

## Voltage Detectors

# Voltage Detector ICs with Watchdog Timer

**BD37Axx Series    BD87Axx Series    BD99A41F**

## General Description

The BD37A19FVM, BD37A41FVM, BD87A28FVM, BD87A29FVM, BD87A34FVM, BD87A41FVM and BD99A41F are watchdog timer reset ICs. It delivers a high precision detection voltage of  $\pm 1.5\%$  and a super-low current consumption of 5  $\mu\text{A}$  (Typ.). It can be used in a wide range of electronic devices to monitor power supply voltages and in system operation to prevent runaway operation.

## Features

- Built-in watchdog timer
- Reset delay time can be set with the CT pin's external capacitance
- Watchdog timer monitor time and reset time can be set with the CTW pin's external capacitance.
- Output circuit type: N-channel open drain

## Applications

All devices using microcontrollers or DSP, including vehicle equipment, displays, servers, DVD players, and telephone systems

## Key Specifications

- RESET power supply voltage range: 1.0V to 10V
- WDT power supply voltage range: 2.5V to 10V
- High precision detection voltage:
  - (Ta = 25°C)  $\pm 1.5\%$
  - (Ta = -40°C to 105°C)  $\pm 2.5\%$
- Super-low current consumption: 5  $\mu\text{A}$  (Typ.)
- Operating temperature range: -40°C to +105°C

## Packages

- MSOP8

W (Typ.) x D (Typ.) x H (Max.)  
2.90mm x 4.00mm x 0.90mm



- SOP8

5.00mm x 6.20mm x 1.71mm



## Ordering Information

| B D 3 7 A 1 9 F V M |  |  |                   |  |  | -           | T R                                 |
|---------------------|--|--|-------------------|--|--|-------------|-------------------------------------|
| Part Number         |  |  | Detection Voltage |  |  | Package     | Packaging and forming specification |
| 37A : WDT H Active  |  |  | 19 : 1.9V         |  |  | FVM : MSOP8 | TR: Embossed tape and reel          |
| 87A : WDT L Active  |  |  | 28 : 2.8V         |  |  | F : SOP8    | E2: Embossed tape and reel          |
| 99A : WDT H Active  |  |  | 29 : 2.9V         |  |  |             |                                     |
|                     |  |  | 34 : 3.4V         |  |  |             |                                     |
|                     |  |  | 41 : 4.1V         |  |  |             |                                     |

## Lineup

| Detection voltage (Typ.) | INH logic | Package |              | Orderable Part Number |
|--------------------------|-----------|---------|--------------|-----------------------|
| 1.9V                     | H: Active | MSOP8   | Reel of 3000 | BD37A19FVM-TR         |
| 4.1V                     | H: Active | MSOP8   | Reel of 3000 | BD37A41FVM-TR         |
| 2.8V                     | L: Active | MSOP8   | Reel of 3000 | BD87A28FVM-TR         |
| 2.9V                     | L: Active | MSOP8   | Reel of 3000 | BD87A29FVM-TR         |
| 3.4V                     | L: Active | MSOP8   | Reel of 3000 | BD87A34FVM-TR         |
| 4.1V                     | L: Active | MSOP8   | Reel of 3000 | BD87A41FVM-TR         |
| 4.1V                     | H: Active | SOP8    | Reel of 2500 | BD99A41F-E2           |

●Pin Configurations

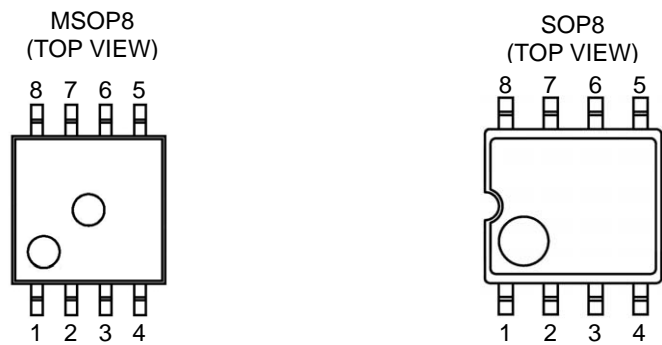


Figure 1. Pin Configurations

●Pin Descriptions

| BD37AxxFVM |          |   | BD87AxxFVM / BD99A41F |          |  |
|------------|----------|---|-----------------------|----------|--|
| No.        | Pin name | Function  | No.                   | Pin name | Function   |
| 1          | CLK      | Clock input from microcontroller                  | 1                     | CTW      | WDT time setting capacitor connection pin  |
| 2          | CT       | Reset delay time setting capacitor connection pin | 2                     | CT       | Reset delay time setting capacitor connection pin  |
| 3          | CTW      | WDT time setting capacitor connection pin         | 3                     | CLK      | Clock input from microcontroller   |
| 4          | VDD      | Power supply pin                                  | 4                     | GND      | GND pin  |
| 5          | N.C.     | NC pin  | 5                     | VDD      | Power supply pin   |
| 6          | GND      | GND pin   | 6                     | INH      | WDT ON/OFF setting pin<br>INH=H/L:WDT=OFF/ON(BD87AxxFVM)<br>INH=H/L:WDT=ON/OFF(BD99A41F) |
| 7          | INH      | WDT ON/OFF setting pin<br>INH=H/L:WDT=ON/OFF      | 7                     | N.C.     | NC pin   |
| 8          | RESET    | Reset output pin                                  | 8                     | RESET    | Reset output pin   |

