

Voltage Detector IC Series

# Low Voltage Free Delay Time Setting CMOS Voltage Detector IC Series



**BU42xx series BU43xx series**

●General Description

ROHM CMOS reset IC series with adjustable output delay is a high-accuracy low current consumption reset IC series with a built-in delay circuit. The lineup was established with two output types (Nch open drain and CMOS output) and detection voltages range from 0.9V to 4.8V in increments of 0.1V, so that the series may be selected according to the application at hand.

●Features

- Free delay time setting by external capacitor
- Two output types (Nch open drain and CMOS output)
- Ultra-low current consumption
- Wide operating temperature range
- Very small and low height package

●Key Specifications

- Detection voltage: 0.9V to 4.8V (Typ.)  
0.1V steps
- High accuracy detection voltage: ±1.0%
- Ultra-low current consumption: 0.55µA (Typ.)
- Operating temperature range: -40°C to +125°C

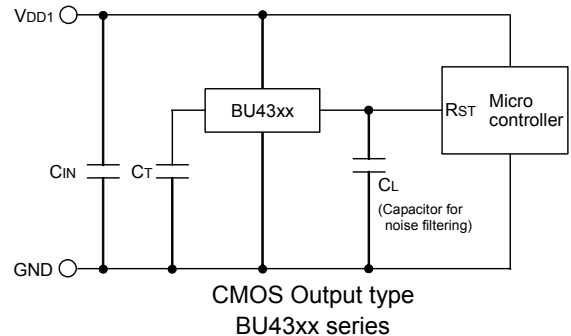
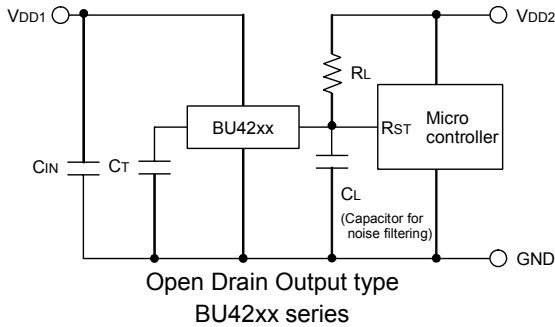
●Package

- SSOP5: 2.90mm x 2.80mm x 1.15mm
- SOP4: 2.00mm x 2.10mm x 0.95mm
- VSO5: 1.60mm x 1.60mm x 0.60mm

●Applications

All electronic devices that use micro controllers and logic circuits

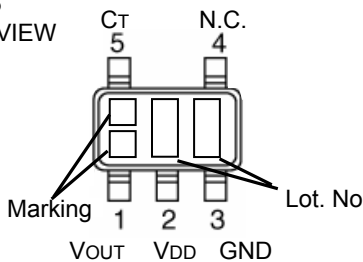
●Typical Application Circuit



●Connection Diagram & Pin Descriptions

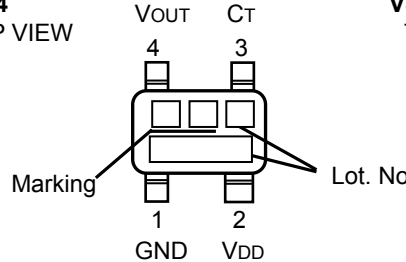
SSOP5

TOP VIEW



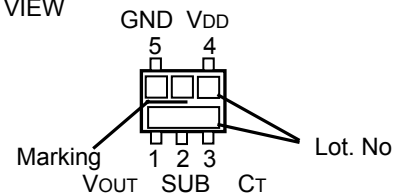
SOP4

TOP VIEW



VSO5

TOP VIEW



PIN No.	Symbol	Function
1	VOUT	Reset output
2	VDD	Power supply voltage
3	GND	GND
4	N.C.	Unconnected terminal
5	CT	Capacitor connection terminal for output delay time

PIN No.	Symbol	Function
1	GND	GND
2	VDD	Power supply voltage
3	CT	Capacitor connection terminal for output delay time
4	VOUT	Reset output

PIN No.	Symbol	Function
1	VOUT	Reset output
2	SUB	Substrate*
3	CT	Capacitor connection terminal for output delay time
4	VDD	Power supply voltage
5	GND	GND

\*Connect the substrate to VDD

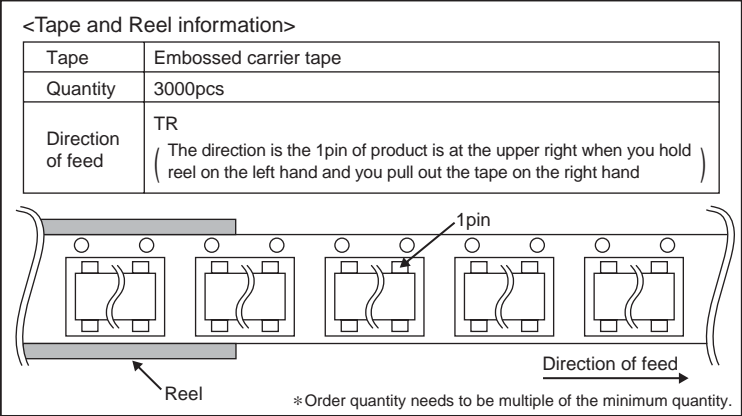
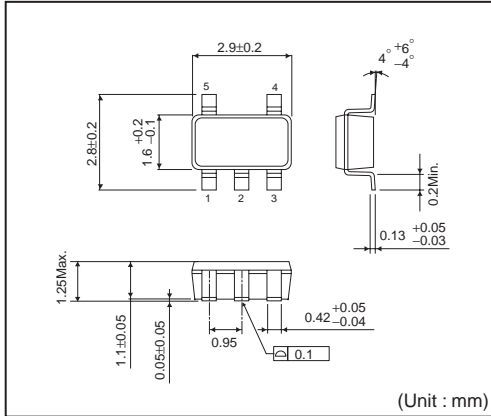
○Product structure : Silicon monolithic integrated circuit ○This product is not designed protection against radioactive rays.

