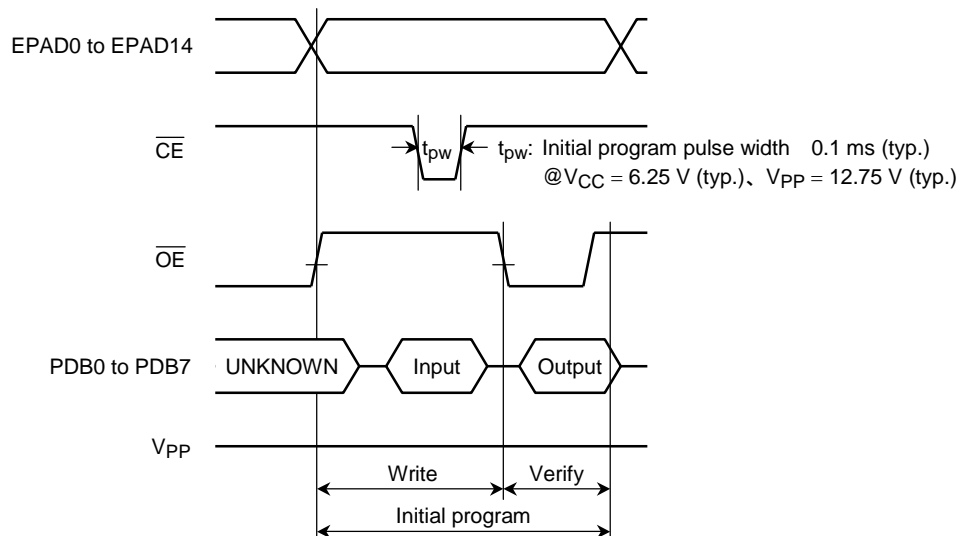


Note: $t_{cyc} = 1\ \mu\text{s}$ (f_{XTH} , $f_{osc2} = 2\text{ MHz}$) $t_{cyc} = 1/f_{XTH} \times 2\text{ Clock}$

(2) At program execution ($T_{opr} = 25^{\circ}\text{C} \pm 1.5^{\circ}\text{C}$, $V_{SS} = 0\text{ V}$)

Characteristics		Symbol	Applicable Pin	Test Condition	Min	Typ.	Max	Unit
Input voltage	High level	V_{IH2}	IO11 to IO14 IO21 to IO24	—	0.7 V_{CC}	—	V_{CC}	V
	Low level	V_{IL2}	IN1 to IN4 S ₂₅ to S ₄₁	—	V_{SS}	—	0.12 V_{CC}	
Operating voltage		V_{CC}	V_{DD}	—	6.00	6.25	6.50	V
Program supply voltage		V_{PP}	TEST	—	12.5	12.75	13.0	V

Program Timing Chart



Note 1: Turn supply voltage V_{PP} (12.75 V) on at the same time as or after V_{CC} supply voltage. At power off, turn off at the same time as or before V_{CC} supply voltage.

Note 2: When $V_{PP} = 12.75\text{ V} \pm 0.25\text{ V}$, do not insert/remove the device because this will damage the device. That is, do not insert/remove the device while the program is being executed.

Note 3: The maximum rating of the V_{PP} pin is 13 V. While the program is being executed, including overshoot, make sure that a voltage exceeding 13 V is not applied.

8.2 Electrical Characteristic in MCU Mode

TMP04090FXXXX (ES), JTMP04090XXXXS (ES)

(1) 3.0 V version (Unless otherwise specified, $V_{SS} = 0$ V, $T_{opr} = 0$ to 40°C)

