

Voltage Detector IC Series

# Standard CMOS Voltage Detector IC



**BD48xxx series    BD49xxx series**

● **General Description**

ROHM's BD48xxx and BD49xxx series are highly accurate, low current consumption reset IC series. The lineup was established with two output types (Nch open drain and CMOS output) and detection voltages range from 2.3V to 6.0V in increments of 0.1V, so that the series may be selected according the application at hand.

● **Features**

- High accuracy detection
- Ultra-low current consumption
- Two output types (Nch open drain and CMOS output)
- Wide Operating temperature range
- Very small and low height package

● **Key Specifications**

- Detection voltage: 2.3V to 6.0V (Typ.), 0.1V steps
- High accuracy detection voltage: ±1.0%
- Ultra-low current consumption: 0.9µA (Typ.)
- Operating temperature range: -40°C to +105°C

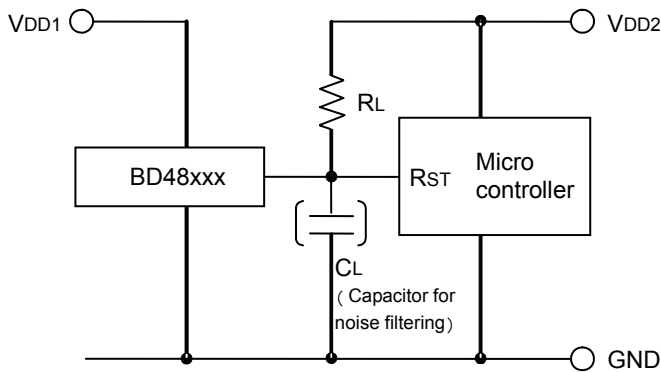
● **Package**

- SSOP5: 2.90mm x 2.80mm x 1.15mm
- VSO5: 1.60 mm x 1.60mm x 0.60mm

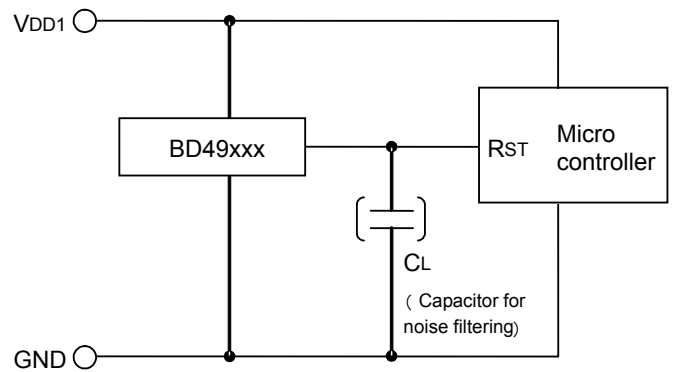
● **Applications**

All electronic devices that use micro controllers and logic circuit.

● **Typical Application Circuit**



(Open Drain Output type)  
BD48xxx series

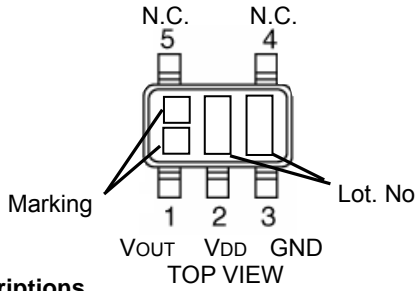


(CMOS Output type)  
BD49xxx series

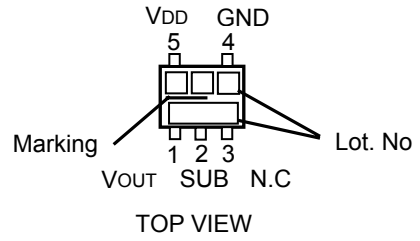
○Product structure : Silicon monolithic integrated circuit    ○This product is not designed protection against radioactive rays.

● Connection Diagram

SSOP5



VSO5



● Pin Descriptions

SSOP5		
PIN No.	Symbol	Function
1	VOUT	Reset Output
2	VDD	Power Supply Voltage
3	GND	GND
4	N.C.	Unconnected Terminal
5	N.C.	Unconnected Terminal

VSO5		
PIN No.	Symbol	Function
1	VOUT	Reset Output
2	SUB	Substrate*
3	N.C.	Unconnected Terminal
4	GND	GND
5	VDD	Power Supply Voltage

\*Connect the substrate to GND.

● Ordering Information

**B D 4 8**

Standard CMOS Reset IC  
BD48: Open Drain Type  
BD49: CMOS Output Type

**E**

Package 1  
Blank : SSOP5  
VSO5  
E : SSOP5

**2 3**

Reset Voltage Value  
23 : 2.3V to  
(0.1V step)  
60 : 6.0V

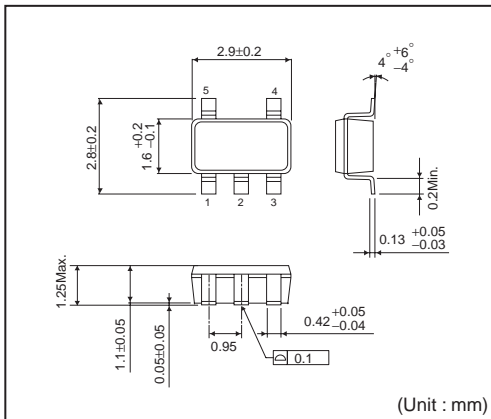
**G**

Package 2  
G : SSOP5  
FVE:VSO5

**TR**

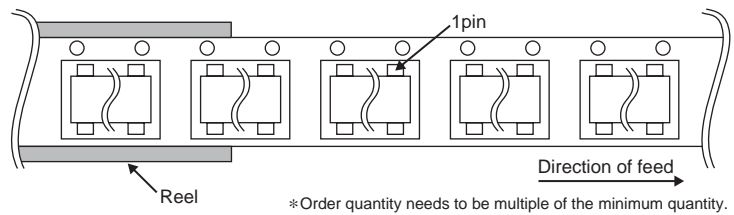
Packaging and forming specification  
TR: Embossed tape and reel