●Ordering Information

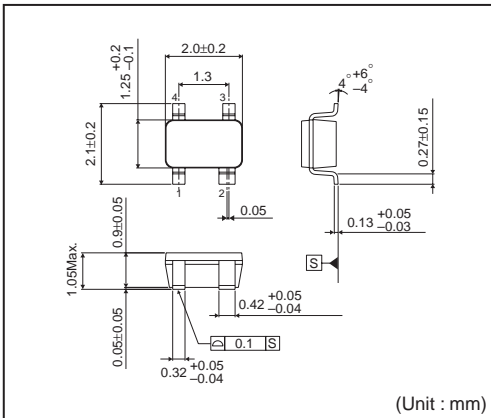
**B U X X X X X** - **T R**

Part Number	Output Type 42 : Open Drain 43 : CMOS	Reset Voltage Value 09 : 0.9V ↓ 0.1V step 48 : 4.8V	Package G : SSOP5 F : SOP4 FVE : VSOF5	Packageing and forming specification TR : Embossed tape and reel
-------------	---	--	---	---

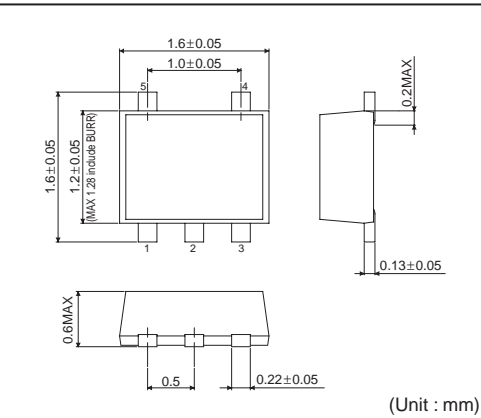
**SSOP5**



**SOP4**



**VSOF5**



●Lineup

Making	Detection voltage	Part Number	Making	Detection voltage	Part Number	Making	Detection voltage	Part Number	Making	Detection voltage	Part Number
ZR	4.8V	BU4248	YV	2.8V	BU4228	1H	4.8V	BU4348	0M	2.8V	BU4328
ZQ	4.7V	BU4247	YU	2.7V	BU4227	1G	4.7V	BU4347	0L	2.7V	BU4327
ZP	4.6V	BU4246	YT	2.6V	BU4226	1F	4.6V	BU4346	0K	2.6V	BU4326
ZN	4.5V	BU4245	YS	2.5V	BU4225	1E	4.5V	BU4345	0J	2.5V	BU4325
ZM	4.4V	BU4244	YR	2.4V	BU4224	1D	4.4V	BU4344	0H	2.4V	BU4324
ZL	4.3V	BU4243	YQ	2.3V	BU4223	1C	4.3V	BU4343	0G	2.3V	BU4323
ZK	4.2V	BU4242	YP	2.2V	BU4222	1B	4.2V	BU4342	0F	2.2V	BU4322
ZJ	4.1V	BU4241	YN	2.1V	BU4221	1A	4.1V	BU4341	0E	2.1V	BU4321
ZH	4.0V	BU4240	YM	2.0V	BU4220	0Z	4.0V	BU4340	0D	2.0V	BU4320
ZG	3.9V	BU4239	YL	1.9V	BU4219	0Y	3.9V	BU4339	0C	1.9V	BU4319
ZF	3.8V	BU4238	YK	1.8V	BU4218	0X	3.8V	BU4338	0B	1.8V	BU4318
ZE	3.7V	BU4237	YJ	1.7V	BU4217	0W	3.7V	BU4337	0A	1.7V	BU4317
ZD	3.6V	BU4236	YH	1.6V	BU4216	0V	3.6V	BU4336	ZZ	1.6V	BU4316
ZC	3.5V	BU4235	YG	1.5V	BU4215	0U	3.5V	BU4335	ZY	1.5V	BU4315
ZB	3.4V	BU4234	YF	1.4V	BU4214	0T	3.4V	BU4334	ZX	1.4V	BU4314
ZA	3.3V	BU4233	YE	1.3V	BU4213	0S	3.3V	BU4333	ZW	1.3V	BU4313
YZ	3.2V	BU4232	YD	1.2V	BU4212	0R	3.2V	BU4332	ZV	1.2V	BU4312
YY	3.1V	BU4231	YC	1.1V	BU4211	0Q	3.1V	BU4331	ZU	1.1V	BU4311
YX	3.0V	BU4230	YB	1.0V	BU4210	0P	3.0V	BU4330	ZT	1.0V	BU4310
YW	2.9V	BU4229	YA	0.9V	BU4209	0N	2.9V	BU4329	ZS	0.9V	BU4309

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

Parameter		Symbol	Limit	Unit
Power Supply Voltage		VDD	-0.3 to +7	V
Output Voltage	Nch Open Drain Output	VOUT	GND-0.3 to +7	V
	CMOS Output		GND-0.3 to VDD+0.3	
Power Dissipation	SSOP5 <sup>*1*4</sup>	Pd	540	mW
	SOP4 <sup>*2*4</sup>		400	
	VSO5 <sup>*3*4</sup>		210	
Operation Temperature Range		T <sub>opt</sub>	-40 to +125	°C
Ambient Storage Temperature		T <sub>stg</sub>	-55 to +125	°C

\*1 When used at temperatures higher than Ta=25°C, the power is reduced by 5.4mW per 1°C above 25°C.