●Block Diagrams

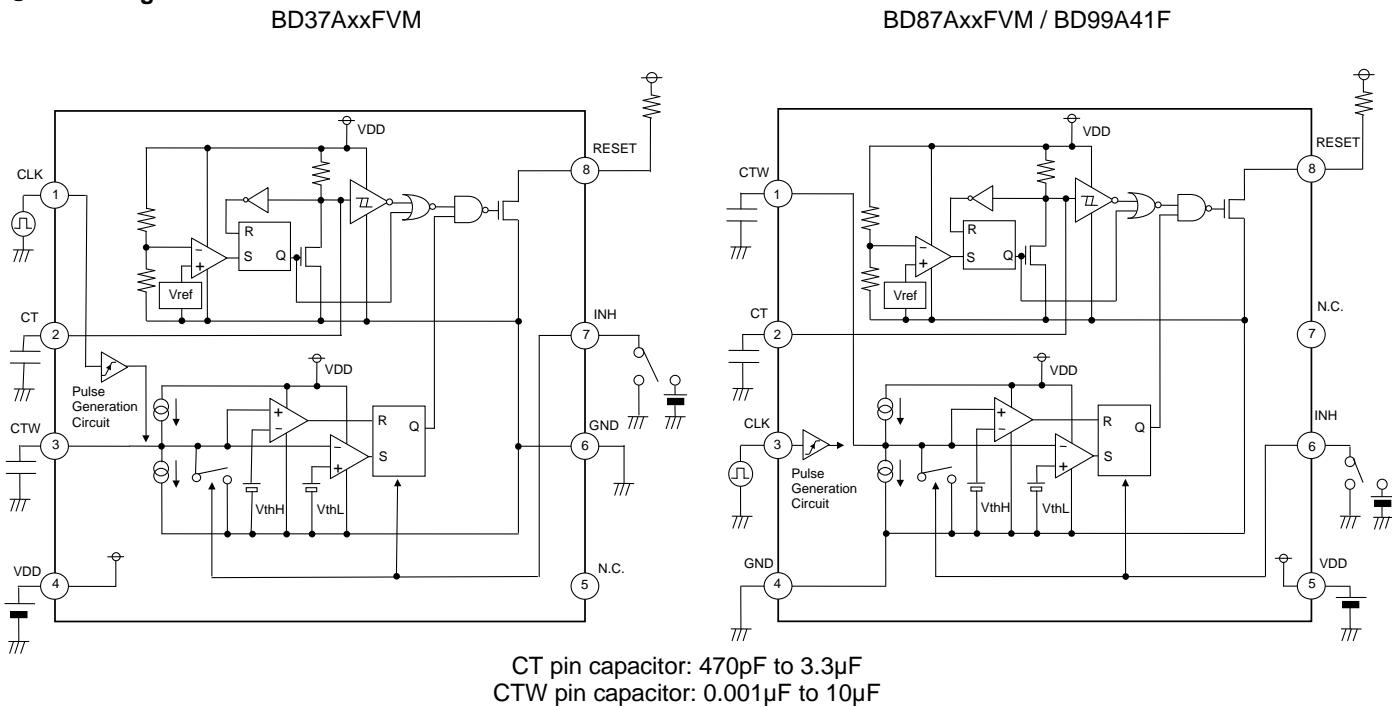


Figure 2. Block Diagrams

### ●Absolute Maximum Ratings (Ta=25°C)

| Parameter                          | Symbol | Ratings           | Unit |
|------------------------------------|--------|-------------------|------|
| Power supply voltage <sup>*1</sup> | VDD    | -0.3 to 10        | V    |
| CT pin voltage                     | VCT    | -0.3 to VDD + 0.3 | V    |
| CTW pin voltage                    | VCTW   | -0.3 to VDD + 0.3 | V    |
| RESET pin voltage                  | VRESET | -0.3 to VDD + 0.3 | V    |
| INH pin voltage                    | VINH   | -0.3 to VDD + 0.3 | V    |
| CLK pin voltage                    | VCLK   | -0.3 to VDD + 0.3 | V    |
| Power dissipation                  | Pd     | 470 <sup>*2</sup> | mW   |
|                                    |        | 550 <sup>*3</sup> |      |
| Operating ambient temperature      | Topr   | -40 to + 105      | °C   |
| Storage temperature                | Tstg   | -55 to + 125      | °C   |
| Maximum junction temperature       | Tjmax  | 125               | °C   |

\*1 Do not exceed Pd.

\*2 MSOP8 : Reduced by 4.70 mW/°C over 25°C, when mounted on a glass epoxy board (70 mm × 70 mm × 1.6 mm).

\*3 SOP8 : Reduced by 5.50 mW/°C over 25°C, when mounted on a glass epoxy board (70 mm × 70 mm × 1.6 mm).

### ●Recommended Operating Ratings (Ta = -40°C to 105°C)

| Parameter                  | Symbol    | Min. | Max. | Unit |
|----------------------------|-----------|------|------|------|
| RESET power supply voltage | VDD RESET | 1.0  | 10   | V    |
| WDT power supply voltage   | VDD WDT   | 2.5  | 10   | V    |

### ●Electrical Characteristics

(Unless otherwise specified, Ta = -40°C to 105°C, VDD = 5V)

Unless otherwise specified, Ta = -40°C to 105°C, VDD = 1.0V

| Parameter                                     | Symbol      | Limits |            |            | Unit       | Conditions                              |                     |
|---|-------------|--------|------------|------------|------------|---|---------------------|
|   |             | Min.   | Typ.       | Max.       |            |   |                     |
| [Overall]                                     |             |        |            |            |            |   |                     |
| Total supply current 1 (during WDT operation) | IDD1        | —      | 5          | 14         | μA         | INH : WDT ON Logic Input<br>CTW = 0.1μF |                     |
| Total supply current 2 (when WDT stopped)     | IDD2        | —      | 5          | 14         | μA         | INH : WDT OFF Logic Input               |                     |
| Output leak current                           | Ileak       | —      | —          | 1          | μA         | VDD = VDS = 10V                         |                     |
| Output current capacity                       | IOL         | 0.7    | —          | —          | mA         | VDD = 1.2V, VDS = 0.5V                  |                     |
| [RESET]                                       |             |        |            |            |            |   |                     |
| Detection voltage 1                           | 1.9V Detect | VDET1  | 1.871      | 1.900      | 1.929      | V                                       | Ta = 25°C           |
|   | 2.8V Detect | VDET1  | 2.758      | 2.800      | 2.842      | V                                       | Ta = 25°C           |
|   | 2.9V Detect | VDET1  | 2.886      | 2.930      | 2.974      | V                                       | Ta = 25°C           |
|   | 3.4V Detect | VDET1  | 3.349      | 3.400      | 3.451      | V                                       | Ta = 25°C           |
|   | 4.1V Detect | VDET1  | 4.039      | 4.100      | 4.162      | V                                       | Ta = 25°C           |
| Detection voltage 2                           | 1.9V Detect | VDET2  | 1.852      | 1.900      | 1.948      | V                                       | Ta = -40°C to 105°C |
|   | 2.8V Detect | VDET2  | 2.730      | 2.800      | 2.870      | V                                       | Ta = -40°C to 105°C |
|   | 2.9V Detect | VDET2  | 2.857      | 2.930      | 3.003      | V                                       | Ta = -40°C to 105°C |
|   | 3.4V Detect | VDET2  | 3.315      | 3.400      | 3.485      | V                                       | Ta = -40°C to 105°C |
|   | 4.1V Detect | VDET2  | 4.007      | 4.100      | 4.202      | V                                       | Ta = -40°C to 105°C |
| Hysteresis width                              | 1.9V Detect | Vrhys  | VDET×0.03  | VDET×0.13  | VDET×0.19  | V                                       | Ta=-40°C~105°C      |
|   | 2.8V Detect | Vrhys  | VDET×0.018 | VDET×0.045 | VDET×0.060 | V                                       | Ta=-40°C~105°C      |
|   | 2.9V Detect | Vrhys  | VDET×0.02  | VDET×0.05  | VDET×0.06  | V                                       | Ta=-40°C~105°C      |
|   | 3.4V Detect | Vrhys  | VDET×0.02  | VDET×0.05  | VDET×0.07  | V                                       | Ta=-40°C~105°C      |
|   | 4.1V Detect | Vrhys  | VDET×0.018 | VDET×0.035 | VDET×0.050 | V                                       | Ta=-40°C~105°C      |

## ●Electrical Characteristics - Continued

(Unless otherwise specified, Ta = -40°C to 105°C, VDD = 5V)

| Parameter                                 | Symbol | Limits    |          |           | Unit | Conditions  |
|---|--------|-----------|----------|-----------|------|---|
|   |        | Min.      | Typ.     | Max.      |      |   |
| RESET transmission delay time: low → high | TPLH   | 3.9       | 6.9      | 10.1      | ms   | CT = 0.001μF <sup>*1</sup><br>When VDD = VDET ±0.5V |
| Delay circuit resistance                  | Rrst   | 5.8       | 10.0     | 14.5      | MΩ   | VCT = GND   |
| Delay pin threshold voltage               | VCTH   | VDD×0.3   | VDD×0.45 | VDD×0.6   | V    | RL = 470KΩ  |
| Delay pin output current                  | ICT    | 150       | —        | —         | μA   | VDD = 1.50V, VCT = 0.5V                             |
| Min. operating voltage                    | VOPL   | 1.0       | —        | —         | V    | VOL ≤ 0.4V, RL = 470KΩ                              |
| [WDT]                                     |        |           |          |           |      |   |
| WDT monitor time                          | TwH    | 7.0       | 10.0     | 20.0      | ms   | CTW = 0.01μF <sup>*2</sup>                          |
| WDT reset time                            | TwL    | 2.4       | 3.3      | 7.0       | ms   | CTW = 0.01μF <sup>*3</sup>                          |
| Clock input pulse width                   | TWCLK  | 500       | —        | —         | ns   |   |
| CLK high threshold voltage                | VCLKH  | VDD × 0.8 | —        | VDD       | V    |   |
| CLK low threshold voltage                 | VCLKL  | 0         | —        | VDD × 0.3 | V    |   |
| INH high threshold voltage                | VINHH  | VDD × 0.8 | —        | VDD       | V    |   |
| INH low threshold voltage                 | VINHL  | 0         | —        | VDD × 0.3 | V    |   |
| CTW charge current                        | ICTWC  | 0.25      | 0.50     | 0.75      | μA   | VCTW = 0.2V   |
| CTW discharge current                     | ICTWO  | 0.75      | 1.50     | 2.00      | μA   | VCTW = 0.8V   |

\*1 TPLH can be varied by changing the CT capacitance value.  
 $TPLH(s) \approx 0.69 \times Rrst(M\Omega) \times CT(\mu F)$  Rrst = 10 MΩ(Typ.)

