Voltage Detector IC Series for Automotive

Counter Timer Built-in CMOS Voltage Detector IC

BD45Exxxx-M series BD46Exxxx-M series

●General Description

ROHM's BD45Exxxx-M and BD46Exxxx-M series are highly accurate, low current consumption Voltage Detector IC series. Because the counter timer delay circuit is built into those series, an external capacitor for the delay time setting is unnecessary. The lineup was established with two output types (Nch open drain and CMOS output) and detection voltages range from 2.3V to 4.8V in increments of 0.1V, so that the series may be selected according to application.

●Features

- Counter Timer Built-in
- No delay time setting capacitor required
- Ultra-low current consumption
- Two output types (Nch open drain and CMOS output)
- Package SSOP5 is similar to SOT-23-5 (JEDEC)
- AEC-Q100 Qualified

●Key Specifications

- Detection voltage: 2.3V to 4.8V (Typ.) 0.1V steps
- High accuracy detection voltage: ±1.0%
- Ultra-low current consumption: 0.85µA (Typ.)
- Operating temperature range: -40°C to +105°C
- Three internal, fixed delay time: 50ms, 100ms, 200ms

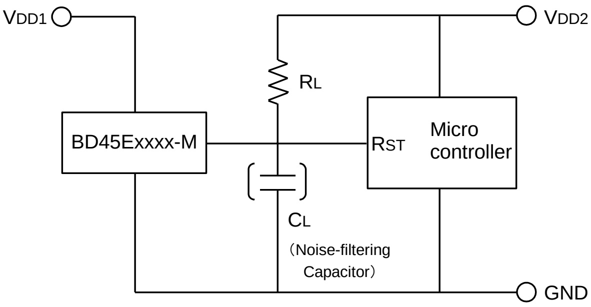
●Package

SSOP5  2.90mm x 2.80mm x 1.25mm

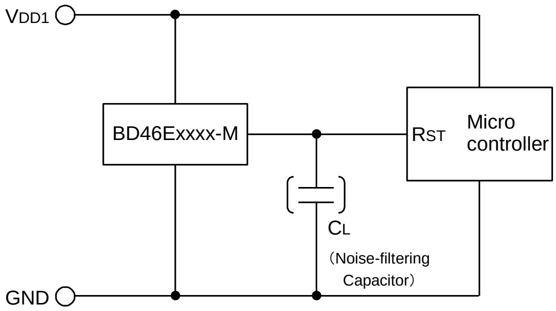
●Applications

Circuits using microcontrollers or logic circuits that require a reset for automotive applications (car navigation, car audio, meter panel, exterior lamp etc.)

●Typical Application Circuit



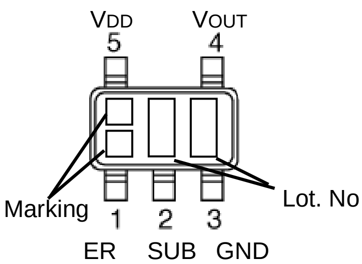
(Open Drain Output Type)
BD45Exxxx-M series



(CMOS Output Type)
BD46Exxxx-M series

●Connection Diagram

SSOP5



●Pin Descriptions

PIN No.	Symbol	Function
1	ER	Manual Reset
2	SUB	Substrate *
3	GND	GND
4	VOUT	Reset Output
5	VDD	Power Supply Voltage

*Connect the substrate to GND.

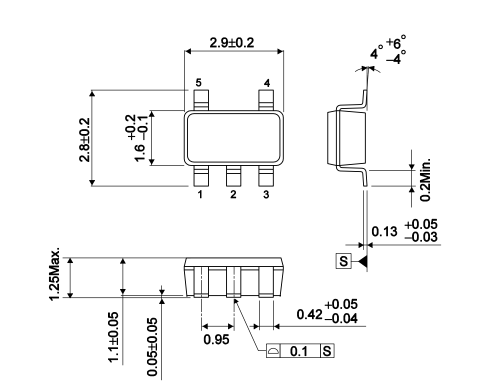
○Product structure：Silicon monolithic integrated circuit ○This product is not designed for protection against radioactive rays