\*2 When used at temperatures higher than Ta=25°C, the power is reduced by 4.0mW per 1°C above 25°C.

\*3 When used at temperatures higher than Ta=25°C, the power is reduced by 2.1mW per 1°C above 25°C.

\*4 When a ROHM standard circuit board (70mm×70mm×1.6mm, glass epoxy board) is mounted.

### ● Electrical Characteristics (Unless Otherwise Specified Ta=-25 to 125°C)

Parameter	Symbol	Condition	Limit			Unit	
			Min.	Typ.	Max.		
Detection Voltage	V <sub>DET</sub>	VDD=H→L, Ta=25°C, RL=470kΩ	V <sub>DET(T)</sub> ×0.99	V <sub>DET(T)</sub>	V <sub>DET(T)</sub> ×1.01	V	
Circuit Current when ON	I <sub>DD1</sub>	VDD=V <sub>DET</sub> -0.2V	V <sub>DET</sub> =0.9 to 1.3V	-	0.15	0.88	μA
			V <sub>DET</sub> =1.4 to 2.1V	-	0.20	1.05	
			V <sub>DET</sub> =2.2 to 2.7V	-	0.25	1.23	
			V <sub>DET</sub> =2.8 to 3.3V	-	0.30	1.40	
			V <sub>DET</sub> =3.4 to 4.2V	-	0.35	1.58	
			V <sub>DET</sub> =4.3 to 4.8V	-	0.40	1.75	
Circuit Current when OFF	I <sub>DD2</sub>	VDD=V <sub>DET</sub> +2.0V	V <sub>DET</sub> =0.9 to 1.3V	-	0.30	1.40	μA
			V <sub>DET</sub> =1.4 to 2.1V	-	0.35	1.58	
			V <sub>DET</sub> =2.2 to 2.7V	-	0.40	1.75	
			V <sub>DET</sub> =2.8 to 3.3V	-	0.45	1.93	
			V <sub>DET</sub> =3.4 to 4.2V	-	0.50	2.10	
			V <sub>DET</sub> =4.3 to 4.8V	-	0.55	2.28	
Operating Voltage Range	V <sub>OPL</sub>	VOL≤0.4V, Ta=25 to 125°C, RL=470kΩ	0.70	-	-	V	
		VOL≤0.4V, Ta=-40 to 25°C, RL=470kΩ	0.90	-	-		
'High' Output Current (Pch)	I <sub>OH</sub>	VDS=0.5V VDD=6.0V V <sub>DET</sub> =4.0 to 4.8V	2.0	4.0	-	mA	
'Low' Output Current (Nch)	I <sub>OL</sub>	VDS=0.05V VDD=0.85V	20	100	-	μA	
		VDS=0.5V VDD=1.5V V <sub>DET</sub> =1.7 to 4.8V	1.0	3.3	-	mA	
		VDS=0.5V VDD=2.4V V <sub>DET</sub> =2.7 to 4.8V	3.6	6.5	-		
Leak Current when OFF	I <sub>leak</sub>	VDD=VDS=7V Ta=-40 to 85°C	-	0	0.1	μA	
		VDD=VDS=7V Ta=85 to 125°C	-	0	1		
'High' Output Current (Pch)	I <sub>OH</sub>	VDS=0.5V VDD=4.8V V <sub>DET</sub> =0.9 to 3.9V	1.7	3.4	-	mA	
		VDS=0.5V VDD=6.0V V <sub>DET</sub> =4.0 to 4.8V	2.0	4.0	-		
CT pin Threshold Voltage	V <sub>CTH</sub>	VDD=V <sub>DET</sub> ×1.1, V <sub>DET</sub> =0.9 to 2.5V Ta=25°C RL=470kΩ	V <sub>DD</sub> ×0.35	V <sub>DD</sub> ×0.45	V <sub>DD</sub> ×0.55	V	
		VDD=V <sub>DET</sub> ×1.1, V <sub>DET</sub> =2.6 to 4.8V Ta=25°C RL=470kΩ	V <sub>DD</sub> ×0.40	V <sub>DD</sub> ×0.50	V <sub>DD</sub> ×0.60		
Output Delay Resistance	R <sub>CT</sub>	VDD=V <sub>DET</sub> ×1.1 VCT=0.5V Ta=25°C <sup>*1</sup>	9	10	11	MΩ	
CT pin Output Current	I <sub>CT</sub>	VCT=0.1V VDD=0.85V	5	40	-	μA	
		VCT=0.5V VDD=1.5V V <sub>DET</sub> =1.7 to 4.8V	200	400	-		
Detection Voltage Temperature coefficient	V <sub>DET</sub> /ΔT	Ta=-40°C to 125°C	-	±30	-	ppm/°C	
Hysteresis Voltage	ΔV <sub>DET</sub>	VDD=L→H→L Ta=-40 to 125°C RL=470kΩ	V <sub>DET</sub> ≤1.0V	V <sub>DET</sub> ×0.03	V <sub>DET</sub> ×0.05	V <sub>DET</sub> ×0.08	V
			V <sub>DET</sub> ≥1.1V	V <sub>DET</sub> ×0.03	V <sub>DET</sub> ×0.05	V <sub>DET</sub> ×0.07	

\*1: Designed guarantee. (Outgoing inspection is not done all products.)