Recommended operating condition

(T41, T42)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Power supply voltage		V_{DD}	$f_{XTH} = 2$ MHz	2.4	3.0	3.6	V
Oscillation frequency	Low-speed X'tal	f_{XTL1}	$V_{DD} = 2.4$ V to 3.6 V (Note 1)	—	32.768	—	kHz
	High-speed X'tal	f_{XTH1}	$V_{DD} = 2.4$ V to 3.6 V (Note 2)	—	2.0	—	
	High-speed CR	f_{XTH2}	$V_{DD} = 3.0$ V (Note 3)	—	2.0	—	MHz
Input voltage	High level	V_{IH}	$V_{DD} = 2.4$ V	$V_{DD} \times 0.8$	—	V_{DD}	V
			$V_{DD} = 3.6$ V	$V_{DD} \times 0.7$	—	V_{DD}	
	Low level	V_{IL}	$V_{DD} = 2.4$ V	0	—	$V_{DD} \times 0.2$	
			$V_{DD} = 3.6$ V	0	—	$V_{DD} \times 0.3$	
Quadrupler capacitance		C_1, C_2	—	—	0.1	—	μF
Voltage capacitance		V_{1C}	—	—	0.1	—	μF
		V_{2C}	—	—	0.1	—	
		V_{3C}	—	—	0.1	—	
		V_{4C}	—	—	0.1	—	
		V_{XTC}	—	—	0.1	—	

Note 1: Crystal oscillation circuit is used for low-speed oscillator.

Note 2: Crystal oscillation circuit is used for High-speed oscillator.

Note 3: An RC oscillating circuit configured with an external R is used for the high-speed oscillator.

Oscillation (3.0 V version)

(T41, T42)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
OSC starting voltage	Low-speed X'tal	V_{STA1}	$T_{STA} = 10$ s, $T_{opr} = 25^{\circ}\text{C}$ (Note 4)	1.85	—	—	V
	High-speed X'tal	V_{STA2}	$T_{STA} = 8$ ms	2.20	—	—	
OSC holding voltage	Low-speed X'tal	V_{HOLD1}	—	1.65	—	—	V
	High-speed X'tal	V_{HOLD2}	—	2.0	—	—	
Frequency of high-speed OSC		f_{osc2}	$V_{DD} = 3.0$ V, $R_f = 13.3$ k Ω (Note 5)	—	2.0	—	MHz

Note 4: Internal CR oscillator for low-speed oscillator.

Note 5: An RC oscillating circuit configured with an external R is used for the high-speed oscillator.

DC Characteristic (3.0 V version)