SSOP5



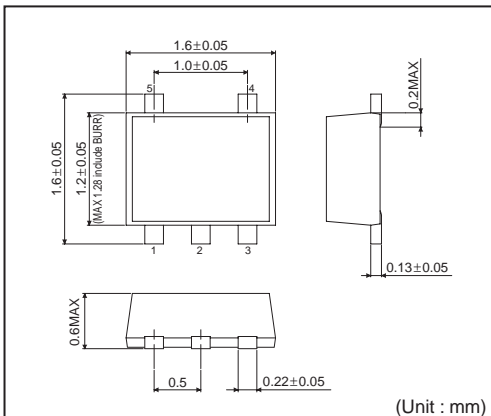
<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	3000pcs
Direction of feed	TR (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)



\*Order quantity needs to be multiple of the minimum quantity.

VSO5



## ●Lineup

Marking	Detection Voltage	Part Number	Marking	Detection Voltage	Part Number	Marking	Detection Voltage	Part Number	Marking	Detection Voltage	Part Number
EW	6.0V	BD4860	EB	4.1V	BD4841	GW	6.0V	BD4960	GB	4.1V	BD4941
EV	5.9V	BD4859	EA	4.0V	BD4840	GV	5.9V	BD4959	GA	4.0V	BD4940
EU	5.8V	BD4858	DV	3.9V	BD4839	GU	5.8V	BD4958	FV	3.9V	BD4939
ET	5.7V	BD4857	DU	3.8V	BD4838	GT	5.7V	BD4957	FU	3.8V	BD4938
ES	5.6V	BD4856	DT	3.7V	BD4837	GS	5.6V	BD4956	FT	3.7V	BD4937
ER	5.5V	BD4855	DS	3.6V	BD4836	GR	5.5V	BD4955	FS	3.6V	BD4936
EQ	5.4V	BD4854	DR	3.5V	BD4835	GQ	5.4V	BD4954	FR	3.5V	BD4935
EP	5.3V	BD4853	DQ	3.4V	BD4834	GP	5.3V	BD4953	FQ	3.4V	BD4934
EN	5.2V	BD4852	DP	3.3V	BD4833	GN	5.2V	BD4952	FP	3.3V	BD4933
EM	5.1V	BD4851	DN	3.2V	BD4832	GM	5.1V	BD4951	FN	3.2V	BD4932
EL	5.0V	BD4850	DM	3.1V	BD4831	GL	5.0V	BD4950	FM	3.1V	BD4931
EK	4.9V	BD4849	DL	3.0V	BD4830	GK	4.9V	BD4949	FL	3.0V	BD4930
EJ	4.8V	BD4848	DK	2.9V	BD4829	GJ	4.8V	BD4948	FK	2.9V	BD4929
EH	4.7V	BD4847	DJ	2.8V	BD4828	GH	4.7V	BD4947	FJ	2.8V	BD4928
EG	4.6V	BD4846	DH	2.7V	BD4827	GG	4.6V	BD4946	FH	2.7V	BD4927
EF	4.5V	BD4845	DG	2.6V	BD4826	GF	4.5V	BD4945	FG	2.6V	BD4926
EE	4.4V	BD4844	DF	2.5V	BD4825	GE	4.4V	BD4944	FF	2.5V	BD4925
ED	4.3V	BD4843	DE	2.4V	BD4824	GD	4.3V	BD4943	FE	2.4V	BD4924
EC	4.2V	BD4842	DD	2.3V	BD4823	GC	4.2V	BD4942	FD	2.3V	BD4923