V<sub>DET(T)</sub>: Standard Detection Voltage(0.9V to 4.8V, 0.1V step)

RL: Pull-up resistor to be connected between VOUT and power supply.

●Block Diagrams

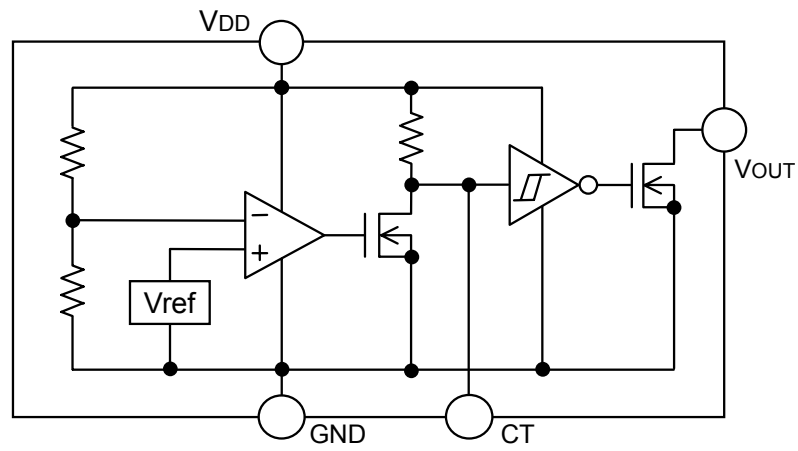


Fig.1 BU42xx Series

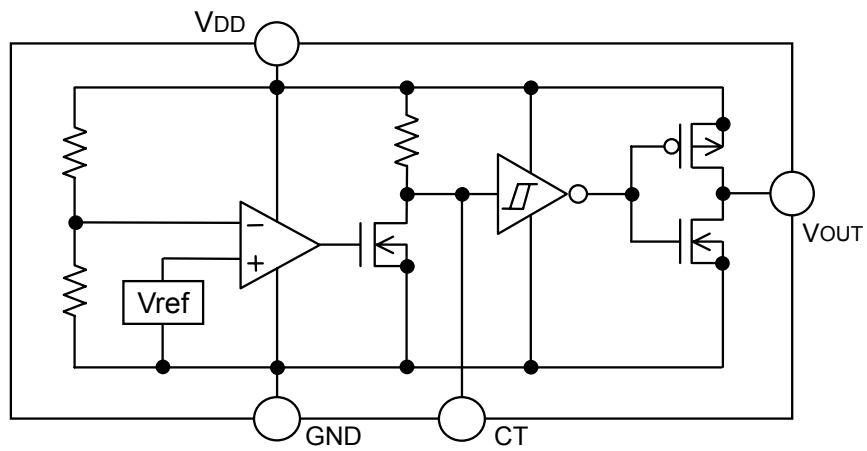


Fig.2 BU43xx Series

● Typical Performance Curves

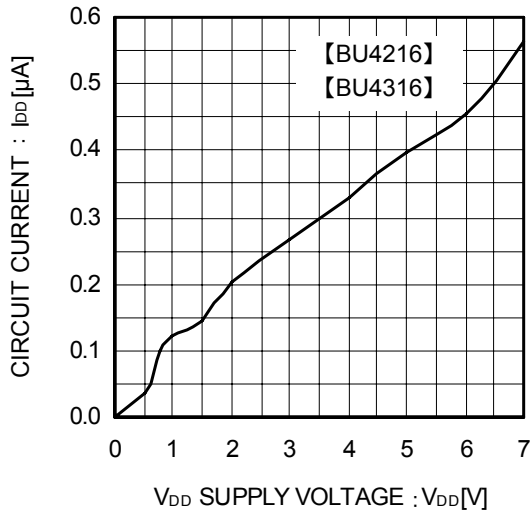


Fig.3 Circuit Current

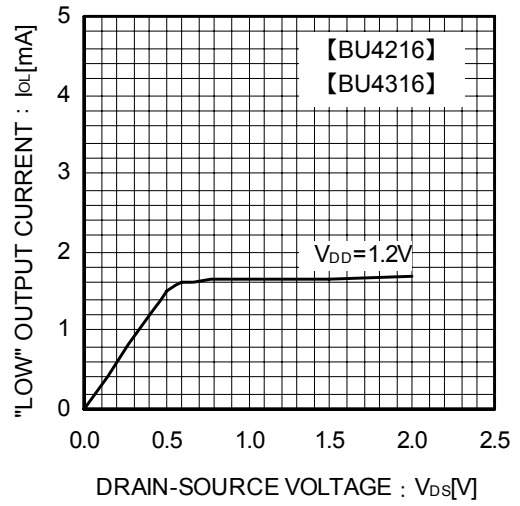


Fig.4 "LOW" Output Current

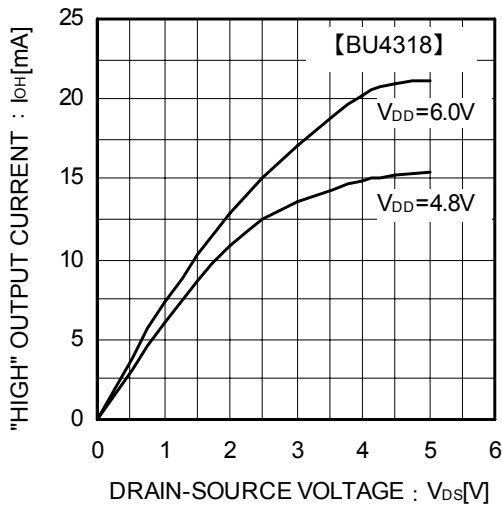


Fig.5 "High" Output Current

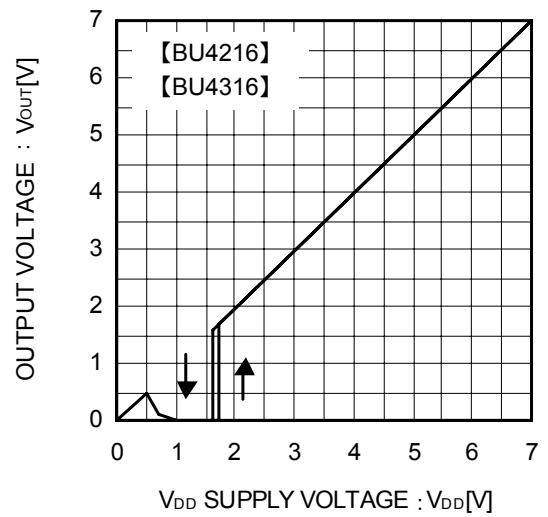


Fig.6 I/O Characteristics

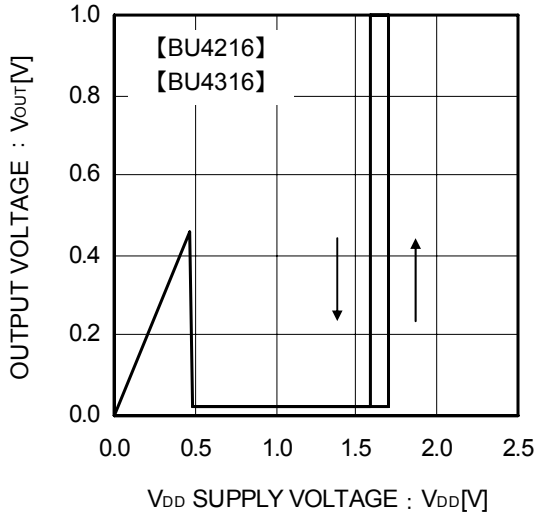


Fig.7 Operating Limit Voltage

