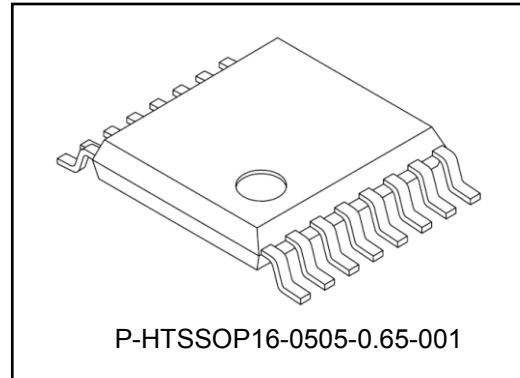


# TB9021FNG

## Low Dropout Voltage Regulator with Watchdog Timer

TB9021FNG is a 5V Voltage regulator for Automotive Micro Controller. 5V regulator Circuit and Watch Dog Timer for external MCU are built-in and achieve High accuracy Output Voltage ( $5V \pm 0.1V$ ) with 200mA Current. and reducing external Parts. Abnormal Detection Function such as Current Limiter and Over Temperature Detection are also built-in.

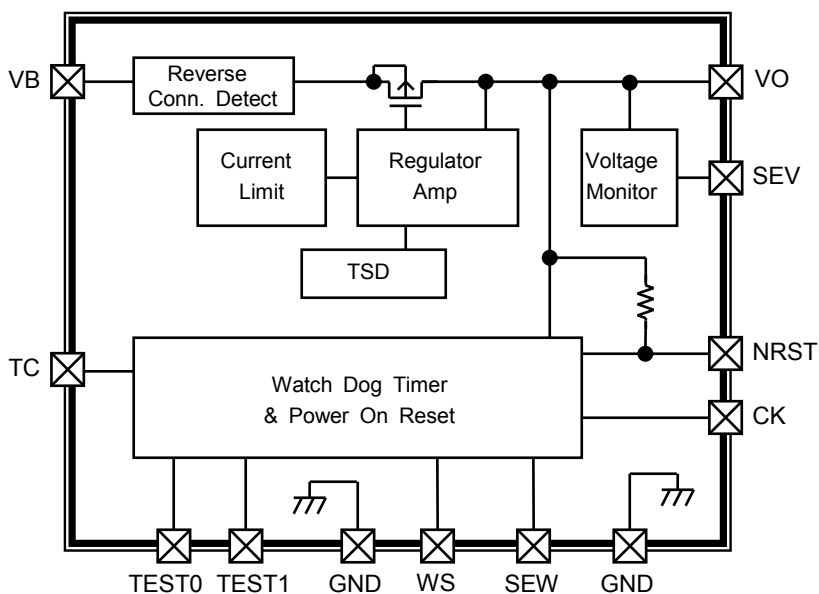


Weight: 0.062g (typ.)

