

# MB3793-42/30

## POWER-VOLTAGE MONITORING IC WITH WATCHDOG TIMER

### DESCRIPTION

The MB3793 is an integrated circuit to monitor power voltage; it incorporates a watchdog timer.

A reset signal is output when the power is cut or falls abruptly. When the power recovers normally after resetting, a power-on reset signal is output to microprocessor units (MPUs). An internal watchdog timer with two inputs for system operation diagnosis can provide a fail-safe function for various application systems.

Two models with detection voltages of 4.2 and 3.0 V are available. There is also a mask option that can detect voltages of 4.9 to 3.0 V in 0.1-V steps.

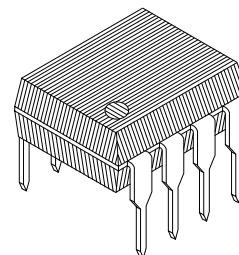
The model numbers are MB3793-42 or -30 corresponding to the detected voltage. The model number and package code are as shown below.

Model No.	Package code	Detection voltage
MB3793-42	3793-A	4.2 V
MB3793-30	3793-N	3.0 V

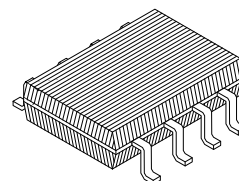
### FEATURES

- Precise detection of power voltage fall:  $\pm 2.5\%$
- Detection voltage with hysteresis
- Low power dispersion:  $I_{CC} = 27 \mu A$  (reference)
- Internal dual-input watchdog timer
- Watchdog-timer halt function (by inhibition pin)
- Independently-set watchdog and reset times
- Mask option for detection voltage (4.9 to 3.0 V, 0.1-V steps)

8-PIN PLASTIC DIP  
(DIP-8P-M01)

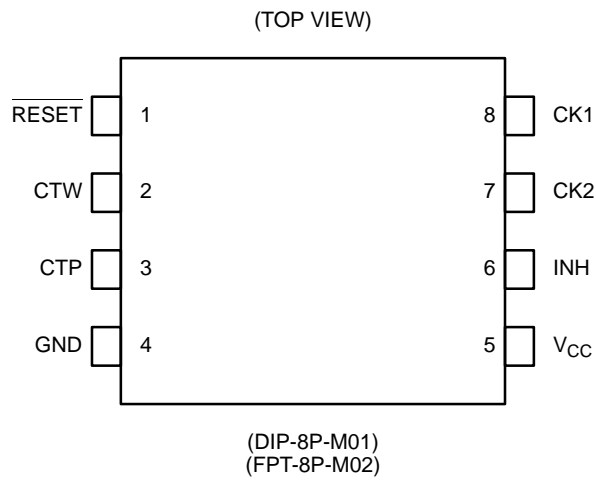


8-PIN PLASTIC SOL  
(FPT-8P-M02)



This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields. However, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit.

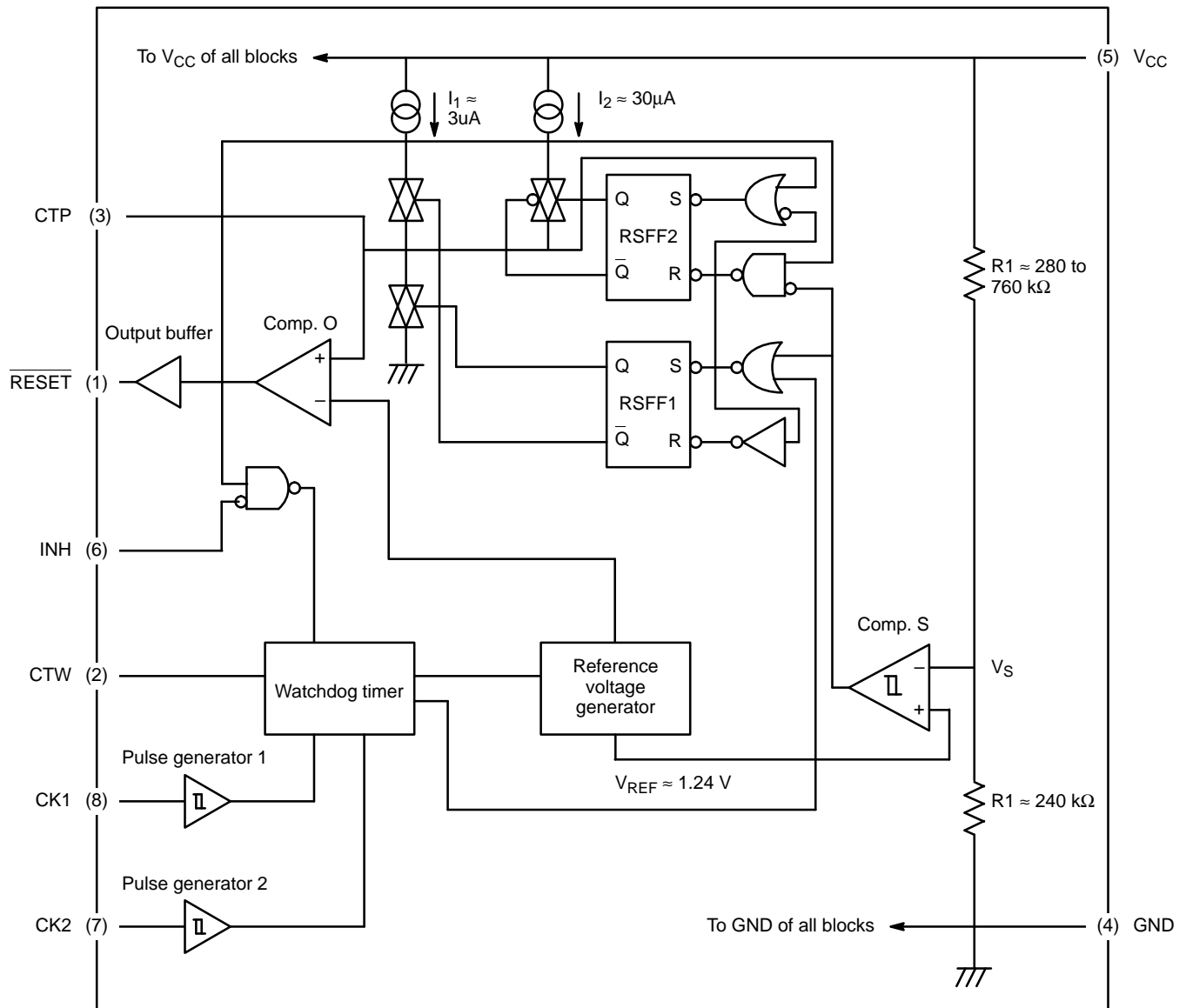
PIN ASSIGNMENT



PIN DESCRIPTION

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	RESET	Outputs reset	5	V <sub>CC</sub>	Power supply
2	CTW	Sets monitoring time	6	INH	Inhibits watchdog timer function
3	CTP	Sets power-on reset hold time	7	CK2	Inputs clock 2
4	GND	Ground	8	CK1	Inputs clock 1

# BLOCK DIAGRAM



## BLOCK FUNCTIONS

### 1. Comp. S

Comp. S is a comparator with hysteresis to compare the reference voltage with a voltage ( $V_S$ ) that is the result of dividing the power voltage ( $V_{CC}$ ) by resistors 1 and 2. When  $V_S$  falls below 1.24 V, a reset signal is output. This function enables the MB3793 to detect an abnormality within 1  $\mu$ s when the power is cut or falls abruptly.

### 2. Comp. O

Comp. O is a comparator to control the reset signal ( $\overline{\text{RESET}}$ ) output and compares the threshold voltage with the voltage at the CTP pin for setting the power-on reset hold time. When the voltage at the CTP pin exceeds the threshold voltage, resetting is canceled.

### 3. Reset output buffer

Since the reset ( $\overline{\text{RESET}}$ ) output buffer has CMOS organization, no pull-up resistor is needed.

