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MB3793-27D/28D/30D

ASSP for Power Management
BIPOLAR
Power-Voltage Monitoring IC with Watchdog Timer

Data Sheet (Full Production)

Notice to Readers: This document states the current technical specifications regarding the Spansion product(s) described herein. Spansion Inc. deems the products to have been in sufficient production volume such that subsequent versions of this document are not expected to change. However, typographical or specification corrections, or modifications to the valid combinations offered may occur.

Publication Number DS405-00023 Revision 1.0 Issue Date November 28, 2014

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When a product has been in production for a period of time such that no changes or only nominal changes are expected, the Preliminary designation is removed from the data sheet. Nominal changes may include those affecting the number of ordering part numbers available, such as the addition or deletion of a speed option, temperature range, package type, or VIO range. Changes may also include those needed to clarify a description or to correct a typographical error or incorrect specification. Spansion Inc. applies the following conditions to documents in this category:

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Questions regarding these document designations may be directed to your local sales office.

MB3793-27D/28D/30D

ASSP for Power Management
BIPOLAR
Power-Voltage Monitoring IC with Watchdog Timer

Data Sheet (Full Production)

1. DESCRIPTION

The MB3793 is an integrated circuit to monitor power voltage; it incorporates a watchdog timer.
A reset signal is output when the power supply voltage is cut or falls instantaneously. When the power supply recovers normally after resetting, a power-on reset signal is output to monitor the power supply voltage. A built-in watchdog timer with two inputs for system operation diagnosis can provide a fail-safe function for various application systems.

Model No.	Marking Code	Detection voltage
MB3793-27D	3793DY	2.7 V
MB3793-28D	3793DR	2.8 V
MB3793-30D	3793DC	3.0 V

2. FEATURES

- Precise detection of power voltage fall: ±2.5%
- Detection voltage with hysteresis
- Built-in dual-input watchdog timer
- Watchdog timer halt function
- Independently-set watchdog and reset times
- Open drain output
- Package : SOP

3. APPLICATION

The MB3793 has various uses such as the amusement devices.

Online Design Simulation
Easy DesignSim

This product supports the web-based design simulation tool.
It can easily select external components and can display useful information.
Please access from the following URL.
http://www.spansion.com/easydesignsim/

Publication Number DS405-00023 Revision 1.0 Issue Date November 28, 2014

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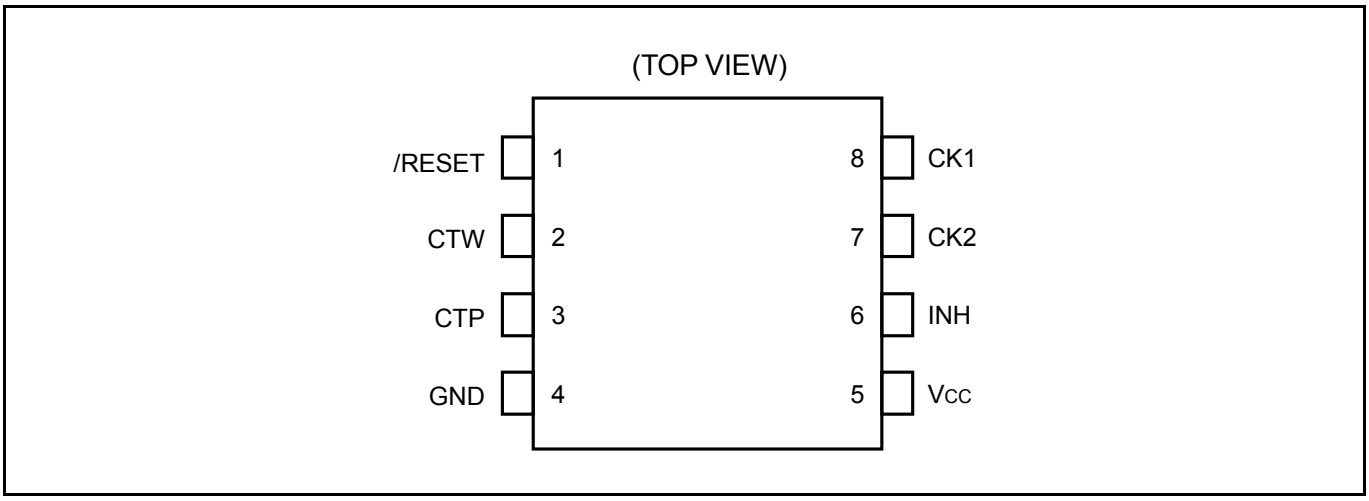
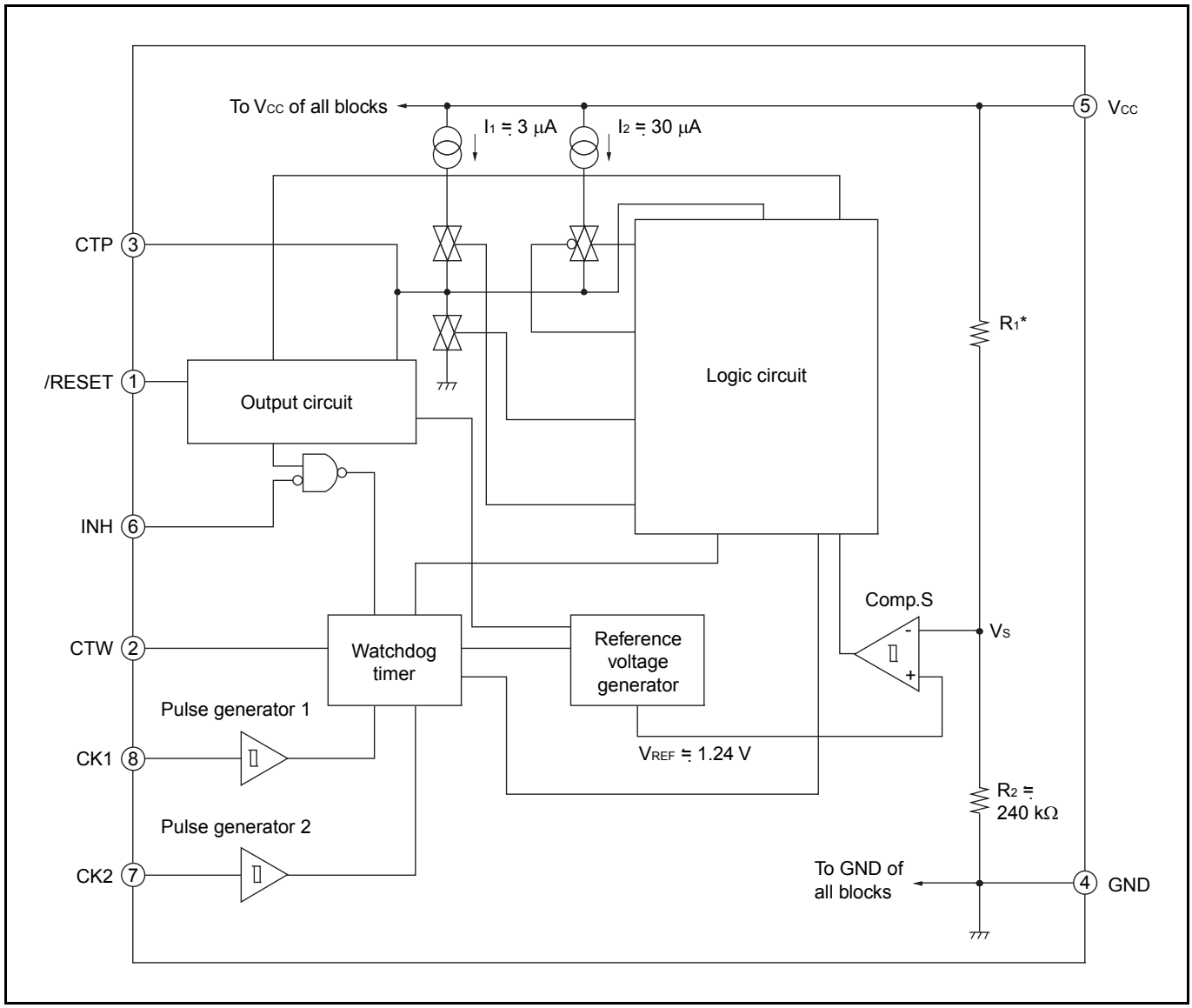
4. PIN ASSIGNMENT



5. PIN DESCRIPTION

Pin No.	Symbol	Description
1	/RESET	Reset output pin (Open drain)
2	CTW	Watchdog timer monitoring time setting pin
3	CTP	Power-on reset hold time setting pin
4	GND	Ground pin
5	V_{CC}	Power supply pin
6	INH	This pin forces the watchdog timer on/off. When setting this pin to the High level, the watchdog timer is stopped.
7	CK2	Clock 2 input pin
8	CK1	Clock 1 input pin

6. BLOCK DIAGRAM



*: See the following table.

Model No.	Resistance value (R_1)
MB3793-27D	295 kΩ
MB3793-28D	315 kΩ
MB3793-30D	360 kΩ

7. BLOCK FUNCTIONS

Comp.S

Comp.S is a comparator with hysteresis to compare the reference voltage with a voltage (VS) that is the result of dividing the power supply voltage (VCC) by resistors R1 and R2. When VS falls below 1.24 V, a reset signal is output. This function enables the MB3793 to detect an abnormality within 1 □s when the power supply is cut or falls instantaneously.

Output circuit

The output circuit has a comparator to control the reset signal (/RESET) output. When the voltage at the CTP pin for setting the power-on reset hold time exceeds the threshold voltage, resetting is canceled.

Since the reset (/RESET) output buffer has the CMOS organization, no pull-up resistor is needed.

Pulse generator

The pulse generator generates pulses when the voltage at the CK1 and CK2 input clock pins changes from Low level to High level (positive-edge trigger) and exceeds the threshold voltage; it sends the clock signal to the watchdog timer.

Watchdog timer

The watchdog timer can monitor two clock pulses. Short-circuit the CK1 and CK2 clock pins to monitor a single clock pulse.

Logic circuit

The logic circuit controls charging and discharging of the power-on reset hold time setting capacity (CTP) on a signal of Comp.S and Watchdog timer.