Marking	Detection Voltage	Part Number	Marking	Detection Voltage	Part Number	Marking	Detection Voltage	Part Number	Marking	Detection Voltage	Part Number
Cm	6.0V	BD48E60	Be	4.1V	BD48E41	Ff	6.0V	BD49E60	Ea	4.1V	BD49E41
Ck	5.9V	BD48E59	Bd	4.0V	BD48E40	Fe	5.9V	BD49E59	Dy	4.0V	BD49E40
Ch	5.8V	BD48E58	Bc	3.9V	BD48E39	Fd	5.8V	BD49E58	Dr	3.9V	BD49E39
Cg	5.7V	BD48E57	Bb	3.8V	BD48E38	Fc	5.7V	BD49E57	Dp	3.8V	BD49E38
Cf	5.6V	BD48E56	Ba	3.7V	BD48E37	Fb	5.6V	BD49E56	Dn	3.7V	BD49E37
Ce	5.5V	BD48E55	Ay	3.6V	BD48E36	Fa	5.5V	BD49E55	Dm	3.6V	BD49E36
Cd	5.4V	BD48E54	Ar	3.5V	BD48E35	Ey	5.4V	BD49E54	Dk	3.5V	BD49E35
Cc	5.3V	BD48E53	Ap	3.4V	BD48E34	Er	5.3V	BD49E53	Dh	3.4V	BD49E34
Cb	5.2V	BD48E52	An	3.3V	BD48E33	Ep	5.2V	BD49E52	Dg	3.3V	BD49E33
Ca	5.1V	BD48E51	Am	3.2V	BD48E32	En	5.1V	BD49E51	Df	3.2V	BD49E32
By	5.0V	BD48E50	Ak	3.1V	BD48E31	Em	5.0V	BD49E50	De	3.1V	BD49E31
Br	4.9V	BD48E49	Ah	3.0V	BD48E30	Ek	4.9V	BD49E49	Dd	3.0V	BD49E30
Bp	4.8V	BD48E48	Ag	2.9V	BD48E29	Eh	4.8V	BD49E48	Dc	2.9V	BD49E29
Bn	4.7V	BD48E47	Af	2.8V	BD48E28	Eg	4.7V	BD49E47	Db	2.8V	BD49E28
Bm	4.6V	BD48E46	Ae	2.7V	BD48E27	Ef	4.6V	BD49E46	Da	2.7V	BD49E27
Bk	4.5V	BD48E45	Ad	2.6V	BD48E26	Ee	4.5V	BD49E45	Cy	2.6V	BD49E26
Bh	4.4V	BD48E44	Ac	2.5V	BD48E25	Ed	4.4V	BD49E44	Cr	2.5V	BD49E25
Bg	4.3V	BD48E43	Ab	2.4V	BD48E24	Ec	4.3V	BD49E43	Cp	2.4V	BD49E24
Bf	4.2V	BD48E42	Aa	2.3V	BD48E23	Eb	4.2V	BD49E42	Cn	2.3V	BD49E23

●Absolute Maximum Ratings (Ta=25°C)

Parameter		Symbol	Limits	Unit
Power Supply Voltage		V <sub>DD-GND</sub>	-0.3 to +10	V
Output Voltage	Nch Open Drain Output	V <sub>OUT</sub>	GND-0.3 to +10	V
	CMOS Output		GND-0.3 to V <sub>DD</sub> +0.3	
Power	SSOP5 <sup>*1*3</sup>	Pd	540	mW
Dissipation	VSO5 <sup>*2*3</sup>		210	
Operating Temperature		Topr	-40 to +105	°C
Ambient Storage Temperature		Tstg	-55 to +125	°C

\*1 Use above Ta=25°C results in a 5.4mW loss per degree.

\*2 Use above Ta=25°C results in a 2.1mW loss per degree.

\*3 When a ROHM standard circuit board (70mm×70mm×1.6mm glass epoxy board) is mounted.

●Electrical Characteristics (Unless Otherwise Specified Ta=-40 to 105°C)

Parameter	Symbol	Condition	Limit			Unit	
			Min.	Typ.	Max.		
Detection Voltage	V <sub>DET</sub>	R <sub>L</sub> =470kΩ, V <sub>DD</sub> =H→L <sup>*1</sup>	V <sub>DET</sub> (T) ×0.99	V <sub>DET</sub> (T)	V <sub>DET</sub> (T) ×1.01	V	
Output Delay Time "L→H"	t <sub>PLH</sub>	C <sub>L</sub> =100pF R <sub>L</sub> =100kΩ V <sub>out</sub> =GND→50% <sup>*2</sup>	-	-	100	μs	
Circuit Current when ON	I <sub>CC1</sub>	V <sub>DD</sub> =V <sub>DET</sub> -0.2V <sup>*1</sup>	V <sub>DET</sub> =2.3-3.1V	-	0.51	1.53	μA
			V <sub>DET</sub> =3.2-4.2V	-	0.56	1.68	
			V <sub>DET</sub> =4.3-5.2V	-	0.60	1.80	
			V <sub>DET</sub> =5.3-6.0V	-	0.66	1.98	
Circuit Current when OFF	I <sub>CC2</sub>	V <sub>DD</sub> =V <sub>DET</sub> +2.0V <sup>*1</sup>	V <sub>DET</sub> =2.3-3.1V	-	0.75	2.25	μA
			V <sub>DET</sub> =3.2-4.2V	-	0.80	2.40	
			V <sub>DET</sub> =4.3-5.2V	-	0.85	2.55	
			V <sub>DET</sub> =5.3-6.0V	-	0.90	2.70	
Operating Voltage Range	V <sub>OPL</sub>	V <sub>OL</sub> ≤0.4V, Ta=25 to 105°C, R <sub>L</sub> =470kΩ	0.95	-	-	V	
		V <sub>OL</sub> ≤0.4V, Ta=-40 to 25°C, R <sub>L</sub> =470kΩ	1.20	-	-		
'Low' Output Current (Nch)	I <sub>OL</sub>	V <sub>DS</sub> =0.5V, V <sub>DD</sub> =1.5V, V <sub>DET</sub> =2.3-6.0V	0.4	1.0	-	mA	
		V <sub>DS</sub> =0.5V, V <sub>DD</sub> =2.4V, V <sub>DET</sub> =2.7-6.0V	2.0	4.0	-		
'High' Output Current (Pch) (BD49xxx Series)	I <sub>OH</sub>	V <sub>DS</sub> =0.5V, V <sub>DD</sub> =4.8V, V <sub>DET</sub> =2.3-4.2V	0.7	1.4	-	mA	
		V <sub>DS</sub> =0.5V, V <sub>DD</sub> =6.0V, V <sub>DET</sub> =4.3-5.2V	0.9	1.8	-		
		V <sub>DS</sub> =0.5V, V <sub>DD</sub> =8.0V, V <sub>DET</sub> =5.3-6.0V	1.1	2.2	-		
Leak Current when OFF (BD48xxx Series)	I <sub>leak</sub>	V <sub>DD</sub> =V <sub>DS</sub> =10V <sup>*1</sup>	-	-	0.1	μA	
Detection Voltage Temperature coefficient	V <sub>DET</sub> /ΔT	Ta=-40°C to 105°C (Designed Guarantee)	-	±100	±360	ppm/°C	
Hysteresis Voltage	ΔV <sub>DET</sub>	V <sub>DD</sub> =L→H→L	V <sub>DET</sub> ×0.03	V <sub>DET</sub> ×0.05	V <sub>DET</sub> ×0.08	V	