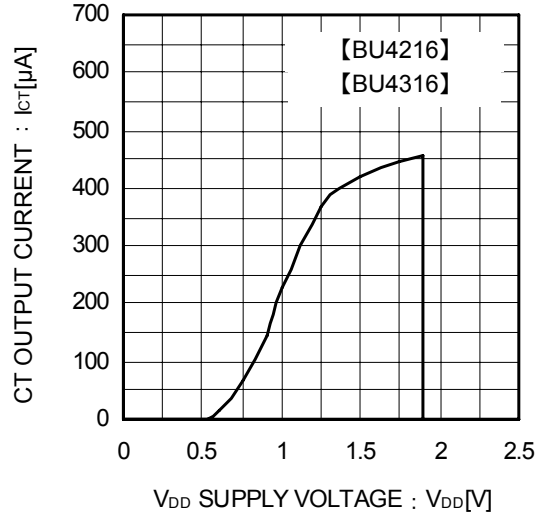


Fig.8 CT Terminal Current

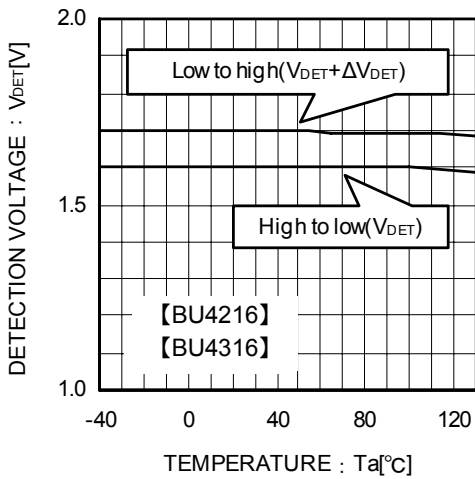


Fig.9 Detecting Voltage Release Voltage

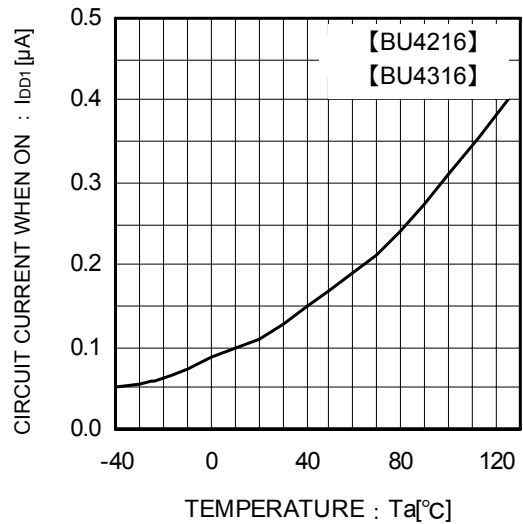


Fig.10 Circuit Current when ON

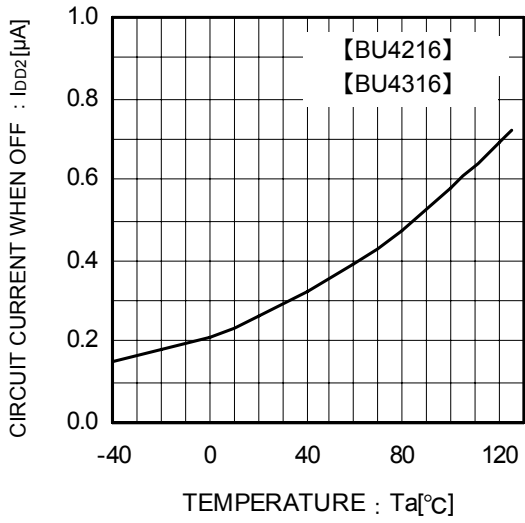


Fig.11 Circuit Current when OFF

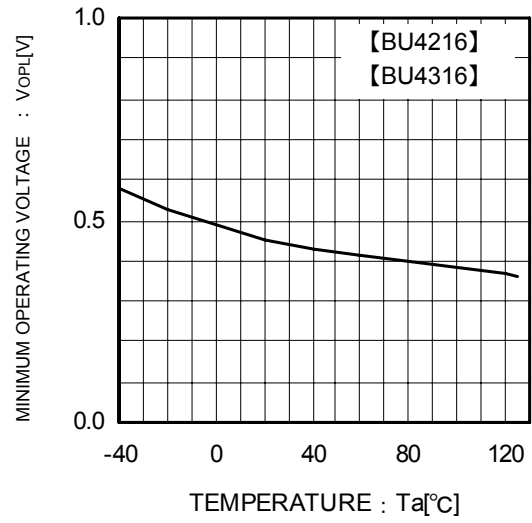


Fig.12 Operating Limit Voltage

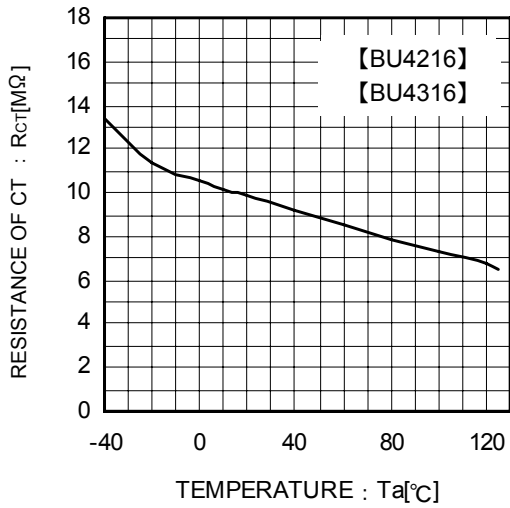


Fig.13 C<sub>T</sub> Terminal Circuit Resistance

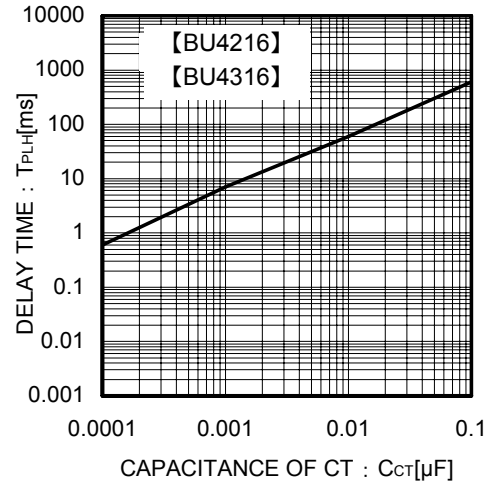


Fig.14 Delay Time (t<sub>PLH</sub>) and C<sub>T</sub> Terminal External Capacitance

● Application Information

Explanation of Operation

For both the open drain type(Fig.15)and the CMOS output type(Fig.16), the detection and release voltages are used as threshold voltages. When the voltage applied to the VDD pins reaches the applicable threshold voltage, the Vout terminal voltage switches from either “High” to “Low” or from “Low” to “High”. BU42xx and BU43xx series have delay time function which set tPLH (Output “Low”→”High”) using an external capacitor (CCT). Because the BU42xx series uses an open drain output type, it is possible to connect a pull-up resistor to VDD or another power supply [The output “High” voltage (VOUT) in this case becomes VDD or the voltage of the other power supply].