8. ABSOLUTE MAXIMUM RATINGS

Parameter		Symbol	Conditions	Rating		Unit
				Min	Max	
Power supply voltage(*1)		V_{CC}	—	−0.3	+7.0	V
/RESET pin voltage		$V_{/RESET}$	—	−0.3	+7.0	V
Input voltage(*1)	CK1	V_{CK1}	—	−0.3	V_{CC} + 0.3 (≤ +7)	V
	CK2	V_{CK2}	—			
	INH	V_{INH}	—			
/RESET output voltage(*1)	/RESET	V_{OL}, V_{OH}(*2)	—	−0.3	+7.0	V
/RESET output current		I_{OL}	—	0	+10	mA
Power dissipation		P_D	Ta ≤ +85 °C	—	200	mW
Storage temperature		Tstg	—	−55	+125	°C

*1: The voltage is based on the ground voltage (0 V).

*2: The /RESET output voltage V_{OH} is the applied voltage to the pull-up resistor.

WARNING:

1. Semiconductor devices may be permanently damaged by application of stress (including, without limitation, voltage, current or temperature) in excess of absolute maximum ratings. Do not exceed any of these ratings.

9. RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Conditions	Value			Unit
			Min	Typ	Max	
Power supply voltage	V_{CC}	—	1.2	3.3	4.0	V
/RESET pin voltage	$V_{/RESET}$	—	0	—	4.0	V
Reset (/RESET) output current	I_{OL}	—	0	—	+ 5	mA
Power-on reset hold time setting capacity	C_{TP}	—	0.001	0.1	10	µF
Watchdog timer monitoring time setting capacity(*1)	C_{TW}	—	0.001	0.01	1	µF
Operating ambient temperature	Ta	—	−40	+25	+85	°C

*1: The watchdog timer monitor time range depends on the rating of the setting capacitor.

WARNING:

1. *The recommended operating conditions are required in order to ensure the normal operation of the semiconductor device. All of the device's electrical characteristics are warranted when the device is operated under these conditions.*
2. *Any use of semiconductor devices will be under their recommended operating condition.*
3. *Operation under any conditions other than these conditions may adversely affect reliability of device and could result in device failure.*
4. *No warranty is made with respect to any use, operating conditions or combinations not represented on this data sheet. If you are considering application under any conditions other than listed herein, please contact sales representatives beforehand.*

10. ELECTRICAL CHARACTERISTICS

10.1 DC Characteristics

(V_{CC} = +3.3 V, Ta = +25°C)

Parameter		Symbol	Conditions		Value			Unit
					Min	Typ	Max	
Power supply current	MB3793-27D	I_{CC1}	After exit from reset		—	38	50	µA
	MB3793-28D				—	30	50	µA
	MB3793-30D				—	33	48	µA
Detection voltage	MB3793-34D	V_{SL}	V_{CC} falling	Ta = + 25 °C	2.63	2.70	2.77	V
				Ta = – 40 °C to + 85 °C	2.59(*1)	2.70	2.81(*1)	V
		V_{SH}	V_{CC} rising	Ta = + 25 °C	2.69	2.76	2.83	V
				Ta = – 40 °C to + 85 °C	2.65(*1)	2.76	2.87(*1)	V
	MB3793-37D	V_{SL}	V_{CC} falling	Ta = + 25 °C	2.73	2.80	2.87	V
				Ta = – 40 °C to + 85 °C	2.69(*1)	2.80	2.81(*1)	V
		V_{SH}	V_{CC} rising	Ta = + 25 °C	2.80	2.87	2.94	V
				Ta = – 40 °C to + 85 °C	2.76(*1)	2.87	2.98	V
	MB3793-40D	V_{SL}	V_{CC} falling	Ta = + 25 °C	2.93	3.00	3.07	V
				Ta = – 40 °C to + 85 °C	2.89(*1)	3.00	3.11(*1)	V
		V_{SH}	V_{CC} rising	Ta = + 25 °C	3.00	3.07	3.14	V
				Ta = – 40 °C to + 85 °C	2.96(*1)	3.07	3.18(*1)	V
Detection voltage hysteresis width	MB3793-27D	V_{SHYS}	$V_{SH} - V_{SL}$		35	80	120	mV
	MB3793-28D				25	70	100	mV
	MB3793-30D				30	70	110	mV
CK input threshold voltage		V_{CIH}	—		1.4(*1)	1.9	2.5	V
		V_{CIL}	—		0.8	1.3	1.8(*1)	V
CK input hysteresis width		V_{CHYS}	—		0.4(*1)	0.6	0.8(*1)	V
INH input voltage		V_{IIH}	CK Rise		3.5	—	V_{CC}	V
		V_{IIL}	CK Fall		0	—	0.8	V
Logic input current (CK1,CK2,INH)		I_{IH}	$V_{IH} = V_{CC}$		—	0	1.0	µA
		I_{IL}	VI_L = 0 V		-1.0	0	—	µA
Reset output voltage		V_{OL}	$I_{/RESET}$ = +5 mA		—	0.12	0.40	V
Reset output minimum power supply voltage		V_{CCL}	$I_{/RESET}$ = +50 µA		—	0.8	1.2	V
Cut off current		Ioff	$V_{/RESET}$ = 6.0 V		—	—	1	µA

*1: This parameter is guaranteed by design, which is not supported by a final test.

10.2 AC Characteristics

(V_{CC} = +3.3 V, Ta = +25°C)

Parameter	Symbol	Conditions	Value			Unit
			Min	Typ	Max	
Power-on reset hold time	t_{PR}	C_{TP} = 0.1 µF	30	75	120	ms
Watchdog timer monitoring time	t_{WD}	C_{TW} = 0.01 µF, C_{TP} = 0.1 µF	8	16	24	ms
Watchdog timer reset time	t_{WR}	C_{TP} = 0.1 µF	2	5.5	9	ms
CK input pulse width	t_{CKW}	—	500	—	—	ns
CK input pulse cycle	t_{CKT}	—	20	—	—	µs
Reset falling time	Tf (*1)	C_L = 50 pF, Pull-up 470 kΩ	—	—	500	ns

*1: The voltage range is 10% to 90% at testing the reset output transition time.

11. TIMING DIAGRAM

Figure 11-1 Basic operation (Positive clock pulse)

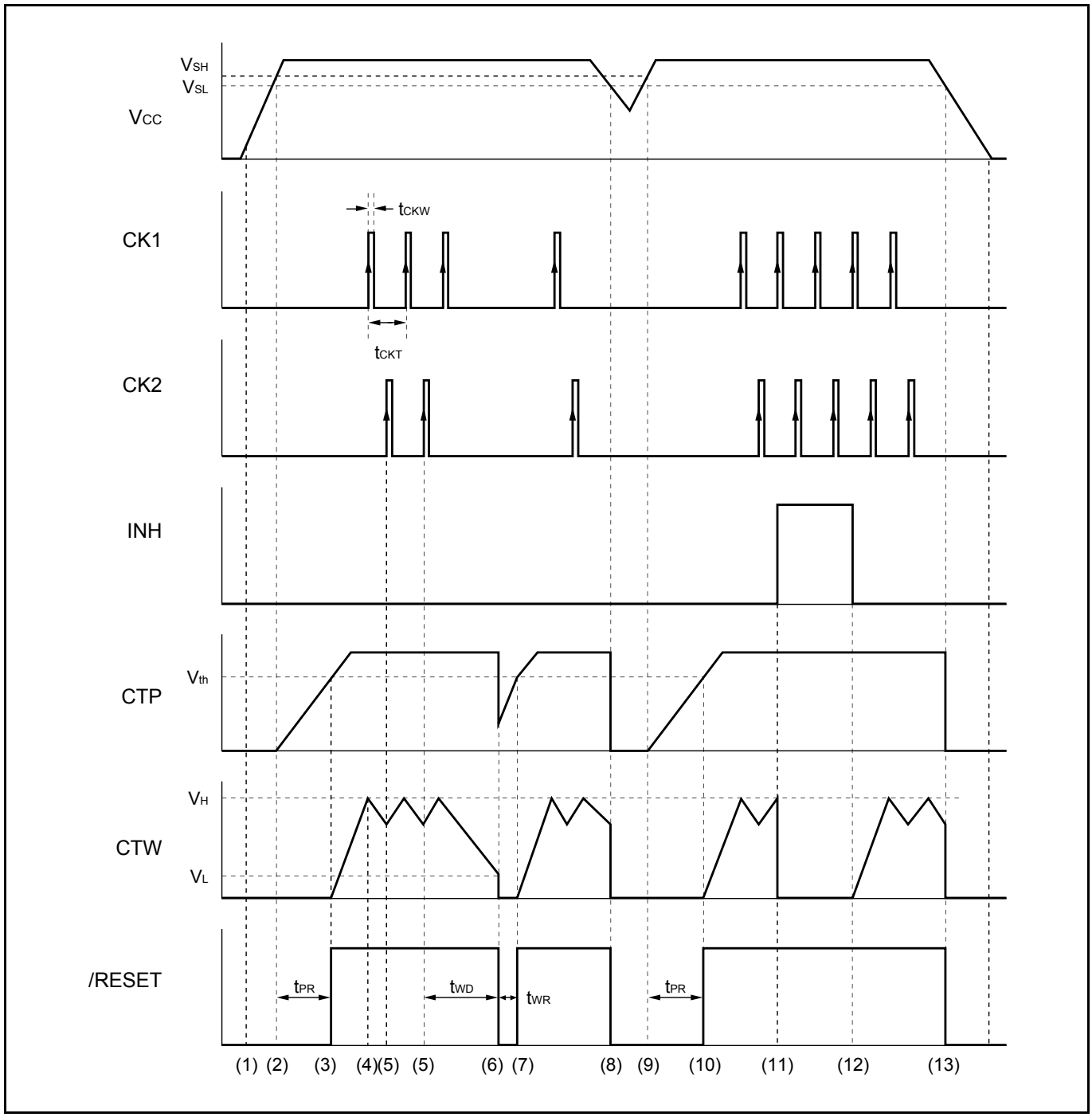


Figure 11-2 Basic operation (Negative clock pulse)