V<sub>DET</sub>(T): Standard Detection Voltage(2.3V to 6.0V, 0.1V step)

R<sub>L</sub>: Pull-up resistor to be connected between V<sub>OUT</sub> and power supply.

C<sub>L</sub>: Capacitor to be connected between V<sub>OUT</sub> and GND.

Designed Guarantee. (Outgoing inspection is not done on all products.)

\*1 Guarantee is Ta=25°C.

\*2 t<sub>PLH</sub>:V<sub>DD</sub>=(V<sub>DET</sub> typ.-0.5V)→(V<sub>DET</sub> typ.+0.5V)

●Block Diagrams

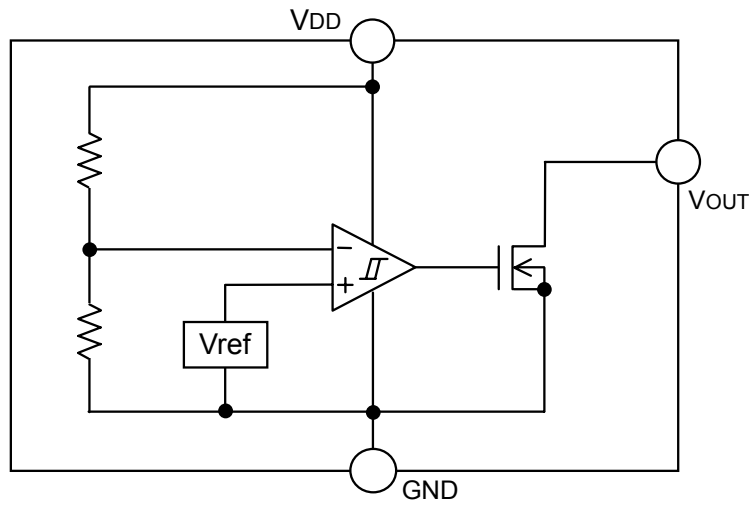


Fig.1 BD48xxx series

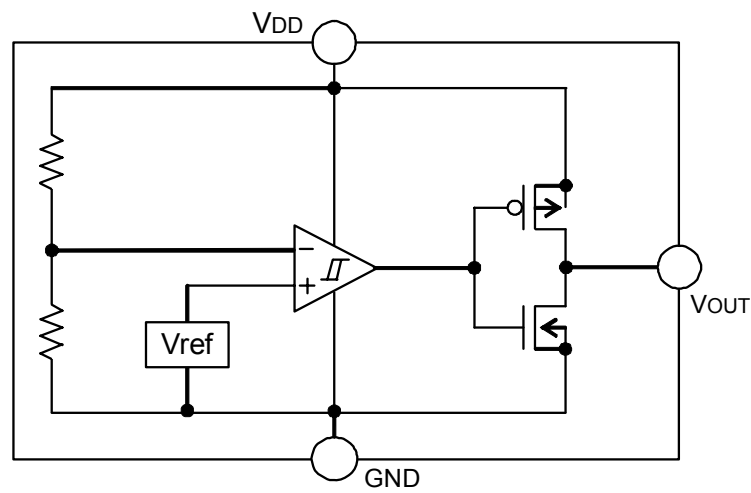


Fig.2 BD49xxx series

● Typical Performance Curves

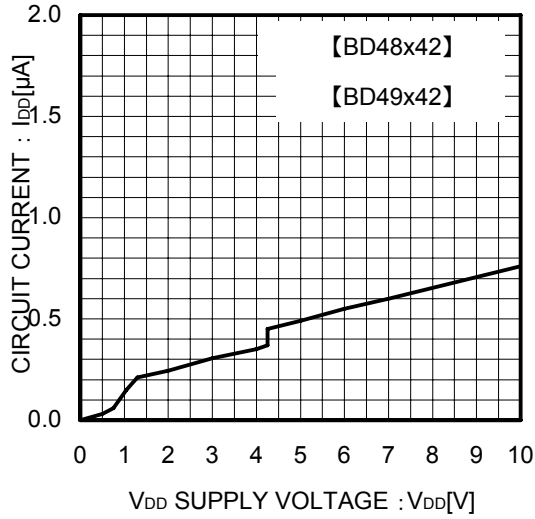


Fig.3 Circuit Current

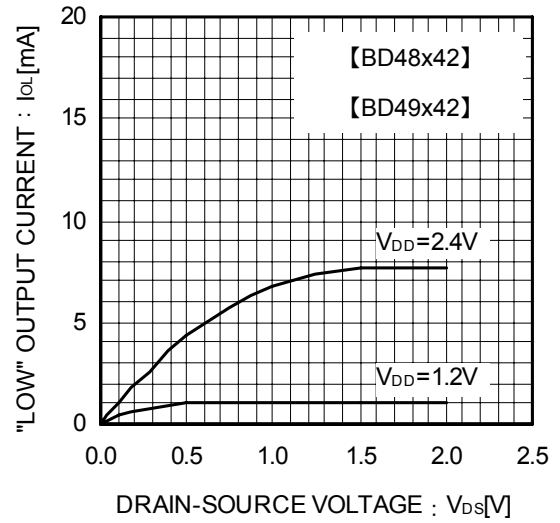


Fig.4 "Low" Output Current

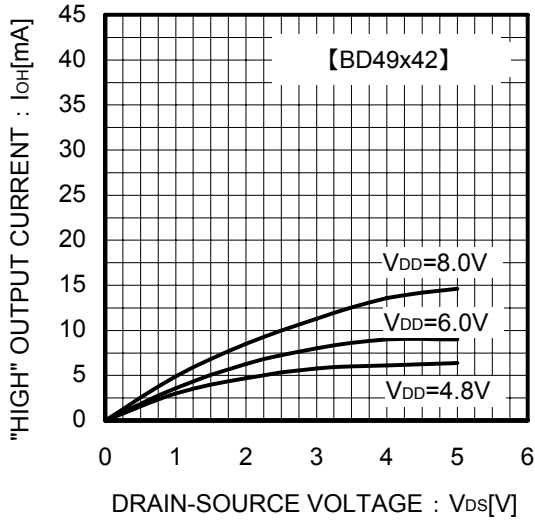


Fig.5 "High" Output Current

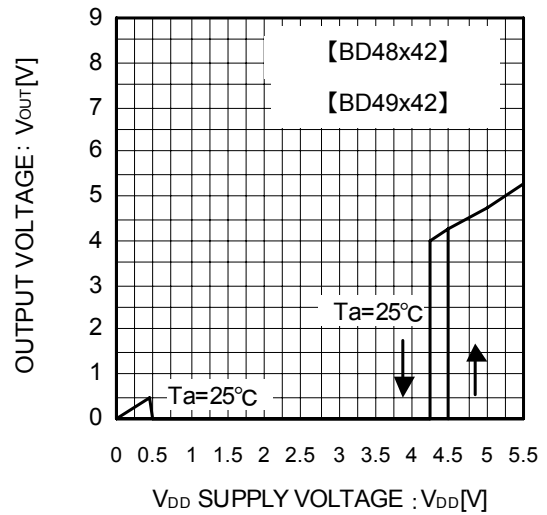


Fig.6 I/O Characteristics

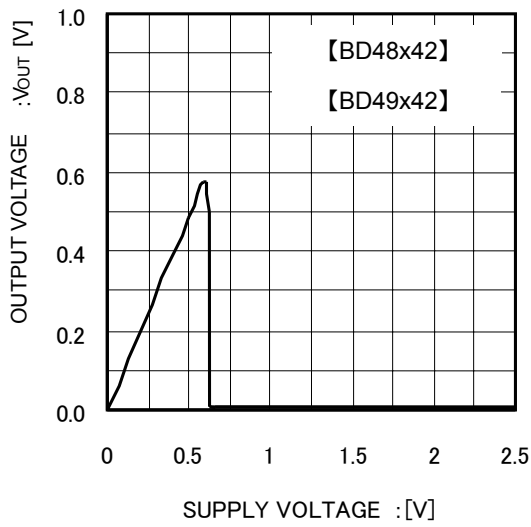


