Datasheet

Voltage Detector (Reset) IC Series for Automotive Application

Free Time Delay Setting Dual Output Window Voltage Detector (Reset) IC

BD52W03G-C

General Description

ROHM's free time delay setting window voltage detector ICs are highly accurate, with low current consumption feature that uses CMOS process. Delay time setting can be control by an external capacitor. It has dual N-channel open drain output. The time delay has ±50 % accuracy for the entire operating temperature range of -40 °C to +125 °C.

Features

- AEC-Q100 Qualified(Note 1)
- Functional Safety Supportive Automotive Products
- Under and Over Voltage Monitor
- Free Time Delay Setting
- Nch Open Drain Output
- Very Small, Lightweight and Thin Package
- SSOP6 Package is Similar to SOT-23-6 (JEDEC)

(Note 1) Grade 1

Application

All Automotive Devices That Requires Voltage Detection

Key Specifications

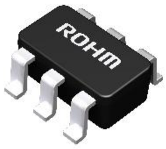
- Over Voltage Detection: 1.98 V (Typ)
- Under Voltage Detection: 1.62 V (Typ)
- Ultra-Low Current Consumption: 300 nA (Typ)
- Delay Time Accuracy: ±50 % (-40 °C to +125 °C) (CT pin capacitor ≥ 1 nF)

Special Characteristics

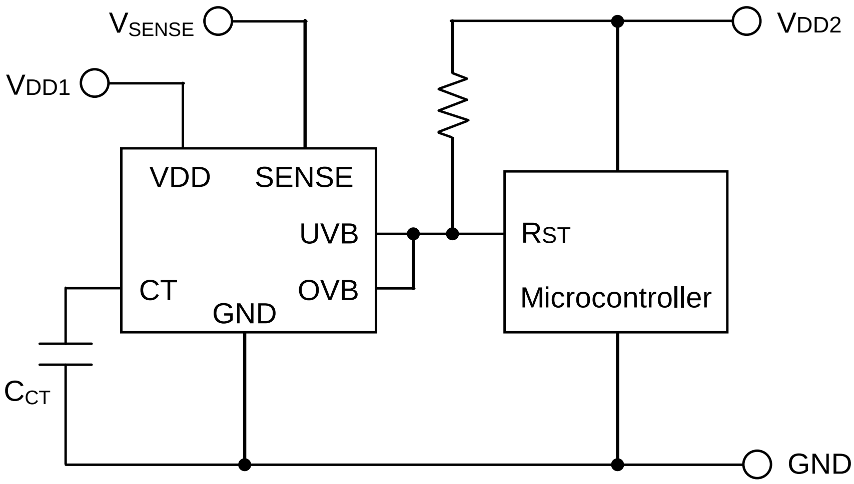
- Detection Voltage Accuracy: ±5.0 % (-40 °C to +125 °C)

Package

Package	W (Typ) x D (Typ) x H (Max)
SSOP6:	2.90 mm x 2.80 mm x 1.25 mm

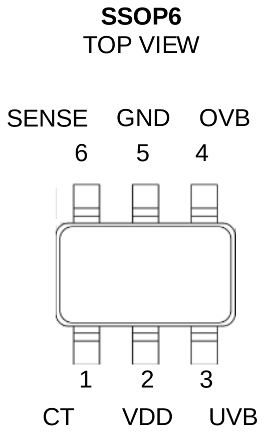


Typical Application Circuit



〇Product structure : Silicon integrated circuit 〇This product has no designed protection against radioactive rays.

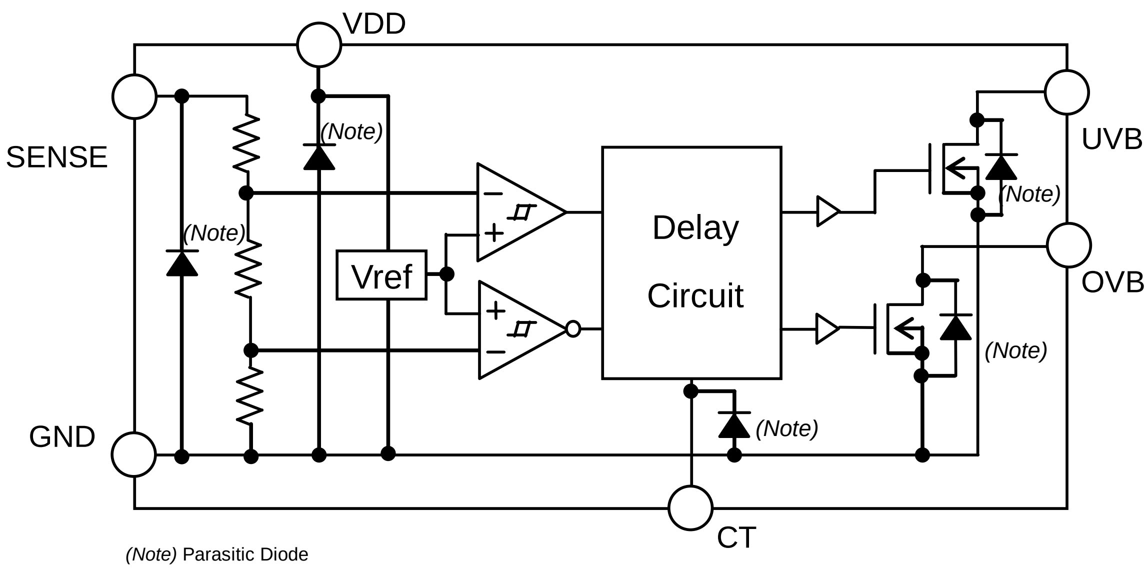
Pin Configuration



Pin Description

Pin No.	Pin Name	Function
1	CT	Capacitor connection pin for output delay time setting
2	VDD	Power supply voltage
3	UVB	Under voltage detection output pin
4	OVB	Over voltage detection output pin
5	GND	GND
6	SENSE	SENSE pin

Block Diagram



(Note) Parasitic Diode

Absolute Maximum Ratings (Ta = 25 °C)

Parameter	Symbol	Limit	Unit
Power Supply Voltage	V_{DD}	-0.3 to +7	V
SENSE Pin Voltage	V_{SENSE}	-0.3 to +7	
CT Pin Voltage	V_{CT}	(GND - 0.3) to +7	
UVB Pin Voltage	V_{UVB}	(GND - 0.3) to +7	
OVB Pin Voltage	V_{OVB}	(GND - 0.3) to +7	
UVB Pin Output Current	I_{OUVB}	70	mA
OVB Pin Output Current	I_{OOVB}	70	
Maximum Junction Temperature	Tjmax	+150	°C
Storage Temperature Range	Tstg	-55 to +150	°C

Caution 1: *Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.*

Caution 2: *Should by any chance the maximum junction temperature rating be exceeded the rise in temperature of the chip may result in deterioration of the properties of the chip. In case of exceeding this absolute maximum rating, design a PCB with thermal resistance taken into consideration by increasing board size and copper area so as not to exceed the maximum junction temperature rating.*

Thermal Resistance *(Note 1)*

Parameter	Symbol	Thermal Resistance (Typ)		Unit
		1s *(Note 3)*	2s2p *(Note 4)*	
SSOP6				
Junction to Ambient	θ_{JA}	376.5	185.4	°C/W
Junction to Top Characterization Parameter *(Note 2)*	Ψ_{JT}	40	30	°C/W

(Note 1) Based on JESD51-2A (Still-Air).
(Note 2) The thermal characterization parameter to report the difference between junction temperature and the temperature at the top center of the outside surface of the component package.
(Note 3) Using a PCB board based on JESD51-3.
(Note 4) Using a PCB board based on JESD51-7.