\*2 TwH can be varied by changing the CTW capacitance value.  
 $TwH(s) \approx (0.5 \times CTW(\mu F))/ICTWC(\mu A)$  ICTWC = 0.5 μA (Typ.)

\*3 TwL can be varied by changing the CTW capacitance value.  
 $TwL(s) \approx (0.5 \times CTW(\mu F))/ICTWO(\mu A)$  ICTWO = 1.5 μA (Typ.)

### ● Typical Performance Curves

(Unless otherwise specified,  $T_a = 25^\circ\text{C}$ ) : 4.1V Detection

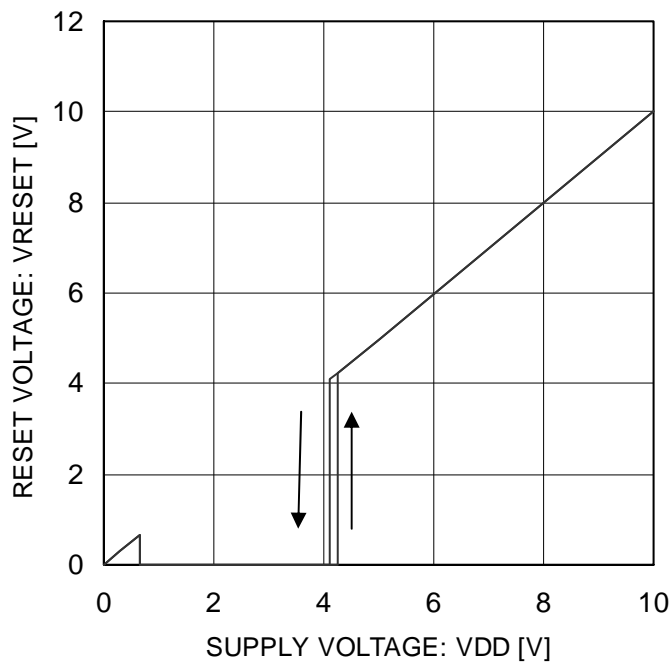


Figure 3. Detection Voltage

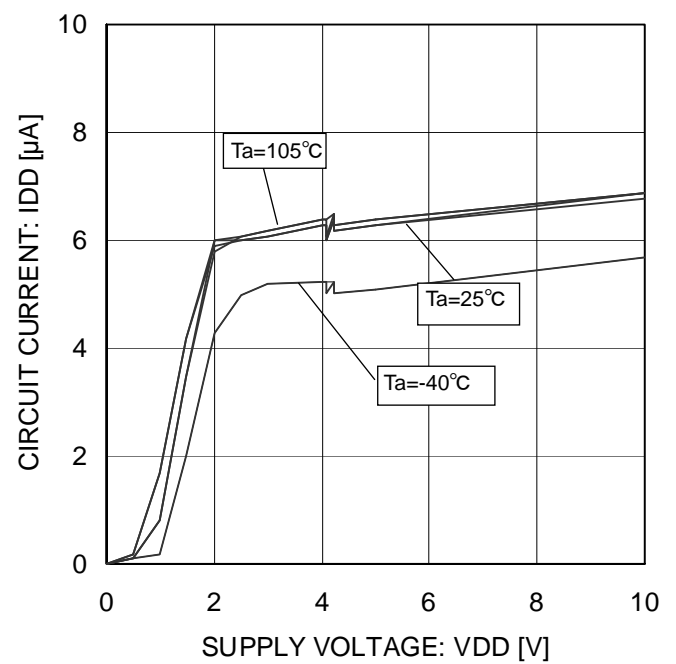


Figure 4. Total Supply Current

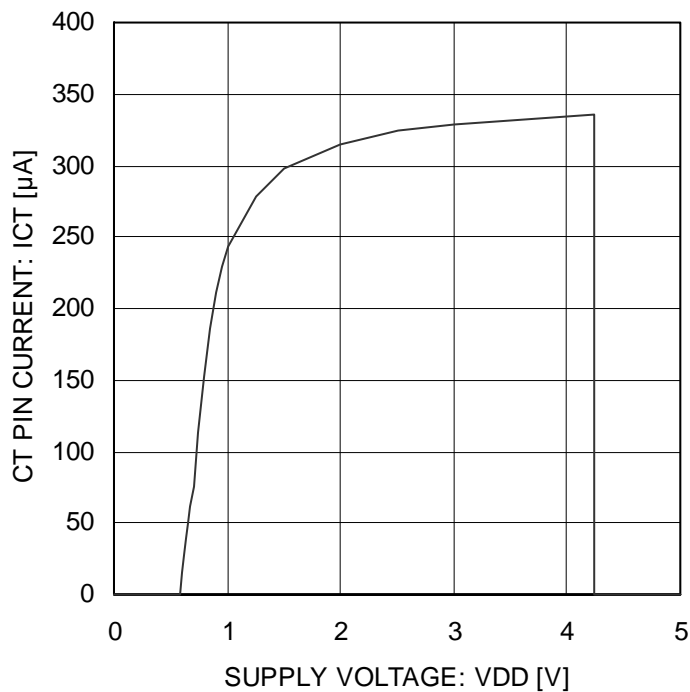


Figure 5. Delay Pin Current vs Power Supply Voltage