Fig.7 Operating Limit Voltage

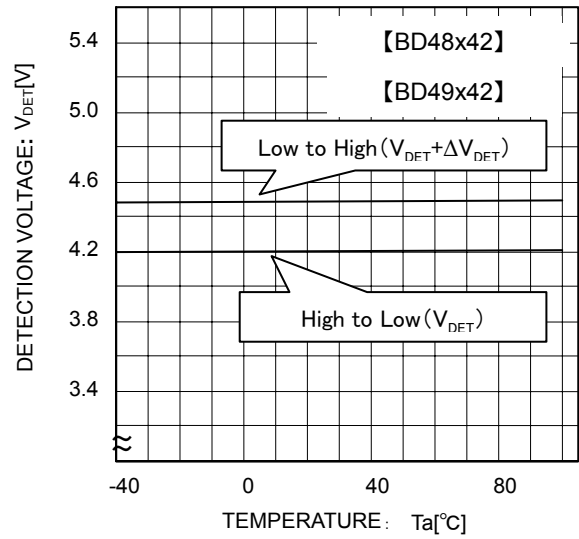


Fig.8 Detection Voltage Release Voltage

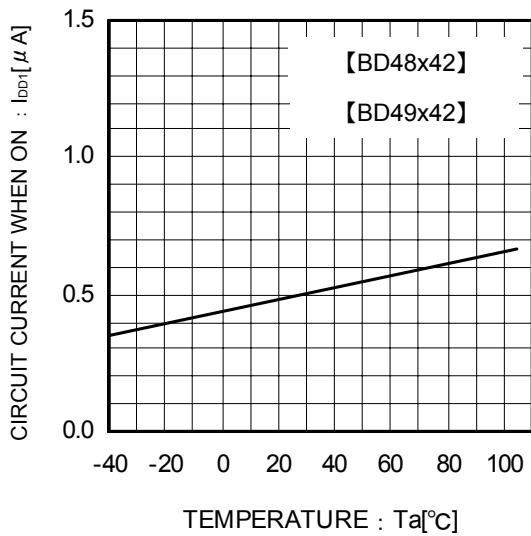


Fig.9 Circuit Current when ON

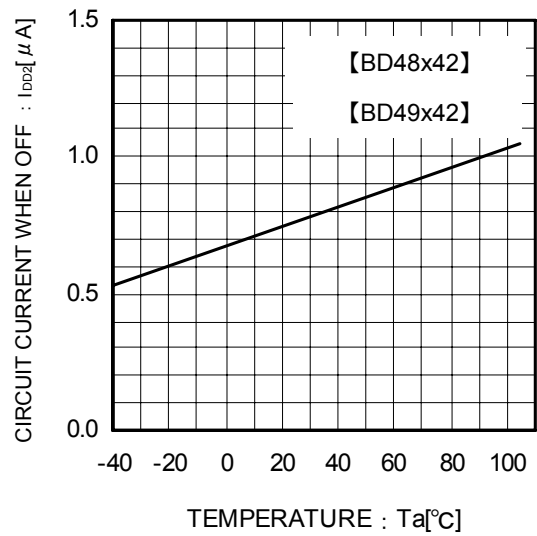


Fig.10 Circuit Current when OFF

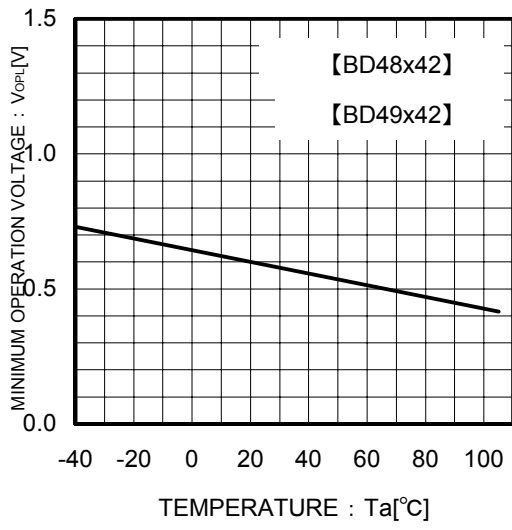


Fig.11 Operating Limit Voltage

● Application Information

Explanation of Operation

For both the open drain type (Fig.12) and the CMOS output type (Fig.13), the detection and release voltages are used as threshold voltages. When the voltage applied to the  $V_{DD}$  pins reaches the applicable threshold voltage, the  $V_{OUT}$  terminal voltage switches from either “High” to “Low” or from “Low” to “High”. Because the BD48xxx series uses an open drain output type, it is possible to connect a pull-up resistor to  $V_{DD}$  or another power supply [The output “High” voltage ( $V_{OUT}$ ) in this case becomes  $V_{DD}$  or the voltage of the other power supply].