Layer Number of Measurement Board	Material	Board Size
Single	FR-4	114.3 mm x 76.2 mm x 1.57 mmt

Top	
Copper Pattern	Thickness
Footprints and Traces	70 μm

Layer Number of Measurement Board	Material	Board Size
4 Layers	FR-4	114.3 mm x 76.2 mm x 1.6 mmt

Top		2 Internal Layers		Bottom	
Copper Pattern	Thickness	Copper Pattern	Thickness	Copper Pattern	Thickness
Footprints and Traces	70 μm	74.2 mm x 74.2 mm	35 μm	74.2 mm x 74.2 mm	70 μm

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Operating Supply Voltage	V_{DD}	1.6	-	6.0	V
SENSE Pin Voltage	V_{SENSE}	0	-	6.0	V
Operating Temperature	Topr	-40	+25	+125	°C

Electrical Characteristics (Unless otherwise specified Ta = -40 °C to +125 °C, V_{DD} = 1.6 V to 6.0 V)

Parameter	Symbol	Condition		Limit			Unit
				Min	Typ	Max	
Under Voltage Detection Voltage	V_{UVDET}	BD52W03G-C	V_{SENSE} = H→L, R_L = 100 kΩ	1.54	1.62	1.70	V
Over Voltage Detection Voltage	V_{OVDET}	BD52W03G-C	V_{SENSE} = L→H, R_L = 100 kΩ	1.88	1.98	2.08	V
Circuit Current	I_{DD}	V_{DD} = V_{SENSE} = (V_{UVDET} + V_{OVDET}) / 2		-	0.3	3.0	µA
UVB Operating Voltage Range	V_{OPLUVB}	V_{OLUVB} ≤ 0.4 V, Ta = -40 °C to +125 °C, R_L = 100 kΩ		1.6	-	-	V
OVB Operating Voltage Range	V_{OPLOVB}	V_{OLOVB} ≤ 0.4 V, Ta = -40 °C to +125 °C, R_L = 100 kΩ		1.6	-	-	V
UVB "Low" Output Voltage	V_{OLUVB}	V_{SENSE} < V_{UVDET}, V_{DD} = 1.6 V, I_{SINK} = 1.0 mA		-	-	0.4	V
		V_{SENSE} < V_{UVDET}, V_{DD} = 2.4 V, I_{SINK} = 2.0 mA		-	-	0.4	
OVB "Low" Output Voltage	V_{OLOVB}	V_{SENSE} > V_{OVDET}, V_{DD} = 1.6 V, I_{SINK} = 1.0 mA		-	-	0.4	V
		V_{SENSE} > V_{OVDET}, V_{DD} = 2.4 V, I_{SINK} = 2.0 mA		-	-	0.4	
L→H Propagation Delay Time	t_{PLH}	V_{UVB} = GND→50 %, C_{CT} = 0.01 µF, V_{DD} = 3.0 V *(Note 1)*		27.7	55.5	83.2	ms

R_L: Pull-up resistor connected between UVB, OVB and power supply.
(Note 1) CT delay capacitor range: open to 4.7 µF.

Typical Performance Curves

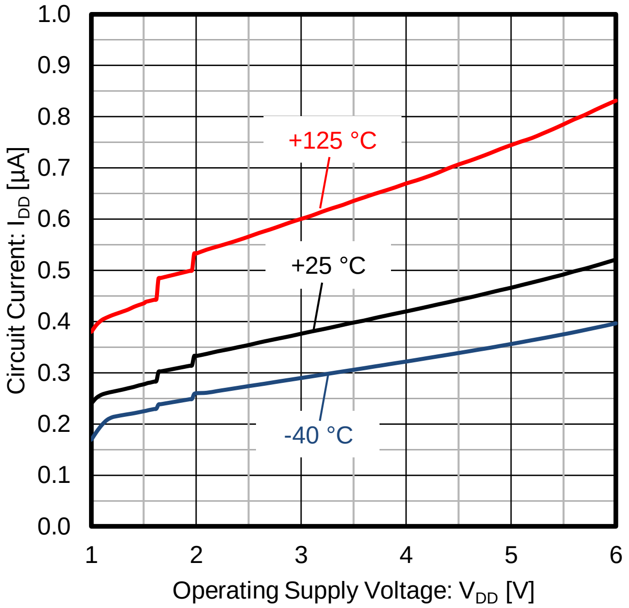


Figure 1. Circuit Current vs Operating Supply Voltage (VDD = SENSE)

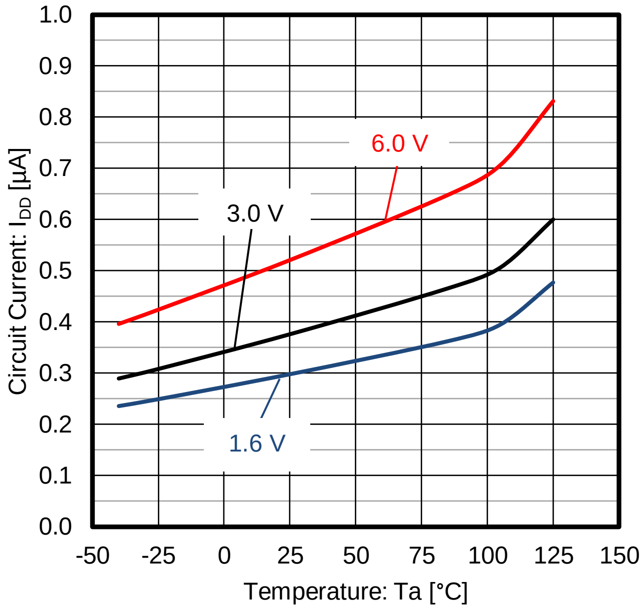


Figure 2. Circuit Current vs Temperature (VDD = SENSE)

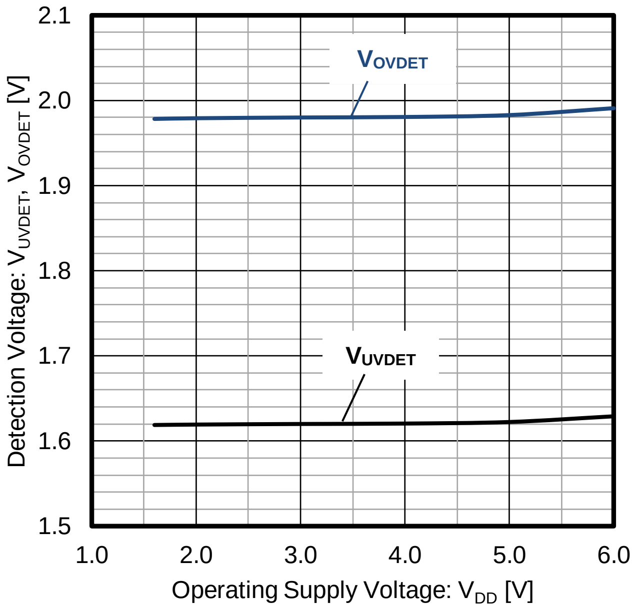


Figure 3. Detection Voltage vs Operating Supply Voltage (Ta = 25 °C)

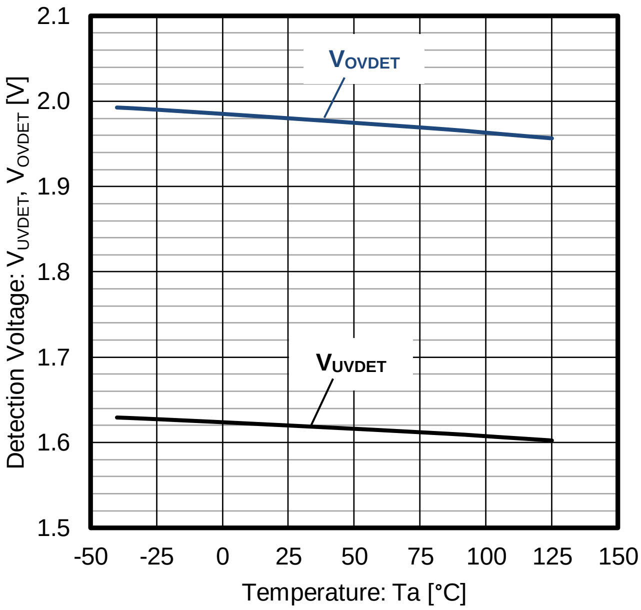


Figure 4. Detection Voltage vs Temperature (V_{DD} = 3 V)

(Note) The above data is measurement value of typical sample, it is not guaranteed.