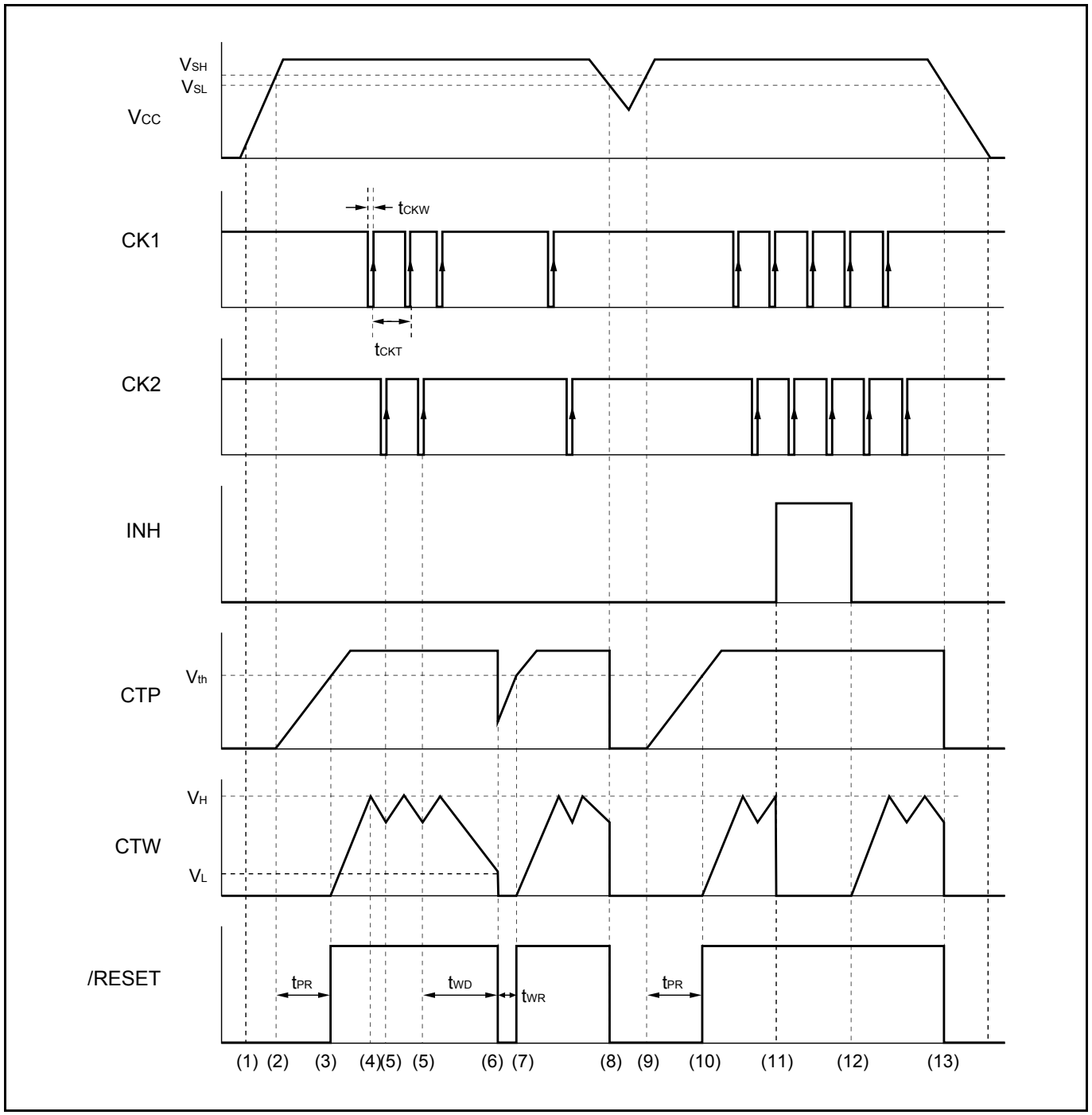
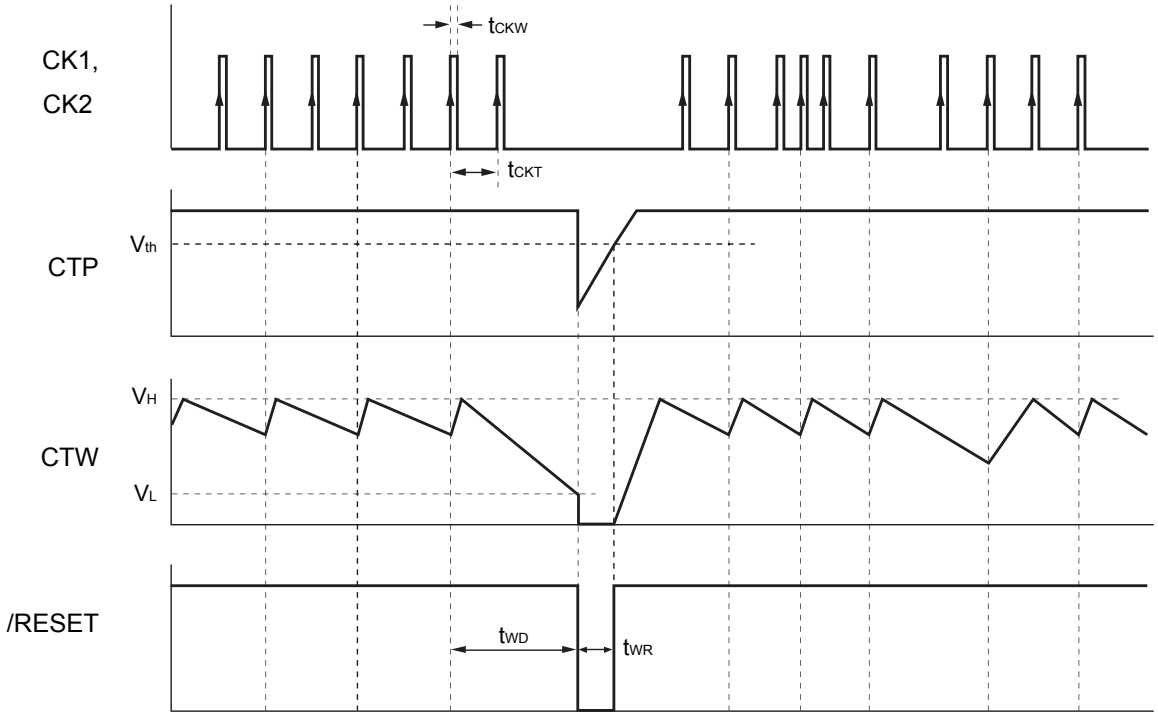


Figure 11-3 Single-clock input monitoring (Positive clock pulse)



Note : The MB3793 can monitor only one clock.
The MB3793 checks the clock signal at every other input pulse.
Therefore, set watchdog timer monitor time t_{WD} to the time that allows the MB3793 to monitor the period twice as long as the input clock pulse.

Figure 11-4 Inhibit function operation (Positive clock pulse)

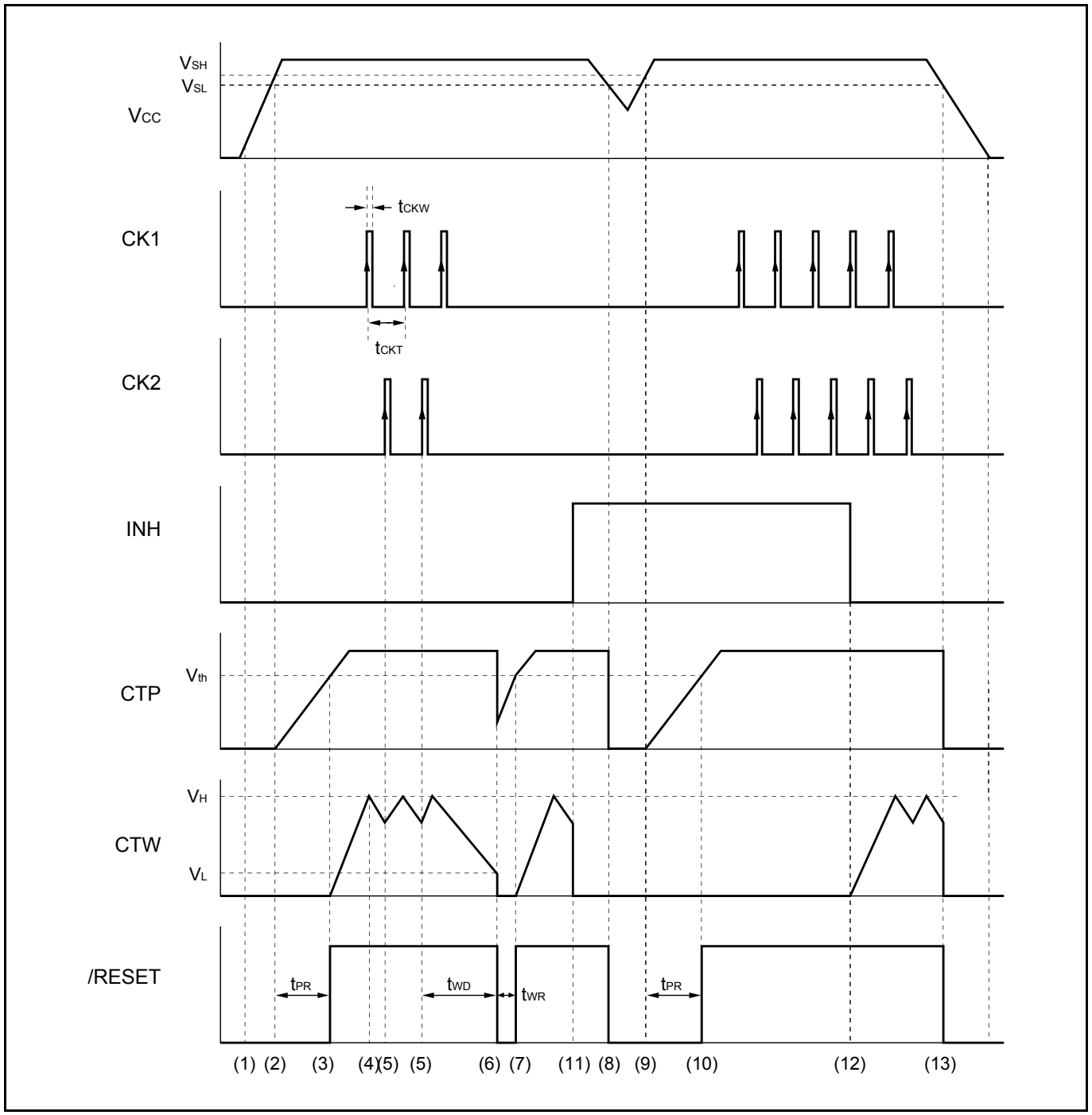
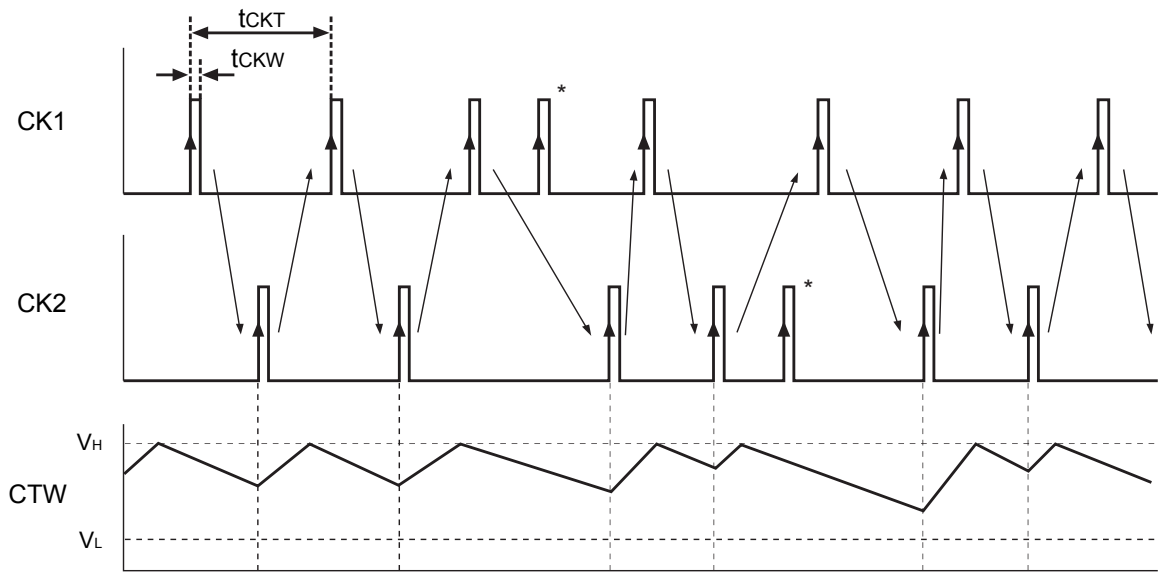