●Ordering Information

B	D	x	x	E	x	x	x	x	−	M	T	R

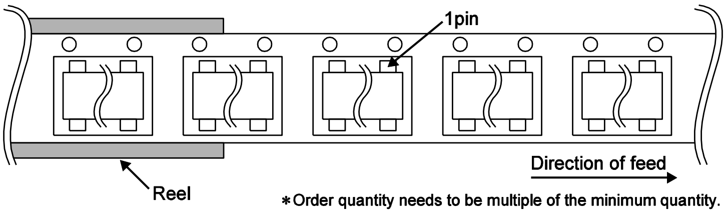
- Part Number
- Output Type: 45 : Open Drain, 46 : CMOS
- Reset Voltage Value: 23 : 2.3V ⇩ 0.1V step 48 : 4.8V
- Counter Timer Delay Time Settings: 5 : 50ms, 1 : 100ms, 2 : 200ms
- Package: G : SSOP5
- Product Category: M : Automotive Category
- Packaging and forming specification: TR : Embossed tape 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.

●Lineup

Table 1. Open Drain Output Type

Detection Voltage	50ms Marking	50ms Part Number	100ms Marking	100ms Part Number	200ms Marking	200ms Part Number
4.8V	a2	BD45E485	d1	BD45E481	f9	BD45E482
4.7V	a1	BD45E475	c9	BD45E471	f8	BD45E472
4.6V	Yy	BD45E465	c8	BD45E461	f7	BD45E462
4.5V	Yr	BD45E455	c7	BD45E451	f6	BD45E452
4.4V	Yp	BD45E445	c6	BD45E441	f5	BD45E442
4.3V	Yn	BD45E435	c5	BD45E431	f4	BD45E432
4.2V	Ym	BD45E425	c4	BD45E421	f3	BD45E422
4.1V	Yk	BD45E415	c3	BD45E411	f2	BD45E412
4.0V	Yh	BD45E405	c2	BD45E401	f1	BD45E402
3.9V	Yg	BD45E395	c1	BD45E391	e9	BD45E392
3.8V	Yf	BD45E385	b9	BD45E381	e8	BD45E382
3.7V	Ye	BD45E375	b8	BD45E371	e7	BD45E372
3.6V	Yd	BD45E365	b7	BD45E361	e6	BD45E362
3.5V	Yc	BD45E355	b6	BD45E351	e5	BD45E352
3.4V	Yb	BD45E345	b5	BD45E341	e4	BD45E342
3.3V	Ya	BD45E335	b4	BD45E331	e3	BD45E332
3.2V	Uy	BD45E325	b3	BD45E321	e2	BD45E322
3.1V	Ur	BD45E315	b2	BD45E311	e1	BD45E312
3.0V	Up	BD45E305	b1	BD45E301	d9	BD45E302
2.9V	Un	BD45E295	a9	BD45E291	d8	BD45E292
2.8V	Um	BD45E285	a8	BD45E281	d7	BD45E282
2.7V	Uk	BD45E275	a7	BD45E271	d6	BD45E272
2.6V	Uh	BD45E265	a6	BD45E261	d5	BD45E262
2.5V	Ug	BD45E255	a5	BD45E251	d4	BD45E252
2.4V	Uf	BD45E245	a4	BD45E241	d3	BD45E242
2.3V	Ue	BD45E235	a3	BD45E231	d2	BD45E232

●**Lineup - continued**

Table 2. CMOS Output Type

	Counter Timer Delay Time Settings					
	50ms		100ms		200ms	
Detection Voltage	Marking	Part Number	Marking	Part Number	Marking	Part Number
4.8V	k8	BD46E485	p7	BD46E481	1f	BD46E482
4.7V	k7	BD46E475	p6	BD46E471	1e	BD46E472
4.6V	k6	BD46E465	p5	BD46E461	1d	BD46E462
4.5V	k5	BD46E455	p4	BD46E451	1c	BD46E452
4.4V	k4	BD46E445	p3	BD46E441	1b	BD46E442
4.3V	k3	BD46E435	p2	BD46E431	1a	BD46E432
4.2V	k2	BD46E425	p1	BD46E421	y9	BD46E422
4.1V	k1	BD46E415	n9	BD46E411	y8	BD46E412
4.0V	h9	BD46E405	n8	BD46E401	y7	BD46E402
3.9V	h8	BD46E395	n7	BD46E391	y6	BD46E392
3.8V	h7	BD46E385	n6	BD46E381	y5	BD46E382
3.7V	h6	BD46E375	n5	BD46E371	y4	BD46E372
3.6V	h5	BD46E365	n4	BD46E361	y3	BD46E362
3.5V	h4	BD46E355	n3	BD46E351	y2	BD46E352
3.4V	h3	BD46E345	n2	BD46E341	y1	BD46E342
3.3V	h2	BD46E335	n1	BD46E331	r9	BD46E332
3.2V	h1	BD46E325	m9	BD46E321	r8	BD46E322
3.1V	g9	BD46E315	m8	BD46E311	r7	BD46E312
3.0V	g8	BD46E305	m7	BD46E301	r6	BD46E302
2.9V	g7	BD46E295	m6	BD46E291	r5	BD46E292
2.8V	g6	BD46E285	m5	BD46E281	r4	BD46E282
2.7V	g5	BD46E275	m4	BD46E271	r3	BD46E272
2.6V	g4	BD46E265	m3	BD46E261	r2	BD46E262
2.5V	g3	BD46E255	m2	BD46E251	r1	BD46E252
2.4V	g2	BD46E245	m1	BD46E241	p9	BD46E242
2.3V	g1	BD46E235	k9	BD46E231	p8	BD46E232