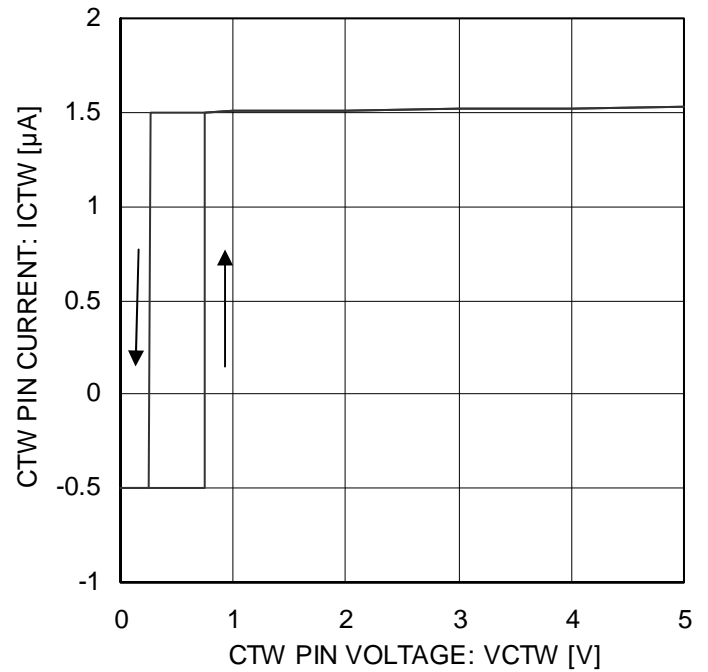


Figure 6. CTW Charge Discharge Current

# ● Typical Performance Curves – continued

(Unless otherwise specified,  $T_a = 25^\circ\text{C}$ ) : 4.1V Detection

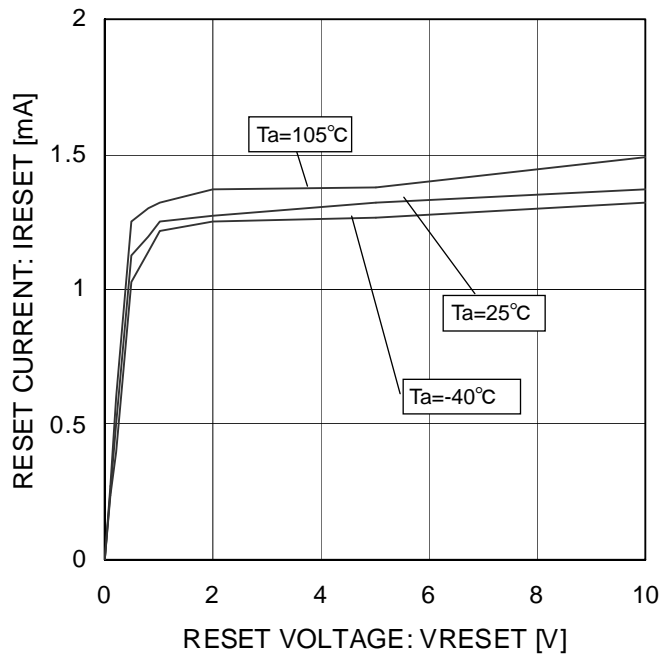


Figure 7. Output Current

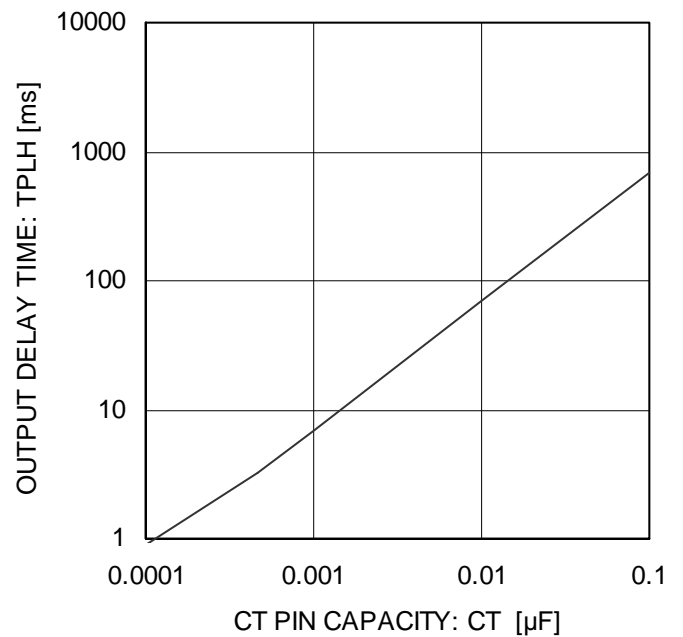


Figure 8. T RESET Transmission Delay Time vs Capacitance

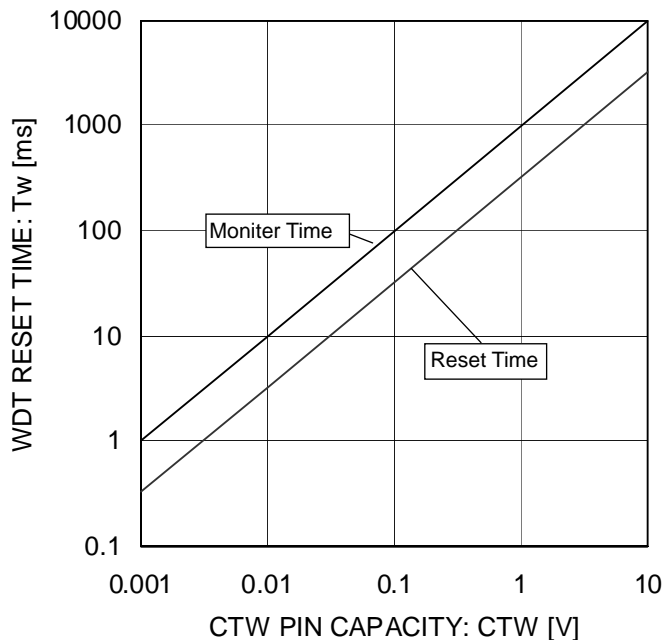


Figure 9. WDT Time vs Capacitance

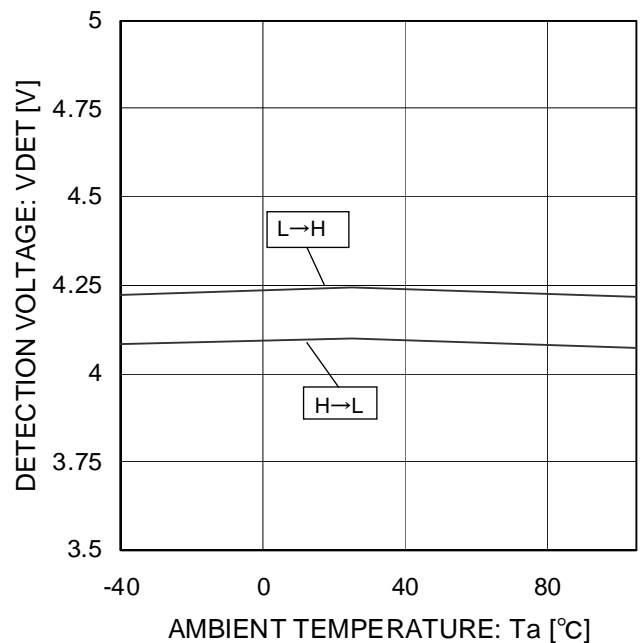


Figure 10. Detection Voltage vs Temperature

●Typical Performance Curves – continued  
(Unless otherwise specified, Ta = 25°C) : 4.1V Detection