Typical Performance Curves - continued

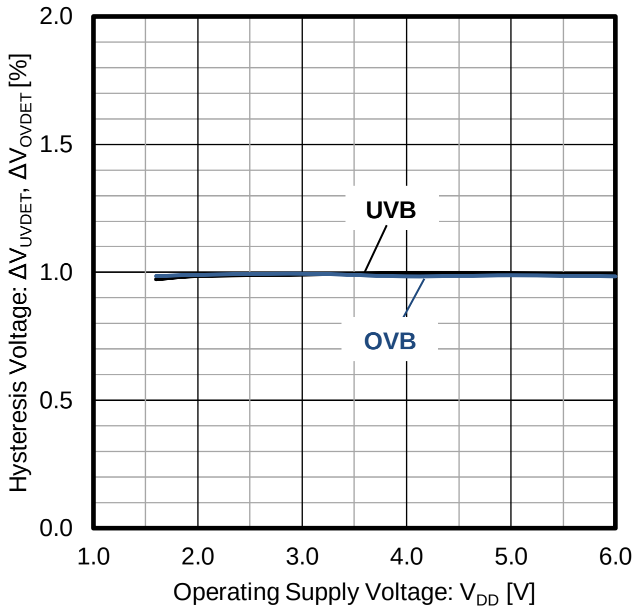


Figure 5. Hysteresis Voltage vs Operating Supply Voltage (Ta = 25 °C)

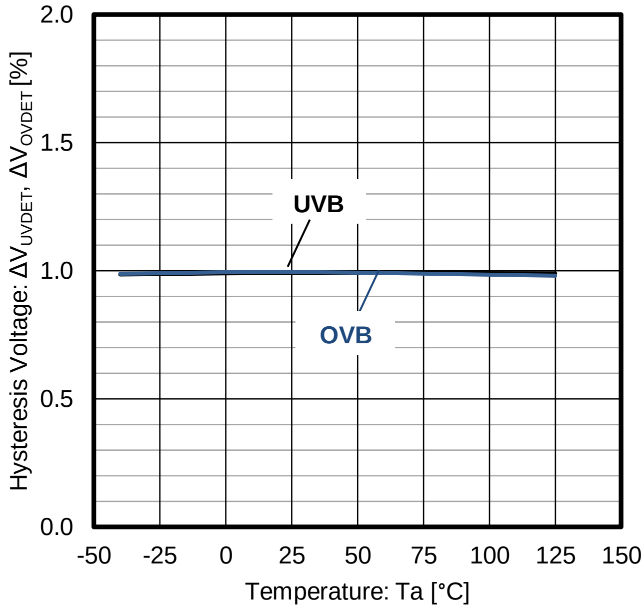


Figure 6. Hysteresis Voltage vs Temperature (V_{DD} = 3 V)

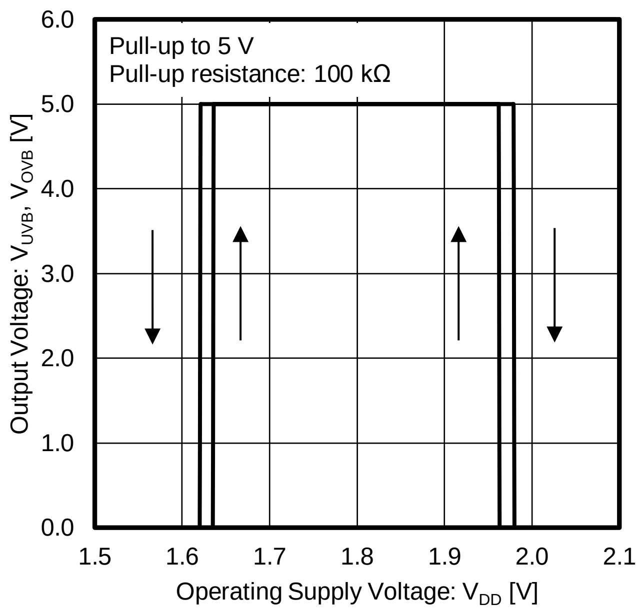


Figure 7. Output Voltage vs Operating Supply Voltage (Ta = 25 °C, VDD = SENSE, UVB = OVB)

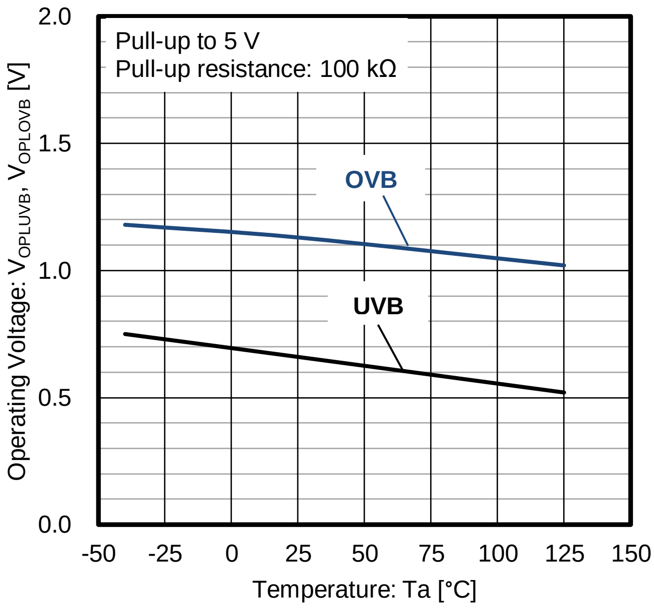


Figure 8. Operating Voltage vs Temperature

(Note) The above data is measurement value of typical sample, it is not guaranteed.

Typical Performance Curves - continued

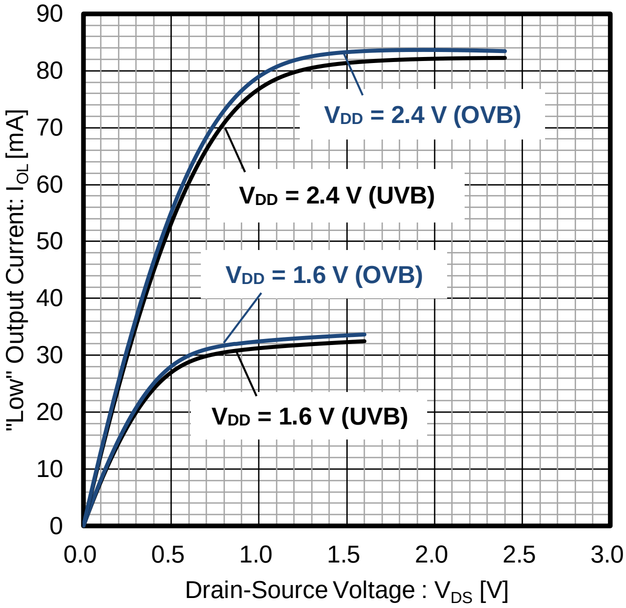


Figure 9. "Low" Output Current vs Drain-Source Voltage (Ta = 25 °C)