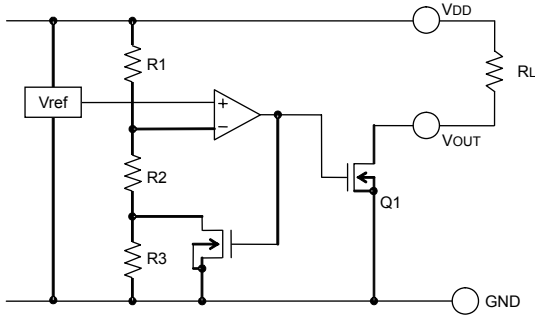


Fig.12 (BD48xxx series Internal Block Diagram)

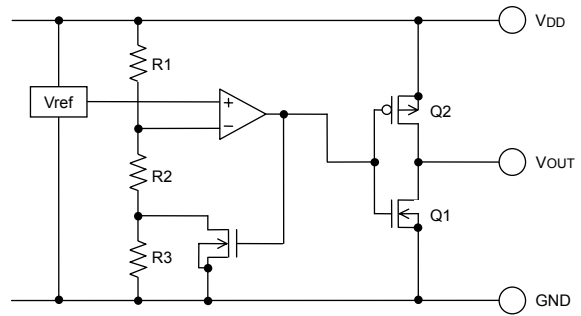


Fig.13 (BD49xxx series Internal Block Diagram)

Reference Data

Examples of Leading ( $t_{PLH}$ ) and Falling ( $t_{PHL}$ ) Output

Part Number	$t_{PLH}$ ( $\mu s$ )	$t_{PHL}$ ( $\mu s$ )
BD48x45	39.5	87.8
BD49x45	32.4	52.4

$V_{DD}=4.3V \rightarrow 5.1V$

$V_{DD}=5.1V \rightarrow 4.3V$

\*This data is for reference only.

The figures will vary with the application, so please confirm actual operating conditions before use.

Timing Waveform

Example: the following shows the relationship between the input voltages  $V_{DD}$  and the output voltage  $V_{OUT}$  when the input power supply voltage  $V_{DD}$  is made to sweep up and sweep down (the circuits are those in Fig.12 and 13).