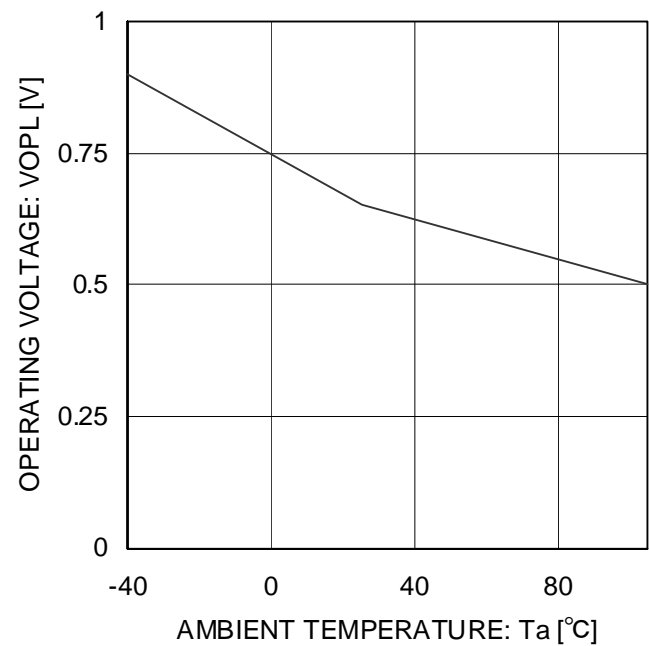


Figure 11. Operating Marginal Voltage vs Temperature

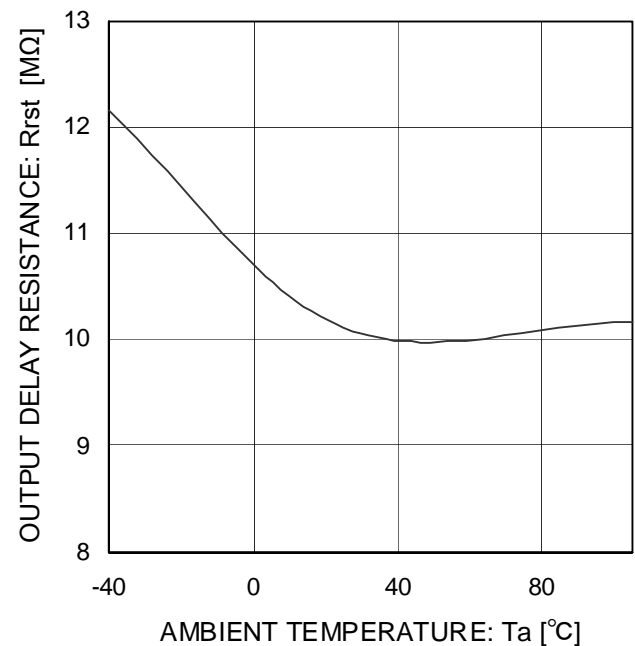


Figure 12. CT Pin Circuit Resistance vs Temperature

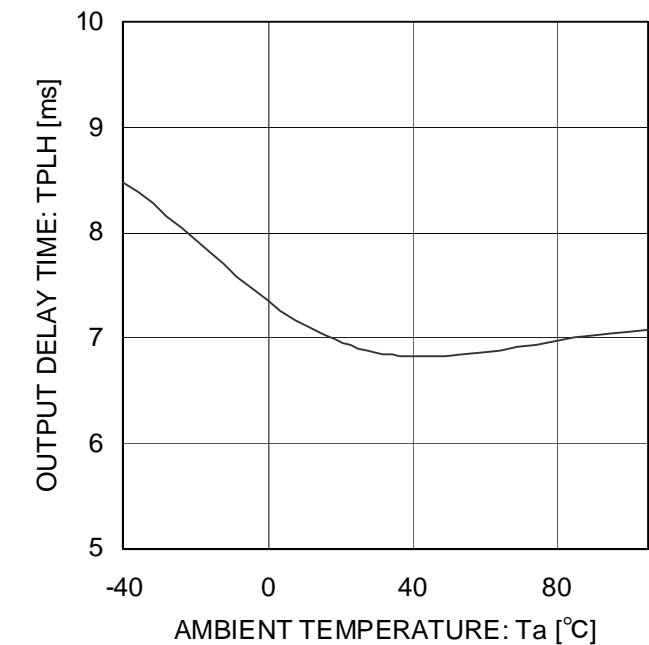


Figure 13. RESET Transmission Delay Time vs Temperature

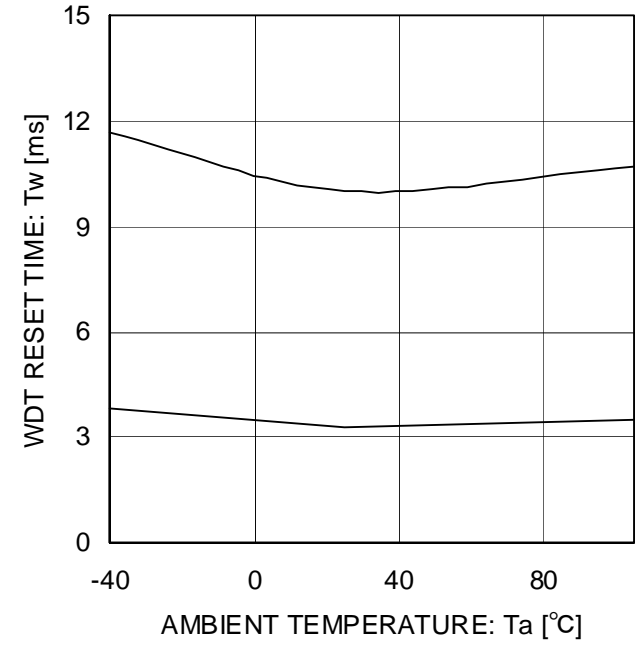


Figure 14. WDT Time vs Temperature

## ●Timing chart

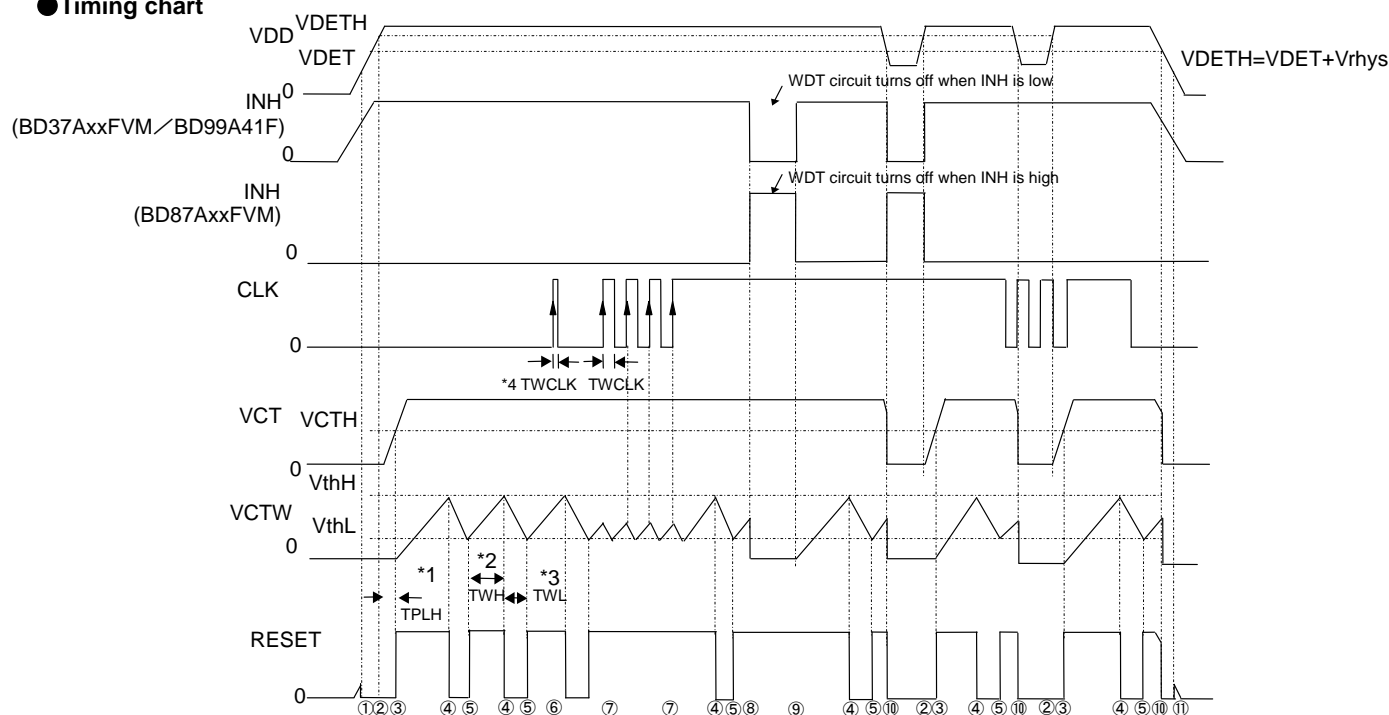


Figure 15. Timing Chart

## ●Explanation

- ① The RESET pin voltage (RESET) switches to low when the power supply voltage (VDD) falls to 0.8 V.
- ② The external capacitor connected to the CT pin begins to charge when VDD rises above the reset detection voltage (VDETH). The RESET signal stays low until VDD reaches the VDETH voltage and switches to high when VDD reaches or exceeds the VDETH voltage. The RESET transmission delay time TPLH allowed to elapse before RESET switches from low to high is given by the following equation:  

$$TPLH(s) \approx 0.69 \times R_{rst} \times CT(\mu F) \cdots [1]$$
 R<sub>rst</sub> denotes the IC's built-in resistance and is designed to be 10 MΩ (Typ.). CT denotes the external capacitor connected to the CT pin.
- ③ The external capacitor connected to the CTW pin begins to charge when RESET rises, triggering the watchdog timer.
- ④ The CTW pin state switches from charge to discharge when the CTW pin voltage (VCTW) reaches V<sub>thH</sub>, and RESET switches from high to low. The watchdog timer monitor time TWH is given by the following equation:  

$$TWH(s) \approx (0.5 \times CTW(\mu F)) / (ICTWC) \cdots [2]$$
 ICTWC denotes the CTW charge current and is designed to be 0.50 μA (Typ.). CTW denotes the external capacitor connected to the CTW pin.
- ⑤ The CTW pin state switches from charge to discharge when VCTW reaches V<sub>thL</sub>, and RESET switches from low to high. The watchdog timer reset time TWL is given by the following equation:  

$$TWL(s) \approx (0.5 \times CTW(\mu F)) / (ICTWO) \cdots [3]$$
 ICTWO denotes the CTW discharge current and is designed to be 1.50 μA (Typ.).
- ⑥ The CTW pin state may not switch from charge to discharge when the CLK input pulse width TWCLK is short. Use a TWCLK input pulse width of at least 500 ns.  

$$TWCLK \geq 500 \text{ ns (Min.)}$$
- ⑦ When a pulse (positive edge trigger) of at least 500 ns is input to the CLK pin while the CTW pin is charging, the CTW state switches from charge to discharge. Once it discharges to V<sub>thL</sub>, it will charge again.
- ⑧ Watchdog timer operation is forced off when the INH pin switches to low (L: BD37Axx Series, BD99A41F, H: BD87AxxSeries). At that time, only the watchdog timer is turned off. Reset detection is performed normally.
- ⑨ The watchdog timer function turns on when the INH pin switches to high(H: BD37Axx Series, BD99A41F, L: BD87AxxSeries). The external capacitor connected to the CTW pin begins to charge at that time.
- ⑩ RESET switches from high to low when VDD falls to the RESET detection voltage (VDET) or lower.
- ⑪ When VDD falls to 0 V, the RESET signal stays low until VDD reaches 0.8 V.