● **Absolute maximum ratings**

Parameter		Symbol	Limits	Unit
Power Supply Voltage		V_{DD}-GND	-0.3 to +10	V
Output Voltage	Nch Open Drain Output	VOUT	GND-0.3 to +10	V
	CMOS Output		GND-0.3 to V_{DD}+0.3	
Output Current		IO	60	mA
ER pin Voltage		VCT	GND-0.3 to V_{DD}+0.3	V
Power Dissipation *1,*2		Pd	540	mW
Operating Temperature		Topr	-40 to +105	°C
Ambient Storage Temperature		Tstg	-55 to +125	°C

*1 Reduced by 5.4mW/°C when used over 25°C.
*2 When mounted on ROHM standard circuit board (70mm×70mm×1.6mm, glass epoxy board).

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

Parameter	Symbol	Condition		Limit Min.	Limit Typ.	Limit Max.	Unit
Detection Voltage	VDET	VDD=H→L, RL=470kΩ *1		VDET(T) ×0.99	VDET(T)	VDET(T) ×1.01	V
		VDET=2.5V	Ta=+25°C	2.475	2.5	2.525	
			Ta=-40°C to 85°C	2.418	-	2.584	
			Ta=85°C to 105°C	2.404	-	2.597	
		VDET=3.0V	Ta=+25°C	2.970	3.0	3.030	
			Ta=-40°C to 85°C	2.901	-	3.100	
			Ta=85°C to 105°C	2.885	-	3.117	
		VDET=3.3V	Ta=+25°C	3.267	3.3	3.333	
			Ta=-40°C to 85°C	3.191	-	3.410	
			Ta=85°C to 105°C	3.173	-	3.428	
		VDET=4.2V	Ta=+25°C	4.158	4.2	4.242	
			Ta=-40°C to 85°C	4.061	-	4.341	
			Ta=85°C to 105°C	4.039	-	4.364	
		VDET=4.8V	Ta=+25°C	4.752	4.8	4.848	
			Ta=-40°C to 85°C	4.641	-	4.961	
			Ta=85°C to 105°C	4.616	-	4.987	
Detection Voltage Temperature coefficient	VDET/ ΔT	-40°C to +105°C		-	±100	±360	ppm/°C
Hysteresis Voltage	ΔVDET	VDD＝L→H→L, RL=470kΩ		VDET(T) ×0.03	VDET(T) ×0.05	VDET(T) ×0.08	V
'High' Output Delay time	tPLH	CL=100pF, RL=100kΩ *1,*2,*3	BD45Exx5, BD46Exx5	45	50	55	ms
			BD45Exx1, BD46Exx1	90	100	110	
			BD45Exx2, BD46Exx2	180	200	220	
Circuit Current when ON	IDD1	VDD=VDET-0.2V, VER=0V VDET=2.3V to 3.1V *1		-	0.70	2.10	µA
		VDD=VDET-0.2V, VER=0V VDET=2.3V to 3.1V		-	0.70	2.85	
		VDD=VDET-0.2V, VER=0V VDET=3.2V to 4.2V *1		-	0.75	2.25	
		VDD=VDET-0.2V, VER=0V VDET=3.2V to 4.2V		-	0.75	3.00	
		VDD=VDET-0.2V, VER=0V VDET=4.3V to 4.8V *1		-	0.80	2.40	
		VDD=VDET-0.2V, VER=0V VDET=4.3V to 4.8V		-	0.80	3.15	
Circuit Current when OFF	IDD2	VDD=VDET+0.2V, VER=0V VDET=2.3V to 3.1V *1		-	0.75	2.25	µA
		VDD=VDET+0.2V, VER=0V VDET=2.3V to 3.1V		-	0.75	4.28	
		VDD=VDET+0.2V, VER=0V VDET=3.2V to 4.2V *1		-	0.80	2.40	
		VDD=VDET+0.2V, VER=0V VDET=3.2V to 4.2V		-	0.80	4.50	
		VDD=VDET+0.2V, VER=0V VDET=4.3V to 4.8V *1		-	0.85	2.55	
		VDD=VDET+0.2V, VER=0V VDET=4.3V to 4.8V		-	0.85	4.73	