Figure 11-5 Clock pulse input supplementation (Positive clock pulse)



Note : The MB3793 watchdog timer monitors Clock1 (CK1) and Clock2 (CK2) pulses alternately. When a CK2 pulse is detected after detecting a CK1 pulse, the monitoring time setting capacity (C_{TW}) switches to charging from discharging.
Therefore, the second and later pulses will be ignored even if only CK1 or CK2 pulses are input continuously like * (the * pulse is ignored in the example above).

12. OPERATION SEQUENCE

Positive clock pulse input

See “Figure 11-1 Basic operation (positive clock pulse)” under “11. TIMING DIAGRAM”.

Negative clock pulse input

See “Figure 11-2 Basic operation (negative clock pulse)” under “11. TIMING DIAGRAM”.

The MB3793 operates in the same way whether it inputs positive or negative pulses.

Single-clock input monitoring

To use the MB3793 while monitoring only one clock, connect clock pins CK1 and CK2.

Although the MB3793 operates basically in the same way as when monitoring two clocks, it monitors the clock signal at every other input pulse.

See “Figure 11-3 Single-clock input monitoring (positive clock pulse)” under “11. TIMING DIAGRAM”.

Description of Operations

The numbers given to the following items correspond to numbers (1) to (13) used in “11. TIMING DIAGRAM”.

(1) The MB3793 outputs a reset signal when the power supply voltage (VCC) reaches about 0.8 V (VCCL).

(2) If VCC reaches or exceeds the rise-time detected voltage VSH, the MB3793 starts charging the power-on reset hold time setting capacitor CTP. At this time, the output remains in a reset state.

(3) When CTP has been charged for a certain period of time TPR (until the CTP pin voltage exceeds the threshold voltage (Vth) after the start of charging), the MB3793 cancels the reset (setting the /RESET pin to “H” level from “L” level).
The Vth value is about 2.4 V with VCC = 3.3 V

The power-on reset hold time t_{PR} is set with the following equation:
t_{PR} (ms) $\fallingdotseq$ A $\times$ C_{TP} (μF)
The value of A is about 750 with V_{CC} = 3.3 V. The MB3793 also starts charging the watchdog timer monitor time setting capacitor (C_{TW}).

(4) When the voltage at the watchdog timer monitor time setting pin CTW reaches the “H” level threshold voltage V_H, the C_{TW} switches from the charge state to the discharge state.
The value of V_H is always about 1.24 V regardless of the detected voltage.

(5) If the CK2 pin inputs a clock pulse (positive edge trigger) when the C_{TW} is being discharged in the CK1-CK2 order or simultaneously, the C_{TW} switches from the discharge state to the charge state.
The MB3793 repeats operations (4) and (5) as long as the CK1/CK2 pin inputs clock pulses with the system logic circuit operating normally.

(6) If no clock pulse is fed to the CK1 or CK2 pin within the watchdog timer monitor time t_{WD} due to some problem with the system logic circuit, the CTW pin is set to the “L” level threshold voltage V_L or less and the MB3793 outputs a reset signal (setting the /RESET pin to “L” level from “H” level).
The value of V_L is always about 0.24 V regardless of the detected voltage.
The watchdog timer monitor time t_{WD} is set with the following equation:

t_{WD} (ms) $\fallingdotseq$ B $\times$ C_{TW} (μF) + C $\times$ C_{TP} (μF)
The value of B is hardly affected by the power supply voltage; it is about 1600 with V_{CC} = 5.0 V.
The value of C is 0.
For this reason:
t_{WD} (ms) $\fallingdotseq$ B $\times$ C_{TW} (μF)

(7) When a certain period of time t_{WR} has passed (until the CTP pin voltage reaches or exceeds V_{th} again after recharging the C_{TP}), the MB3793 cancels the reset signal and starts operating the watchdog timer. The watchdog timer monitor reset time t_{WR} is set with the following equation:

t_{WR} (ms) ≒ D × C_{TP} (μF)

The value of D is 55 with V_{CC} = 3.3 V and 50 with V_{CC} = 3.0 V.

The MB3793 repeats operations (4) and (5) as long as the CK1/CK2 pin inputs clock pulses. If no clock pulse is input, the MB3793 repeats operations (6) and (7).

(8) If V_{CC} is lowered to the fall-time detected voltage (V_{SL}) or less, the CTP pin voltage decreases and the MB3793 outputs a reset signal (setting the /RESET pin to “L” level from “H” level).

(9) When V_{CC} reaches or exceeds V_{SH} again, the MB3793 starts charging the C_{TP}.

(10) When the CTP pin voltage reaches or exceeds V_{th}, the MB3793 cancels the reset and restarts operating the watchdog timer. It repeats operations (4) and (5) as long as the CK1/CK2 pin inputs clock pulses.

(11) Making the Inhibit function active (setting the INH pin to “H” from “L”) forces the watchdog timer to stop operation.
This stops only the watchdog timer, leaving the MB3793 monitoring V_{CC} (operations (8) to (10)).
The watchdog timer remains inactive unless the Inhibit function pin input is canceled.
The inhibit function (INH) pin must be connecting a voltage of lower as possible impedance, to evade noise.
Set the input pulse time width for Inhibit function (time of “L” level or “H” level) longer than the watchdog timer monitoring time (t_{WD}).

(12) Canceling the inhibit input (setting the INH pin to “L” from “H”) restarts the watchdog timer.

(13) The reset signal is output when the power supply is turned off to set V_{CC} to V_{SL} or less.

1. Equation of time-setting capacitances (C_{TP} and C_{TW}) and set time

t_{PR} [ms] ≒ A × C_{TP} [μF]

t_{WD} [ms] ≒ B × C_{TW} [μF]

t_{WR} [ms] ≒ D × C_{TP} [μF]

Values of A, B, C and D

A	B	C	D	Remark
750	1600	0	55	V_{CC} = 3.3 V
1300	1500	0	100	V_{CC} = 5.0 V

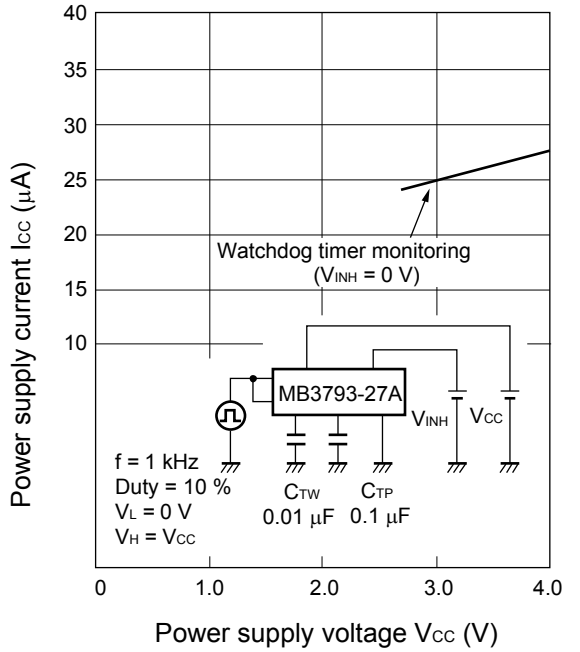
Note: The width of value of t_{PR}, t_{WD} and t_{WR} becomes the same ratio as width (Min, Max) of each specification value.

