

# System Reset (Built-in Watch Dog Timer) Monolithic IC MM1099

## Outline

The function of this IC series MM1099 is to accurately reset systems, a generating reset signal at the time of instantaneous supply voltage off or lowering in varied CPU and other logic system.

Further, with the watch dog timer built-in it can diagnose the operation of the system, intermittently generating reset pulses when they operate erroneously to prevent runaway.

## Features

1. Built-in watch dog timer
2. Low current consumption 130μA TYP.
3. Low operating threshold voltage  $V_{CC}=0.8V$
4. Watch dog stop function (RCT terminal)
5. Long clock monitoring time  
 $T_{PR}$  (POWER ON) :  $T_{WD}$  (clock monitoring)=1 : 1
6. Fewer outer components

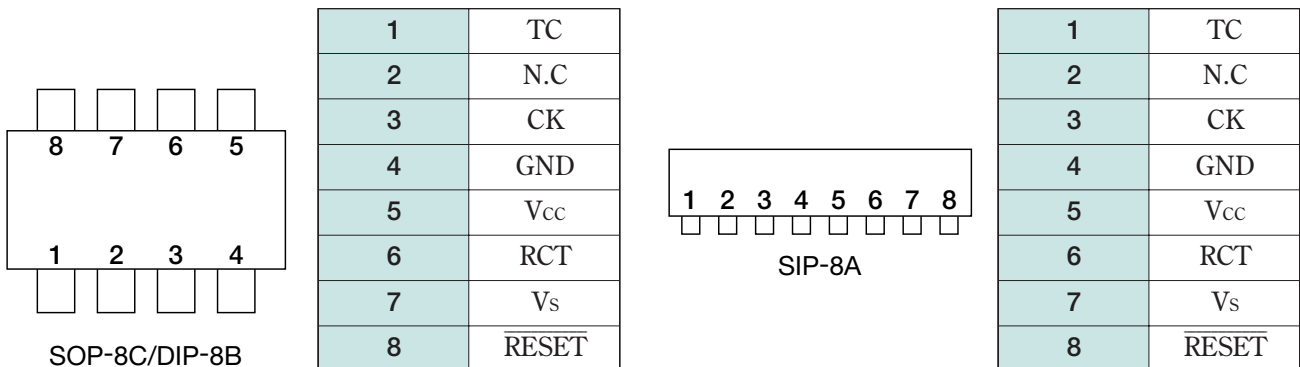
## Package

- DIP-8B (MM1099AD, MM1099BD)
- SOP-8C (MM1099AF, MM1099BF)
- SIP-8A (MM1099AS, MM1099BS)

## Applications

1. Reset circuit for microcomputers, CPU and MPU.
2. Reset circuit for logic circuitry.
3. Monitoring of microcomputer system, etc.

## Pin Assignment



## Pin Description

Pin No.	Pin name	Function	
1	TC	Variable terminals $T_{WD}$ , $T_{WR}$ and $T_{PR}$ The time for $T_{WD}$ , $T_{WR}$ and $T_{PR}$ to be determined by the external capacitor.	$T_{PR} (mS) = 5000 \times C_T (\mu F)$ $T_{WD} (mS) = 500 \times C_T (\mu F)$ $T_{WR} (mS) = 100 \times C_T (\mu F)$
2	N.C		
3	CK	Clock input terminal Inputs the clock from the logic system.	
4	GND	Ground terminal	
5	V <sub>CC</sub>	Voltage detection MM1099A→3.2V MM1099B→4.2V	
6	RCT	Watchdog timer stop pin Operation modes: Operation → OPEN, Stop → connect to GND	
7	V <sub>s</sub>	Detect voltage variable terminal	
8	RESET	Reset output pin (low output)	