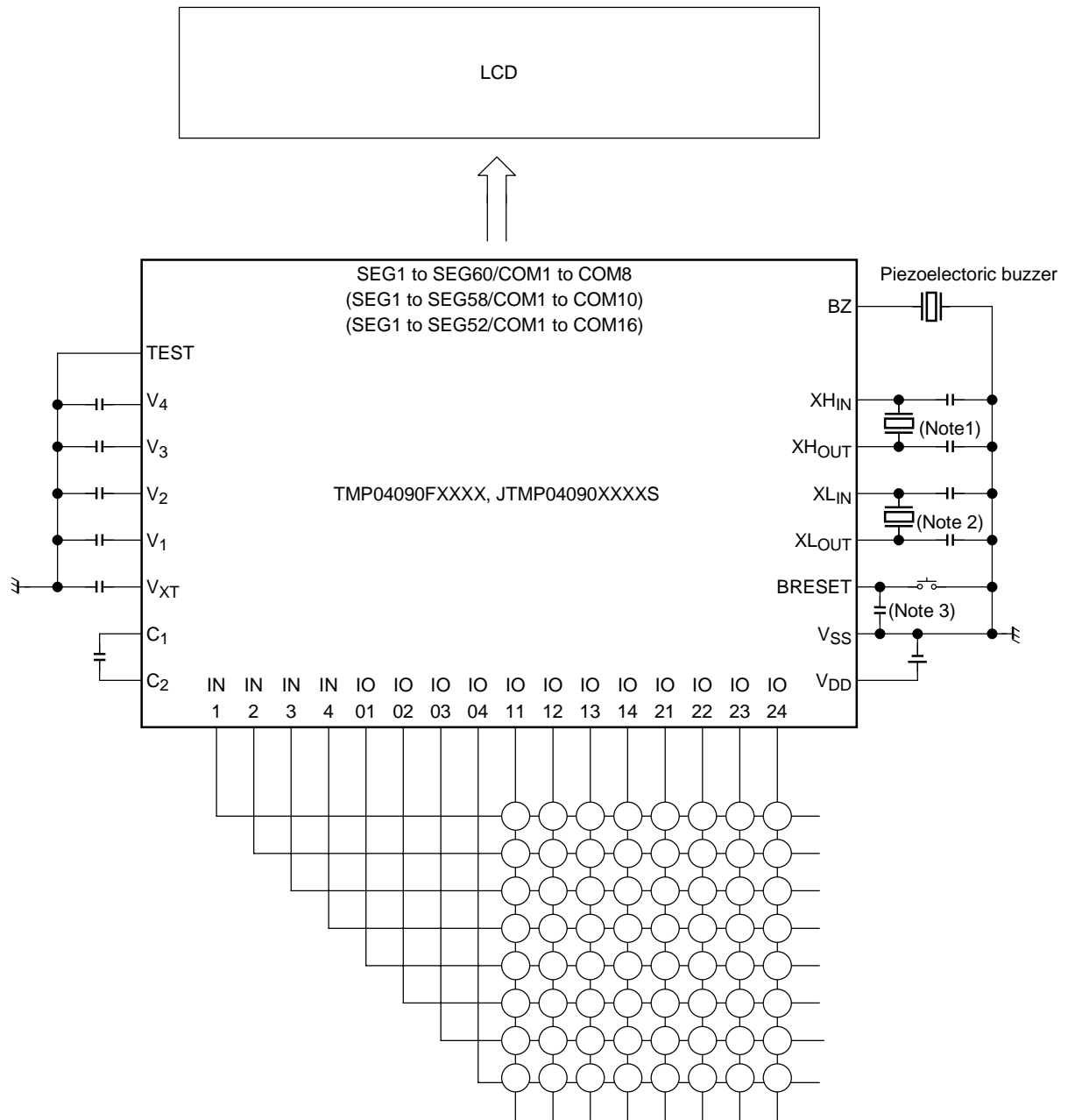
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit	
Input current (1) (IN1 to IN4, IO01 to IO04, IO11 to IO14, IO21 to IO24)	I_{IH1}	$V_{DD} = 3.6 \text{ V}, V_{IN} = 0 \text{ V}$	-500	—	500	nA	
	I_{IL1}	$V_{DD} = 3.6 \text{ V}, V_{IN} = 3.6 \text{ V}$	6.43	9.0	15.0	μA	
Input current (2) (BRESET)	I_{IH2L}	$V_{DD} = 3.6 \text{ V}, V_{IN} = 0 \text{ V},$ Low resistor side	-120	-72	-51.4	μA	
	I_{IH2H}	$V_{DD} = 3.6 \text{ V}, V_{IN} = 0 \text{ V},$ High resistor side	-12	-7.2	-5.14		
Input current (3) (TEST)	I_{IL3}	$V_{DD} = 3.6 \text{ V}, V_{IN} = 3.6 \text{ V}$	10.0	18.0	27.0	μA	
Output current (1) (IO11 to IO14, IO21 to IO24)	I_{OH1}	$V_{DD} = 2.4 \text{ V}, V_{OH} = 1.9 \text{ V}$	—	—	-1.5	mA	
	I_{OL1}	$V_{DD} = 2.4 \text{ V}, V_{OL} = 0.5 \text{ V}$	0.89	1.25	2.08		
Output current (2) (BZ)	I_{OH2}	$V_{DD} = 2.4 \text{ V}, V_{OH} = 1.9 \text{ V}$	—	—	-2.0	mA	
	I_{OL2}	$V_{DD} = 2.4 \text{ V}, V_{OL} = 0.5 \text{ V}$	2.0	—	—		
Output current (3) (SEGMENT)	I_{OH3}	$V_{DD} = 3.0 \text{ V},$ $V_{REG} = 1.125 \text{ V},$ $V_2 = 2.25 \text{ V},$ $V_3 = 3.375 \text{ V},$ $V_4 = 4.5 \text{ V}$	$V_{OH} =$ $V_4 - 0.5 \text{ V}$	—	—	-100	μA
	I_{OL3}		$V_{OL} = 0.5 \text{ V}$	100	—	—	
	I_{OM3}		$V_{OM} =$ $V_2 - 0.5 \text{ V}$	—	—	-50	
Output current (4) (COMMON)	I_{OH4}	$V_{DD} = 3.0 \text{ V},$ $V_{REG} = 1.125 \text{ V},$ $V_2 = 2.25 \text{ V},$ $V_3 = 3.375 \text{ V},$ $V_4 = 4.5 \text{ V}$	$V_{OH} =$ $V_4 - 0.5 \text{ V}$	—	—	-100	μA
	I_{OL4}		$V_{OL} = 0.5 \text{ V}$	100	—	—	
	I_{OM4}		$V_{OM} =$ $V_3 - 0.5 \text{ V}$	—	—	-50	
	I_{OM4}		$V_{OM} =$ $V_1 + 0.5 \text{ V}$	50	—	—	
Constant output voltage	V_{REG1}	$V_{DD} = 3.0 \text{ V}$ (Note 1)	1.075	1.125	1.175	V	
	V_{REG2}	$V_{DD} = 3.0 \text{ V}$ (Note 2)	—	1.8	—		
Quadrupler output voltage	V_2	$V_{DD} = 3.0 \text{ V}$ $V_{REG} = 1.125 \text{ V}, T_a = 25^\circ\text{C}$	2.05	2.25	2.45	V	
	V_3		3.175	3.375	3.575		
	V_4		4.3	4.5	4.7		