2. Example (when C_{TP} = 0.1 μF and C_{TW} = 0.01 μF)

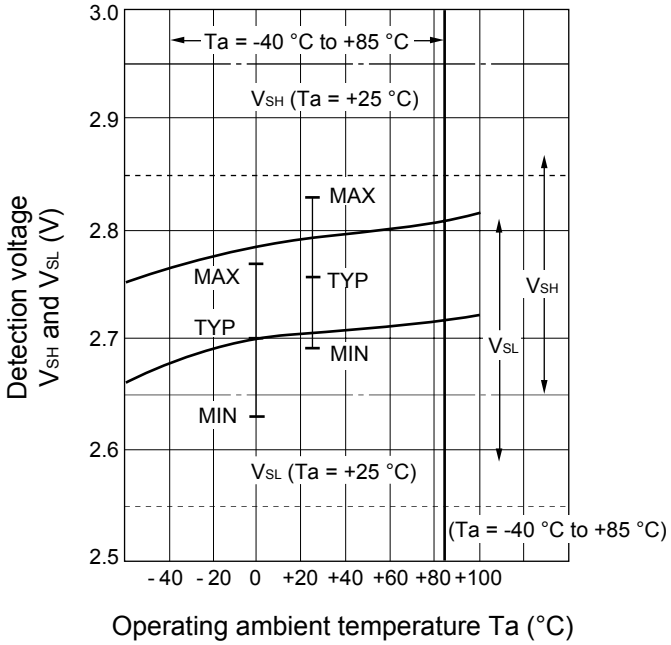
	Symbol	V_{CC} = 3.3 V	V_{CC} = 5.0 V
time (ms)	t_{PR}	75	130
	t_{WD}	16	15
	t_{WR}	5.5	10

13. TYPICAL CHARACTERISTICS

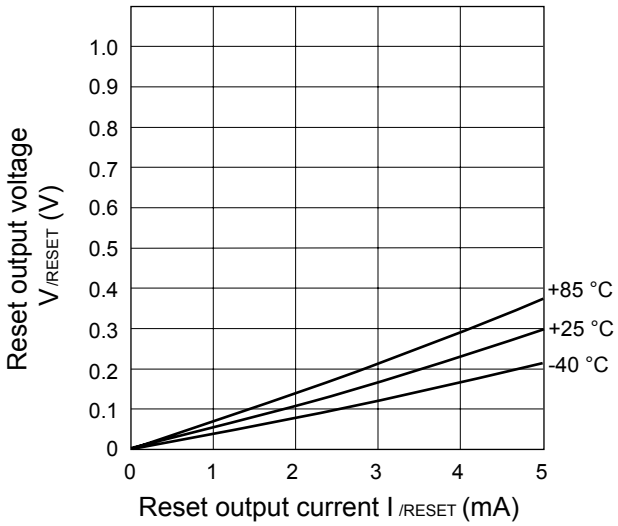
I_{CC} - V_{CC} characteristics (MB3793-27D)



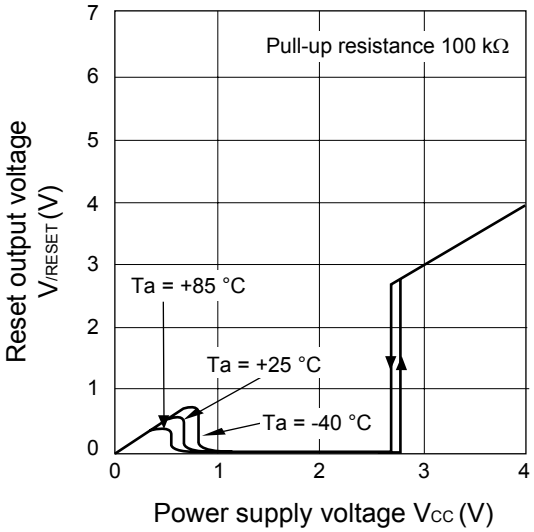
V_{SH}, V_{SL} - Ta characteristics (MB3793-27D)



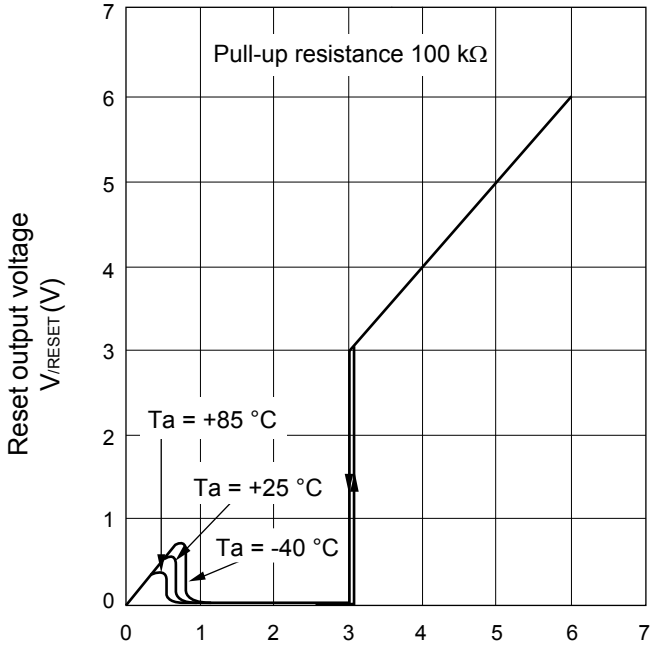
$V_{/RESET}$ - $I_{/RESET}$ characteristics (N-MOS side)



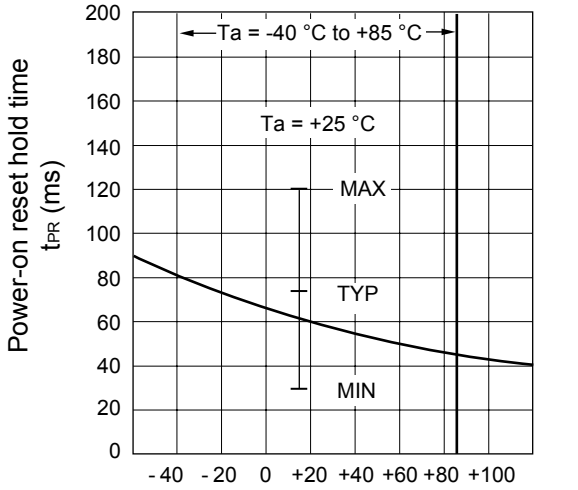
$V_{/RESET}$ - V_{CC} characteristics (MB3793-27D)



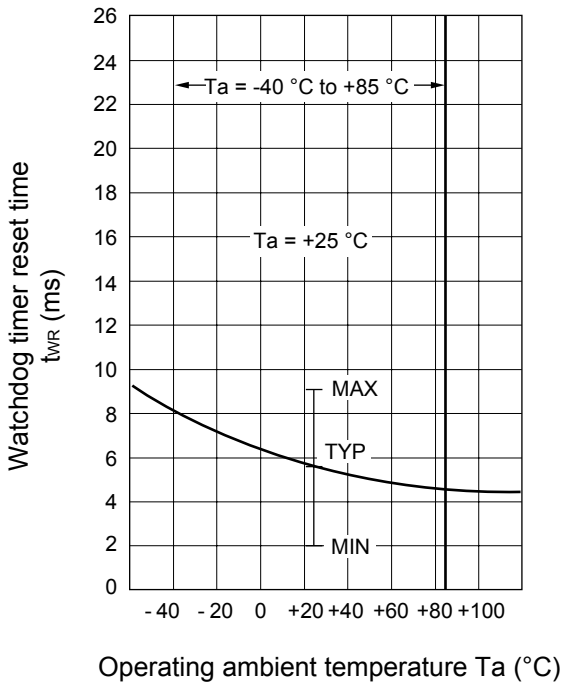
$V_{/RESET}$ - V_{CC} characteristics (MB3793-27D)