### 4. Pulse generator

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

### 5. Watchdog timer

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

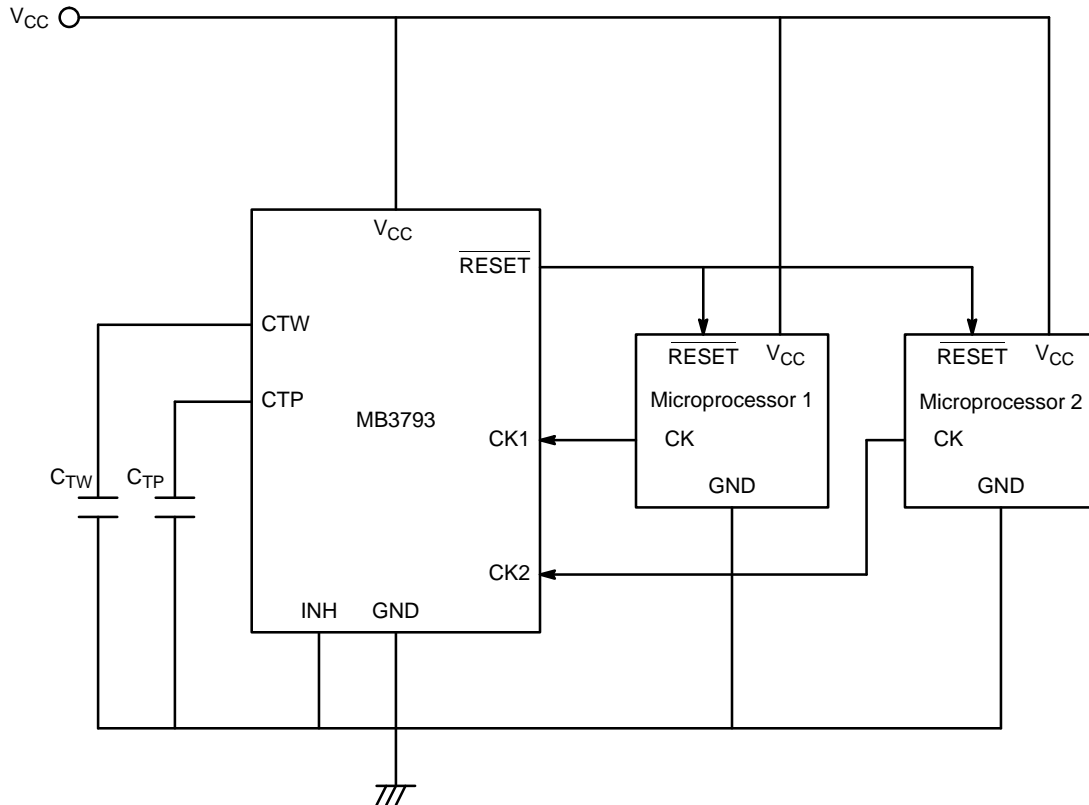
### 6. Inhibition pin

The inhibition (INH) pin forces the watchdog timer on/off. When this pin is High level, the watchdog timer is stopped.

### 7. Flip-flop circuit

The flip-flop circuit RSFF1 controls charging and discharging of the power-on reset hold time setting capacity ( $C_{TP}$ ). The flip-flop circuit RSFF2 switches the charging accelerator for charging  $C_{TP}$  during resetting on/off. This circuit only functions during resetting and does not function at power-on reset.

## STANDARD CONNECTION



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

$$t_{PR} \text{ (ms)} \approx A \times C_{TP} \text{ (}\mu\text{F)}$$

$$t_{WD} \text{ (ms)} \approx B \times C_{TW} \text{ (}\mu\text{F)} + C \times C_{TP} \text{ (}\mu\text{F)}$$

However, when  $\frac{C_{TP}}{C_{TW}} \leq \text{about } 10$ ,

$$t_{WD} \text{ (ms)} \approx B \times C_{TW} \text{ (}\mu\text{F)}$$

$$t_{WR} \text{ (ms)} \approx D \times C_{TP} \text{ (}\mu\text{F)}$$

Values of A, B, C, and D

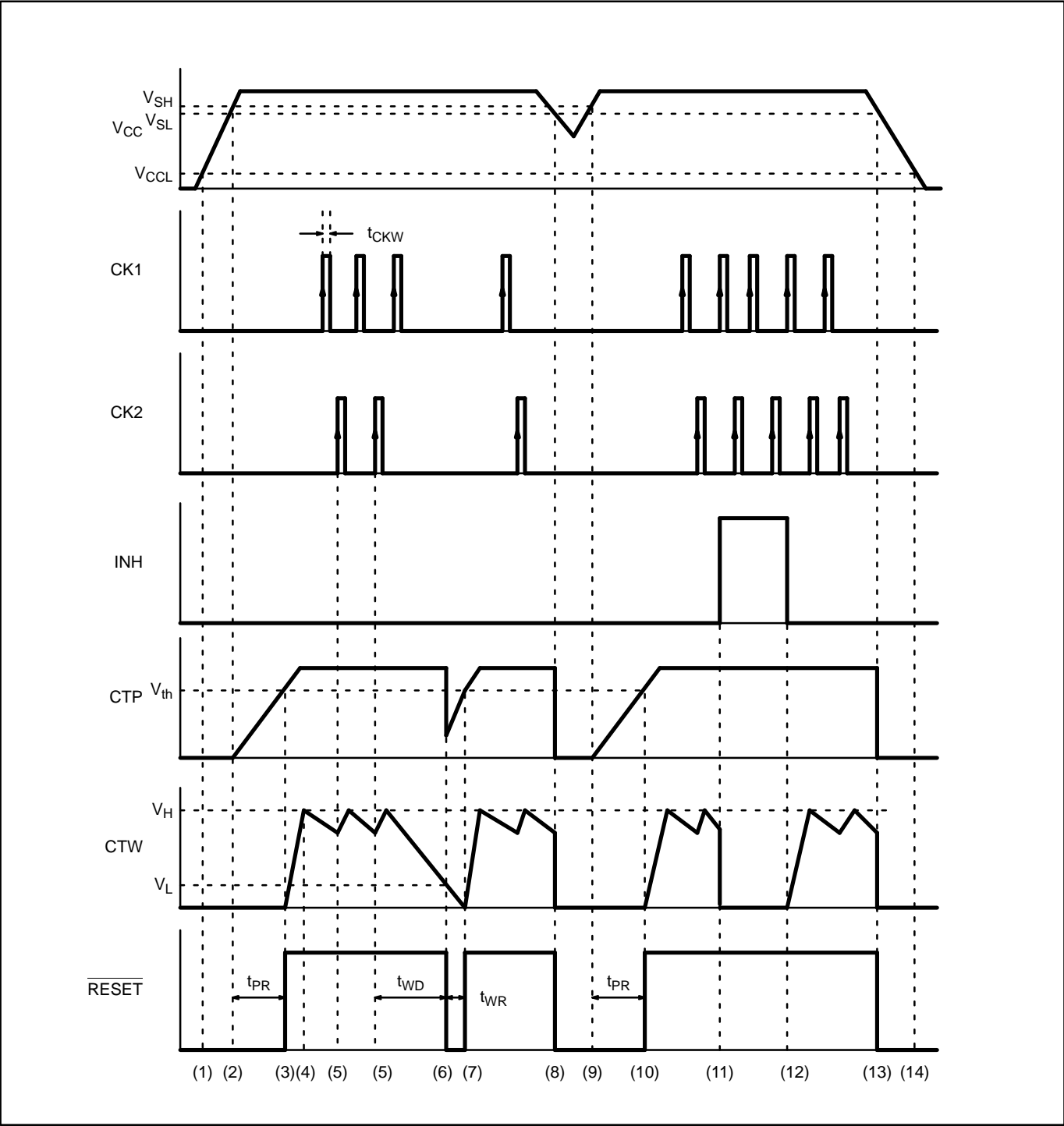
Model No.	A	B	C	D	Remark
MB3793-42	1300	1500	3	100	
MB3793-30	750	1600	4	55	

(Example) When  $C_{TP} = 0.1 \mu\text{F}$  and  $C_{TW} = 0.01 \mu\text{F}$ ,

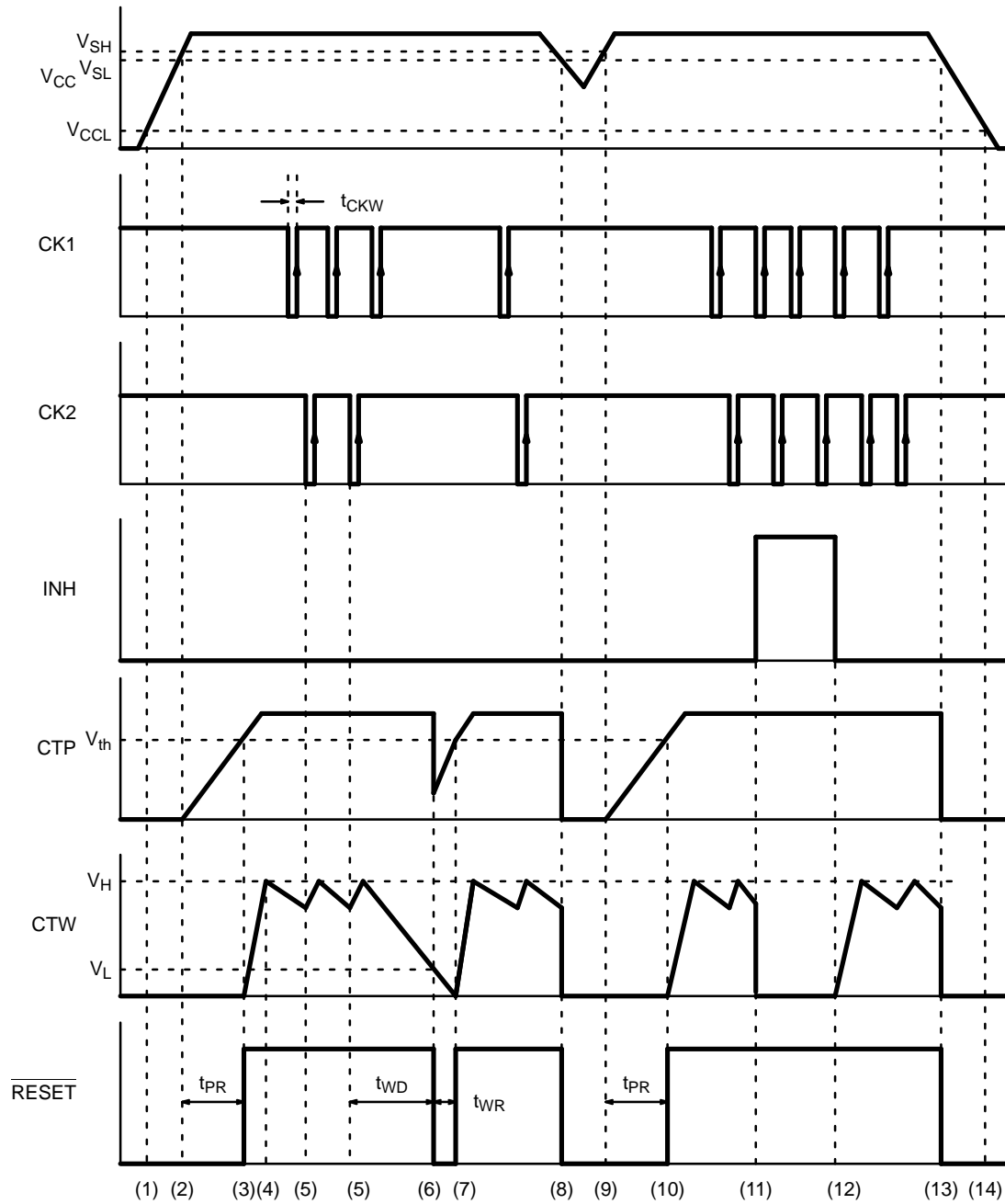
- MB3793-42
  - $t_{PR} \approx 130 \text{ [ms]}$
  - $t_{WD} \approx 15 \text{ [ms]}$
  - $t_{WR} \approx 10 \text{ [ms]}$
- MB3793-30
  - $t_{PR} \approx 75 \text{ [ms]}$
  - $t_{WD} \approx 16 \text{ [ms]}$
  - $t_{WR} \approx 5.5 \text{ [ms]}$