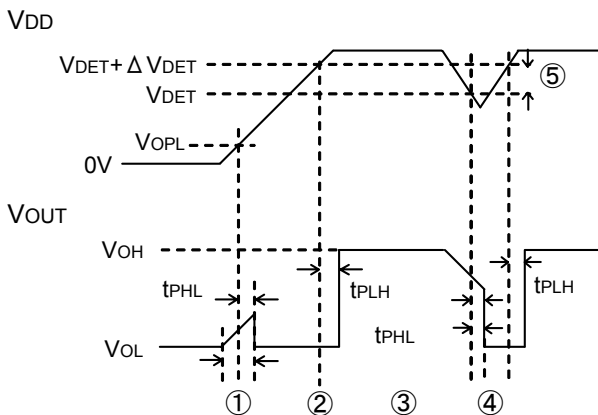


Fig.14

- ① When the power supply is turned on, the output is unsettled from after over the operating limit voltage ( $V_{OPL}$ ) until  $t_{PHL}$ . There fore it is possible that the reset signal is not outputted when the rise time of  $V_{DD}$  is faster than  $t_{PHL}$ .
- ② When  $V_{DD}$  is greater than  $V_{OPL}$  but less than the reset release voltage ( $V_{DET} + \Delta V_{DET}$ ), the output voltages will switch to Low.
- ③ If  $V_{DD}$  exceeds the reset release voltage ( $V_{DET} + \Delta V_{DET}$ ), then  $V_{OUT}$  switches from L to H.
- ④ If  $V_{DD}$  drops below the detection voltage ( $V_{DET}$ ) when the power supply is powered down or when there is a power supply fluctuation,  $V_{OUT}$  switches to L (with a delay of  $t_{PHL}$ ).
- ⑤ The potential difference between the detection voltage and the release voltage is known as the hysteresis width ( $\Delta V_{DET}$ ). The system is designed such that the output does not flip-flop with power supply fluctuations within this hysteresis width, preventing malfunctions due to noise.

Circuit Applications

1) Examples of a common power supply detection reset circuit.

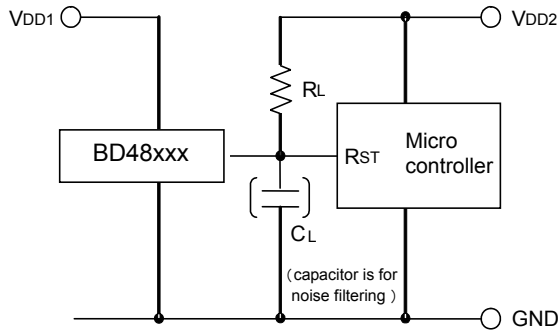


Fig.15 Open Drain Output Type

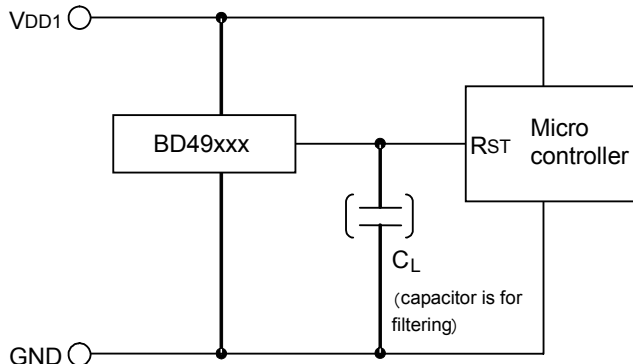


Fig.16 CMOS Output Type

Application examples of BD48xxx series (Open Drain output type) and BD49xxx series (CMOS output type) are shown below.

CASE1: the power supply of the microcontroller ( $V_{DD2}$ ) differs from the power supply of the reset detection ( $V_{DD1}$ ). Use the open drain output type (BD48xxx) attached a load resistance ( $R_L$ ) between the output and  $V_{DD2}$ . (As shown Fig.15)

CASE2: the power supply of the microcontroller ( $V_{DD1}$ ) is same as the power supply of the reset detection ( $V_{DD1}$ ). Use CMOS output type (BD49xxx) or open drain output type (BD48xxx) attached a load resistance ( $R_L$ ) between the output and  $V_{DD1}$ . (As shown Fig.16)

When a capacitance  $C_L$  for noise filtering is connected to the  $V_{OUT}$  pin (the reset signal input terminal of the microcontroller), please take into account the waveform of the rise and fall of the output voltage ( $V_{OUT}$ ).

**●Operational Notes**

## 1 . Absolute maximum range

Absolute Maximum Ratings are those values beyond which the life of a device may be destroyed. We cannot be defined the failure mode, such as short mode or open mode. Therefore a physical security countermeasure, like fuse, is to be given when a specific mode to be beyond absolute maximum ratings is considered.

## 2 . GND potential

GND terminal should be a lowest voltage potential every state.

Please make sure all pins, which are over ground even if, include transient feature.

## 3 . Electrical Characteristics

Be sure to check the electrical characteristics that are one the tentative specification will be changed by temperature, supply voltage, and external circuit.

## 4 . Bypass Capacitor for Noise Rejection

Please put into the capacitor of 1 $\mu$ F or more between  $V_{DD}$  pin and GND, and the capacitor of about 1000pF between  $V_{OUT}$  pin and GND, to reject noise. If extremely big capacitor is used, transient response might be late. Please confirm sufficiently for the point.

## 5 . Short Circuit between Terminal and Soldering

Don't short-circuit between Output pin and  $V_{DD}$  pin, Output pin and GND pin, or  $V_{DD}$  pin and GND pin. When soldering the IC on circuit board, please be unusually cautious about the orientation and the position of the IC. When the orientation is mistaken the IC may be destroyed.

## 6 . Electromagnetic Field

Mal-function may happen when the device is used in the strong electromagnetic field.