### Feature

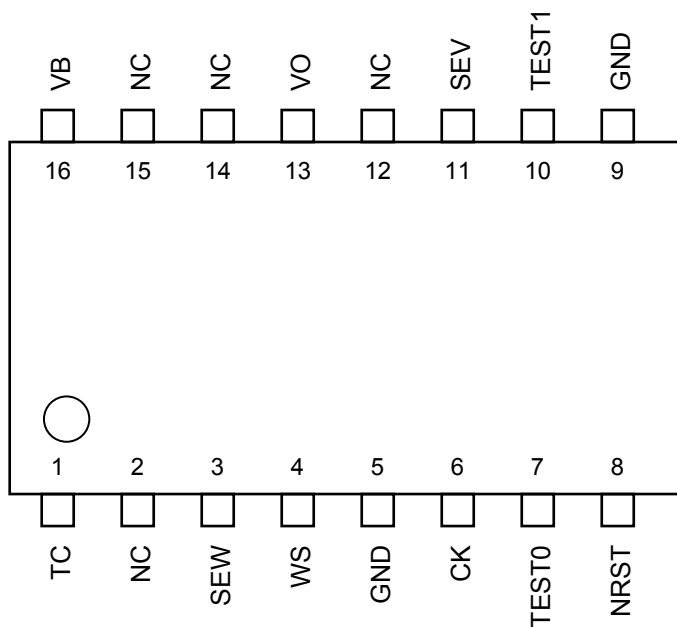
- High Accuracy Output Voltage :  $5V \pm 0.1V$
- Output Current : 200mA (Current Limiter 300mA(typ.))
- IN-OUT Drop Voltage : 0.25V (ILOAD=200mA)
- Low Standby Current : 30 $\mu$ A(typ.)
- Various Abnormal Detection : Over Temperature/Current Limiter/Reverse Connection
- Low Voltage Detection : 4.2V(typ.) & 4.7V(typ.) Selectable
- Power On Reset : Reset Signal Time Length Adjustable
- Watch Dog Timer : WINDOW Type Lower Detection : "CK" lower frequency than setting time by "CT"  
Higher Detection : "CK" higher frequency than 1ms(typ.) during 10ms
- The product(s) is/are compatible with RoHS regulations (EU directive 2011 / 65 / EU) as indicated, if any, on the packaging label ("[[G]]/RoHS COMPATIBLE", "[[G]]/RoHS [[Chemical symbol(s) of controlled substance(s)]]", "RoHS COMPATIBLE" or "RoHS COMPATIBLE, [[Chemical symbol(s) of controlled substance(s)]]>MCV").

**INTERNAL BLOCK DIAGRAM AND PIN LAYOUT**



**[Note]** Some of the functional blocks,circuit,or constants in the block diagram may be omitted or simplified for explanatory purpose.

**PIN LAYOUT**



## PIN CONNECTION

PIN No.	PIN NAME	DEFINITION
1	TC	RESET signal width of RESET Timer and Watch Dog Timer setting PIN. Connect Capacitor(CT) to GND. Refer Electrical Spec, for the detail of Timer signal width.
3	SEW	Watch Dog Timer Type Selection SEW=GND : WINDOW Type. Refer to the section of the Watch Dog Timer-2. SEW=VO : Reset at CK>TWD(set by "CT"). Refer to the section of the Watch Dog Timer-1. This setting should be fixed on PCB. (cannot change "SEW" in the operation)
4	WS	Watch Dog Timer Enable/Disable. WS=GND : Watch Dog Timer Enable WS=VO : Watch Dog Timer Disable
5	GND	GND
6	CK	Clock Input for Watch Dog Timer.
7	TEST0	TEST PIN. Connect to GND on PCB.
8	NRST	Output of Reset Signal. Build-In Pull Up resistance 10kΩ to VO.
9	GND	GND
10	TEST1	TEST PIN. Connect to GND
11	SEV	The selector of RESET Detection Voltage. SEV=GND : RESET Detection Voltage : 4.7V(typ.) SEV=VO : " : 4.2V(typ.)
13	VO	Output of 5V regulator. Current Capacity 200mA.
16	VB	Power Input
2,12, 14,15	NC	Non Connection