# TIMING CHART

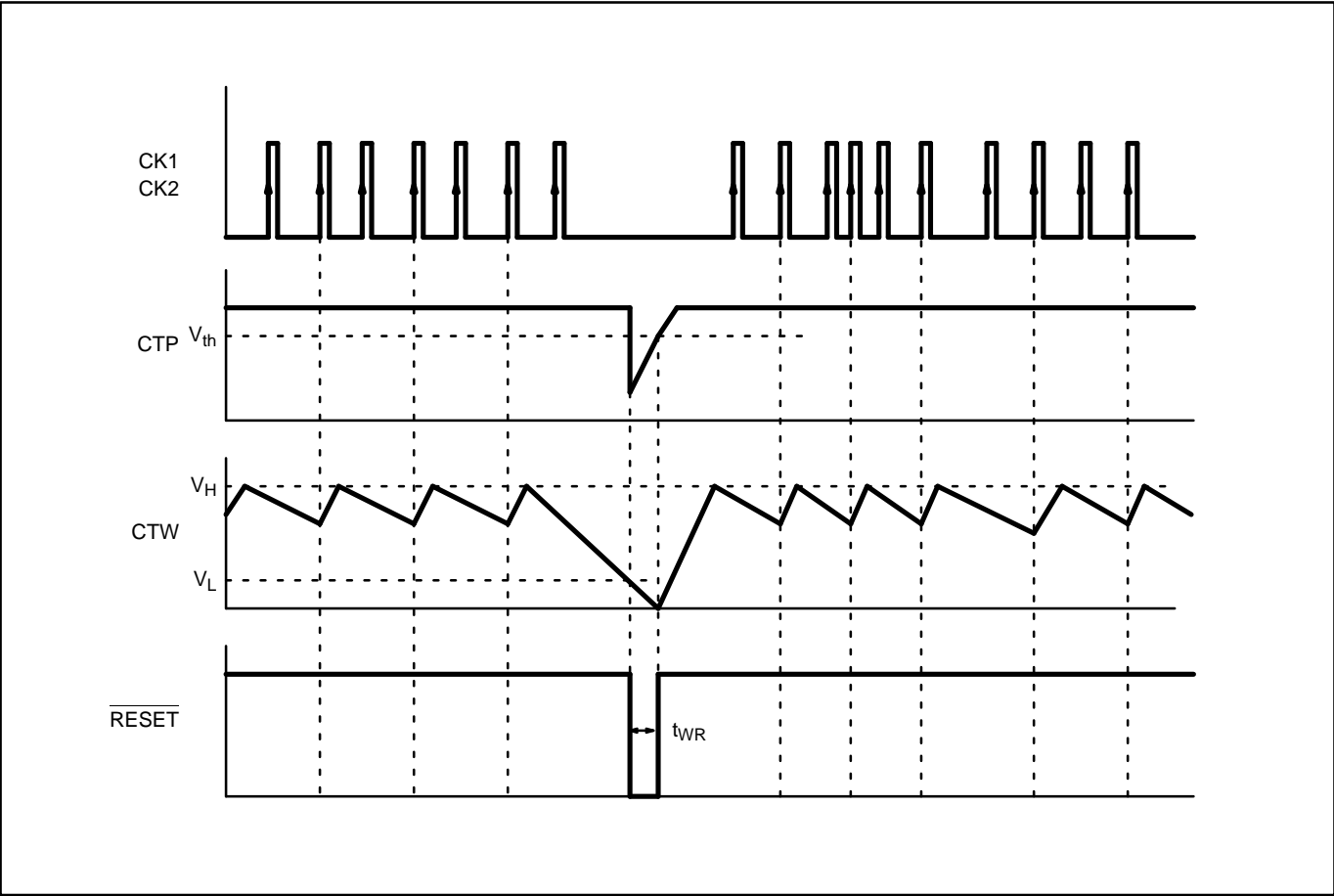
## 1. Basic operation (Positive clock pulse)