Note 1: Constant output voltage for Quadrupler (V_1)

Note 2: Constant output for low-speed oscillation circuit (V_{XT})

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit	
Power supply voltage (1) (High-speed crystal oscillation circuit) (Low-speed crystal oscillation circuit)	I _{DDOP}	V _{DD} = 3.0 V, f _H = 2 MHz, f _L = 32 kHz, CPM3 mode	Display ON	—	—	1.2	mA
			Display OFF	—	—	1.2	
	I _{DD} SLOW	V _{DD} = 3.0 V, f _L = 32 kHz, f _H = STOP, CPM1 mode	Display ON	—	—	30.0	μA
			Display OFF	—	—	29.0	
	I _{DD} HOLD	V _{DD} = 3.0 V, f _H = STOP, f _L = STOP, HALT mode	Display ON	—	—	21.0	
			Display OFF	—	—	20.0	
	I _{DD} STOP	V _{DD} = 3.0 V, f _H = STOP, f _L = STOP, STOP mode	—	—	1.2		
	Power supply voltage (2) (High-speed CR oscillation circuit) (Low-speed crystal oscillation circuit)	I _{DDOP}	V _{DD} = 3.0 V, f _H = 2 MHz, f _L = 32 kHz, CPM3 mode	Display ON	—	—	1.5
Display OFF				—	—	1.5	
I _{DD} SLOW		V _{DD} = 3.0 V, f _L = 32 kHz, f _H = STOP, CPM1 mode	Display ON	—	—	33.0	μA
			Display OFF	—	—	32.0	
I _{DD} HOLD		V _{DD} = 3.0 V, f _L = 32 kHz, f _H = stop, HALT mode	Display ON	—	—	20.0	
			Display OFF	—	—	19.0	
I _{DD} STOP		V _{DD} = 3.0 V, f _H = STOP, f _L = STOP, STOP mode	—	—	1.2		