## SELECTABLE FUNCTION TABLE

### Low Voltage Detection Voltage

SEV	Detection Voltage VTH (typ.)
L (GND)	4.7V
H (VO)	4.2V

### Watch Dog Timer Clock Abnormal Hi Frequency detection

SEW	WDT CK Hi-Freq. Detection
L (GND)	Enable
H (VO)	Disable

### Watch Dog Timer Enable

WS	WDT
L (GND)	Enable
H (VO)	Disable

Functional Description

Watch Dog Timer -1

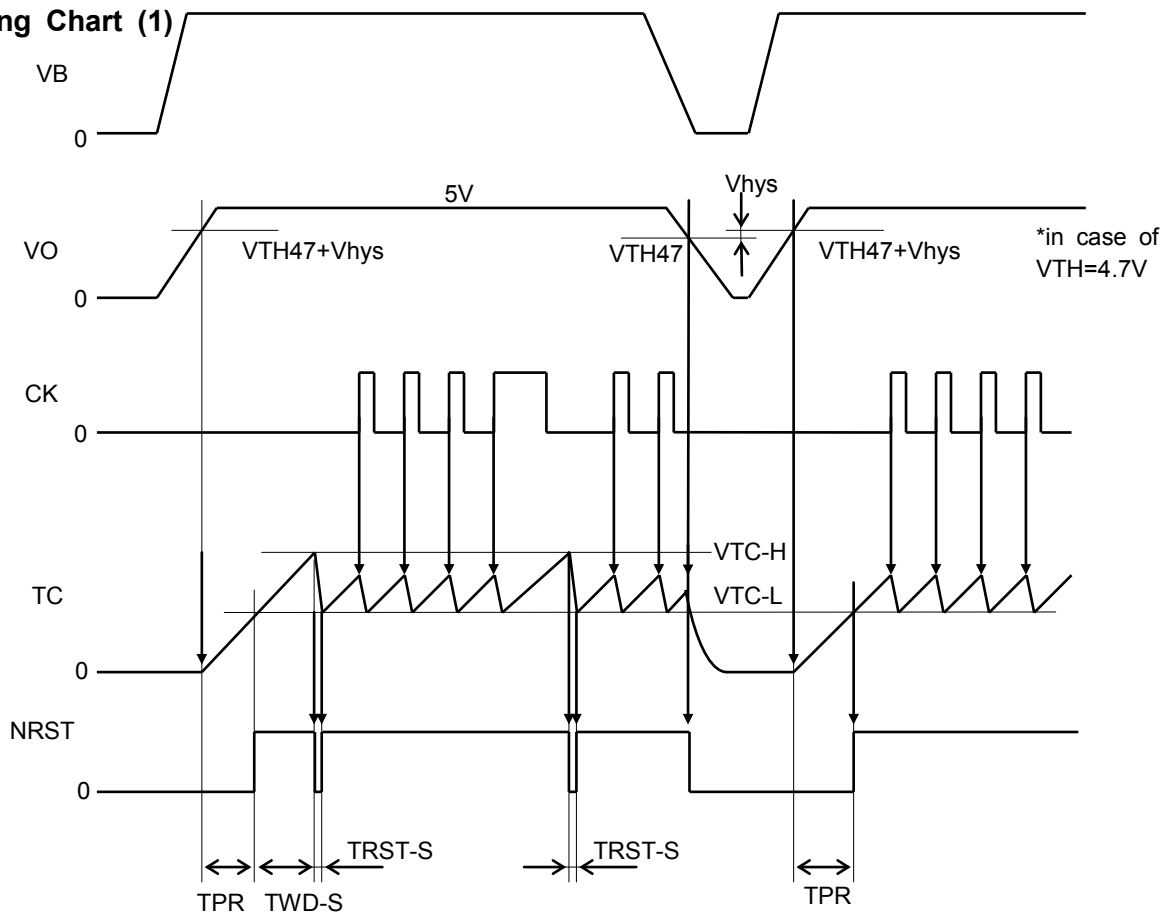
For TB9021FNG built-in Watch dog Timer Function, the signal clock which is made by software of external MCU is needed to input to PIN"CK". External Capacitance which is connected to PIN"TC" is continuously and alternatively perform the charge and the discharge between VTC-H and VTC-L of internal setting voltage. And when Rising Edge of the signal PIN "CK" is detected at voltage charge, it is switched to discharge. Thus when external MCU work properly, the voltage of PIN"TC" does not reach to VTC-H. But when MCU has problem and the software does not work properly , the signal of PIN"CK" disappear and the voltage of PIN"TC" reach to VTC-H and PIN"NRST" output "L" until the voltage of PIN"TC" drop to VTC-L. After this voltage drop to VTC-L, the signal of PIN"NRST" return to "H(Normal)" and PIN"TC" start charge the voltage again. This signal of PIN"NRST" can be used for external MCU reset. Each Time is decided by external Capacitance which is connected to PIN"TC" as follows.

TPR(Signal of Power On Reset: POR) (s) = 2 x CT (μF) (typ.)  
 TWD-S(the detection Time of WDT) (s) = 2 x CT (μF) (typ.)  
 TRST-S(Signal width of Reset) (ms) = 7 x CT (μF) (typ.)