## 2. Basic operation (Negative clock pulse)

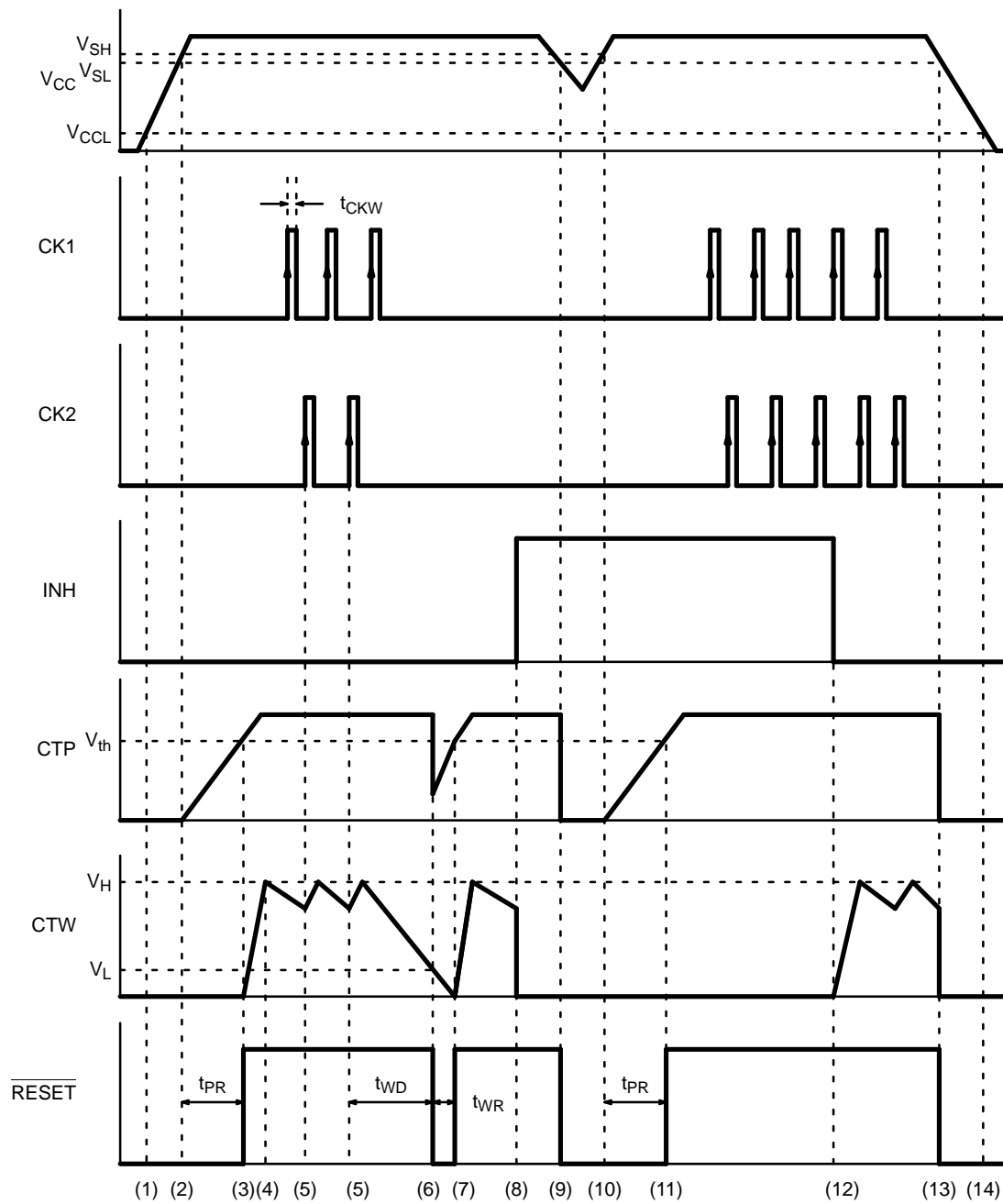


3. Single-clock input monitoring (Positive clock pulse)

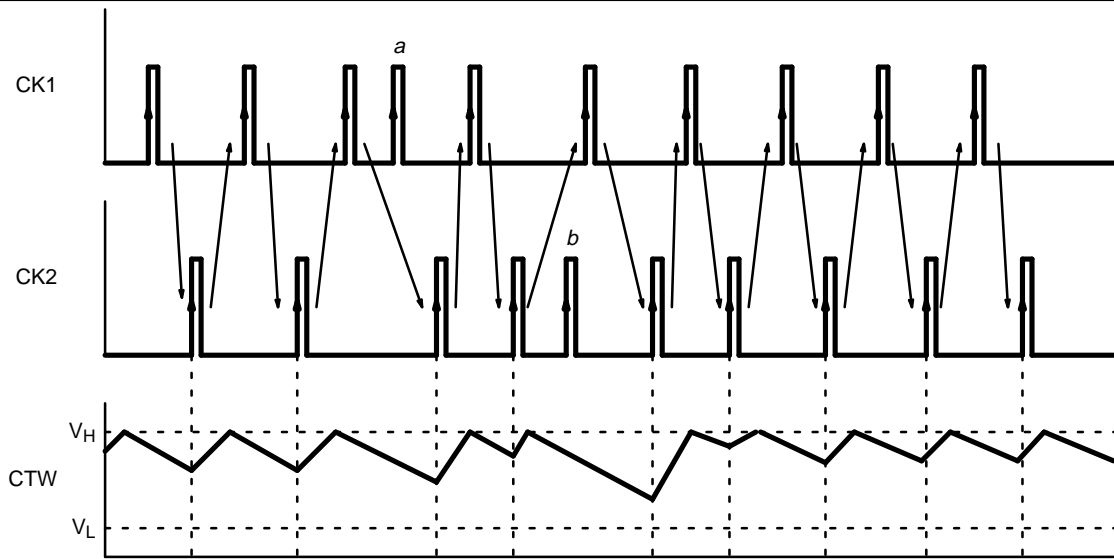




#### 4. Inhibition operation (Positive clock pulse)



## 5. Clock pulse input (Positive clock pulse)



The MB3793 watchdog timer monitors Clock 1 (CK1) and Clock 2 (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.

When two consecutive pulses occur on one side of this alternation before switching, the second pulse is ignored. In the above figure, pulses *a* and *b* are ignored.

## OPERATION SEQUENCE

The operation sequence is explained by using Timing Chart 1.

The following item numbers correspond to the numbers in Timing Chart 1.

- (1) When the power voltage ( $V_{CC}$ ) reaches about 0.8 V ( $V_{CCL}$ ), a reset signal is output.
- (2) When  $V_{CC}$  exceeds the rising-edge detection voltage ( $V_{SH}$ ), charging of power-on reset hold time setting capacitance ( $C_{TP}$ ) is started.  $V_{SH}$  is about 4.3 V in the MB3793-42 and 3.07 V in the MB3793-30.
- (3) When the voltage at the CTP pin setting the power-on reset hold time exceeds the threshold voltage ( $V_{th}$ ), resetting is canceled and the voltage at the RESET pin changes to High level to start charging of the watchdog-timer monitoring time setting capacitance ( $C_{TW}$ ).  $V_{th}$  is about 3.6 V in the MB3793-42 and 2.4 V in the MB3793-30.

The power-on reset hold time ( $t_{PR}$ ) can be calculated by the following equation.

$$t_{PR} (\text{ms}) \approx A \times C_{TP} (\mu\text{F})$$

Where, A is about 1300 in the MB3793-42 and 750 in the MB3793-30.

- (4) When the voltage at the CTW pin setting the monitoring time reaches High level ( $V_H$ ),  $C_{TW}$  switches to discharging from charging.  $V_H$  is about 1.24 V (reference value) in both the MB3793-42 and MB3793-30.
- (5) When clock pulses are input to the CK2 pin during  $C_{TW}$  discharging after clock pulses are input to the CK1 pin—positive-edge trigger,  $C_{TW}$  switches to charging.
- (6) If clock pulse input does not occur at either the CK1 or CK2 clock pins during the watchdog-timer monitoring time ( $t_{WD}$ ), the CTW voltage falls below Low level ( $V_L$ ), a reset signal is output, and the voltage at the RESET pin changes to Low level.  $V_L$  is about 0.24 V in both the MB3793-42 and MB3793-30.

$t_{WD}$  can be calculated from the following equation.

$$t_{WD} (\text{ms}) \approx B \times C_{TW} (\mu\text{F}) + C \times C_{TP} (\mu\text{F})$$

Where, B is about 1500 in the MB3793-42 and 1600 in the MB3793-30. C is about 3 in the MB3793-42 and 4 in the MB3793-30; it is much smaller than B.

Hence, when  $\frac{C_{TP}}{C_{TW}} \leq 10$ , the calculation can be simplified as follows:

$$t_{WD} (\text{ms}) \approx B \times C_{TW} (\mu\text{F})$$

- (7) When the voltage of the CTP pin exceeds  $V_{th}$  again as a result of recharging  $C_{TP}$ , resetting is canceled and the watchdog timer restarts monitoring.

The watchdog timer reset time ( $t_{WR}$ ) can be calculated by the following equation.

$$t_{WR} \text{ (ms)} \approx D \times C_{TP} \text{ (}\mu\text{F)}$$

Where, D is about 100 in the MB3793-42 and 55 in the MB3793-30.

- (8) When  $V_{CC}$  falls below the rising-edge detection voltage ( $V_{SL}$ ), the voltage of the CTP pin falls and a reset signal is output, and the voltage at the  $\overline{\text{RESET}}$  pin changes to Low level.  $V_{SL}$  is about 4.2 V in the MB3793-42 and 3.0 V in the MB3793-30.
- (9) When  $V_{CC}$  exceeds  $V_{SH}$ ,  $C_{TP}$  begins charging.
- (10) When the voltage of the CTP pin exceeds  $V_{th}$ , resetting is canceled and the watchdog timer restarts.
- (11) When an inhibition signal is input (INH pin is High level), the watchdog timer is halted forcibly.  
In this case,  $V_{CC}$  monitoring is continued ((8) - (9)) without the watchdog timer.  
The watchdog timer does not function unless this inhibition input is canceled.
- (12) When the inhibition input is canceled (INH pin is Low level), the watchdog timer restarts.
- (13) When the  $V_{CC}$  voltage falls below  $V_{SL}$  after power-off, a reset signal is output.

Similar operation is also performed for negative clock-pulse input (Timing Chart 2).

Short-circuit the clock pins CK1 and CK2 to monitor a single clock. The basic operation is the same but the clock pulses are monitored at every other pulse (Timing Chart 3).

## ABSOLUTE MAXIMUM RATINGS

( $T_a = +25^\circ\text{C}$ )

Parameter		Symbol	Limits	Unit
Power voltage*		$V_{CC}$	-0.3 to +7	V
Input voltage	CK1	$V_{CK1}$	-0.3 to +7	V
	CK2	$V_{CK2}$		
	INH	$V_{INH}$		
Reset output voltage (direct current)	$\overline{\text{RESET}}$	$I_{OL}$ $I_{OH}$	-10 to +10	mA
Allowable loss ( $T_a \leq +85^\circ\text{C}$ )		$P_D$	200	mW
Storage temperature		$T_{stg}$	-55 to +125	$^\circ\text{C}$

\*The power voltage is based on the ground voltage (0 V).

Note: Permanent device damage may occur if the above ABSOLUTE MAXIMUM RATINGS are exceeded. Functional operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Limits			Unit
		Min.	Typical	Max.	
Reset ( $\overline{\text{RESET}}$ ) output current	$I_{OL}$ $I_{OH}$	-5	—	+5	mA
Power-on reset hold time setting capacity	$C_{TP}$	0.001	—	10	$\mu\text{F}$
Watchdog-timer monitoring time setting capacity	$C_{TW}$	0.001	—	1	$\mu\text{F}$
Watchdog timer monitoring time	$t_{WD}$	0.1	—	1500	ms
Operating ambient temperature	$T_a$	-40	—	+85	$^\circ\text{C}$

Note: These recommended operation conditions guarantee normal logic operation of an LSI circuit. The limits of the AC and DC electrical characteristics are guaranteed within these recommended conditions.