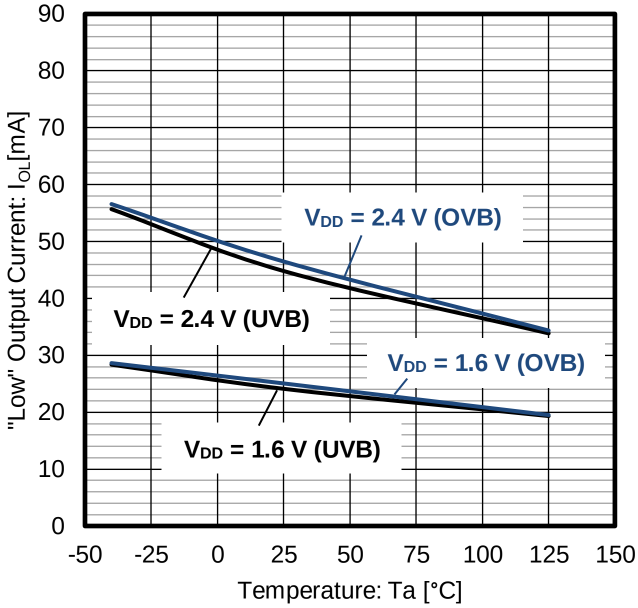


Figure 10. "Low" Output Current vs Temperature (V_{DS} = 0.4 V)

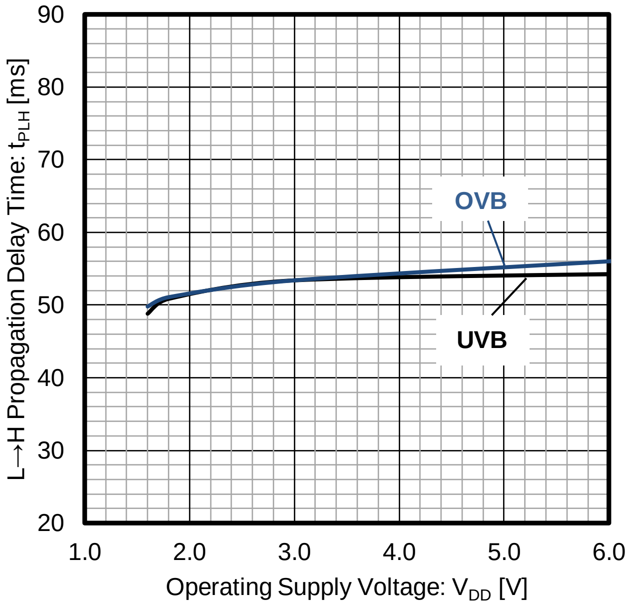


Figure 11. L→H Propagation Delay Time vs Operating Supply Voltage (Ta = 25 °C, C_{CT} = 10 nF)

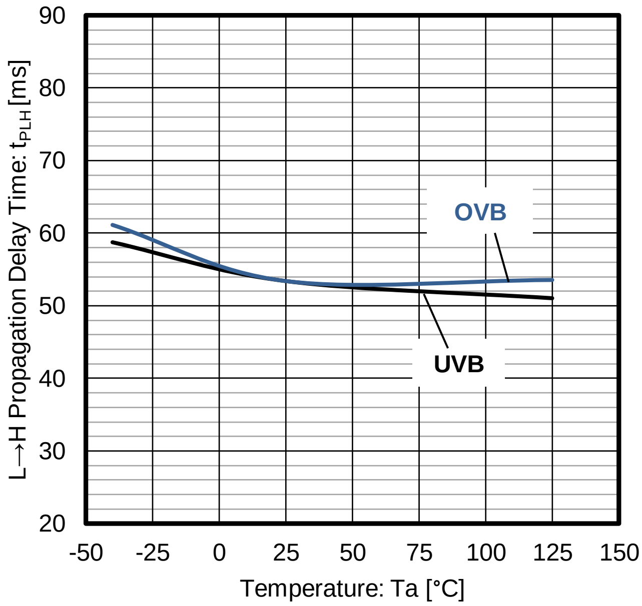


Figure 12. L→H Propagation Delay Time vs Temperature (V_{DD} = 3 V, C_{CT} = 10 nF)

(Note) The above data is measurement value of typical sample, it is not guaranteed.

Typical Performance Curves - continued

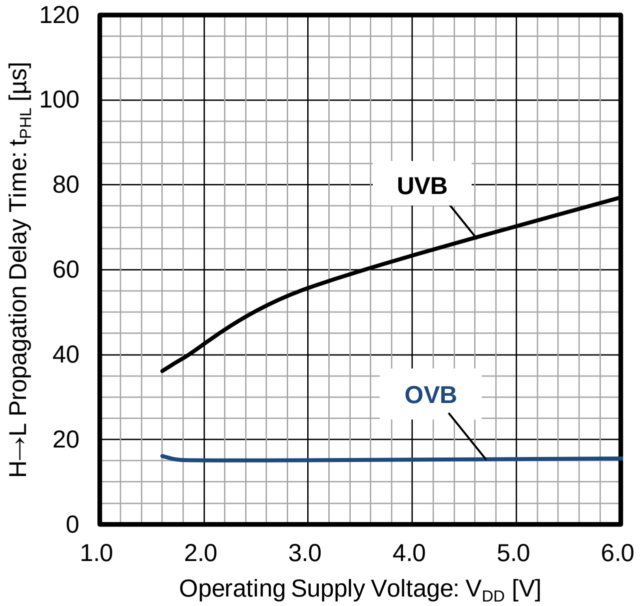


Figure 13. H→L Propagation Delay Time vs Operating Supply Voltage (Ta = 25 °C)

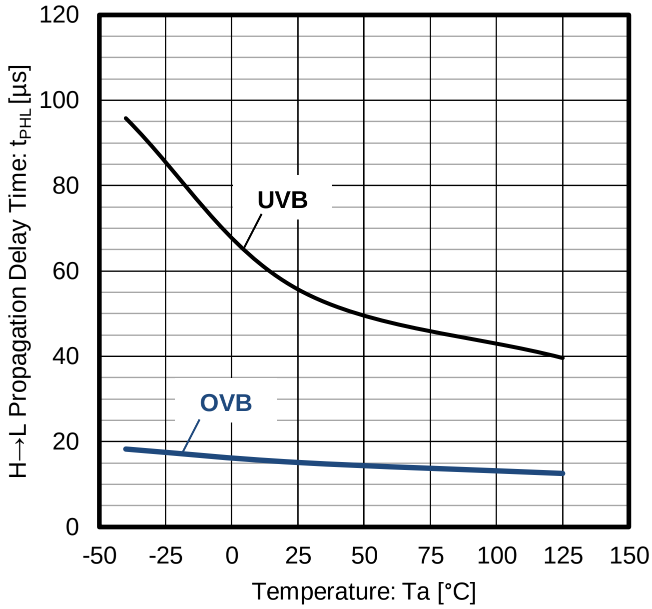


Figure 14. H→L Propagation Delay Time vs Temperature (V_{DD} = 3 V)

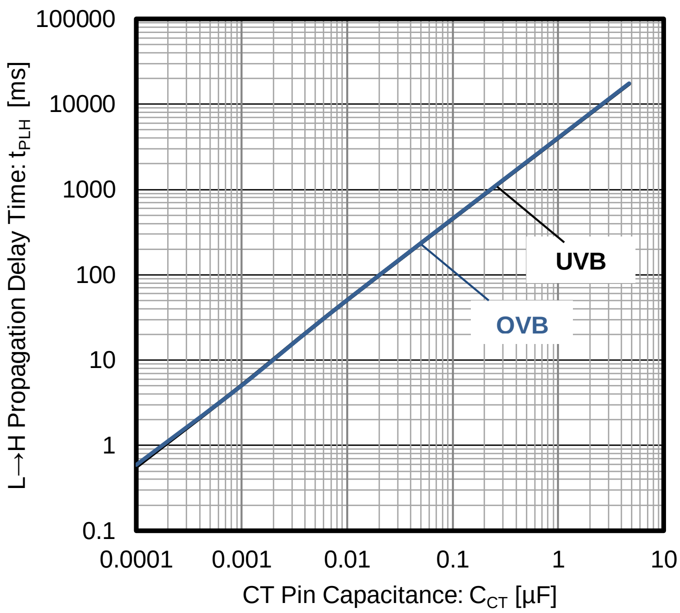


Figure 15. L→H Propagation Delay Time vs CT Pin Capacitance (V_{DD} = 3 V, Ta = 25 °C)