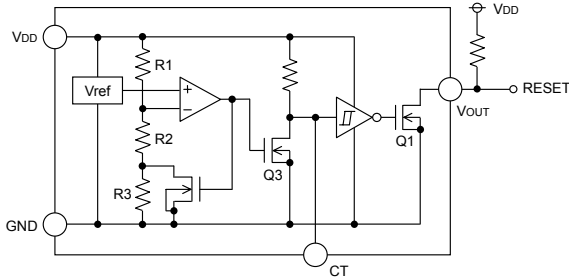


Fig.15 BU42xx type internal block diagram

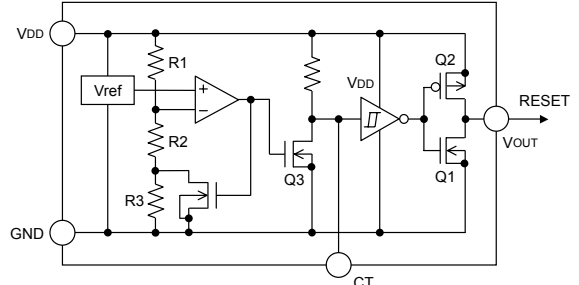


Fig.16 BU43xx type internal block diagram

Setting of Detector Delay Time

This detector IC can be set delay time at the rise of VDD by the capacitor connected to CT terminal.

Delay time at the rise of VDD tPLH:Time until when Vout rise to 1/2 of VDD after VDD rise up and beyond the release voltage(VDET+ΔVDET)

$$T_{PLH} = -1 \times C_{CT} \times R_{CT} \times \ln \left( \frac{V_{DD} - V_{CTH}}{V_{DD}} \right)$$

CCT: CT pin Externally Attached Capacitance  
 RCT: CT pin Internal Impedance(P.2 RCT refer.)

VCTH: CT pin Threshold Voltage(P.2 VCTH refer.)  
 ln: Natural Logarithm

Reference Data of Falling Time (tPHL) Output

Examples of Falling Time (tPHL) Output

Part Number	tPHL [μs]
BU4245	275.7
BU4345	359.3

\* This data is for reference only.

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

Timing Waveforms

Example: the following shows the relationship between the input voltage VDD, the CT Terminal Voltage VCT and the output voltage VOUT when the input power supply voltage VDD is made to sweep up and sweep down (The circuits are those in Fig.15 and 16).

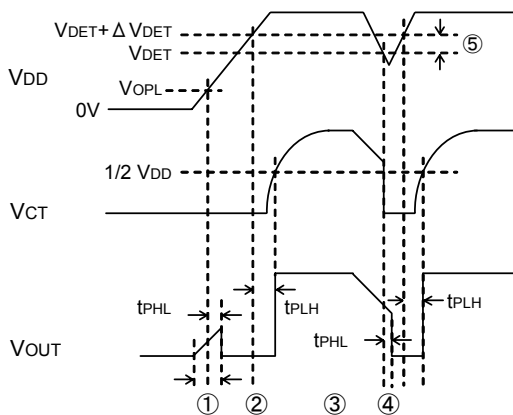


Fig.17 Timing Waveforms

- ① When the power supply is turned on, the output is unsettled from after over the operating limit voltage (VOPL) until tPHL. There fore it is possible that the reset signal is not outputted when the rise time of VDD is faster than tPHL.
- ② When VDD is greater than VOPL but less than the reset release voltage (VDET+ΔVDET), the CT terminal (VCT) and output (VOUT) voltages will switch to L.
- ③ If VDD exceeds the reset release voltage (VDET+VDET), then VOUT switches from L to H (with a delay to the CT terminal).
- ④ If VDD drops below the detection voltage (VDET) when the power supply is powered down or when there is a power supply fluctuation, VOUT switches to L (with a delay of tPHL).
- ⑤ The potential difference between the detection voltage and the release voltage is known as the hysteresis width (VDET). 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

Examples of a common power supply detection reset circuit

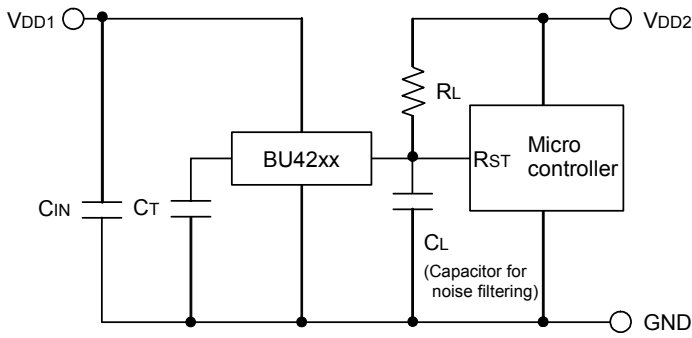


Fig.18 Open Drain Output type

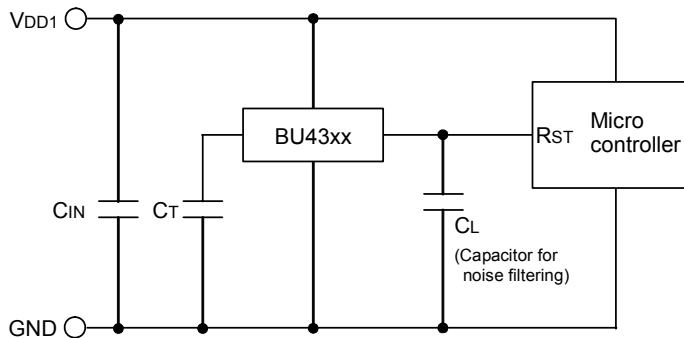


Fig.19 CMOS Output type

Application examples of BU42xx series (Open Drain output type) and BU43xx 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 (BU42xx series) attached a load resistance ( $R_L$ ) between the output and  $V_{DD2}$ . (As shown Fig.18)

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 (BU43xx series) or Open Drain Output Type (BU42xx series) attached a load resistance ( $R_L$ ) between the output and  $V_{DD1}$ . (As shown Fig.19)