## ELECTRICAL CHARACTERISTICS

### 1. DC Characteristics

( $V_{CC} = +5\text{ V}$  (MB3793-42),  $V_{CC} = +3.3\text{ V}$  (MB3793-30),  $T_a = +25^\circ\text{C}$ )

Parameter		Symbol	Test Conditions		Limits			Unit
					Min.	Typical	Max.	
Power current	MB3793-42	I <sub>CC1</sub>	Watchdog timer operation*		—	27	50	μA
		I <sub>CC2</sub>	Watchdog timer halt**		—	25	45	
	MB3793-30	I <sub>CC1</sub>	Watchdog timer operation*		—	25	45	μA
		I <sub>CC2</sub>	Watchdog timer halt**		—	24	45	
Detection voltage	MB3793-42	V <sub>SL</sub>	V <sub>CC</sub> falling	T <sub>a</sub> = +25°C	4.10	4.20	4.30	V
				T <sub>a</sub> = −40 to +85°C	4.05	4.20	4.35	
		V <sub>SH</sub>	V <sub>CC</sub> rising	T <sub>a</sub> = +25°C	4.20	4.30	4.40	V
				T <sub>a</sub> = −40 to +85°C	4.15	4.30	4.45	
	MB3793-30	V <sub>SL</sub>	V <sub>CC</sub> falling	T <sub>a</sub> = +25°C	2.90	3.00	3.10	V
				T <sub>a</sub> = −40 to +85°C	2.85	3.00	3.15	
		V <sub>SH</sub>	V <sub>CC</sub> rising	T <sub>a</sub> = +25°C	2.97	3.07	3.17	V
				T <sub>a</sub> = −40 to +85°C	2.92	3.07	3.22	
Detection voltage hysteresis difference	MB3793-42	V <sub>SHYS</sub>	V <sub>SH</sub> − V <sub>SL</sub>		50	100	150	mV
	MB3793-30				30	70	110	mV
Clock-input threshold voltage		V <sub>thCH</sub>	—		(1.4)	1.9	(2.5)	V
		V <sub>thCL</sub>	—		(0.8)	1.3	(1.8)	V
Clock-input hysteresis		V <sub>CHYS</sub>	—		(0.4)	0.6	(0.8)	V
Inhibition-input threshold voltage		V <sub>thIN</sub>	—		0.8	1.5	2.0	V
Input current	CK1 CK2 INH	I <sub>IH</sub>	V <sub>CK</sub> = V <sub>CC</sub>		—	0	1.0	μA
		I <sub>IL</sub>	V <sub>CK</sub> = 0 V		−1.0	0	—	μA
Reset output voltage	MB3793-42	V <sub>OH</sub>	I <sub>RESET</sub> = −5 mA		4.5	4.75	—	V
		V <sub>OL</sub>	I <sub>RESET</sub> = +5 mA		—	0.12	0.4	V
	MB3793-30	V <sub>OH</sub>	I <sub>RESET</sub> = −3 mA		2.8	3.10	—	V
		V <sub>OL</sub>	I <sub>RESET</sub> = +3 mA		—	0.12	0.4	V
Reset-output minimum power voltage		V <sub>CCL</sub>	I <sub>RESET</sub> = +50 μA		—	0.8	1.2	V

\*At clock input pins CK1 and CK2, the pulse input frequency is 1 kHz and the pulse amplitude is 0 V to  $V_{CC}$ .

\*\*Inhibition input is at High level.

## 2. AC Characteristics

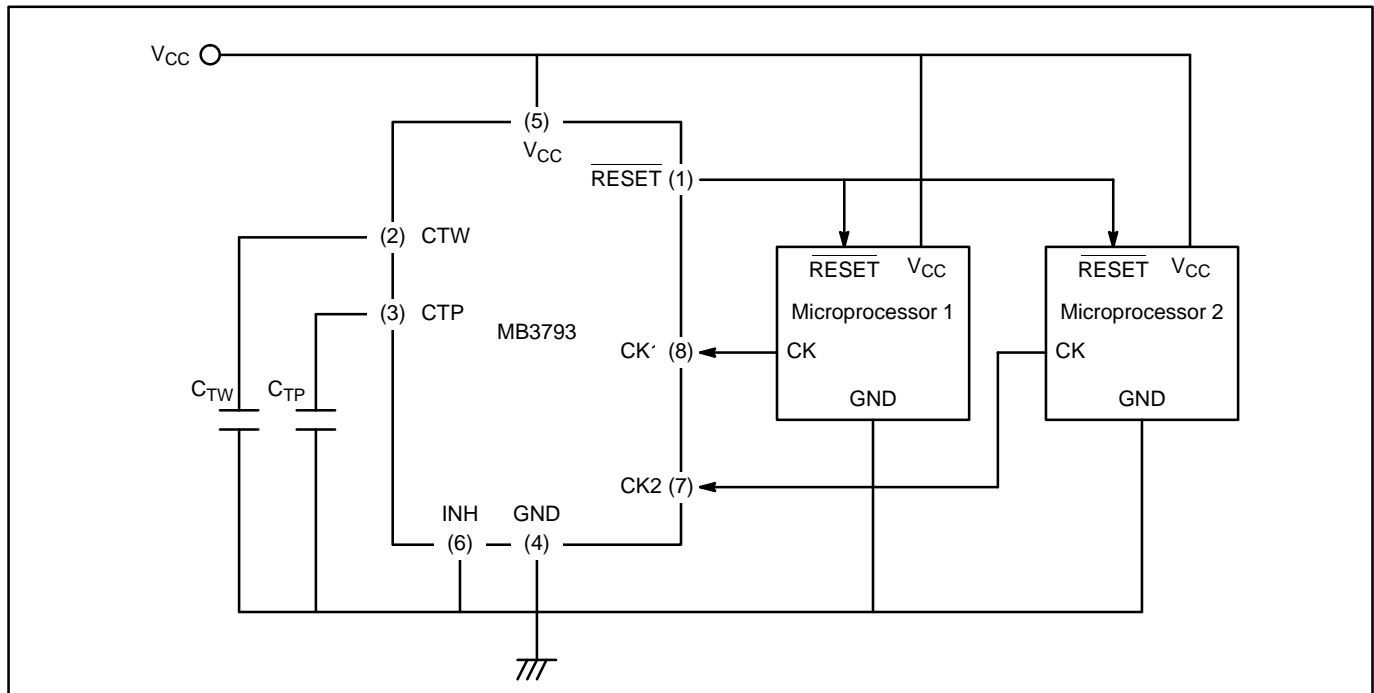
( $V_{CC} = +5\text{ V}$  (MB3793-42),  $V_{CC} = +3.3\text{ V}$  (MB3793-30),  $T_a = +25^\circ\text{C}$ )

Parameter		Symbol	Test Conditions	Limits			Unit
				Min.	Typ.	Max.	
Power-on reset hold time	MB3793-42	$t_{PR}$	$C_{TP} = 0.1\text{ }\mu\text{F}$	80	130	180	ms
	MB3793-30			30	75	120	ms
Watchdog timer monitoring time	MB3793-42	$t_{WD}$	$C_{TW} = 0.01\text{ }\mu\text{F}$	7.5	15	22.5	ms
	MB3793-30		$C_{TP} = 0.1\text{ }\mu\text{F}$	8	16	24	ms
Watchdog timer reset time	MB3793-42	$t_{WR}$	$C_{TP} = 0.1\text{ }\mu\text{F}$	5	10	15	ms
	MB3793-30			2.0	5.5	9	ms
Clock (CK1, CK2) input pulse duration		$t_{CKW}$	—	500	—	—	ns
Reset (RESET) output transition time*	Rising	$t_{TLH}$	$C_L = 50\text{ pF}$	—	—	500	ns
	Falling	$t_{THL}$	$C_L = 50\text{ pF}$	—	—	500	ns

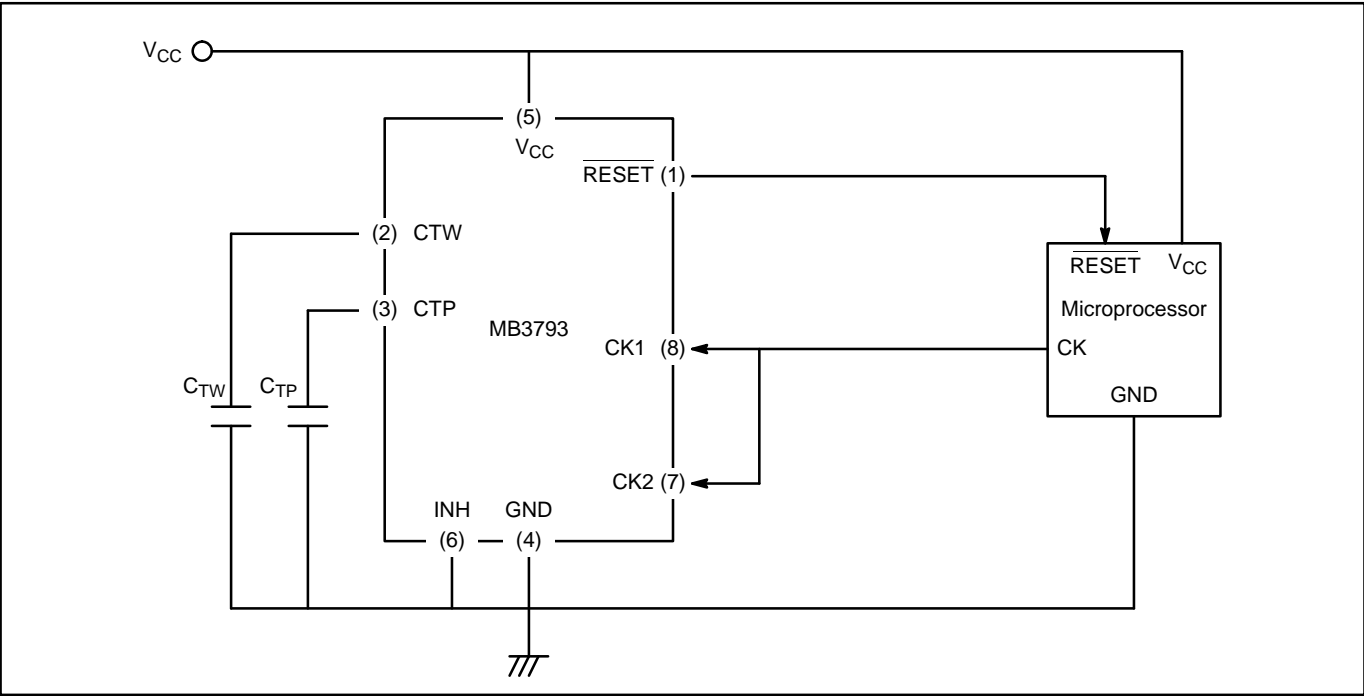
\*The voltage range is 10% to 90% at testing the reset output transition time.