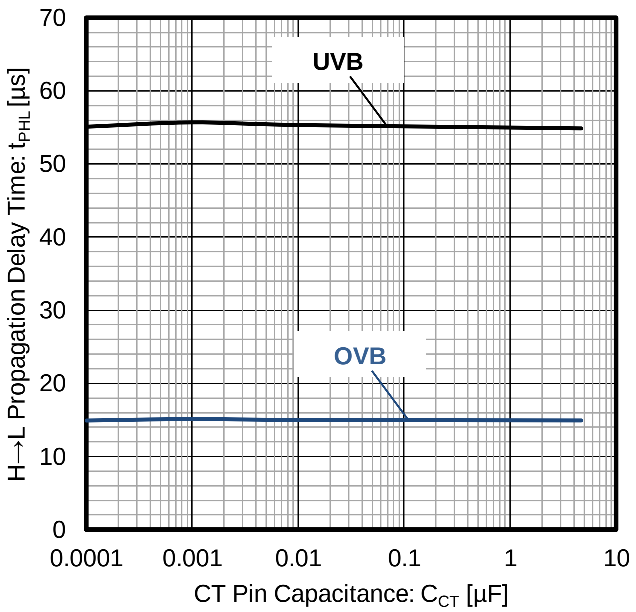


Figure 16. H→L Propagation Delay Time vs CT Pin Capacitance (V_{DD} = 3 V, Ta = 25 °C)

(Note) The above data is measurement value of typical sample, it is not guaranteed.

Timing Chart

The following shows the change of the output voltages when operating supply voltage (V_{DD}) and SENSE pin Voltage (V_{SENSE}) sweep.

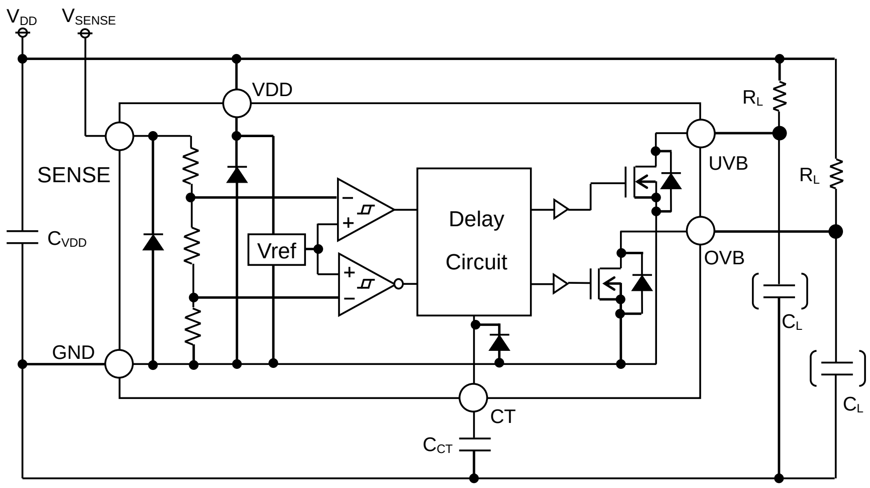


Figure 17. Set-up diagram

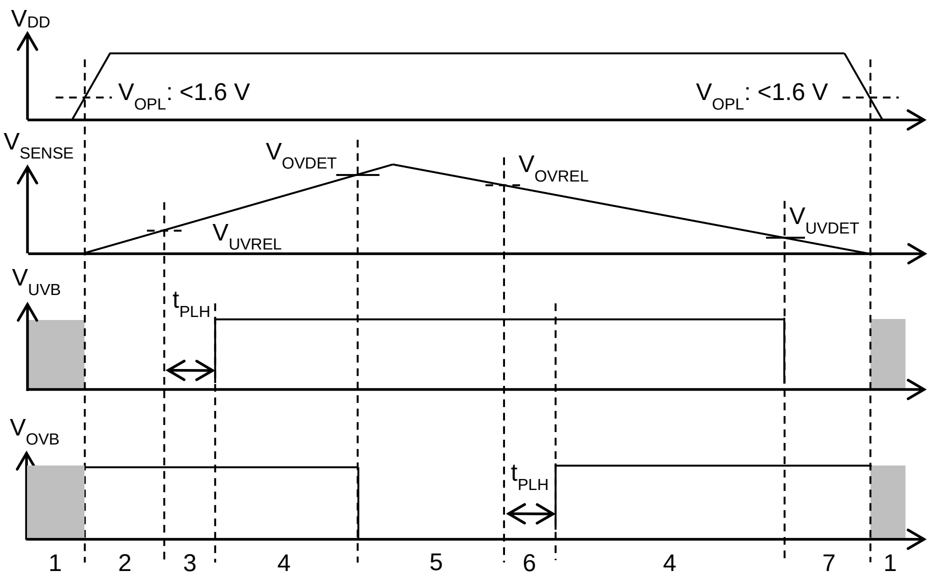


Figure 18. Timing Chart

Operating Conditions Explanation

1. The Output Voltage (V_{OVB} and V_{UVB}) becomes unstable until V_{DD} exceeds the Minimum Operating Voltage (V_{OPL}).
2. When V_{DD} exceeds the Minimum Operating Voltage (V_{OPL}) but V_{SENSE} is the Under Voltage Detection Voltage (V_{UVDET}) or less, V_{UVB} changes to "L" and V_{OVB} changes to "H". However, this change depends on the V_{UVB} and V_{OVB} rise time when the power supply starts up, so thorough confirmation is required.
3. When V_{SENSE} rises and exceeds the Under Voltage Release Voltage (V_{UVREL}), delay time (t_{PLH}) set by the capacitor at CT pin (C_{CT}) happens and V_{UVB} switches from "L" to "H".
4. Both Under Voltage and Over Voltage are undetected so V_{UVB} and V_{OVB} remains "H".
5. When V_{SENSE} rises further and exceeds the Over Voltage Detection Voltage (V_{OVDET}), V_{OVB} changes from "H" to "L" and state becomes Over Voltage Detection.
6. When V_{SENSE} drops and falls below the Over Voltage Release Voltage (V_{OVREL}), delay time (t_{PLH}) set by the capacitor at CT pin (C_{CT}) happens and V_{OVB} switches from "L" to "H".
7. When V_{SENSE} decreases further and falls below the Under Voltage Detection Voltage (V_{UVDET}), V_{UVB} changes from "H" to "L" and state becomes Under Voltage Detection.

(Note) The potential difference between the detection voltage and the release voltage is known as the Hysteresis Voltage width. The system is designed such that the output will not toggle with power supply fluctuations within this hysteresis width, preventing malfunctions due to noise.

Application Information

Operation Description

The detection and release voltage are used as threshold voltages. When the voltage applied to the SENSE pin reaches the applicable threshold voltage, the V_{OVB} and V_{UVB} levels switch from either “H” to “L” or “L” to “H”. BD52W03G-C have delay time function, which set t_{PLH} using an external capacitor connected in CT pin (C_{CT}) when output switches “L” to “H”. Because the BD52W03G-C uses an open drain output type, it is necessary to connect a pull-up resistor to V_{DD} or another power supply. (In this case, the output “H” voltage becomes V_{DD} or the voltage of another power supply).

Setting of Detector Delay Time

The detection release delay time (t_{PLH}) can be set according to the C_{CT} value of the capacitor connected to the CT pin. The detection release delay time (t_{PLH}) is the time when V_{UVB} or V_{OVB} rises to 1/2 of V_{DD} after V_{SENSE} rises and exceeds the under voltage release voltage (V_{UVREL}) or V_{SENSE} drops and falls below the Over Voltage Release Voltage (V_{OVREL}) after V_{DD} rising. The delay time is calculated from the following formula. When CT capacitor is 1 nF or more, delay time when CT pin is open (t_{CTO}) has less effect and t_{PLH} computation is shown on Example No. 2. The result has ±50 % tolerance within the operating temperature range of -40 °C to +125 °C.