VDET(T):Standard Detection Voltage (2.3V to 4.8V, 0.1V step)
RL :Pull-up resistor to be connected between VOUT and power supply.
CL :Capacitor to be connected between VOUT and GND.
*1 Guarantee is Ta=25°C.
*2 tPLH:VDD=(VDET(T)-0.5V)→(VDET(T)+0.5V)
*3 tPLH:VDD=Please set up the rise up time between VDD=0→VDET more than 100µs.
Attention: Please connect 'ER' to the GND when not in use.

●**Electrical characteristics (Unless Otherwise Specified Ta=-40 to 105°C) – continued**

Parameter	Symbol	Condition	Limit			Unit
			Min.	Typ.	Max.	
Operating Voltage Range	V_{OPL}	V_{OL}≤0.4V, R_L=470kΩ, Ta=25 to 105°C	0.95	-	-	V
		V_{OL}≤0.4V, R_L=470kΩ, Ta=-40 to 25°C	1.20	-	-	
'High' Output Voltage (Pch)	V_{OH}	V_{DD}=4.8V, I_{SOURCE}= 1.0 mA, V_{DET}(2.3V to 4.2V)	VDD-0.5	-	-	V
		V_{DD}=6.0V, I_{SOURCE}= 1.2 mA, V_{DET}(4.3V to 4.8V)	VDD-0.5	-	-	
'Low'Output Voltage (Nch)	V_{OL}	V_{DD}=1.2V, I_{SINK} = 0.45 mA	-	-	0.3	V
		V_{DD}=2.4V, I_{SINK} = 1.3 mA, V_{DET}(2.7V to 4.8V)	-	-	0.3	
Leak Current when OFF	I_{leak}	V_{DD}=V_{DS}=10V *1	-	-	0.1	µA
ER Pin 'H' Voltage	V_{EH}	*1	2.0	-	-	V
ER Pin 'L' Voltage	V_{EL}	*1	-	-	0.8	V
ER Pin Input Current	I_{EL}		-	1	10	µA

V_{DET}(T):Standard Detection Voltage (2.3V to 4.8V, 0.1V step)
R_L :Pull-up resistor to be connected between V_{OUT} and power supply.
C_L :Capacitor to be connected between V_{OUT} and GND.
*1 Guarantee is Ta=25°C.
Attention: Please connect 'ER' to the GND when not in use.