## WATCHDOG TIMER USE EXAMPLE

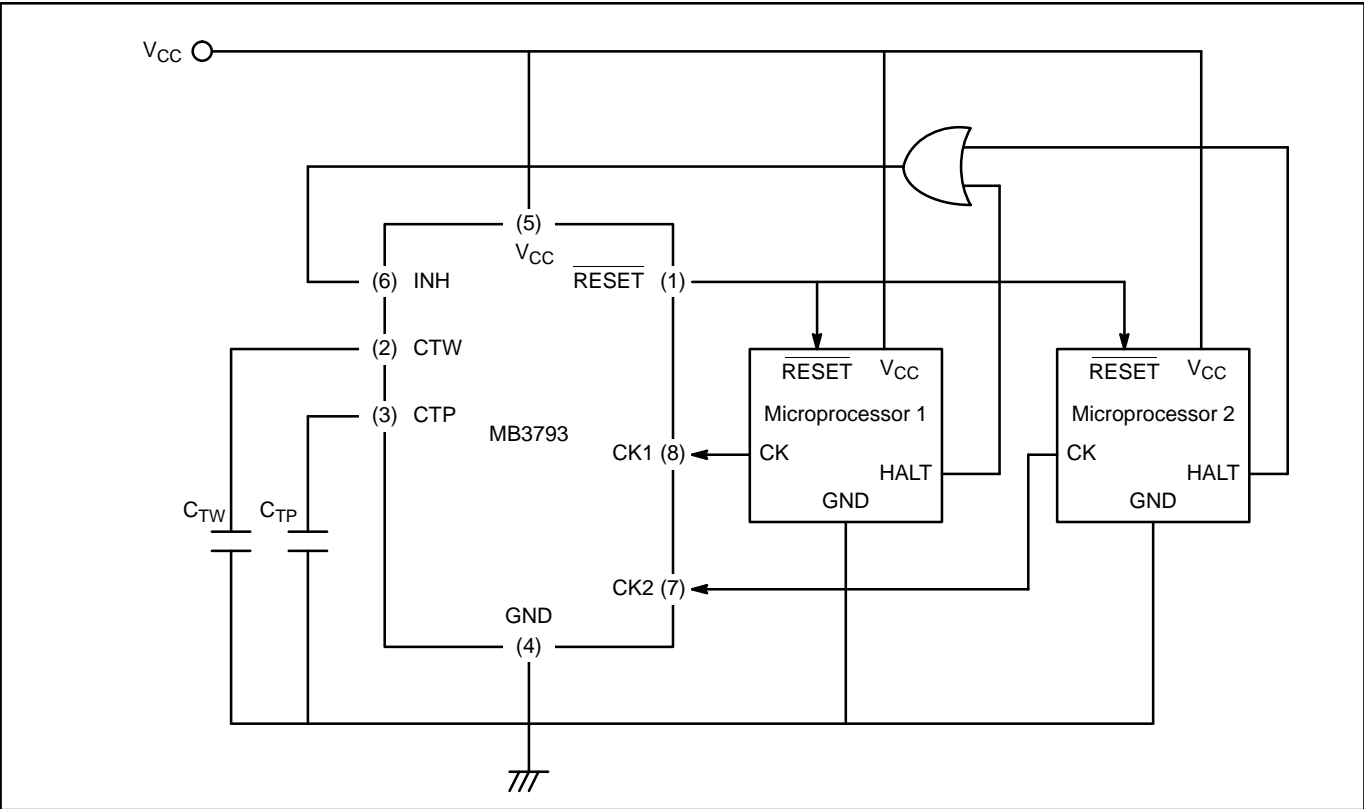
### 1. Monitoring Two Clocks



## 2. Monitoring Single Clock

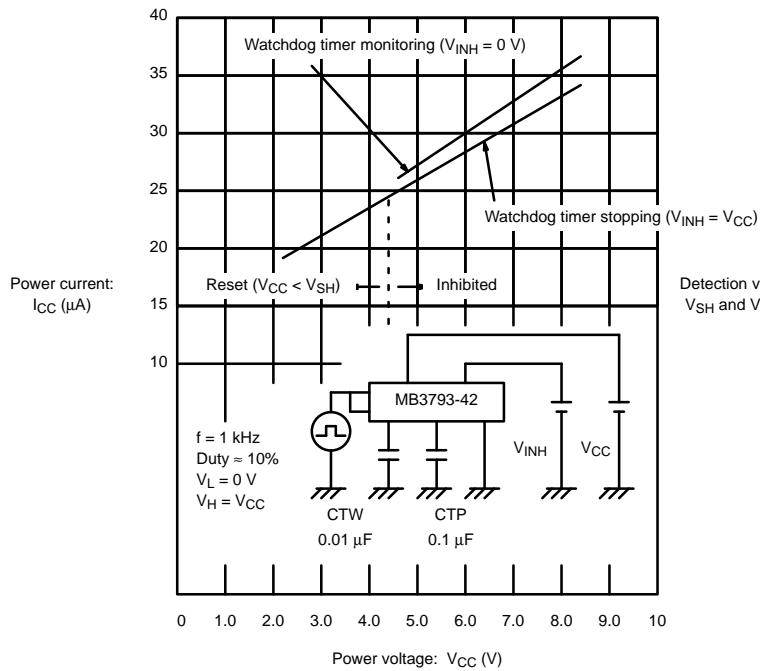


## 3. Watchdog Timer Stopping

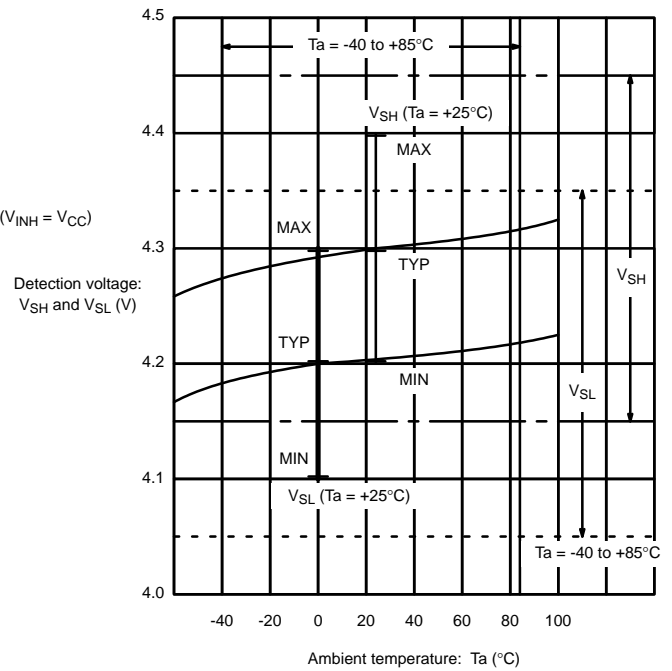


# REFERENCE CHARACTERISTIC CURVES (FOR MB3793-42)

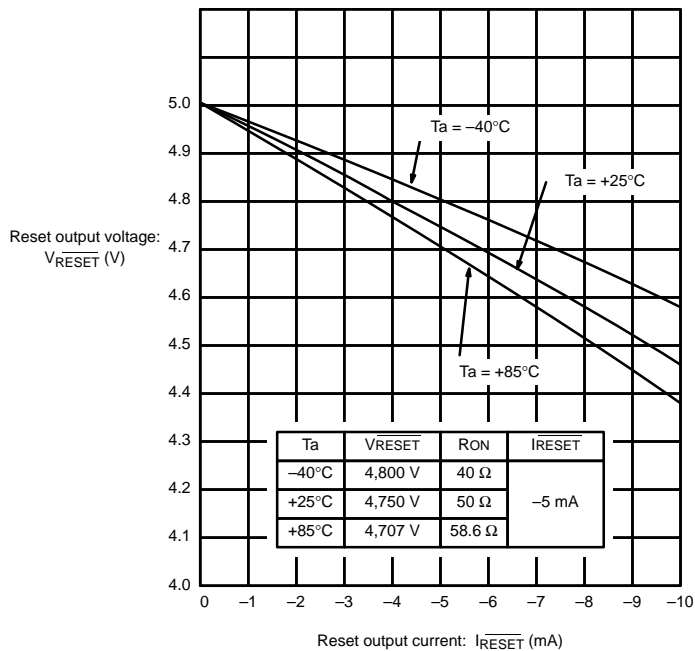
## Power Current - Power Voltage



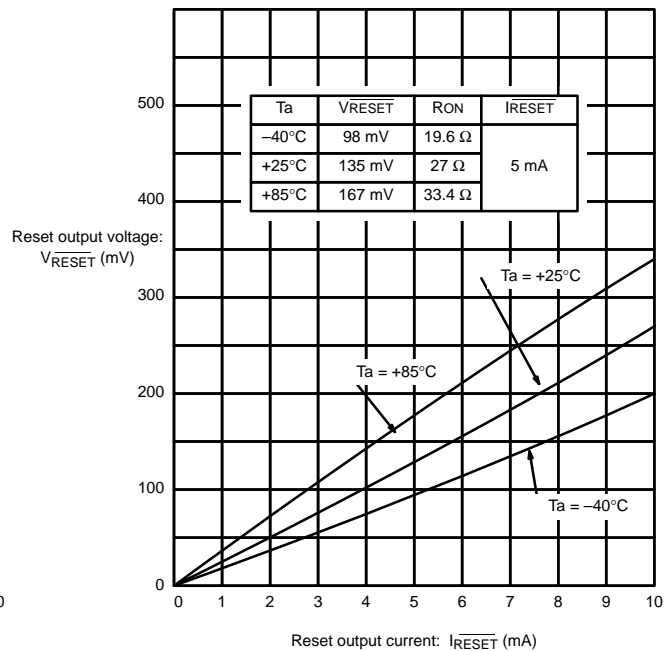
## Detection Voltage - Ambient Temperature