## Absolute Maximum Ratings

Item	Symbol	Rating	Units
Power supply voltage	V <sub>CC</sub> max.	-0.3~+10	V
CK pin input voltage	V <sub>CK</sub>	-0.3~V <sub>CC</sub> +0.3 (≤ +10)	V
V <sub>s</sub> pin input voltage	V <sub>VS</sub>	-0.3~V <sub>CC</sub> +0.3 (≤ +10)	V
Voltage applied to RCT pin	V <sub>RCT</sub>	-0.3~V <sub>CC</sub> +0.3 (≤ +10)	V
Voltage applied to RESET pin	V <sub>OH</sub>	-0.3~V <sub>CC</sub> +0.3 (≤ +10)	V
Allowable loss	P <sub>d</sub>	300	mW
Storage temperature	T <sub>STG</sub>	-40~+125	°C

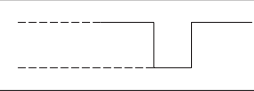
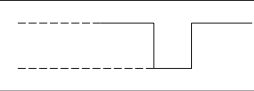
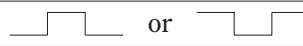
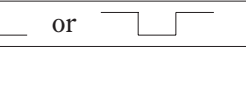
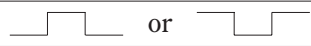

## Recommended Operating Conditions

Item	Symbol	Rating	Units
Power supply voltage	V <sub>CC</sub>	+2.2~+7.0	V
RESET sync current	I <sub>OL</sub>	0~1.0	mA
Clock monitoring time setting	T <sub>WD</sub>	0.1~1000	mS
Clock rise and fall times	t <sub>FC</sub> , t <sub>FC</sub>	<100	μS
TC pin capacitance	C <sub>T</sub>	0.0002~2	μF
Operating temperature	T <sub>OP</sub>	-25~+75	°C

**Electrical Characteristics (DC)** (Except where noted otherwise, MM1099A :  $V_{CC}=3.6V$ ,  $T_a=25^{\circ}C$ , MM1099B :  $V_{CC}=5.0V$ )

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
Consumption current	MM1099A	During watchdog timer operation		(100)	(150)	$\mu A$
	MM1099B			130	195	
Detection voltage	MM1099A	$V_{SL}$ $V_S=OPEN, V_{CC}$ 	3.10	3.20	3.30	V
	MM1099B		4.05	4.20	4.35	
	MM1099A	$V_{SH}$ $V_S=OPEN, V_{CC}$ 	3.15	3.25	3.35	
	MM1099B		4.15	4.30	4.45	
Detection voltage temperature coefficient	$V_S/\Delta T$		$\pm 0.01$		$\%/^{\circ}C$	
Hysteresis voltage	MM1099A	$V_{HYS}$ $V_{SH}-V_{SL}, V_{CC}$ 	25	50	100	mV
	MM1099B		50	100	150	
CK input threshold	$V_{TH}$		0.8	1.2	2	V
CK input current	$I_{IH}$	A : $V_{CK}=3.6V$ , B : $V_{CK}=5.0V$		0	1	$\mu A$
	$I_{IL}$	$V_{CK}=0V$	-12	-6	-2	
Output voltage (High)	MM1099A	$V_{OH}$ $I_{\overline{RESET}} = -1\mu A, V_S=OPEN$	3.0	3.4		V
	MM1099B		4.0	4.5		
Output voltage (Low)	$V_{OL1}$	$I_{\overline{RESET}} = 0.5mA, V_S=0V$		0.2	0.4	V
	$V_{OL2}$	$I_{\overline{RESET}} = 1.0mA, V_S=0V$		0.3	0.5	
R output sync current	$I_{OL}$	$V_{\overline{RESET}} = 1.0V, V_S=0V$	1	2		mA
$C_T$ charge current	$I_{CT1}$	$V_{TC}=1.0V$ during watchdog timer operation	-0.16	-0.24	-0.48	$\mu A$
	$I_{CT2}$	$V_{TC}=1.0V$ during power ON reset operation	-0.16	-0.24	-0.48	$\mu A$
Minimum operating power supply voltage to ensure $\overline{RESET}$	$V_{CCL}$	$V_{\overline{RESET}} = 0.4V$ $I_{\overline{RESET}} = 0.1mA$		0.8	1.0	V

**Electrical Characteristics (AC)** (Except where noted otherwise, MM1096A : V<sub>CC</sub>=3.6V, Ta=25°C MM1096B : V<sub>CC</sub>=5.0V)