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 that 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 to reject noise between V<sub>DD</sub> pin and GND with 1μF over and between V<sub>OUT</sub> pin and GND with 1000pF. 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<sub>DD</sub> pin, Output pin and GND pin, or V<sub>DD</sub> pin and GND pin. When soldering the IC on circuit board please is 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<sub>DD</sub> line impedance might cause oscillation because of the detection current.
8. A V<sub>DD</sub> -GND capacitor (as close connection as possible) should be used in high V<sub>DD</sub> line impedance condition.
9. Lower than the minimum input voltage makes the V<sub>OUT</sub> high impedance, and it must be V<sub>DD</sub> in pull up (V<sub>DD</sub>) condition.
10. Case of needless Delay time, recommended to insert more 470kΩ resistor between V<sub>DD</sub> and C<sub>T</sub>.  
Recommended value of R<sub>L</sub> Resistar is over 50kΩ (V<sub>DET</sub>=1.5 to 4.8V), over 100kΩ (V<sub>DET</sub>=0.9 to 1.4V).
11. 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 10MΩ leakage is assumed between the C<sub>T</sub> terminal and the GND terminal, 1MΩ connection between the C<sub>T</sub> terminal and the V<sub>DD</sub> terminal would be recommended. Also, if the leakage is assumed between the V<sub>OUT</sub> terminal and the GND terminal, the pull up resistor should be less than 1/10 of the assumed leak resistance.  
The value of R<sub>CT</sub> depends on the external resistor that is connected to C<sub>T</sub> terminal, so please consider the delay time that is decided by  $T \times R_{CT} \times C_{CT}$  changes.
12. Delay time (t<sub>PLH</sub>)  

$$t_{PLH} = T \times R_{CT} \times C_{CT} \text{ (sec)}$$
 T: time constant  
 R<sub>CT</sub> : 10MΩ (typ.) (built-in resistor)  
 C<sub>CT</sub> : capacitor connected C<sub>T</sub> pin.  
 Recommended value of C<sub>CT</sub> capacitor is over 100pF.  
 The reference value  

$$(T \times R_{CT}) \times 10^6$$

V <sub>DET</sub> = 0.9 to 2.5V			
Ta = 25°C	(min. = 5.1 × 10 <sup>6</sup> )	typ. = 6.0 × 10 <sup>6</sup>	max = 6.9 × 10 <sup>6</sup> )
Ta = -25 to 125°C	(min. = 3.3 × 10 <sup>6</sup> )	typ. = 6.0 × 10 <sup>6</sup>	max = 8.7 × 10 <sup>6</sup> )
V <sub>DET</sub> = 2.6 to 4.8V			
Ta = 25°C	(min. = 5.9 × 10 <sup>6</sup> )	typ. = 6.9 × 10 <sup>6</sup>	max = 7.9 × 10 <sup>6</sup> )
Ta = -25 to 125°C	(min. = 3.8 × 10 <sup>6</sup> )	typ. = 6.9 × 10 <sup>6</sup>	max = 10.0 × 10 <sup>6</sup> )
13. External parameters  
The recommended parameter range for C<sub>T</sub> is 100pF to 0.1μF. For R<sub>L</sub>, the recommended range is 50kΩ to 1MΩ. There are many factors (board layout, etc) that can affect characteristics. Please verify and confirm using practical applications.
14. C<sub>T</sub> pin discharge  
Due to the capabilities of the C<sub>T</sub> pin discharge transistor, the C<sub>T</sub> pin may not completely discharge when a short input pulse is applied, and in this case the delay time may not be controlled. Please verify the actual operation.
15. Power on reset operation  
Please note that the power on reset output varies with the V<sub>DD</sub> rise up time. Please verify the actual operation.

**16. 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.

**17. 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

## ●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.
- 2) All information contained in this document is current as of the issuing date and subject to change without any prior notice. Before purchasing or using ROHM's Products, please confirm the latest information with a ROHM sales representative.

## ●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.
- 2) ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
  - [a] Installation of protection circuits or other protective devices to improve system safety
  - [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure
- 3) Our Products are designed and manufactured for use under standard conditions and not under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc. prior to use, must be necessary:
  - [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
  - [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.

● **Precaution Regarding Intellectual Property Rights**

- 1) All information and data including but not limited to application example contained in this document is for reference only. ROHM does not warrant that foregoing information or data will not infringe any intellectual property rights or any other rights of any third party regarding such information or data. ROHM shall not be in any way responsible or liable for infringement of any intellectual property rights or other damages arising from use of such information or data.:
- 2) No license, expressly or implied, is granted hereby under any intellectual property rights or other rights of ROHM or any third parties with respect to the information contained in this document.

●Other Precaution

- 1) The information contained in this document is provided on an "as is" basis and ROHM does not warrant that all information contained in this document is accurate and/or error-free. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties resulting from inaccuracy or errors of or concerning such information.
- 2) This document may not be reprinted or reproduced, in whole or in part, without prior written consent of ROHM.
- 3) The Products may not be disassembled, converted, modified, reproduced or otherwise changed without prior written consent of ROHM.
- 4) In no event shall you use in any way whatsoever the Products and the related technical information contained in the Products or this document for any military purposes, including but not limited to, the development of mass-destruction weapons.
- 5) The proper names of companies or products described in this document are trademarks or registered trademarks of ROHM, its affiliated companies or third parties.