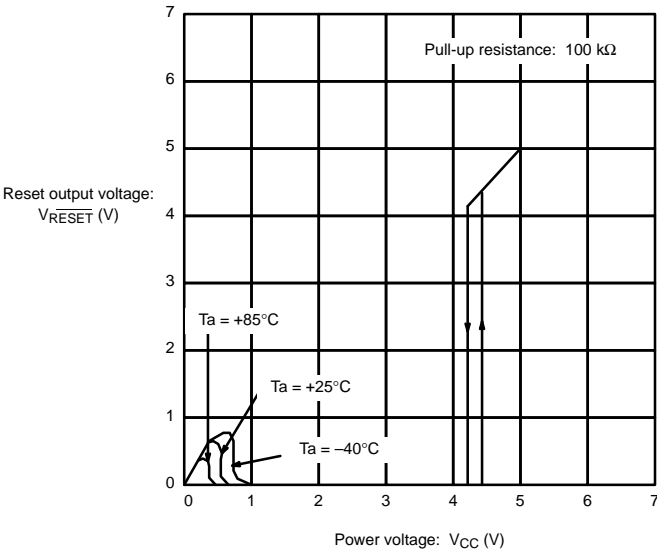
## Reset Output Voltage - Reset Output Current (P-MOS side)



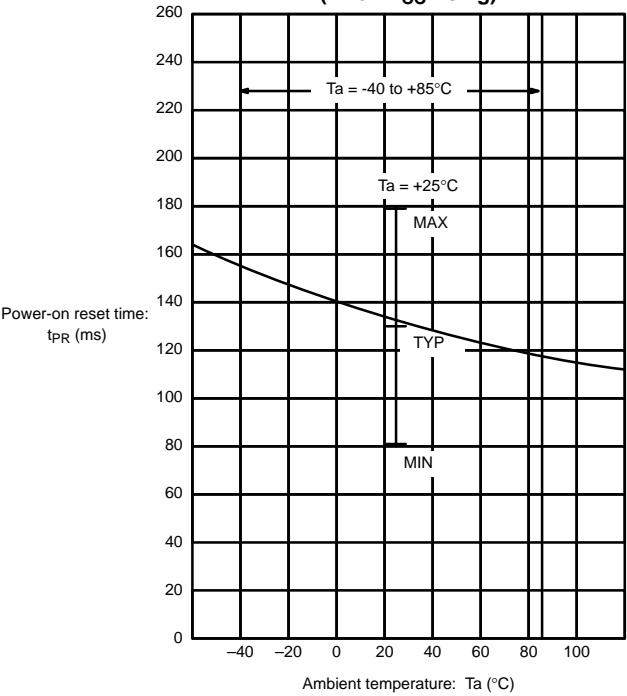
## Reset Output Voltage - Reset Output Current (N-MOS side)



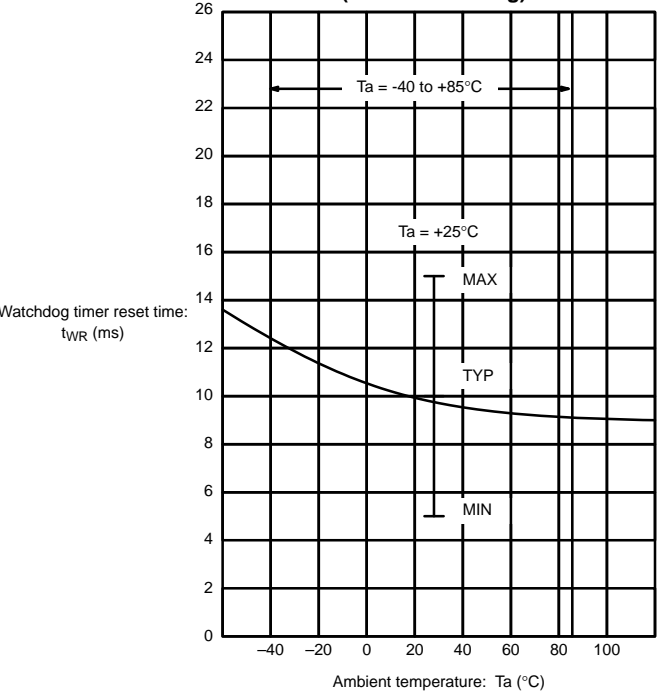
Reset Output Voltage - Power Voltage



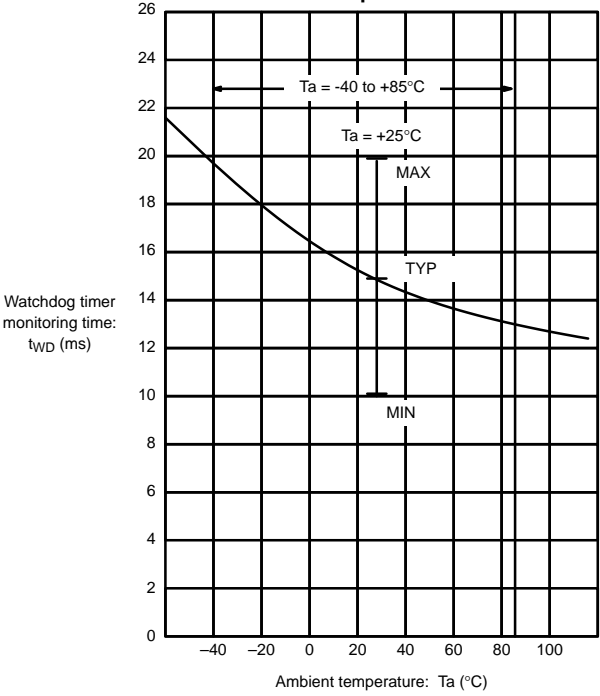
Reset-on Reset Time - Ambient Temperature  
(when  $V_{\text{CC}}$  rising)



Watchdog Timer Reset Time - Ambient Temperature  
(when monitoring)

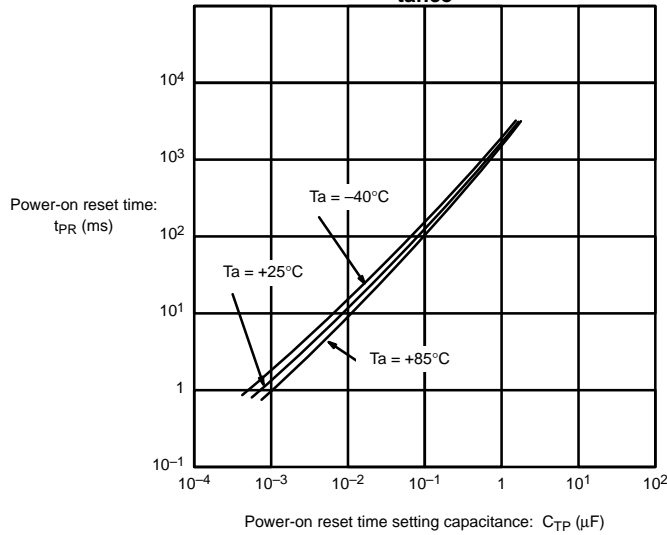


Watchdog Timer Monitoring Time - Ambient Temperature

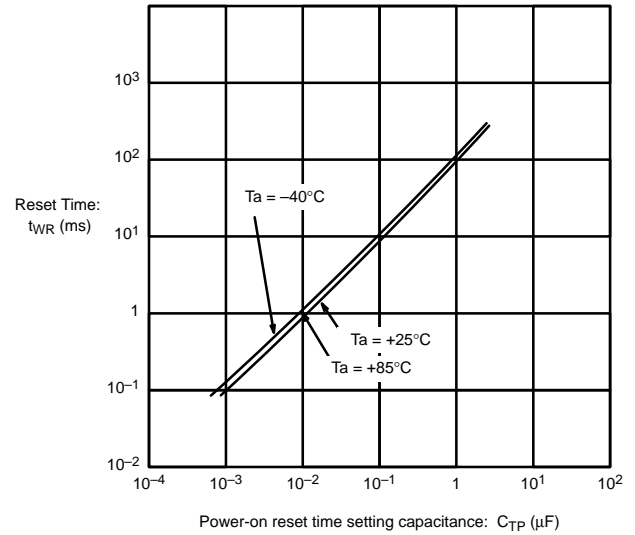




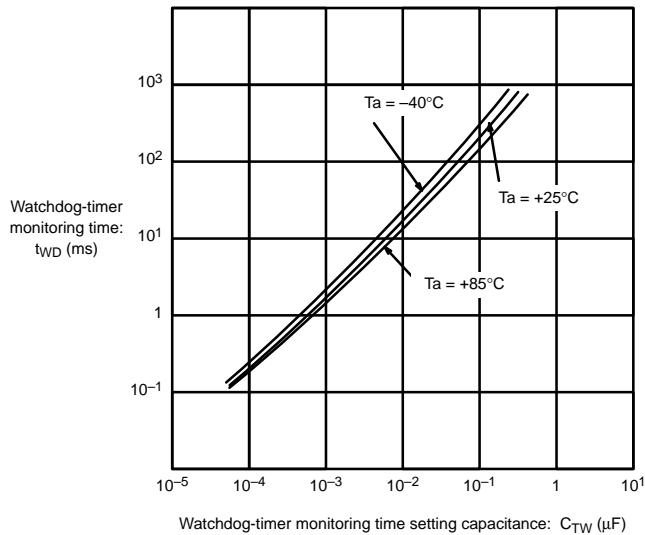
**Power-on Reset Time -  $C_{TP}$  Capacitance**