7 . The  $V_{DD}$  line impedance might cause oscillation because of the detection current.8 . A  $V_{DD}$  -GND capacitor (as close connection as possible) should be used in high  $V_{DD}$  line impedance condition.9 . Lower than the minimum input voltage makes the  $V_{OUT}$  high impedance, and it must be  $V_{DD}$  in pull up ( $V_{DD}$ ) condition.10. This IC has extremely high impedance terminals. Small leak current due to the uncleanness of PCB surface might cause unexpected operations. Application values in these conditions should be selected carefully. If the leakage is assumed between the  $V_{OUT}$  terminal and the GND terminal, the pull-up resistor should be less than 1/10 of the assumed leak resistance.

## 11. External parameters

The recommended parameter range for  $R_L$  is 10k $\Omega$  to 1M $\Omega$ . There are many factors (board layout, etc) that can affect characteristics. Please verify and confirm using practical applications.

## 12. Power on reset operation

Please note that the power on reset output varies with the  $V_{DD}$  rise up time. Please verify the actual operation.

## 13. Precautions for board inspection

Connecting low-impedance capacitors to run inspections with the board may produce stress on the IC. Therefore, be certain to use proper discharge procedure before each process of the test operation.

To prevent electrostatic accumulation and discharge in the assembly process, thoroughly ground yourself and any equipment that could sustain ESD damage, and continue observing ESD-prevention procedures in all handling, transfer and storage operations. Before attempting to connect components to the test setup, make certain that the power supply is OFF. Likewise, be sure the power supply is OFF before removing any component connected to the test setup.

## 14. When the power supply, is turned on because of in certain cases, momentary Rash-current flow into the IC at the logic unsettled, the couple capacitance, GND pattern of width and leading line must be considered.

## Status of this document

The Japanese version of this document is formal specification. A customer may use this translation version only for a reference to help reading the formal version.

If there are any differences in translation version of this document formal version takes priority.

# Notice

## ●Precaution for circuit design

- 1) The products are designed and produced for application in ordinary electronic equipment (AV equipment, OA equipment, telecommunication equipment, home appliances, amusement equipment, etc.). If the products are to be used in devices requiring extremely high reliability (medical equipment, transport equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or operational error may endanger human life and sufficient fail-safe measures, please consult with the ROHM sales staff in advance. If product malfunctions may result in serious damage, including that to human life, sufficient fail-safe measures must be taken, including the following:
  - [a] Installation of protection circuits or other protective devices to improve system safety
  - [b] Installation of redundant circuits in the case of single-circuit failure
- 2) The products are designed for use in a standard environment and not in any special environments. Application of the products in a special environment can deteriorate product performance. Accordingly, verification and confirmation of product performance, prior to use, is recommended if used under the following conditions:
  - [a] Use in various types of liquid, including water, oils, chemicals, and organic solvents
  - [b] Use outdoors where the products are exposed to direct sunlight, or in dusty places
  - [c] Use in places where 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>
  - [d] Use in places where the products are exposed to static electricity or electromagnetic waves
  - [e] Use in proximity to heat-producing components, plastic cords, or other flammable items
  - [f] Use involving sealing or coating the products with resin or other coating materials
  - [g] Use involving unclean solder or use of water or water-soluble cleaning agents for cleaning after soldering
  - [h] Use of the products in places subject to dew condensation
- 3) The products are not radiation resistant.
- 4) Verification and confirmation of performance characteristics of products, after on-board mounting, is advised.
- 5) 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.
- 6) De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta).  
When used in sealed area, confirm the actual ambient temperature.
- 7) Confirm that operation temperature is within the specified range described in product specification.
- 8) Failure induced under deviant condition from what defined in the product specification cannot be guaranteed.

## ●Precaution for Mounting / Circuit board design

- 1) When a highly active halogenous (chlorine, bromine, etc.) flux is used, the remainder 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 Company in advance.

Regarding Precaution for Mounting / Circuit board design, please specially refer to ROHM Mounting specification

## ●Precautions Regarding Application Examples and External Circuits

- 1) If change is made to the constant of an external circuit, allow a sufficient margin due to variations of the characteristics of the products and external components, including transient characteristics, as well as static characteristics.
- 2) The application examples, their constants, and other types of information contained herein are applicable only when the products are used in accordance with standard methods. Therefore, if mass production is intended, sufficient consideration to external conditions must be made.

● **Precaution for Electrostatic**

This product is Electrostatic sensitive product, which may be damaged due to Electrostatic discharge. Please take proper caution during manufacturing and storing so that voltage exceeding Product maximum rating won't 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 following places:
  - [a] Where 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] Where the temperature or humidity exceeds those recommended by the Company
  - [c] Storage in direct sunshine or condensation
  - [d] Storage in 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 recommended storage time period .
- 3) Store / transport cartons in the correct direction, which is indicated on a carton as 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 dry bag.

● **Precaution for product label**

QR code printed on ROHM product label is only for internal use, and please do not use at customer site. It might contain a internal part number that is inconsistent with an product part number.

● **Precaution for disposition**

When disposing products please dispose them properly with a industry waste company.

● **Precaution for Foreign exchange and Foreign trade act**

Since concerned goods might be fallen under controlled goods prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

● **Prohibitions Regarding Industrial Property**

- 1) Information and data on products, including application examples, contained in these specifications are simply for reference; the Company does not guarantee any industrial property rights, intellectual property rights, or any other rights of a third party regarding this information or data. Accordingly, the Company does not bear any responsibility for:
  - [a] infringement of the intellectual property rights of a third party
  - [b] any problems incurred by the use of the products listed herein.
- 2) The Company prohibits the purchaser of its products to exercise or use the intellectual property rights, industrial property rights, or any other rights that either belong to or are controlled by the Company, other than the right to use, sell, or dispose of the products.