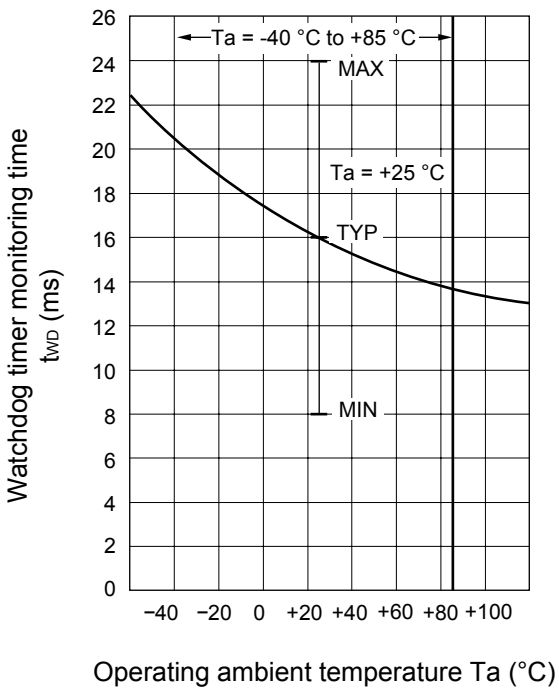
t_{PR} - Ta characteristics



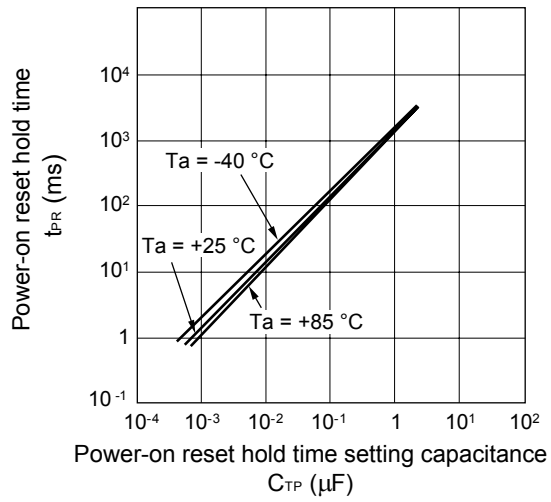
t_{WR} - Ta characteristics



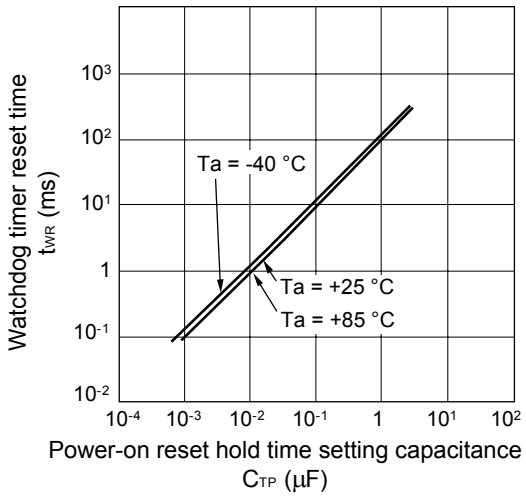
t_{WD} - Ta characteristics



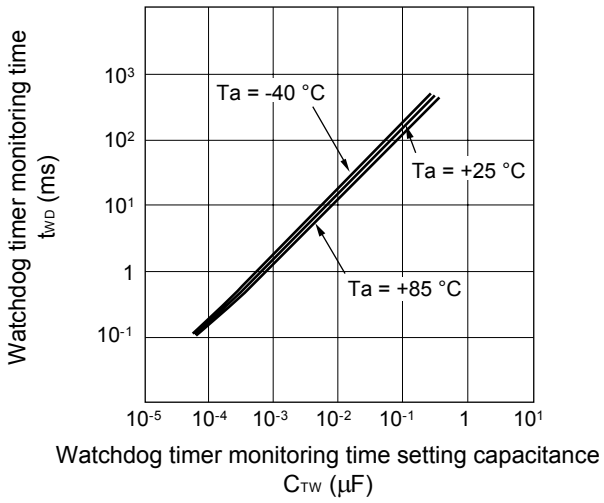
t_{PR} - C_{TP} characteristics



t_{WR} - C_{TP} characteristics



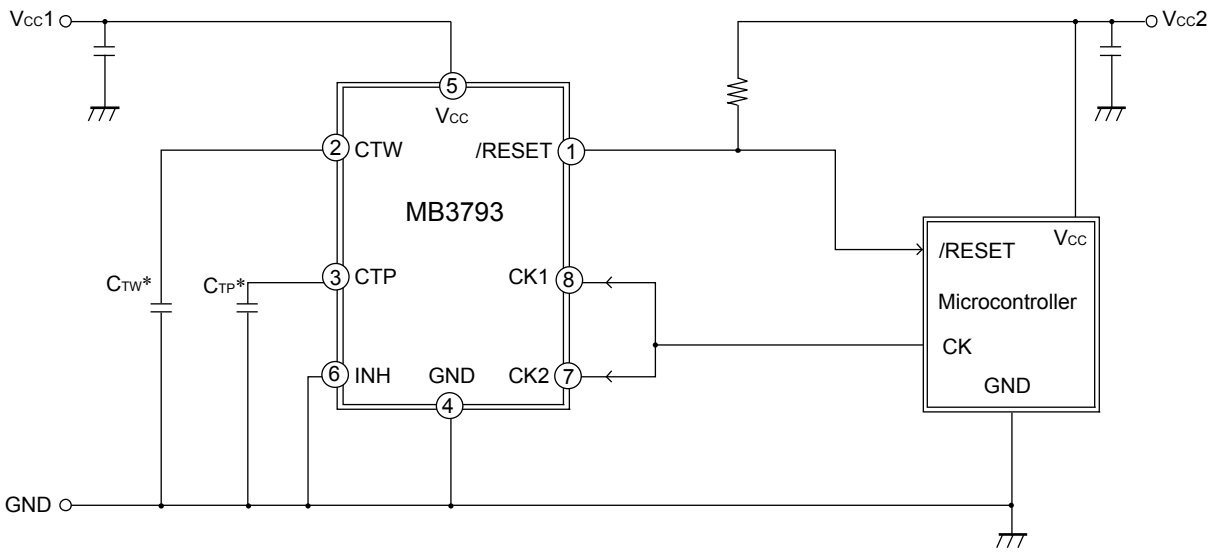
t_{WD} - C_{TW} characteristics



14. APPLICATION EXAMPLE

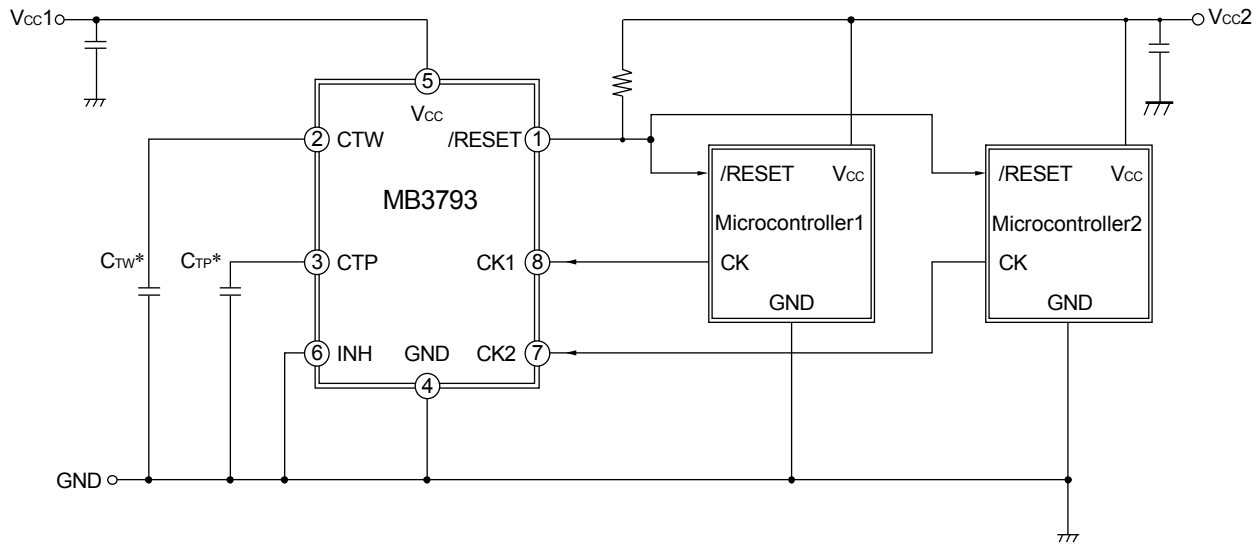
Power supply voltage monitor and watchdog timer

(1) 1-clock monitor



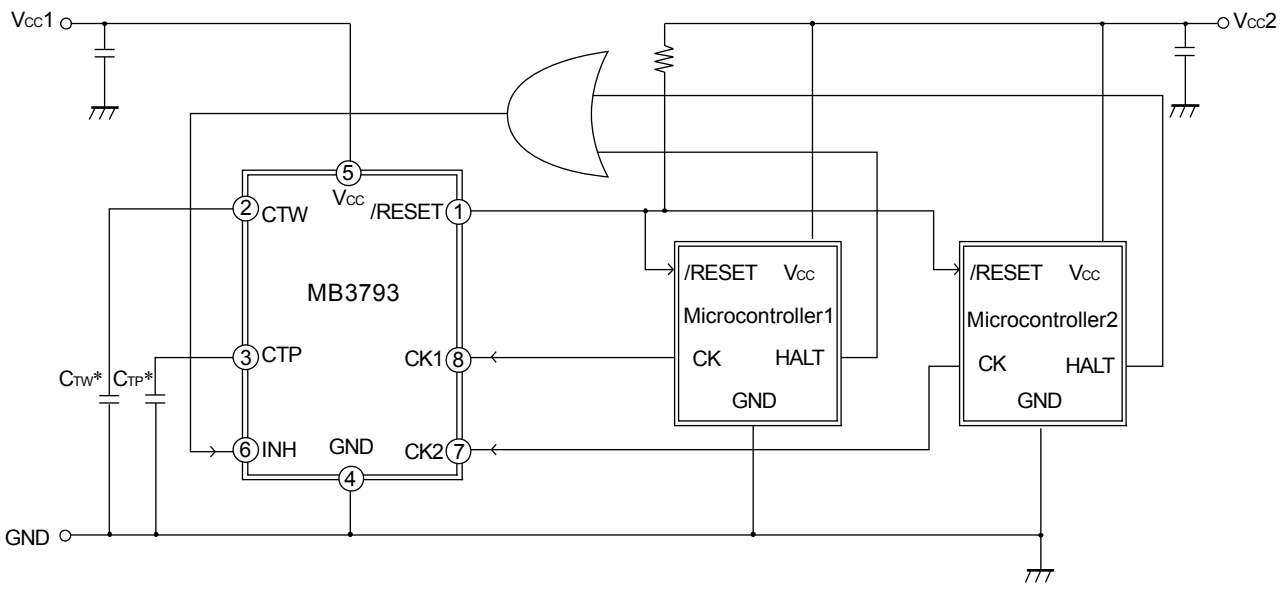
* : Use a capacitor with less leakage current.

(2) 2-clock monitor



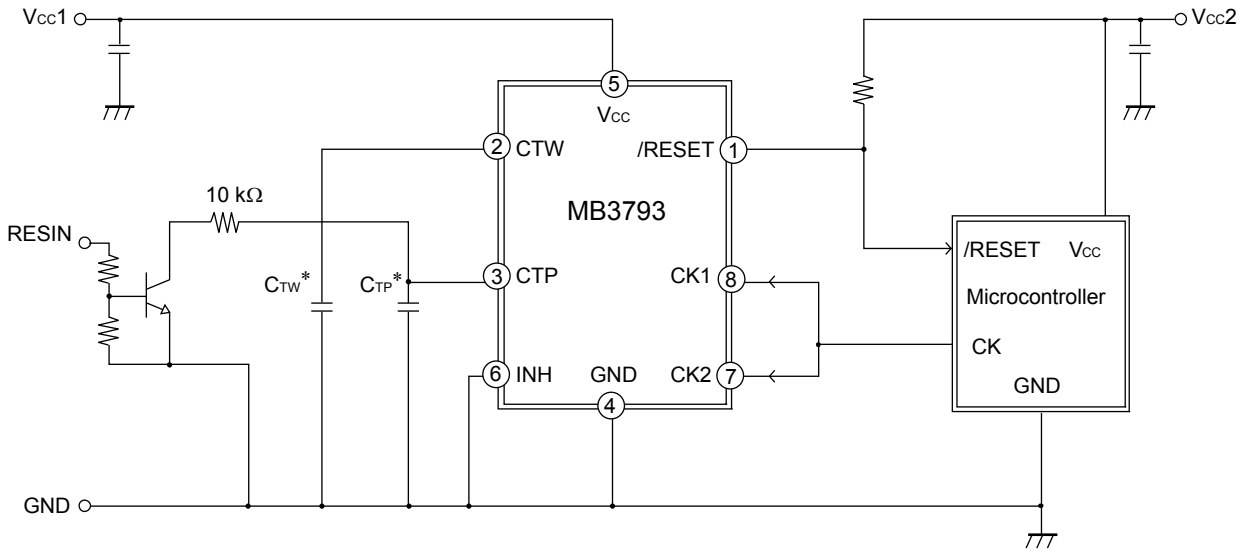
* : Use a capacitor with less leakage current.