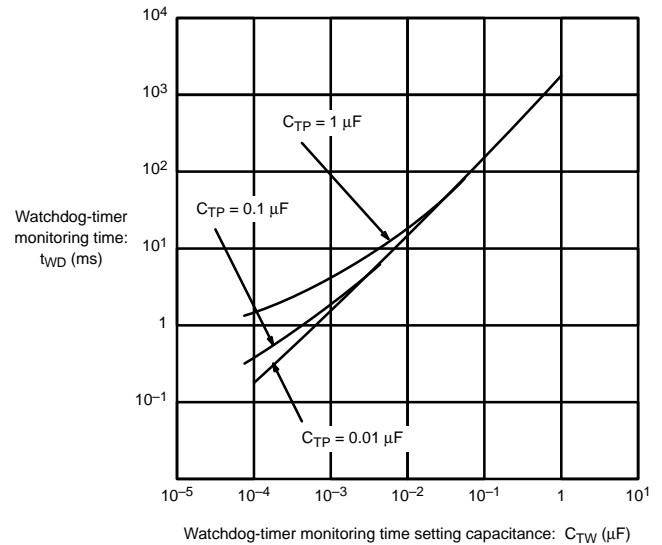
**Reset Time -  $C_{TP}$  Capacitance**



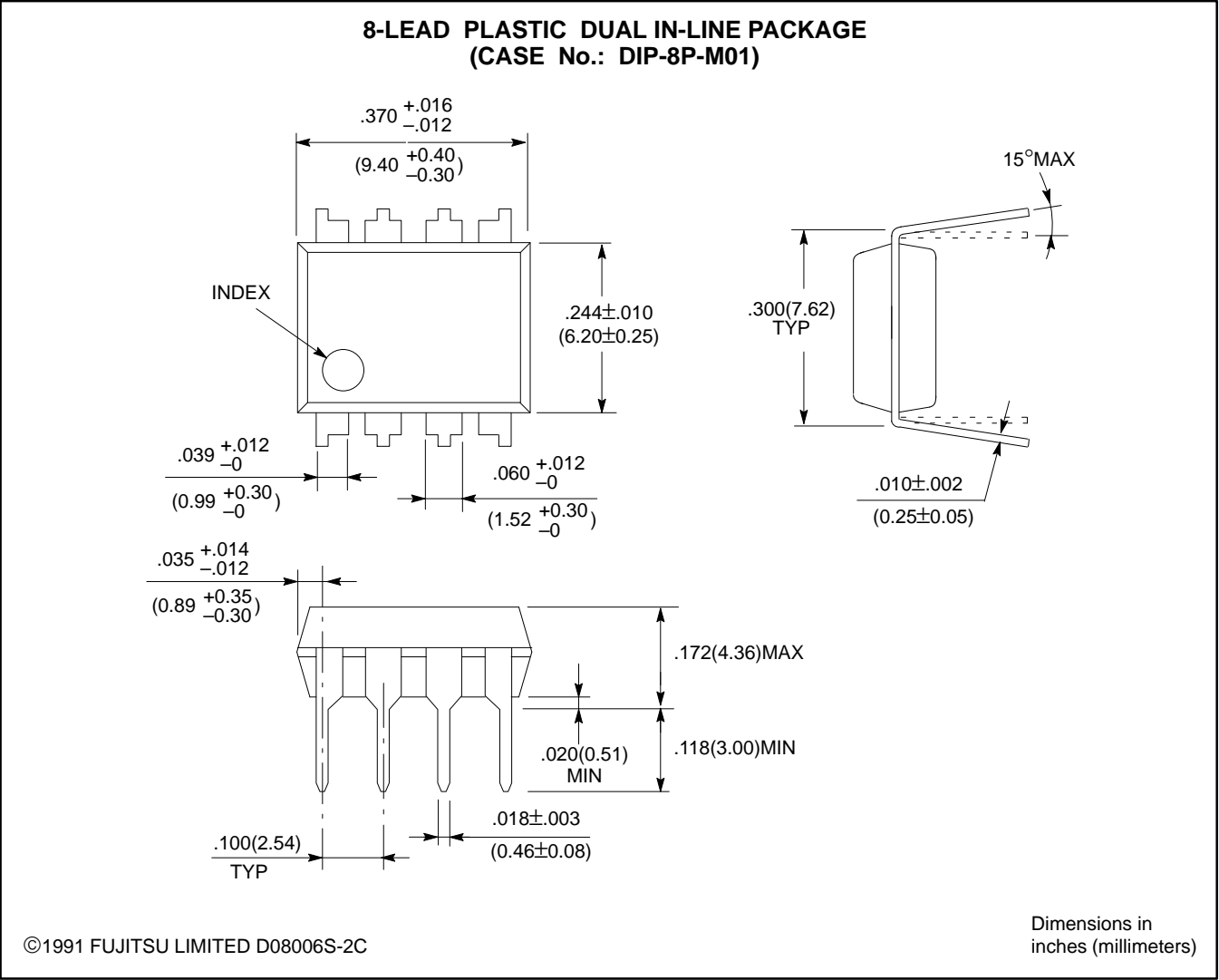
**Watchdog-Timer Monitoring Time -  $C_{TW}$  Capacitance (under  $T_a$  condition)**



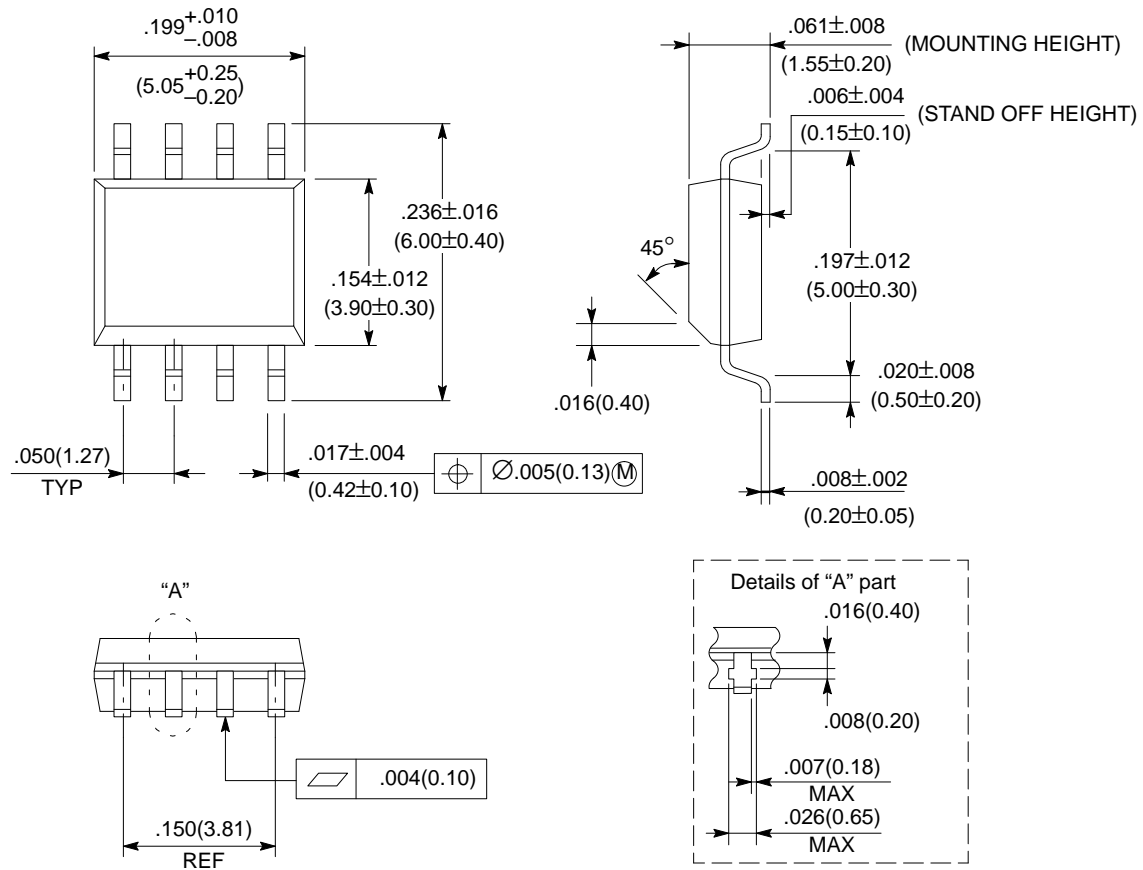
**Watchdog-Timer Monitoring Time -  $C_{TW}$  Capacitance (under  $C_{TP}$  condition)**



PACKAGE DIMENSIONS



### 8-LEAD PLASTIC FLAT PACKAGE (CASE No.: FPT-8P-M02)



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Dimensions in  
inches (millimeters)

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