The following shows TB9021FNG Function.

- Start Up of VO(5V)
- Power On Reset: POR
- Watch Dog Timer Reset Operation: WDT
- VO Low Voltage Detection and recovering Reset Operation

Timing Chart (1)

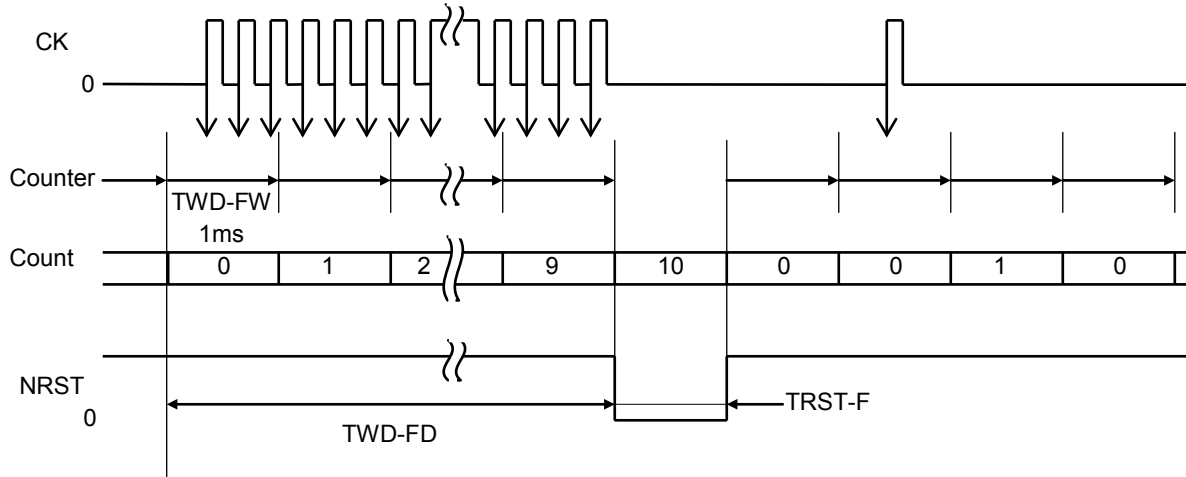


(Start UP POR) (WDT Reset) (WDT Reset) (VO Low Voltage Detect, Reset)

**Watch Dog Timer -2**

TB9021FNG Watch Dog Timer has Abnormal Detection of Input "CK" Frequency.  
 When Input clock frequency of PIN"CK" is faster than 1msec.(typ.) and it is continuously input for 10msec., TB9021FNG detect as abnormal Hi-speed Input of "CK" and output "L" from PIN"NRST" during 1msec.(typ.). (see the following Time chart (2))