Formula: (Ta = 25 °C)

$$t_{PLH} = C_{CT} \times Delay\,Coefficient + t_{CTO} \text{ [s]}$$

where:

C_{CT} is the CT pin external capacitor.

Delay Coefficient is equal to 5.55 x 10^6.

t_{CTO} is the delay time when CT = open(Note 1)

Temperature range	Delay time (t_{CTO})					
	UVB			OVB		
	Min	Typ	Max	Min	Typ	Max
Ta = -40 °C to +125 °C	30 µs	85 µs	250 µs	40 µs	125 µs	600 µs

(Note 1) t_{CTO} is design guarantee only.

Example No. 1:

CT capacitor = 100 pF

$$t_{PLH\_min} = (100 \times 10^{-12} \times 5.55 \times 10^{6}) \times 0.5 + 30 \times 10^{-6} = 308 \text{ µs}$$

$$t_{PLH\_typ} = (100 \times 10^{-12} \times 5.55 \times 10^{6}) \times 1.0 + 85 \times 10^{-6} = 640 \text{ µs}$$

$$t_{PLH\_max} = (100 \times 10^{-12} \times 5.55 \times 10^{6}) \times 1.5 + 250 \times 10^{-6} = 1083 \text{ µs}$$

Example No. 2:

CT capacitor = 1 nF

$$t_{PLH\_typ} = 1 \times 10^{-9} \times 5.55 \times 10^{6} = 5.55 \text{ ms}$$

Application Information - continued

Bypass Capacitor for Noise Rejection

For the stable operation of the IC, put capacitor 0.1 μF or more between the VDD and GND pin and connect it closer to the pin as possible. When using extremely big capacitors, the transient response speed becomes slow so check thoroughly.

External Parameters

The recommended value of CT capacitor is from open to 4.7 μF and pull-up resistance value is 50 kΩ to 1 MΩ. Since the changes are brought by many factors (circuit configuration, board layout, etc.) when using, ensure that confirmation of the real function was carried out. In addition, this IC has high impedance design. So depending on the condition of use, this may be affected by unexpected leak route due to the uncleanness of PCB surface. For example, if a 10 MΩ leakage is assumed between the output and GND pins, it is recommended to set the value of pull-up resistor to 1/10 or less of the impedance of assumed leakage route.

Behavior at less than the Operating Voltage Range

When V_{DD} falls less than the operating voltage range, output will be undefined. When output is connected to pull-up voltage, output will be equivalent to pull-up voltage.

Precautions when Steep Power Supply Rise

In case of a steep power supply rise, the output may be unstable even if V_{DD} exceeds the operating voltage range. This is due to the undefined output when the supply is less than the operating voltage range of the IC. When this waveform affects the application, make the rise time slower by attaching capacitor to VDD (C_{VDD}). As a reference value, the recommended V_{DD} Rise Time is 200 μs or more.

CT Pin Discharge

Due to the capabilities of the CT pin discharge transistor, the CT pin may not completely discharge when a short input pulse is applied, and in this case, the delay time may not be controlled. Verify the actual operation.

Application Examples

Examples of the Power Supply with Resistor Dividers

The following shows example of applications of a resistor divider circuit in applications which the resistor connected to the power supply voltage (VDD) of an IC. In case of the VDD pin is shorted to the SENSE pin, When the output logic changes its state, an Inrush current will flow suddenly into the circuit. This current flow may cause malfunction in the systems operation such as output oscillations, etc. The recommended value of R_A is 4.7 kΩ or less, and C_{VDD} is 0.1 µF or more. (Inrush current will flow suddenly from the power supply (VDD) to GND when the output level switches to "H" or "L".)

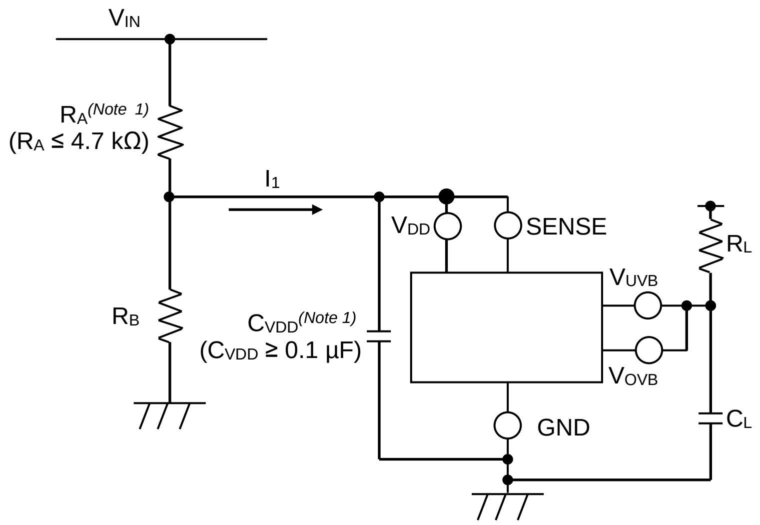


Figure 19. Resistor Divider Connection Application

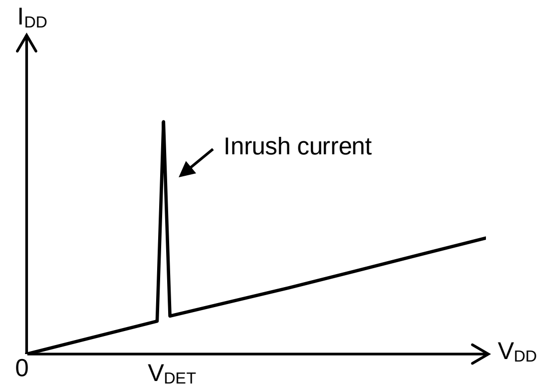


Figure 20. Current Consumption vs V_{DD} Voltage

(Note 1) The circuit example mentioned above does not guarantee successful operation.
Perform thorough evaluation using the actual application and set countermeasures.

For example, during low voltage detection release, a voltage drop [Inrush current (I_1)] x [input resistor (R_A)] is caused by the Inrush current when output changes from "L" to "H", and causes the input voltage to drop. When the input voltage drops and falls below the detection voltage, the output will switch from "H" to "L". At this time, the Inrush current stops flowing through output "L", and the voltage drop disappears. As a result, the output switches from "L" to "H", which again causes the Inrush current to flow and the voltage to drop. This operation repeats and leads to oscillation. In case resistor divider is not use and only use R_A, same response will happen. In addition, note that the same phenomenon occurs during over voltage detection.

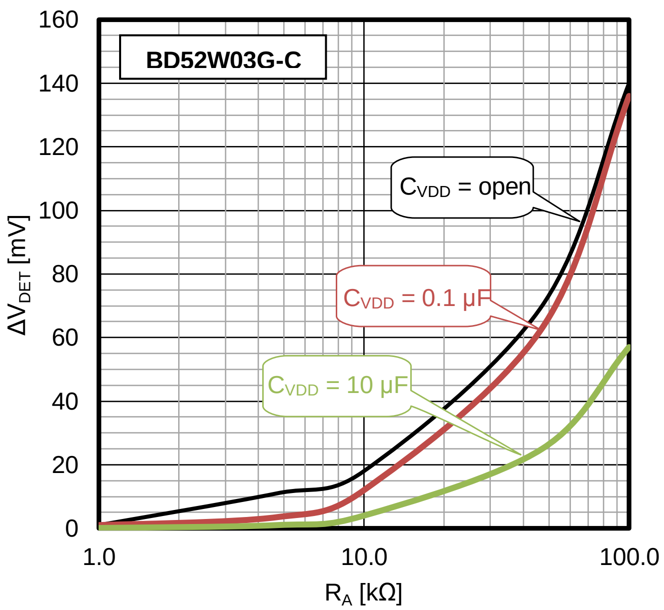


Figure 21. ΔV_{DET} vs R_A (Reference)
(Ta = 125 °C, V_{IN} = SWEEP)

The graph above shows the deviation of detection voltage ΔV_{DET} dependent on R_A and C_{VDD}.