Power supply voltage monitor and watchdog timer stop



* : Use a capacitor with less leakage current.

Setting of compulsory reset



* : Use a capacitor with less leakage current.

It is possible for the /RESET pin to fix to “L” if the CTP pin is short-circuited to GND.
Take care not to change the value of the C_{TP} capacity because of the influence of Tr that is used at the time.

15. USAGE PRECAUTION

Do not configure the IC over the maximum ratings

If the IC is used over the maximum ratings, the LSI may be permanently damaged.
It is preferable for the device to normally operate within the recommended usage conditions. Usage outside of these conditions can have a bad effect on the reliability of the LSI.

Use the devices within recommended operating conditions

The recommended operating conditions are the recommended values that guarantee the normal operations of LSI.
The electrical ratings are guaranteed when the device is used within the recommended operating conditions and under the conditions stated for each item.

Printed circuit board ground lines should be set up with consideration for common impedance

Take appropriate measures against static electricity

- Containers for semiconductor materials should have anti-static protection or be made of conductive material.
- After mounting, printed circuit boards should be stored and shipped in conductive bags or containers.
- Work platforms, tools, and instruments should be properly grounded.
- Working personnel should be grounded with resistance of 250 kΩ to 1 MΩ in series between body and ground.

Do not apply negative voltages

The use of negative voltages below –0.3 V may create parasitic transistors on LSI lines, which can cause malfunctions.

16. ORDERING INFORMATION

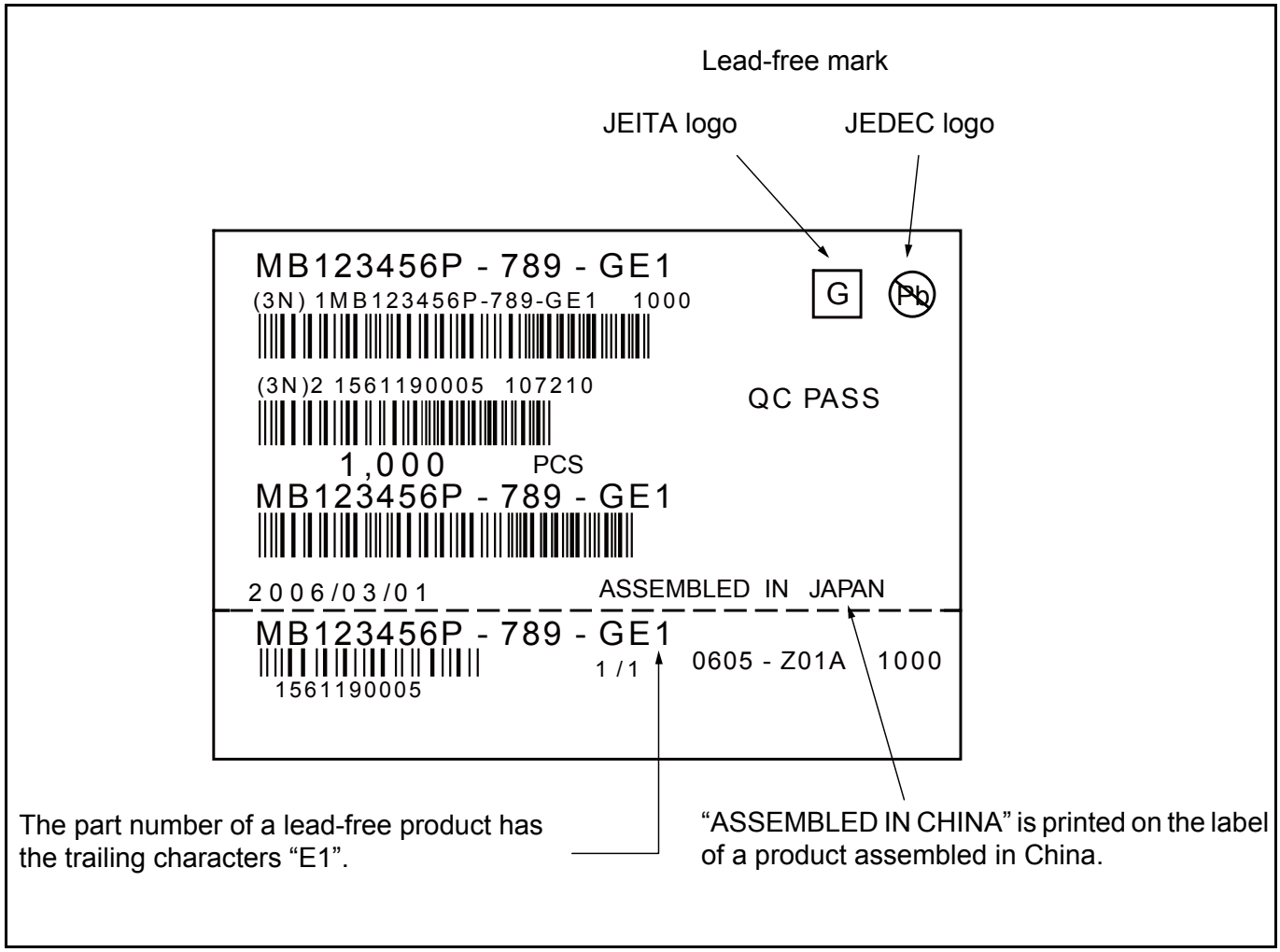
Part number	Package
MB3793-27DPNF	8-pin plastic SOP (FPT-8P-M02)
MB3793-28DPNF	8-pin plastic SOP (FPT-8P-M02)
MB3793-30DPNF	8-pin plastic SOP (FPT-8P-M02)

17. RoHS Compliance Information of Lead

The LSI products of Spansion with “E1” are compliant with RoHS Directive, and has observed the standard of lead, cadmium, mercury, Hexavalent chromium, polybrominated biphenyls (PBB), and polybrominated diphenyl ethers (PBDE).

The product that conforms to this standard is added “E1” at the end of the part number.