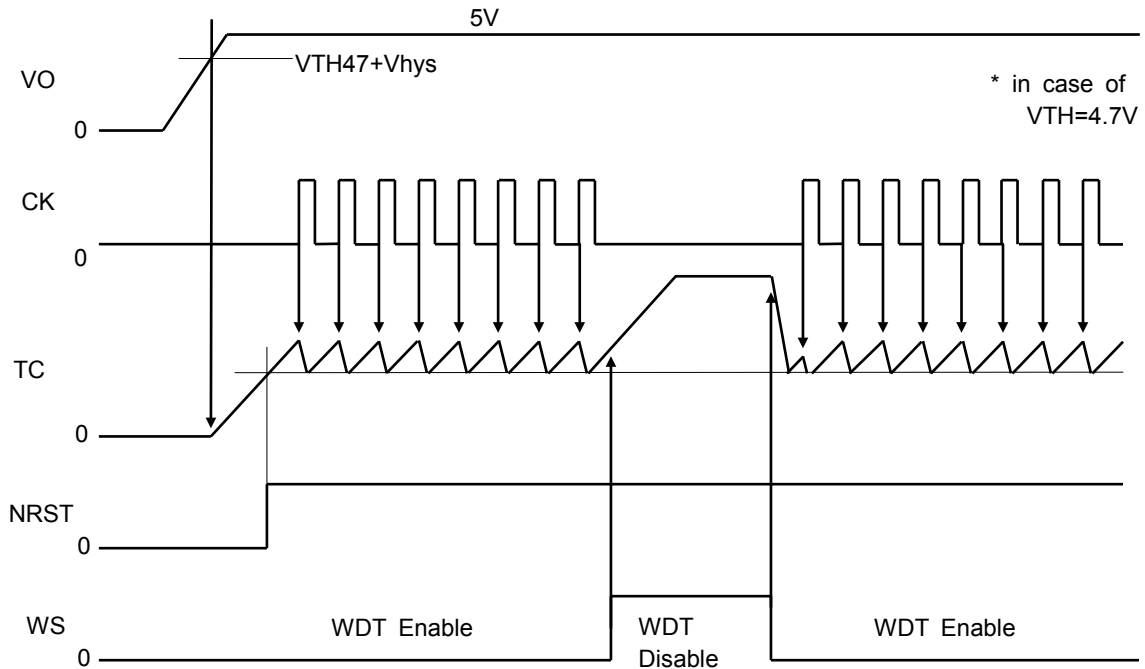
**Timing Chart (2)**



**Watch Dog Timer Enable/Disable**

Watch Dog Timer Enable/Disable is as follows.

**Timing Chart (3)**



**(Note)** Refer "Electrical Specification" for the above Symbol.  
 Timing charts may be simplified for explanatory purpose.

## ABSOLUTE MAXIMUM RATING (Ta = 25°C)

CHARACTERISTICS	SYMBLE	PIN	VALUE	UNIT
Input Voltage	VIN1	VB	50	V
	VIN2	VB	-16 (*)	
Output Current	ILOAD	VO	200	mA
	IOUT	NRST	1	
Operating Temperature	Topr	—	-40 to 125	°C
Junction Temperature	Tj	—	-40 to 150	°C
Strage Temperature	Tstg	—	-55 to 150	°C

**(Note)**

The absolute maximum ratings of a semiconductor device are a set of specified parameter values, which must not be exceeded during operation, even for an instant. If any of these rating would be exceeded during operation, the device electrical characteristics may be irreparably altered and the reliability and lifetime of the device can no longer be guaranteed. Moreover, these operations with exceeded ratings may cause break down, damage and/or degradation to any other equipment. Applications using the device should be designed such that each maximum rating will never be exceeded in any operating conditions. Before using, creating and/or producing designs, refer to and comply with the precautions and conditions set forth in this documents.

**(Note)**

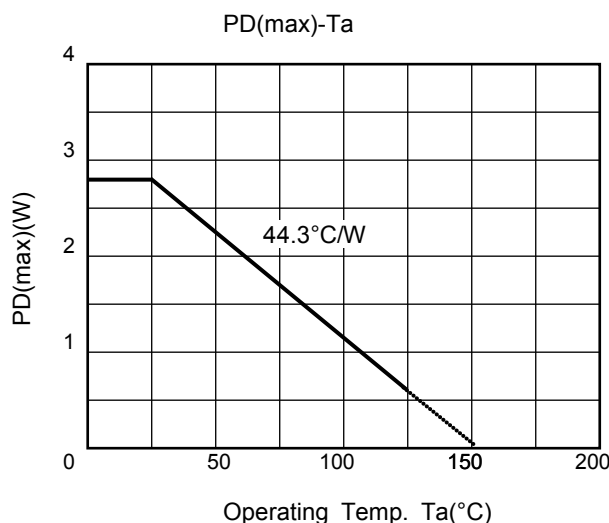
\* REVERSE BATTERY

## THERMAL RESISTANCE DATA (Ta = 25°C)

CHARACTERISTICS	SYMBLE	VALUE	UNIT
Power Consumption	PD	2.8	W
Thermal Resistance	$\theta_{j-a}$	44.3	°C/W
Over Temperature Detection	TSD	165	°C

**(Note)** This Over Temp. Detection is worded over the Maximum Rating Temperature and shipping test does not perform at the Maximum Rating Temperature.