●Power Dissipation

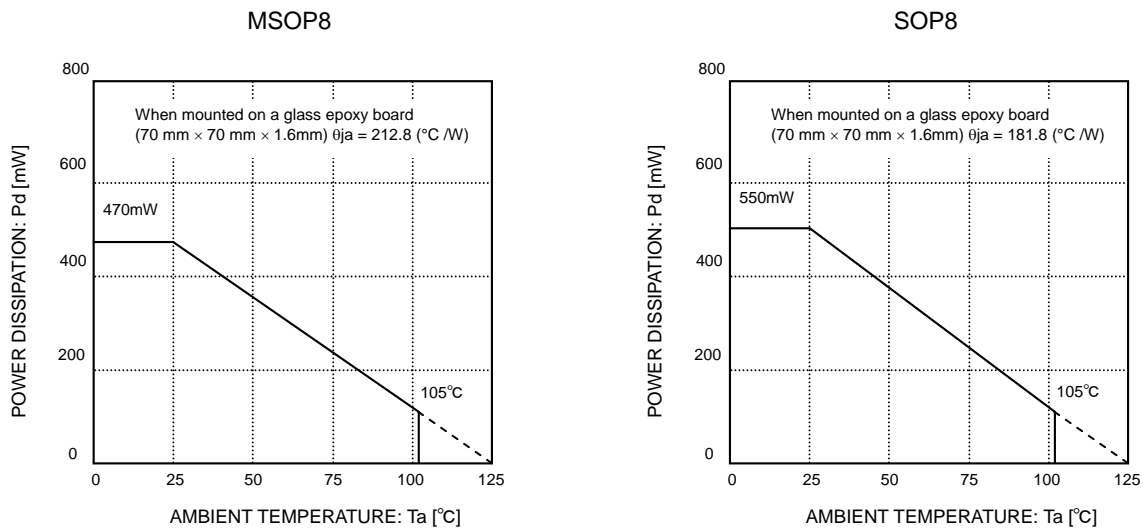


Figure 16. Power Dissipation

●I/O equivalence circuit

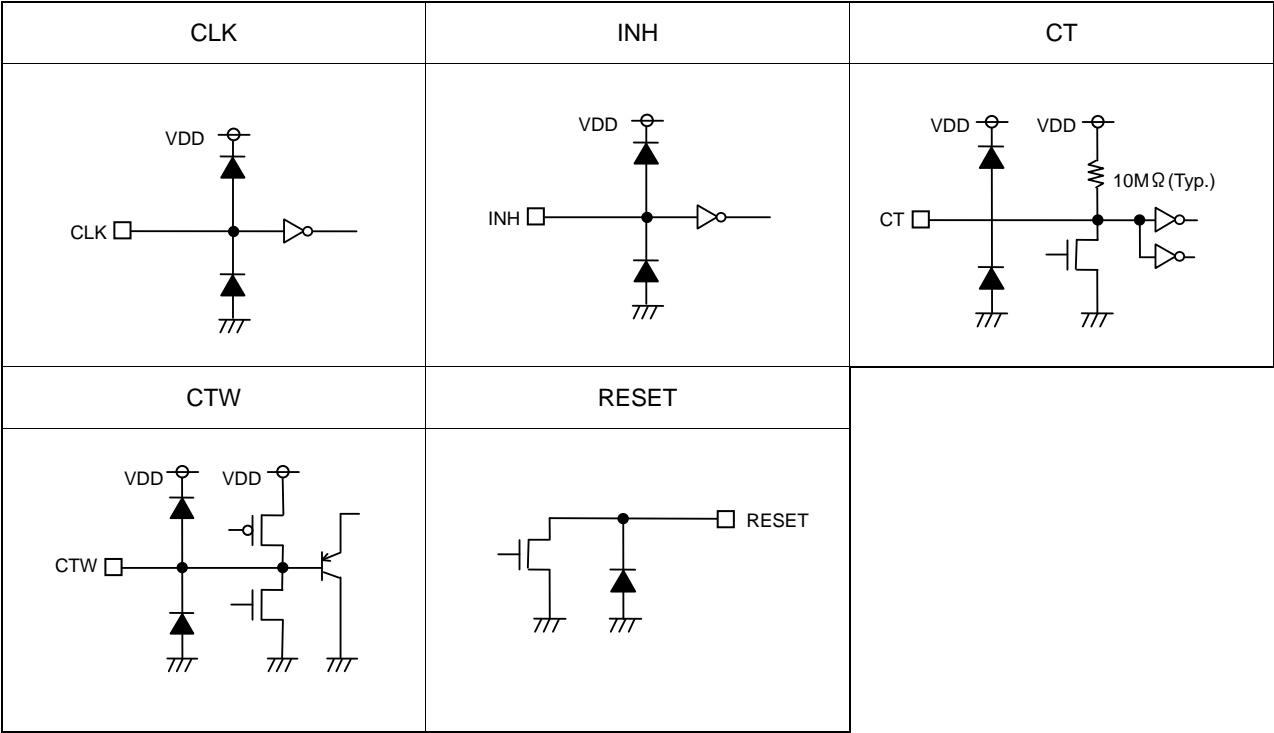


Figure 17. I/O equivalence circuit

### ●External settings for pins and precautions

- 1) Connect a capacitor (0.001  $\mu\text{F}$  to 1,000  $\mu\text{F}$ ) between the VDD and GND pins when the power line impedance is high. Use of the IC when the power line impedance is high may result in oscillation.
- 2) External capacitance  
A capacitor must be connected to the CTW pin. When using a large capacitor such as 1  $\mu\text{F}$ , the INH pin must allow a CTW discharge time of at least 2 ms. The power-on reset time is given by equation [1] on page 8. The WDT time is given by equations [2] and [3] on page 8. The setting times are proportional to the capacitance value from the equations, so the maximum and minimum setting times can be calculated from the electrical characteristics according to the capacitance. Note however that the electrical characteristics do not include the external capacitor's temperature characteristics.

### ●Operational Notes

- 1) Absolute maximum ratings  
An excess in the absolute maximum ratings, such as supply voltage, temperature range of operating conditions, etc., can break down the devices, thus making impossible to identify breaking mode, such as a short circuit or an open circuit. If any over rated values will expect to exceed the absolute maximum ratings, consider adding circuit protection devices, such as fuses.
- 2) GND voltage  
The potential of GND pin must be minimum potential in all operating conditions.
- 3) Thermal design  
Use a thermal design that allows for a sufficient margin in light of the power dissipation ( $P_d$ ) in actual operating conditions.
- 4) Inter-pin shorts and mounting errors  
Use caution when positioning the IC for mounting on printed circuit boards. The IC may be damaged if there is any connection error or if pins are shorted together.
- 5) Actions in strong electromagnetic field  
Use caution when using the IC in the presence of a strong electromagnetic field as doing so may cause the IC to malfunction.
- 6) Testing on application boards  
When testing the IC on an application board, connecting a capacitor to a pin with low impedance subjects the IC to stress. Always discharge capacitors after each process or step. Always turn the IC's power supply off before connecting it to or removing it from a jig or fixture during the inspection process. Ground the IC during assembly steps as an antistatic measure. Use similar precaution when transporting or storing the IC.
- 7) Regarding input pin of the IC  
This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P-N junctions are formed at the intersection of these P layers with the N layers of other elements, creating a parasitic diode or transistor. For example, the relation between each potential is as follows:  
○When  $\text{GND} > \text{Pin A}$  and  $\text{GND} > \text{Pin B}$ , the P-N junction operates as a parasitic diode.  
○When  $\text{GND} > \text{Pin B}$ , the P-N junction operates as a parasitic transistor.  
Parasitic diodes can occur inevitable in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Accordingly, methods by which parasitic diodes operate, such as applying a voltage that is lower than the GND (P substrate) voltage to an input pin, should not be used.