Application Examples - continued

Depending on the application set-up, there are times that V_{DD} voltage is always below the Release Voltage because of the effect of Inrush current as shown follows.

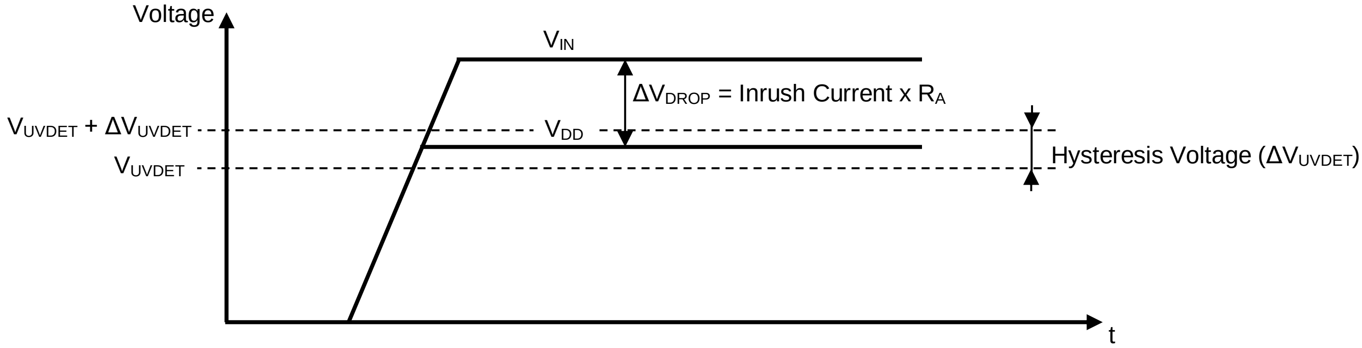


Figure 22. V_{DD} Drop Caused by Inrush Current

Application Examples - continued

Considerations on Input and Output Capacitor

It is suggested to use capacitors between the input pin and GND, and the output pin and GND, which is positioned as near as possible to the pins. The capacitor between the input pin and GND is effective when the power supply impedance increases or when the wiring is long. A large capacitor between the output pin and GND improves stability and output load characteristics. Check the state of mounting. In addition, the ceramic capacitor deviates and has temperature characteristics and AC bias characteristics in general. Furthermore, depending on the usage, the capacitance value decreases over time. It is recommended that ceramic capacitor to use is decided after gathering detailed data information by consulting brand manufacturers.

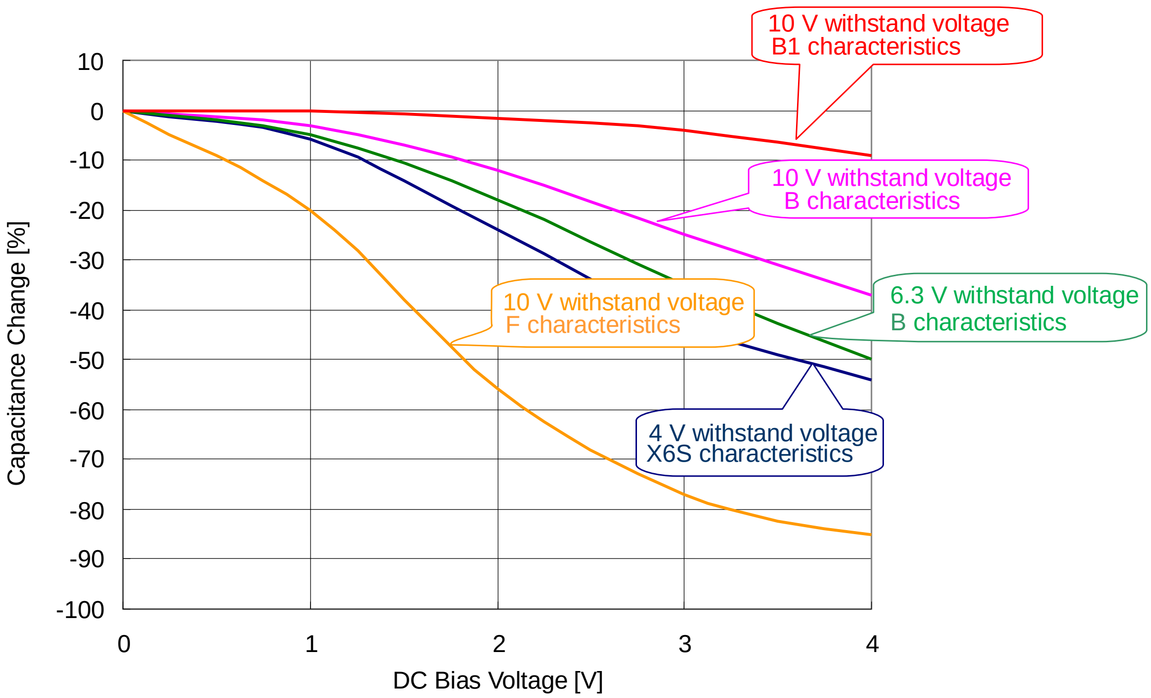
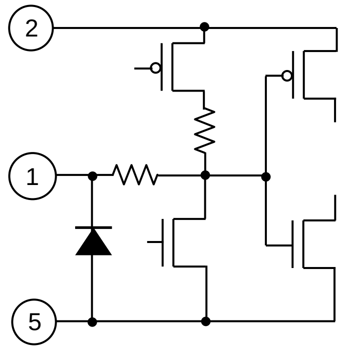
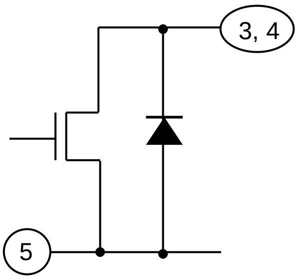
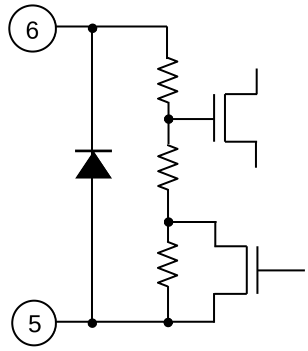


Figure 23. Ceramic Capacitance Change vs DC Bias voltage
(Characteristic example)

I/O Equivalence Circuits

Pin No.	Pin Name	Pin Description	Equivalence Circuit
1	CT	Capacitor connection pin for output delay time setting	
3 4	UVB OVB	Under voltage detection output pin Over voltage detection output pin	
6	SENSE	SENSE pin	

Operational Notes

1. **Reverse Connection of Power Supply**
   Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply pins.

2. **Power Supply Lines**
   Design the PCB layout pattern to provide low impedance supply lines. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

3. **Ground Voltage**
   Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition.

4. **Ground Wiring Pattern**
   When using both small-signal and large-current ground traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

5. **Recommended Operating Conditions**
   The function and operation of the IC are guaranteed within the range specified by the recommended operating conditions. The characteristic values are guaranteed only under the conditions of each item specified by the electrical characteristics.

6. **Inrush Current**
   When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

7. **Testing on Application Boards**
   When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

8. **Inter-pin Short and Mounting Errors**
   Ensure that the direction and position are correct when mounting the IC on the PCB. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground, power supply and output pin. Inter-pin shorts could be due to many reasons such as metal particles, water droplets (in very humid environment) and unintentional solder bridge deposited in between pins during assembly to name a few.

9. **Unused Input Pins**
   Input pins of an IC are often connected to the gate of a MOS transistor. The gate has extremely high impedance and extremely low capacitance. If left unconnected, the electric field from the outside can easily charge it. The small charge acquired in this way is enough to produce a significant effect on the conduction through the transistor and cause unexpected operation of the IC. So unless otherwise specified, unused input pins should be connected to the power supply or ground line.