Item	Symbol	Measurement conditions	Min.	Typ.	Max.	Units
V <sub>CC</sub> input pulse width	T <sub>PI</sub>	V <sub>CC</sub> 3.6V 	8			μS
		V <sub>CC</sub> 2.8V 				
CK input pulse width	T <sub>CKW</sub>	V <sub>CC</sub> 5.0V 	3			μS
		V <sub>CC</sub> 4.0V 				
CK input cycle	T <sub>CK</sub>	CK 	20			μS
Watchdog timer monitoring time *1	T <sub>WD</sub>	C <sub>T</sub> =0.02μF	50	100	150	mS
Reset time for watchdog timer *2	T <sub>WR</sub>	C <sub>T</sub> =0.02μF	1	2	3	mS
Reset hold time for power supply rise *3	T <sub>PR</sub>	C <sub>T</sub> =0.02μF, V <sub>CC</sub> 	50	100	150	mS
Output delay time from V <sub>CC</sub> *4	T <sub>PD</sub>	RESET pin, R <sub>L</sub> =10kΩ, C <sub>L</sub> =20pF		2	10	μS
Output rise time *5	t <sub>R</sub>	RESET pin, R <sub>L</sub> =10kΩ, C <sub>L</sub> =20pF		2.0	4.0	μS
Output fall time *5	t <sub>F</sub>	RESET pin, R <sub>L</sub> =10kΩ, C <sub>L</sub> =20pF		0.2	1.0	μS

Notes :

- \*1 The "monitoring time" means the time interval from the last pulse of the clock pulses for timer clear (negative edge) to the output of the reset pulse. If the clock pulse is not input during this time interval, the reset output will be given.
- \*2 The "reset time" is no other than the reset pulse width, except when resetting the POWER ON.
- \*3 The "reset hold time" is the time interval from the time point when V<sub>CC</sub> exceeds the detect (V<sub>SH</sub>) at the time of Power On Reset (Power variation reset) to the reset release (RESET output "HIGH").
- \*4 The "output delay time" means the time interval from when the supply voltage comes lower than the detect voltage (V<sub>SL</sub>) to when comes the reset state (RESET output "Low").
- \*5 The voltage range is 10 to 90% when measuring the output rise and fall times.
- \*6 By varying the capacitance of C<sub>T</sub>, we can vary the watch dog timer monitoring time (T<sub>WD</sub>), the reset time at the time of the watch dog timer (T<sub>WR</sub>), and the reset hold time at the time of power source rise (T<sub>PR</sub>). The variable time can be expressed by the following formulas:

$$T_{PR} (mS) \approx 5000 \times C_T (\mu F)$$

$$T_{WD} (mS) \approx 5000 \times C_T (\mu F)$$

$$T_{WR} (mS) \approx 100 \times C_T (\mu F)$$

Example : When C<sub>T</sub>=0.02μF

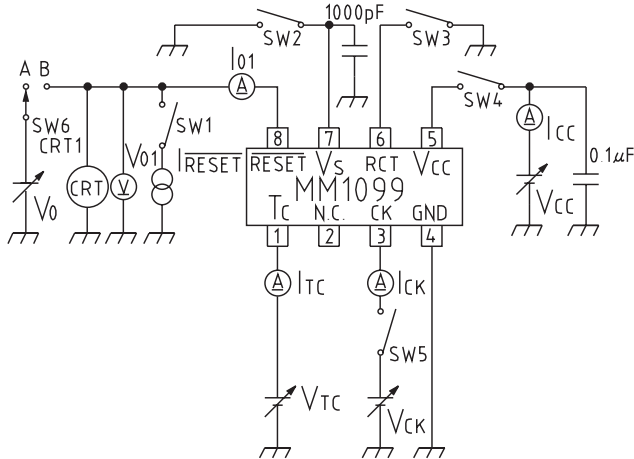
$$T_{PR} \approx 100mS$$

$$T_{WD} \approx 100mS$$

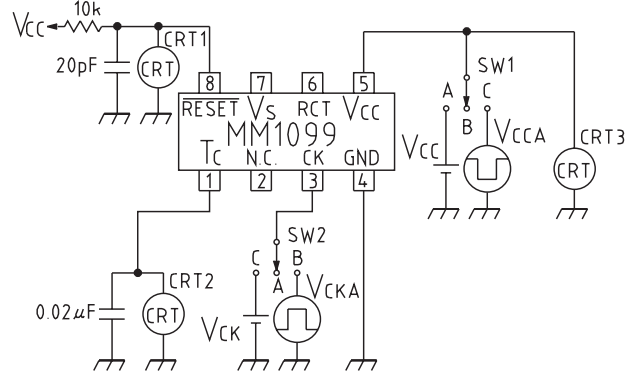
$$T_{WR} \approx 2mS$$

Measuring Circuits

Measuring Circuit 1 (DC)



Measuring Circuit 2 (AC)



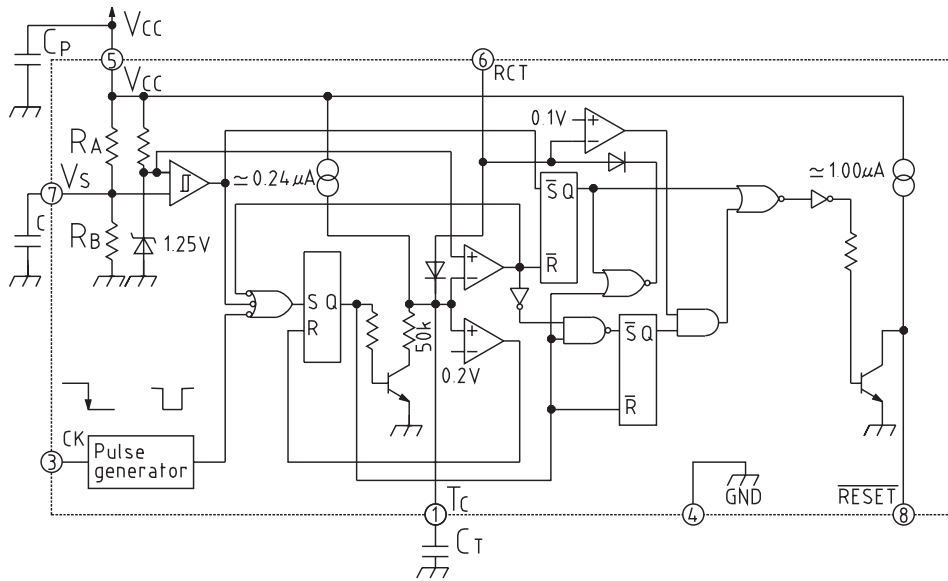
Measuring Circuit 1 SW & Power Supply Table

Item	Symbol	SW1	SW2	SW3	SW4	SW5	SW6	SW7	V <sub>CC</sub>	V <sub>CK</sub>	V <sub>CT</sub>	I <sub>RESET</sub>	VM, IM	Notes
Consumption current	I <sub>CC</sub>	OFF	OFF	OFF	ON	ON	ON	A	3.6V	3.6V	0V	-	I <sub>CC</sub>	
Detection voltage	V <sub>SL</sub>	OFF	OFF	ON	ON	ON	ON	A	3.6V→3V	0V	2V	-	V <sub>01</sub> , CRT1	
	V <sub>SH</sub>	OFF	OFF	ON	ON	ON	ON	A	3V→3.6V	0V	2V	-	V <sub>01</sub> , CRT1	
CK input threshold	V <sub>TH</sub>	OFF	OFF	OFF	ON	ON	ON	A	3.6V	0V→3V	1V	-	I <sub>CK</sub> , V <sub>CK</sub>	
CK input current	I <sub>IH</sub>	OFF	OFF	OFF	ON	ON	ON	A	3.6V	3.6V	0V	-	I <sub>CK</sub>	
	I <sub>IL</sub>	OFF	OFF	OFF	ON	ON	ON	A	3.6V	0V	0V	-	I <sub>CK</sub>	
Output voltage (High)	V <sub>OH</sub>	ON	OFF	ON	ON	ON	ON	A	3.6V	3.6V	2V	-1µA	V <sub>01</sub>	
Output voltage (Low)	V <sub>OL1</sub>	ON	ON	ON	ON	ON	ON	A	3.6V	3.6V	2V	0.5mA	V <sub>01</sub>	
	V <sub>OL2</sub>	ON	ON	ON	ON	ON	ON	A	3.6V	3.6V	2V	1.0mA	V <sub>01</sub>	
Output sink current	I <sub>OL1</sub>	OFF	ON	ON	ON	ON	ON	B	3.6V	3.6V	2V	-	I <sub>01</sub>	V <sub>0</sub> =1V
C <sub>T</sub> charge current 1	I <sub>Tc1</sub>	OFF	OFF	OFF	ON	ON	OFF	A	3.6V	-	1V	-	I <sub>Tc</sub>	
C <sub>T</sub> charge current 2	I <sub>Tc2</sub>	OFF	OFF	OFF	ON	ON	OFF	A	3.6V	-	IV	-	I <sub>Tc</sub>	
Minimum operating power supply voltage to ensure RESET	V <sub>CCL</sub>	ON	OFF	ON	ON	ON	ON	A	0V→2V	0V	0V	-	V <sub>01</sub> , V <sub>CC</sub>	