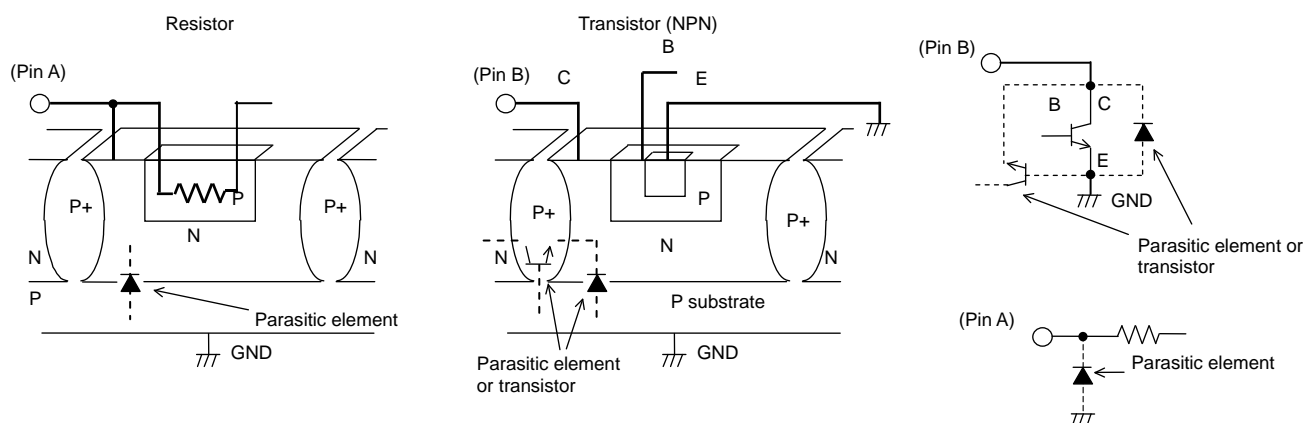


Figure 18. Example of IC structure

## 8) Ground Wiring Pattern

When using both small signal and large current GND patterns, it is recommended to isolate the two ground patterns, placing a single ground point at the ground potential of application so that the pattern wiring resistance and voltage variations caused by large currents do not cause variations in the small signal ground voltage. Be careful not to change the GND wiring pattern of any external components, either.

- 9) Applications or inspection processes with modes where the potentials of the VDD pin and other pins may be reversed from their normal states may cause damage to the IC's internal circuitry or elements. Use an output pin capacitance of 1000  $\mu$ F or lower in case VDD is shorted with the GND pin while the external capacitor is charged. It is recommended to insert a diode for preventing back current flow in series with VDD or bypass diodes between Vcc and each pin.

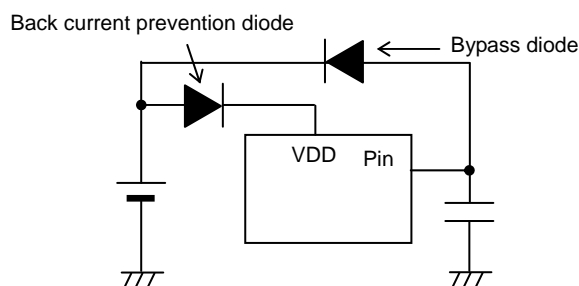


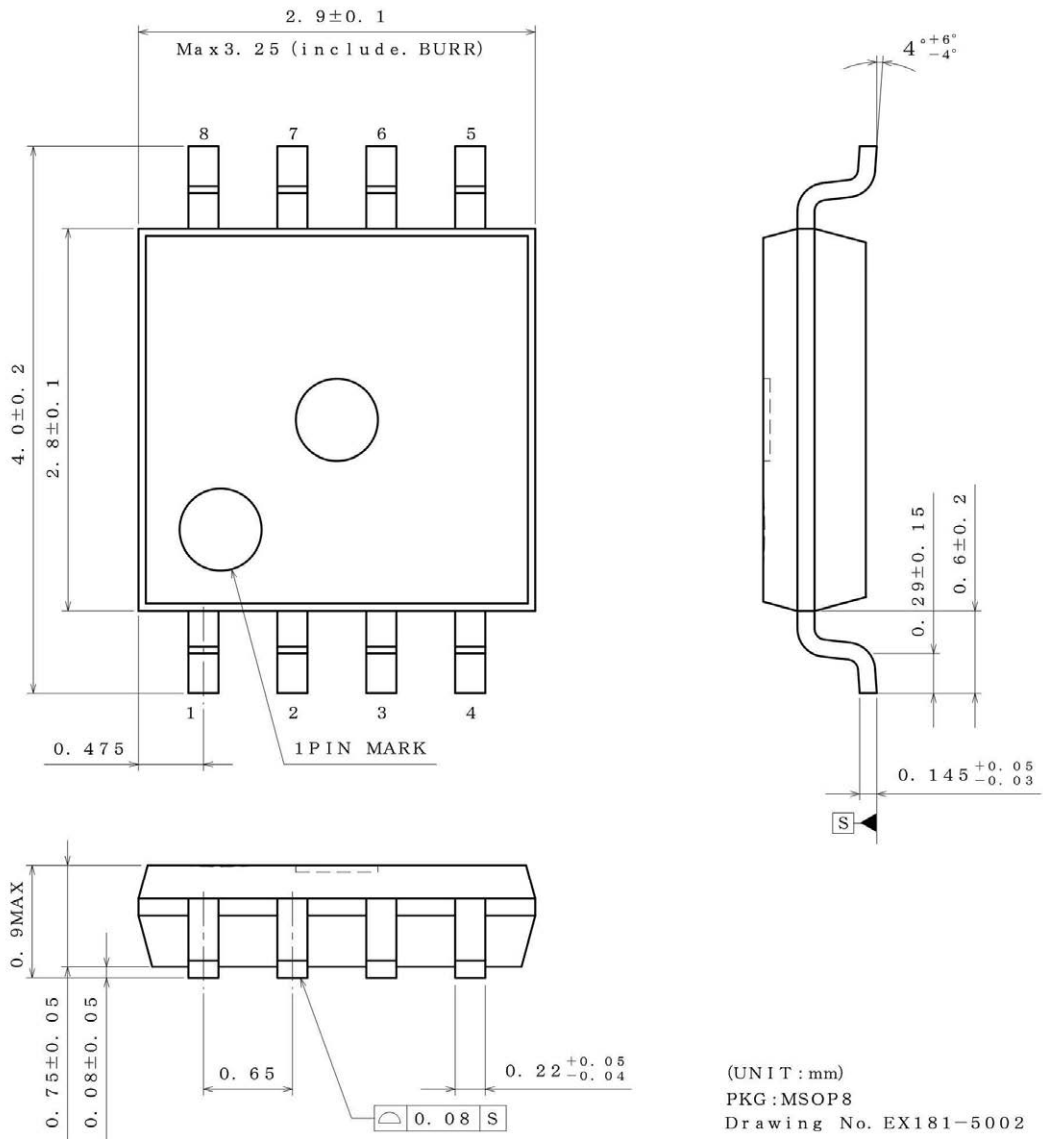
Figure 19.

- 10) When VDD falls below the operating marginal voltage, output will be open. When output is being pulled up to input, output will be equivalent to VDD.
- 11) Input pin  
The CLK and INH pins comprise inverter gates and should not be left open. (These pins should be either pulled up or down.) Input to the CLK pin is detected using a positive edge trigger and does not affect the CLK signal duty. Input the trigger to the CLK pin within the TWH time.