### Power Dissipation of the Package



PCB: JEDEC4L 76.2mm x 114.3mm x t1.6mm

## Static Electrical Characteristics

(The follows are under condition  $V_B = 6$  to  $18$  V,  $T_c = -40$  to  $125^\circ\text{C}$  unless otherwise the follows)

CHARACTERISTICS	SYMBOL	PIN	CONDITION	MIN	TYP.	MAX	UNIT
DC CHARACTERISTICS							
Current Consumption	Icc1	VB	ILOAD<200 $\mu$ A *1	—	30	60	$\mu$ A
	Icc2	VB	200 $\mu$ A $\leq$ ILOAD<1mA *1	—	60	120	
	Icc3	VB	1mA $\leq$ ILOAD *1	—	—	420	
Regulator							
Output Voltage	VREG	VO		4.9	5.0	5.1	V
LINE Regulation	VLINE1	VO	VB=6 to 18V, ILOAD=10mA	—	—	10	mV
	VLINE2		VB=6 to 50V, ILOAD=10mA	—	—	20	
LOAD Regulation	VLOAD	VO	VB=14V, ILOAD=1 to 100mA	—	—	20	mV
Temperature Coefficient		VO		—	0.01	—	%/ $^\circ\text{C}$
IN-OUT Drop Voltage	VDROP	VO	VB=5V ILOAD=200mA	—	0.25	—	V
Current Limiter	ILIMIT	VO		—	300	—	mA
RESET TIMER DC CHARACTERISTICS							
INPUT Current	IIH	SEV,WS	VIN=VO	-1	—	1	$\mu$ A
	IIL	SEW,CK	VIN=GND	-1	—	1	
Input Threthold Voltage	VTH	SEV,WS SEW,CK		$0.2 \times V_O$	—	$0.8 \times V_O$	V
Output Voltage	VOL	NRST	IOL=1mA	—	—	0.5	V
Input Current	IIN	TC		—	-1	—	$\mu$ A
Reset Detection Voltage	VTH47	VO	SEV=GND	—	4.7	—	V
	VTH42		SEV=VO	—	4.2	—	
	Vhys			—	0.1	—	
AC CHARACTERISTICS							
Power On Reset time	TPR	NRST		—	$2 \times CT$	—	s
WDT detection Time	TWD-S	NRST		—	$2 \times CT$	—	s
WDT Abnormal Frequency Detection cycle	TWD-FW	NRST		—	1.0	—	ms
WDT Abnormal Frequency Detection period	TWD-FD	NRST		—	10	—	ms
WDT Reset Signal Width	TRST-S	NRST		—	$7 \times CT$	—	ms
Reset Signal Width at Abnormal Frequency Detection	TRST-F	NRST		—	1.0	—	ms
WDT Input Clock Width	TW	CK		1	—	—	$\mu$ s

\* : Current Consumption Icc1 and Icc2 do not include LOAD Current (ILOAD.)

\* : Unit of CT is ( $\mu$ F).

\* : The above Specification, Power On Reset Time, Watch Dog Timer and Reset Signal Width do not include the tolerant of external Capacitance "CT".