10. **Regarding the Input Pin of the IC**
    In the construction of this IC, P-N junctions are inevitably formed creating parasitic diodes or transistors. The operation of these parasitic elements can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions which cause these parasitic elements to operate, such as applying a voltage to an input pin lower than the ground voltage should be avoided. Furthermore, do not apply a voltage to the input pins when no power supply voltage is applied to the IC. Even if the power supply voltage is applied, make sure that the input pins have voltages within the values specified in the electrical characteristics of this IC.

Operational Notes – continued

11. **Ceramic Capacitor**
When using a ceramic capacitor, determine a capacitance value considering the change of capacitance with temperature and the decrease in nominal capacitance due to DC bias and others.

12. **Functional Safety**
"ISO 26262 Process Compliant to Support ASIL-*"
A product that has been developed based on an ISO 26262 design process compliant to the ASIL level described in the datasheet.
"Safety Mechanism is Implemented to Support Functional Safety (ASIL-*)"
A product that has implemented safety mechanism to meet ASIL level requirements described in the datasheet.
"Functional Safety Supportive Automotive Products"
A product that has been developed for automotive use and is capable of supporting safety analysis with regard to the functional safety.
Note: "ASIL-*" is stands for the ratings of "ASIL-A", "-B", "-C" or "-D" specified by each product's datasheet.

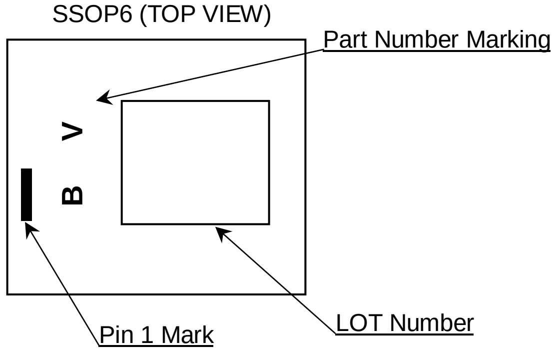
Ordering Information

B	D	5	2	W	0	3	G	-	C	T	R

Package
G: SSOP6

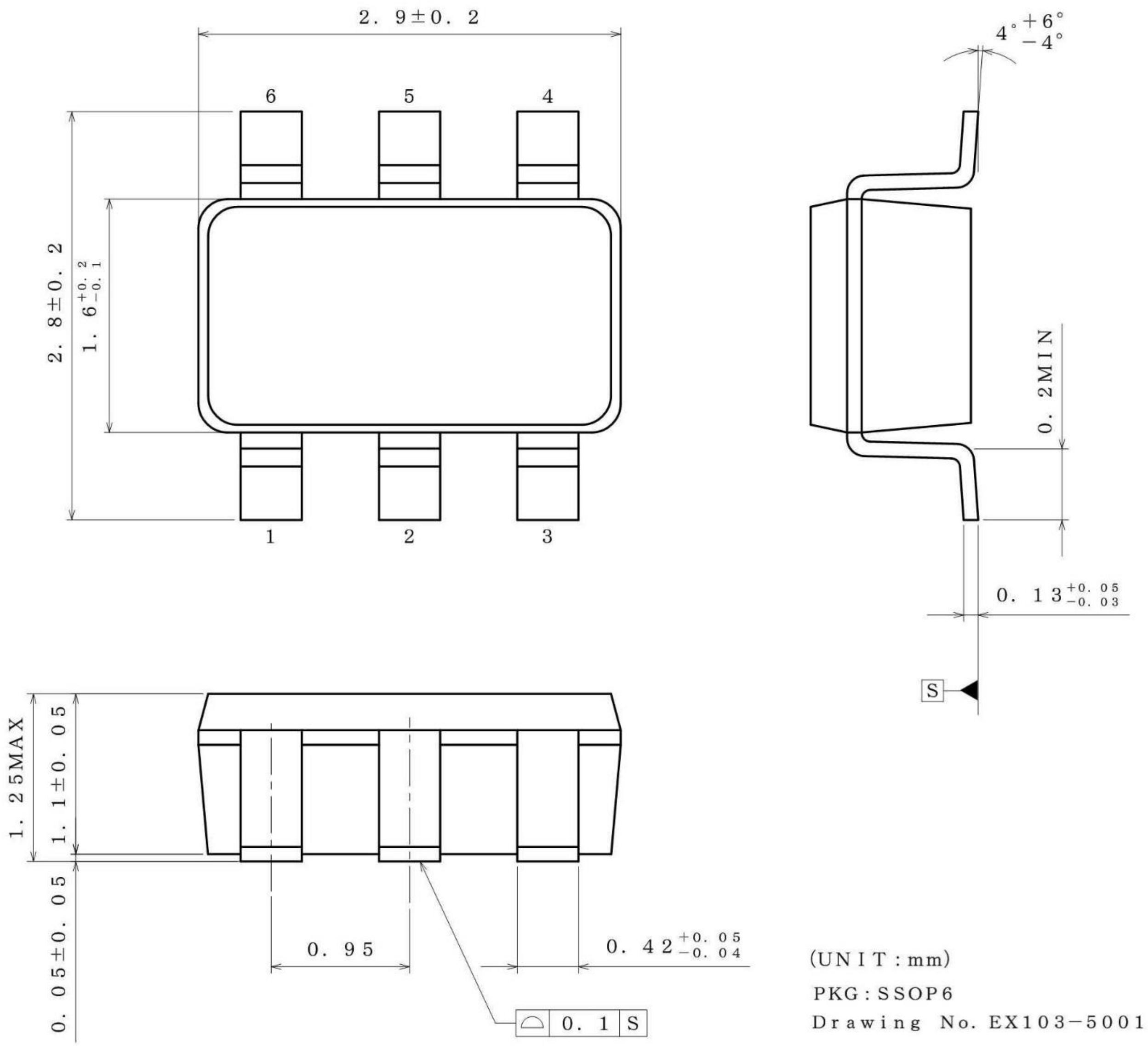
Product Rank
C: for Automotive
Packaging and forming specification
TR: Embossed tape and reel

Marking Diagram



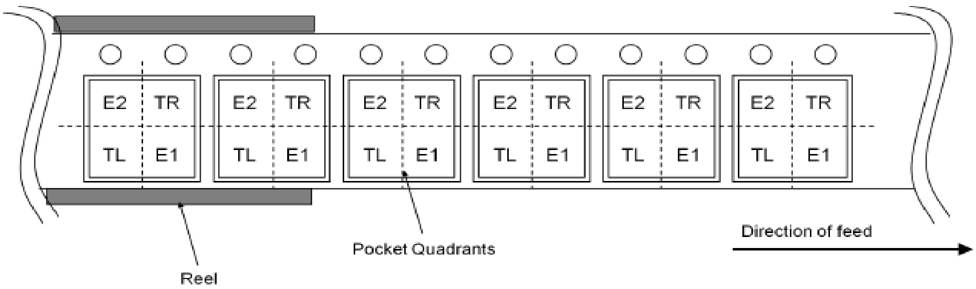
Physical Dimension and Packing Information

Package Name	SSOP6



< 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)



Revision History

Date	Revision	Changes
26.Dec.2019	001	New Release

Notice

Precaution on using ROHM Products

1. If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), aircraft/spacecraft, nuclear power controllers, 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.

   (Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

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 not designed 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_2, H_2S, NH_3, SO_2, and NO_2
   [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 (Exclude cases where no-clean type fluxes is used. However, recommend sufficiently about the residue.); 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 depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction 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 on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, 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_2, H_2S, NH_3, SO_2, and NO_2
   [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

A two-dimensional barcode 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 concerned goods might be fallen under listed items of export control prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

Precaution Regarding Intellectual Property Rights

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