●Physical Dimension, Tape and Reel Information

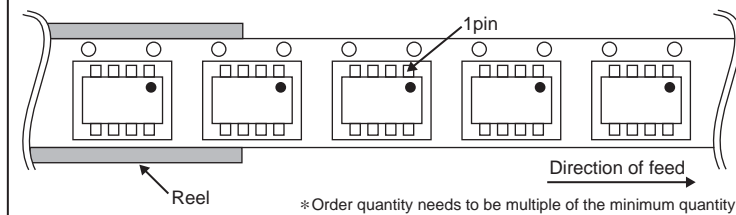
Package Name

MSOP8

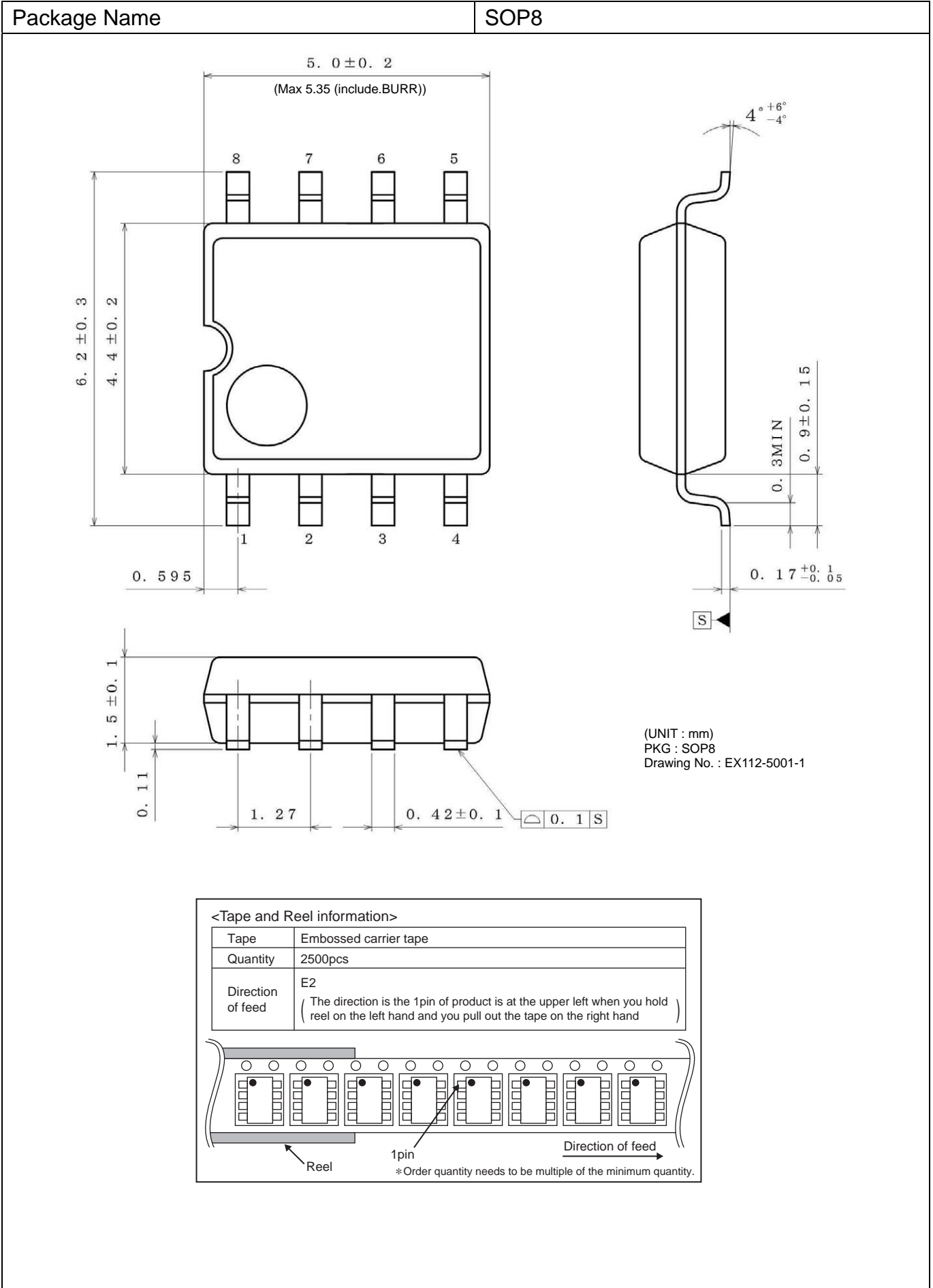


<Tape and Reel information>

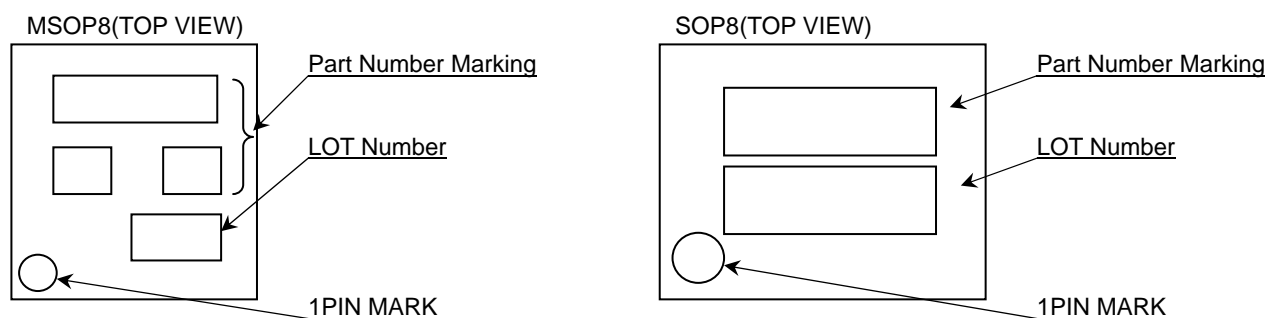
|                   |  |
|-------------------|--|
| Tape              | Embossed carrier tape  |
| Quantity          | 3000pcs  |
| Direction of feed | TR<br>(The direction is the 1pin of product is at the upper right when you hold reel on the left hand and you pull out the tape on the right hand) |



●Physical Dimension, Tape and Reel Information – continued



## ● Marking Diagrams



| Part Number Marking | Package |              | Part Number   |
|---------------------|---------|--------------|---------------|
| D3719               | MSOP8   | Reel of 3000 | BD37A19FVM-TR |
| D3741               | MSOP8   | Reel of 3000 | BD37A41FVM-TR |
| D8728               | MSOP8   | Reel of 3000 | BD87A28FVM-TR |
| D8729               | MSOP8   | Reel of 3000 | BD87A29FVM-TR |
| D8734               | MSOP8   | Reel of 3000 | BD87A34FVM-TR |
| D8741               | MSOP8   | Reel of 3000 | BD87A41FVM-TR |
| 99A41               | SOP8    | Reel of 2500 | BD99A41F-E2   |

## ●Revision History

| Date        | Revision | Changes  |
|-------------|----------|--|
| 12.Apr.2013 | 001      | New Release  |
| 25.Apr.2013 | 002      | P.8 Explanation ⑨ modified.<br>P.9 Figure 17. I/O equivalence circuit the error in writing of the part of CLK was corrected. |

# Notice

## ●General Precaution

- 1) Before you use our Products, you are requested to carefully read this document and fully understand its contents. ROHM shall not be in any way responsible or liable for failure, malfunction or accident arising from the use of any ROHM's Products against warning, caution or note contained in this document.
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## ●Precaution on using ROHM Products

- 1) Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment, transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.
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  - [a] Installation of protection circuits or other protective devices to improve system safety
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  - [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
  - [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
  - [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
  - [f] Sealing or coating our Products with resin or other coating materials
  - [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
  - [h] Use of the Products in places subject to dew condensation
- 4) The Products are not subject to radiation-proof design.
- 5) Please verify and confirm characteristics of the final or mounted products in using the Products.
- 6) In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse) is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.
- 7) De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.
- 8) Confirm that operation temperature is within the specified range described in the product specification.
- 9) ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.



### ●Precaution for Mounting / Circuit board design

- 1) When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.
- 2) In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

### ●Precautions Regarding Application Examples and External Circuits

- 1) If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.
- 2) You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

### ●Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

### ●Precaution for Storage / Transportation

- 1) Product performance and soldered connections may deteriorate if the Products are stored in the places where:
  - [a] the Products are exposed to sea winds or corrosive gases, including Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - [b] the temperature or humidity exceeds those recommended by ROHM
  - [c] the Products are exposed to direct sunshine or condensation
  - [d] the Products are exposed to high Electrostatic
- 2) Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.
- 3) Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.
- 4) Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

### ●Precaution for Product Label

QR code printed on ROHM Products label is for ROHM's internal use only.

### ●Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

### ●Precaution for Foreign Exchange and Foreign Trade act

Since our Products might fall under controlled goods prescribed by the applicable foreign exchange and foreign trade act, please consult with ROHM representative in case of export.

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