## External Capacitance

Parts	MIN	MAX	UNIT
CT	0.0022	0.22	$\mu$ F

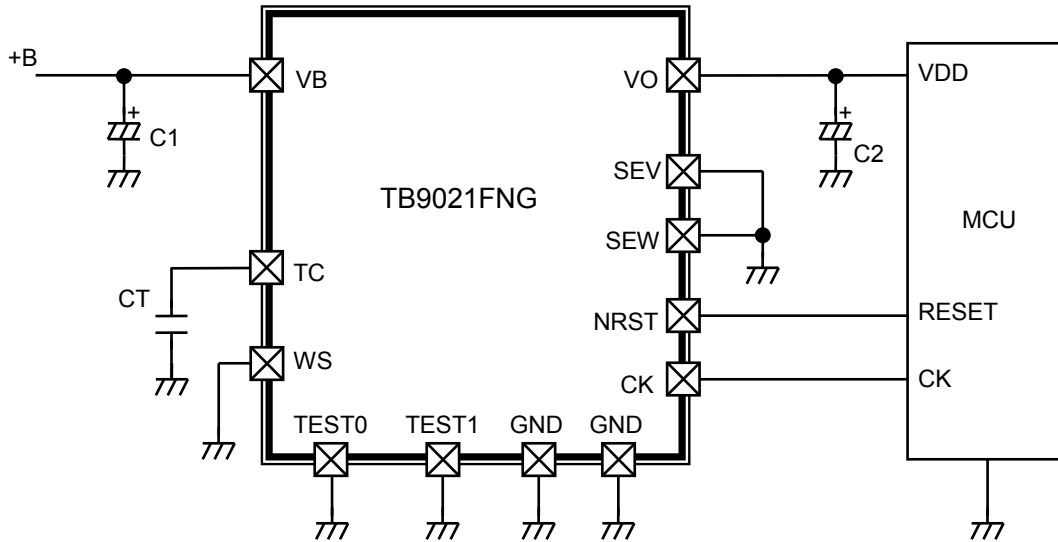
(Note) Charging current of the "CT" is a small value  $1\mu\text{A}(\text{typ.})$ .

And affect the reset signal time width when there is a leak in the small to "CT".

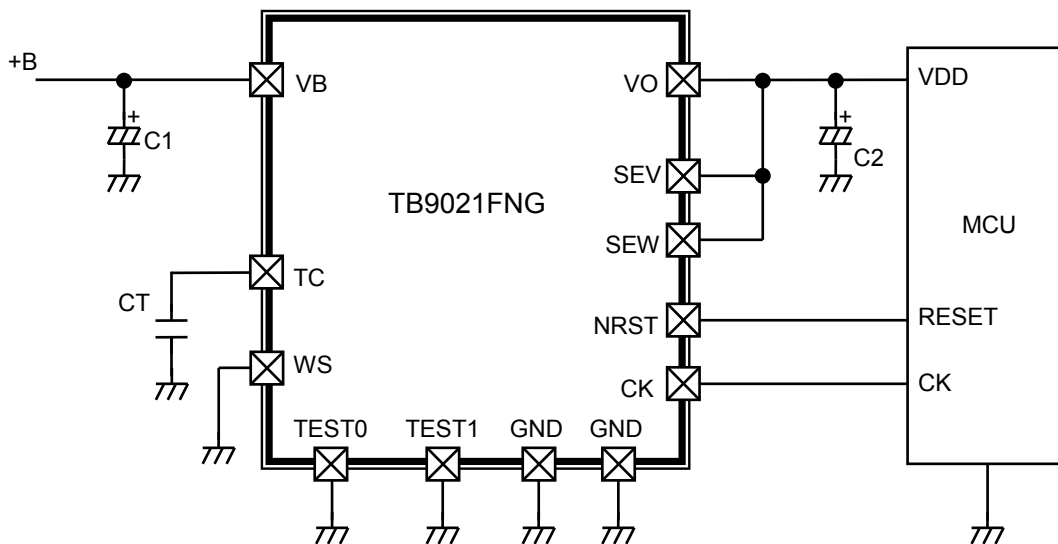
The setting of the capacitor, should be small leakage current.

**APPLICATION CIRCUIT DIAGRAM**

(ex. 1) Watch Dog Timer Low Voltage Detection is in case 4.7V, Abnormal High and Low Speed frequency of Watch Dog Timer Clock “CK” Detection available.



(ex.2) Watch Dog Timer Low Voltage Detection is in case 4.2V, Abnormal Low Speed frequency of Watch Dog Timer Clock “CK” Detection available.