TMP04090FXXXX, TMP04090XXXXS Example of Application Circuit (High-speed crystal oscillation)



Note 1: Recommended high-speed oscillator circuit capacitor: 22 pF (high-speed crystal)

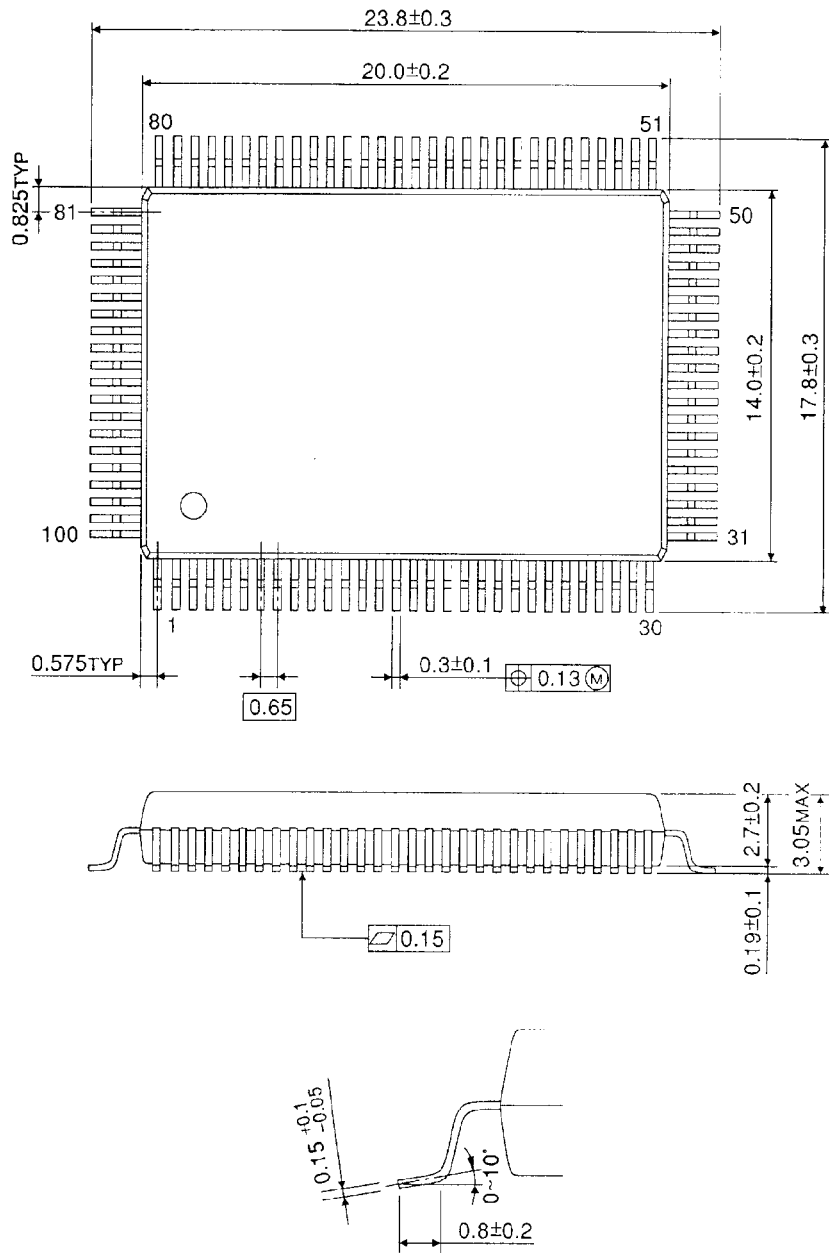
Note 2: Recommended low-speed oscillator circuit capacitor: 15 pF

Note 3: A 0.1-µF capacitor is connected between BRESET and V_{SS}.

Package Dimensions

QFP100-P-1420-0.65A

Unit: mm



Weight: 1.65 g (typ.)

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