Measuring Circuit 2 SW & Power Supply Table

Item	Symbol	SW1	SW2	V <sub>CCA</sub>	V <sub>CC</sub>	V <sub>CkA</sub>	V <sub>CK</sub>	CRT	Notes
V <sub>CC</sub> input pulse width	T <sub>P1</sub>	C	B		-		-	CRT1 CRT2	T <sub>1</sub> =8µS
CK input pulse width	T <sub>CKW</sub>	A	B	-	3.6V		-	CRT1 CRT2	T <sub>2</sub> =3µS
CK input cycle	T <sub>CK</sub>	A	B	-	3.6V		-	CRT1 CRT2	T <sub>3</sub> =20µS
Watchdog timer monitoring time	T <sub>WD</sub>	A	A	-	3.6V	-	3.6V	CRT1 CRT2	
Reset time for watchdog timer	T <sub>WR</sub>	A	A	-	3.6V	-	3.6V	CRT1 CRT2	
Reset hold time for power supply rise	T <sub>PR</sub>	B→A	A	-	3.6V	-	3.6V	CRT1 CRT2	
Output delay time from V <sub>CC</sub>	T <sub>PD</sub>	C	A		-	-	0V	CRT1	
Output rise time	T <sub>R</sub>	A	A	-	3.6V	-	3.6V	CRT1	
Output fall time	T <sub>F</sub>	A	A	-	3.6V	-	3.6V	CRT1	

Block Diagram



	RA	RB
MM1099A	≈ 305k	≈ 195k
MM1099B	≈ 350k	≈ 150k

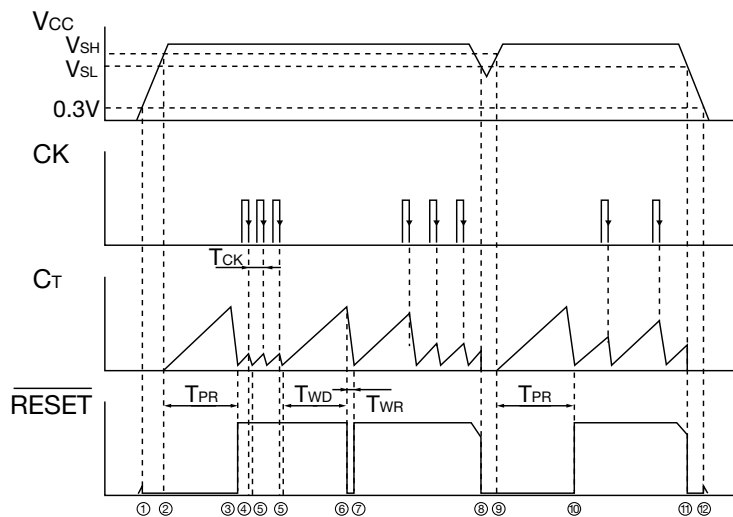
Note 1. Cp = approx. 0.1μF

Note 2. C ≈ 1000pF

Note 3. The watchdog timer can be stopped by grounding the RCT pin.  
(Function as voltage detection circuit.)