18. LABELING SAMPLE



19. MARKING FORMAT

Figure 19-1 MB3793-27D

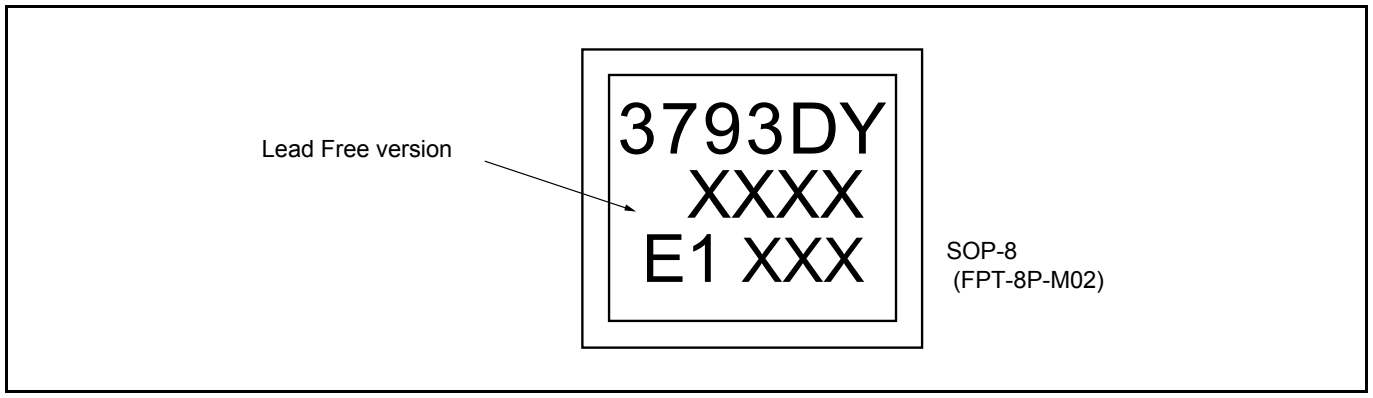


Figure 19-2 MB3793-28D

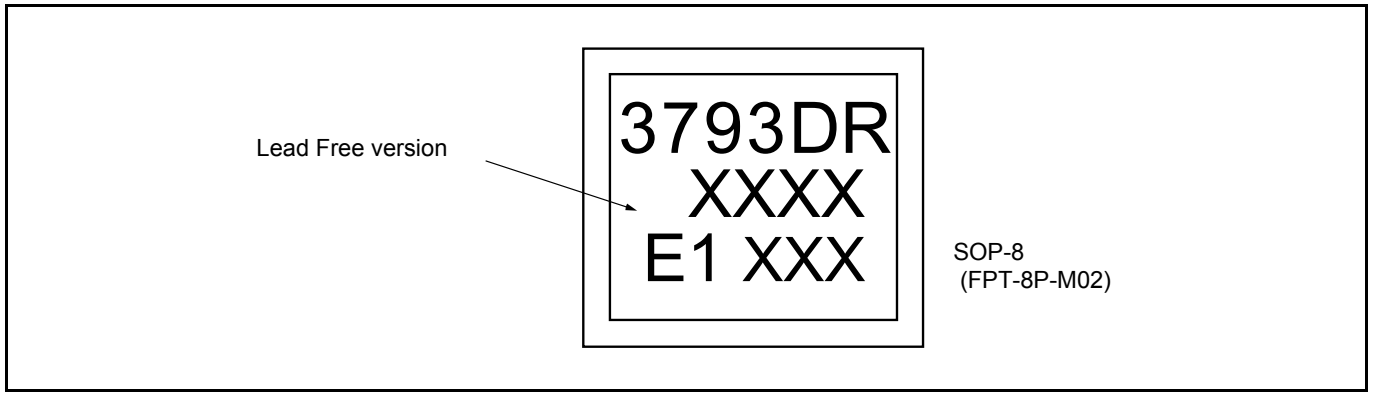
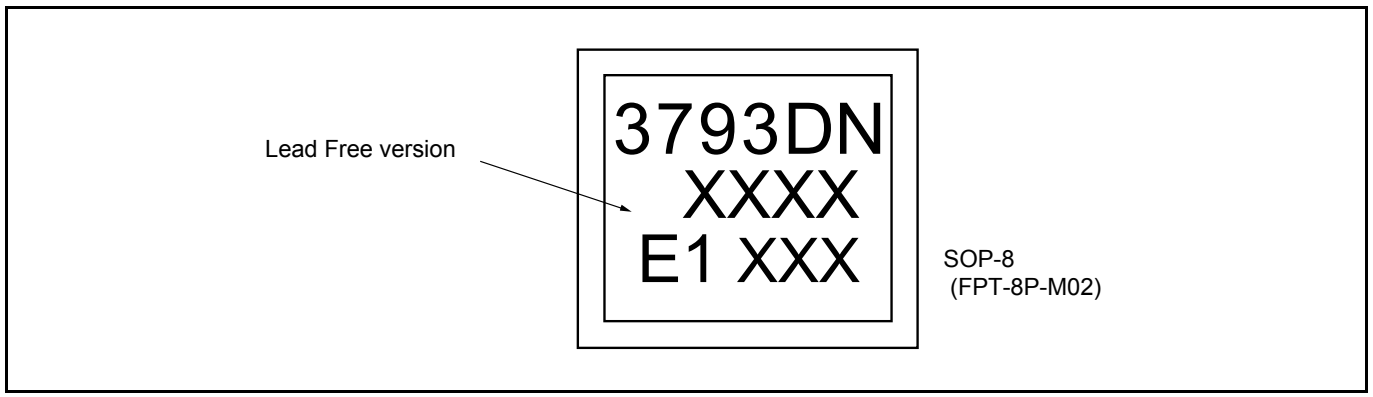


Figure 19-3 MB3793-30D



20. MB3793-27D/28D/30D

RECOMMENDED CONDITIONS OF MOISTURE SENSITIVITY LEVEL

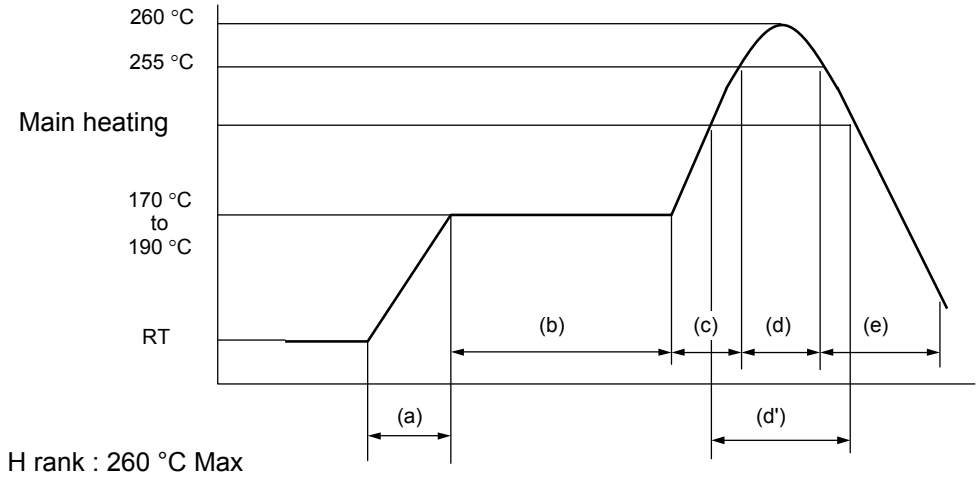
Spansion Recommended Mounting Conditions

Table 20-1 Recommended Reflow Condition

Item	Condition	
Mounting Method	IR (infrared reflow) , warm air reflow	
Mounting times	2 times	
Storage period	Before opening	Please use it within two years after Manufacture.
	From opening to the 2nd reflow	Less than 8 days
	When the storage period after opening was exceeded	Please process within 8 days after baking (125 °C ± 3 °C, 24hrs + 2H/-0H) Baking can be performed up to two times.
Storage conditions	5 °C to 30 °C, 70%RH or less (the lowest possible humidity)	

Mounting Conditions

(1) Reflow Profile



H rank : 260 °C Max

(a) Temperature Increase gradient : Average 1 °C/s to 4 °C/s
(b) Preliminary heating : Temperature 170 °C to 190 °C, 60s to 180s
(c) Temperature Increase gradient : Average 1 °C/s to 4 °C/s
(d) Peak temperature : Temperature 260 °C Max; 255 °C or more, 10s or less
(d') Main heating : Temperature 230 °C or more, 40s or less
or
Temperature 225 °C or more, 60s or less
or
Temperature 220 °C or more, 80s or less
(e) Cooling : Natural cooling or forced cooling

Note : Temperature : the top of the package body

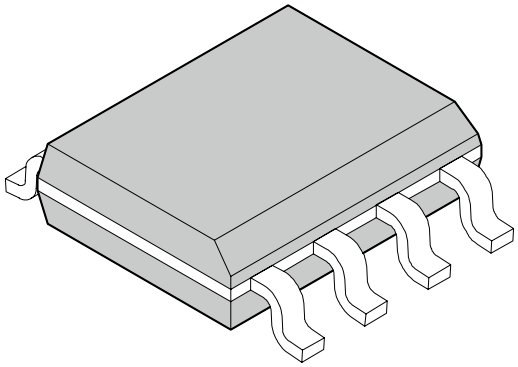
(2) JEDEC Condition: Moisture Sensitivity Level 3 (IPC/JEDEC J-STD-020D)

(3) Recommended manual soldering (partial heating method)

Item	Condition	
Storage period	Before opening	Within two years after manufacture.
	Between opening and mounting	Within two years after manufacture. (No need to control moisture during the storage period because of the partial heating method.)
Storage conditions	5 °C to 30 °C, 70%RH or less (the lowest possible humidity)	
Mounting conditions	Temperature at the tip of a soldering iron: 400 °C Max Time: Five seconds or below per pin(*1)	

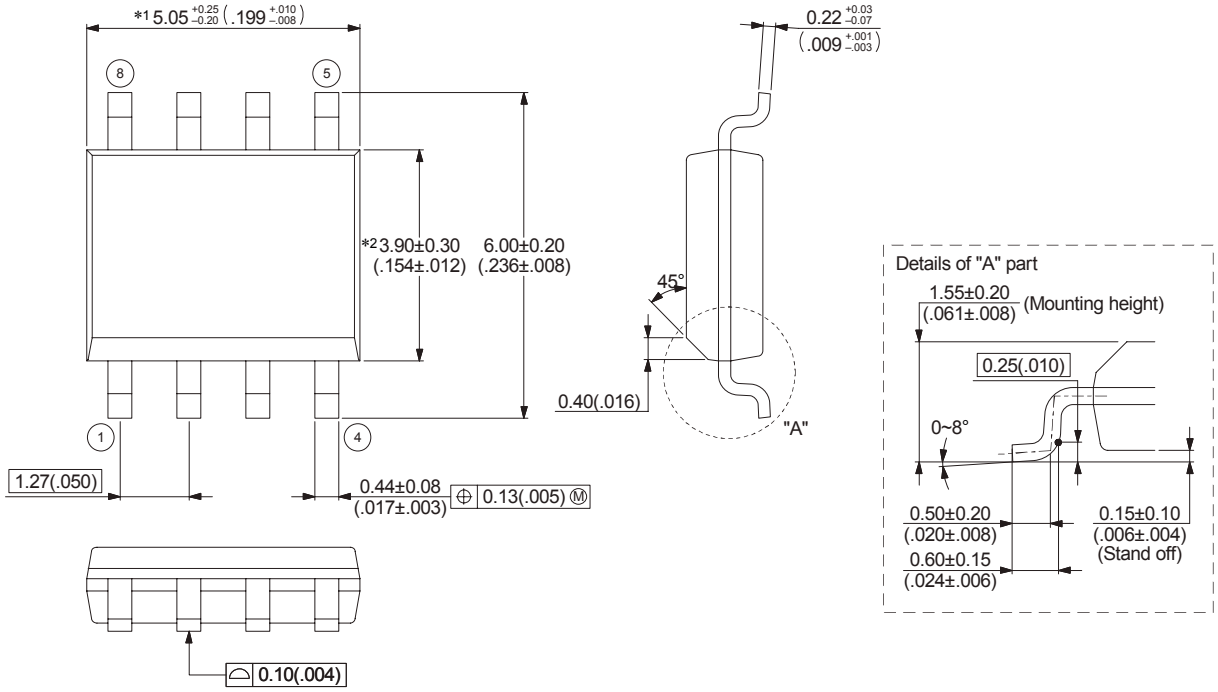
*1: Make sure that the tip of a soldering iron does not come in contact with the package body.

21. PACKAGE DIMENSIONS

8-pin plastic SOP		
	Lead pitch	1.27 mm
	Package width × package length	3.9 mm × 5.05 mm
	Lead shape	Gullwing
	Sealing method	Plastic mold
	Mounting height	1.75 mm MAX
	Weight	0.06 g
(FPT-8P-M02)		

8-pin plastic SOP
(FPT-8P-M02)

Note 1) *1 : These dimensions include resin protrusion.
Note 2) *2 : These dimensions do not include resin protrusion.
Note 3) Pins width and pins thickness include plating thickness.
Note 4) Pins width do not include tie bar cutting remainder.



Dimensions in mm (inches).
Note: The values in parentheses are reference values.

22. MAJOR CHANGES

Page	Section	Change Results
Revision 1.0		
-	-	Initial release

Colophon

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