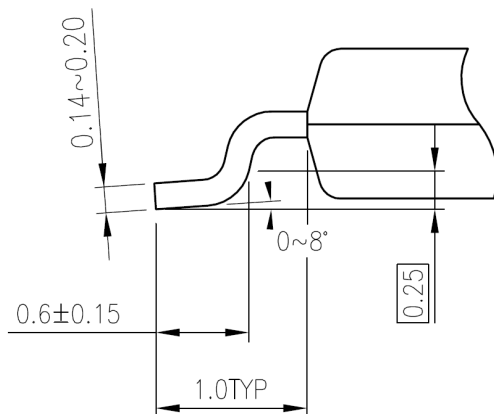
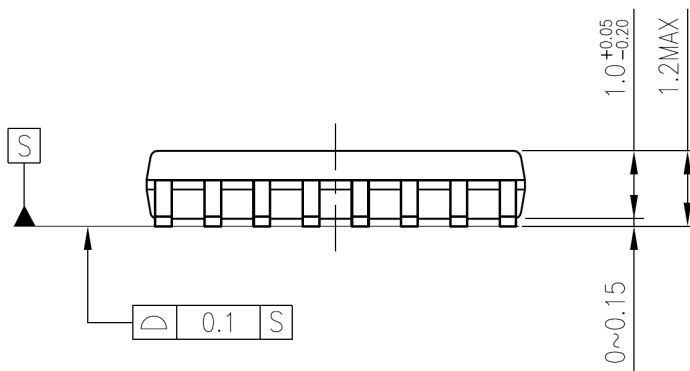
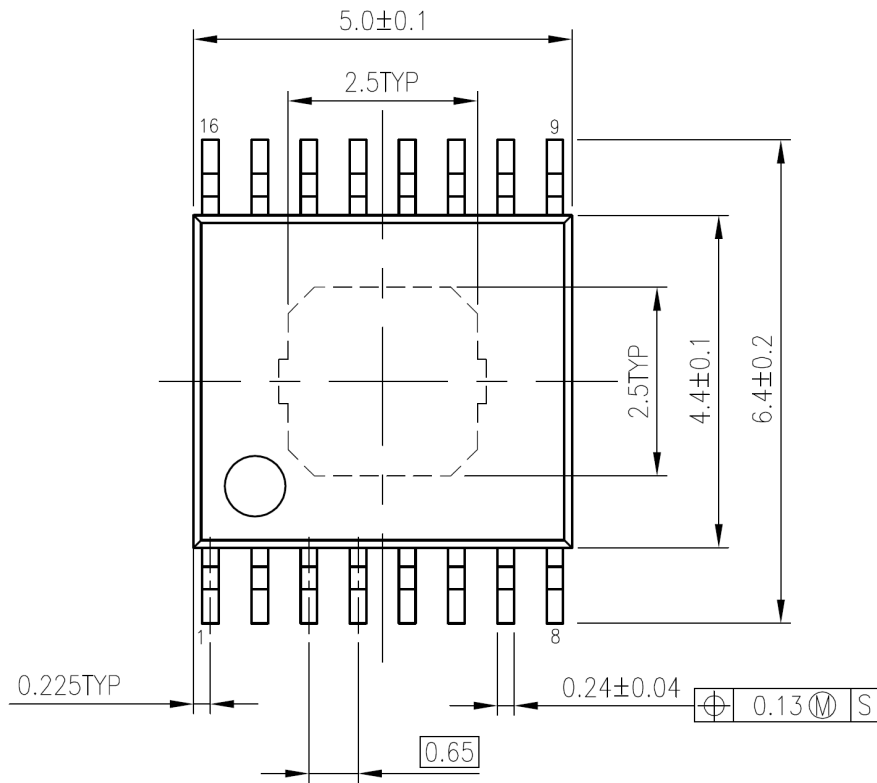
**(Note)**

- C1 and C2 are Capacitance for absorbing disturbances, noise, etc. Connect each capacitor as close to the IC as possible.
- Install the product correctly. Otherwise, it may result in break down, damage and/or deterioration to the product or equipment.
- The application circuits shown in this document are provided for reference purposes only. Especially, a thorough evaluation is required on the phase of mass production design. Toshiba does not grant the use of any industrial property rights with these examples of application circuits.



PACKAGE: P-HTSSOP16-0505-0.65-001

Unit: mm



Weight: 0.062g (typ.)

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