Note 4. TPR, TWD can be varied by pulling up the RCT pit to VCC using a resistor.

Timing Chart



## Description of Operation

1. The  $\overline{\text{RESET}}$  will become "Low" if  $V_{CC}$  rises to about 0.8V.  
Approximately  $1\mu\text{A}$  ( $V_{CC}=0.8\text{V}$ ) of pull up current is output from  $\overline{\text{RESET}}$
2. Charging starts at the capacitor  $C_T$  when  $V_{CC}$  rises to  $V_{SH}$  (MM1099A  $\approx 3.25\text{V}$ , MM1099B  $\approx 4.3\text{V}$ ), when the output has been reset.
3. The output reset is released after a given interval  $T_{PR}$  from when the  $C_T$  Starts charging and to when it discharges (that is, the time from when  $C_T$  voltage takes a given value 1 ( $\approx 1.4\text{V}$ ) up until decreases to a given value 2 ( $\approx 0.2\text{V}$ ). ( $\overline{\text{RESET}}$  will become "High"). The  $\overline{\text{RESET}}$  will output a pull up current, about  $1\mu\text{A}$  ( $V_{CC}=0.8\text{V}$ ). The reset hold time  $T_{PR}$  is expressed by the following formula:  

$$T_{PR} (\text{ms}) \approx 5000 \times C_T (\mu\text{F})$$
 After the reset release  $C_T$  restarts charging and the watch dog timer begins operating.  
 Note that input of clock while POWER ON RESET time  $T_{PR}$  will cause an erroneous operation.
4. If clock is input into CK terminal while  $C_T$  is charging (negative edge trigger),  $C_T$  changes from charging over to discharging.
5. When the  $C_T$  voltage decreases to a given threshold ( $\approx 0.2\text{V}$ ), then discharging changes over to charging. Steps 4 and 5 will be repeated while normal clock is input from the logic system.
6. When the clock ceases and  $C_T$  voltage reaches the RESET ON threshold ( $\approx 1.4\text{V}$ ), the output enters into reset state ( $\overline{\text{RESET}}$  becoming "Low").  
 The  $C_T$  charging time  $T_{WD}$  up until the reset is output (watch dog monitoring time) is expressed by the following formula:  

$$T_{WD} (\text{ms}) \approx 5000 \times C_T (\mu\text{F})$$
7. The reset time at the time of watch dog time  $T_{WR}$  is the discharging time while the  $C_T$  voltage lowers down to the reset off threshold ( $\approx 0.2\text{V}$ ). The calculation formula:  

$$T_{WR} (\text{ms}) \approx 100 \times C_T (\mu\text{F})$$
 After the reset off threshold is reached, the output reset is released and  $C_T$  commences to charge. If thenceforth the clock is input normally, steps 4 and 5 will be repeated, and steps 6 and 7 repeated if the clock ceases.
8. When  $V_{CC}$  lowers down to  $V_{SL}$  (MM1099A  $\approx 3.2\text{V}$ , MM1099B  $\approx 4.2\text{V}$ ), the reset is output. At the same time  $C_T$  charged.
9.  $C_T$  discharging starts when  $V_{CC}$  rises up to  $V_{SH}$ .  
 If  $V_{CC}$  lower instantaneously, charging starts after load discharging of  $C_T$  if the time interval from when  $V_{CC}$  comes lower than  $V_{SL}$  up until when it rises to  $V_{SH}$  or higher is equal or superior to the reference value of  $V_{CC}$  input pulse width  $T_{PI}$ .
10. The output reset is released  $T_{PR}$  after  $V_{CC}$  becomes  $V_{SH}$  or higher, and the watch dog time will start. Then if  $V_{CC}$  becomes  $V_{SL}$  or lower, steps 8 to 10 will be repeated.
11. If power Off occurs, reset is output if  $V_{CC}$  becomes  $V_{SL}$  or lower.
12. When  $V_{CC}$  comes down to 0V, the reset output will hold up until  $V_{CC}$  becomes 0.8V.