● **Block Diagrams**

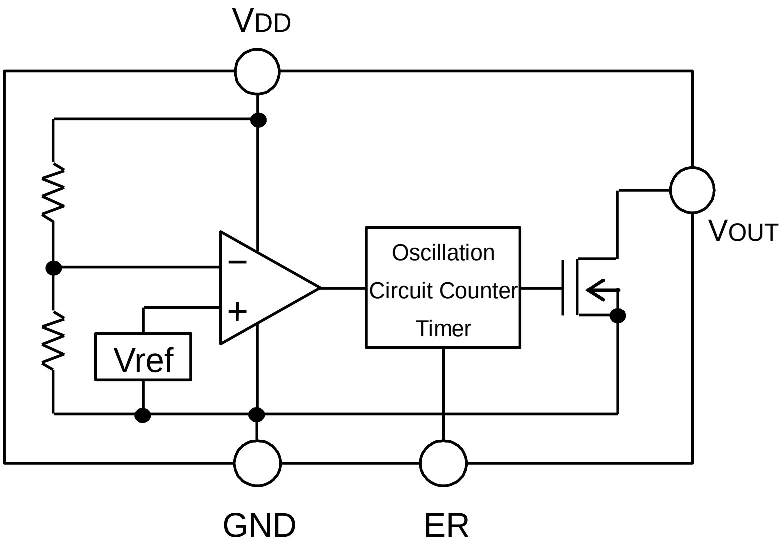


Fig.1 BD45Exxxx-M Series

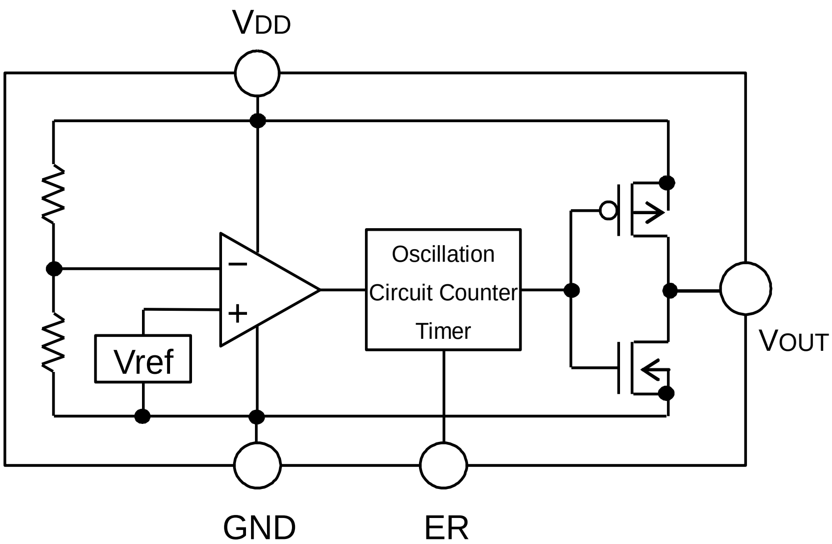


Fig.2 BD46Exxxx-M Series

●Typical Performance Curves

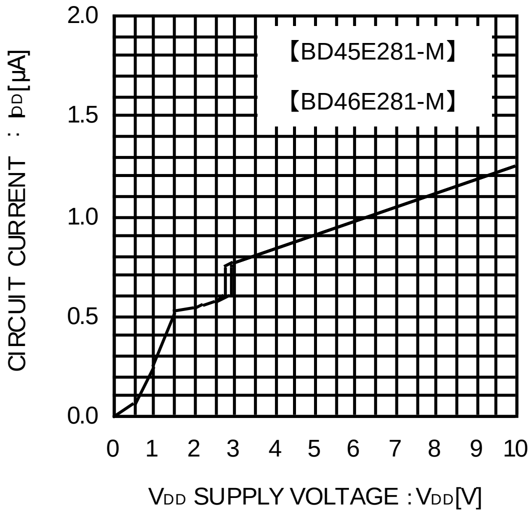


Fig.3 Circuit Current

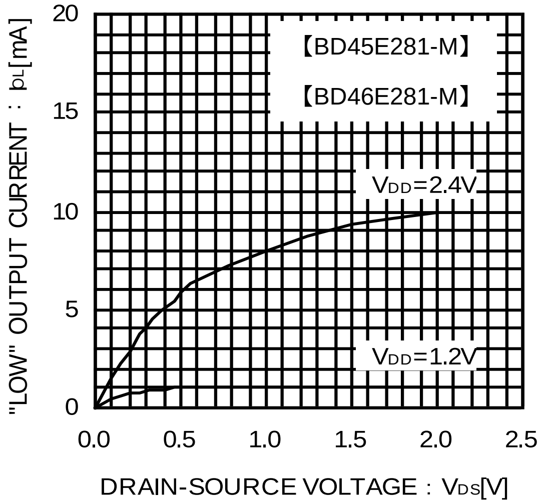


Fig.4 “Low” Output Current

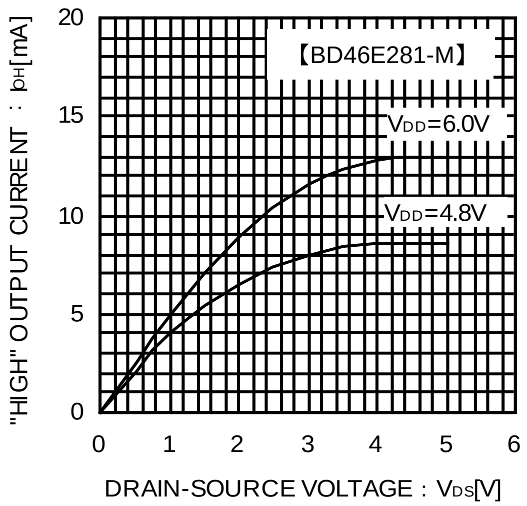


Fig.5 “High” Output Current

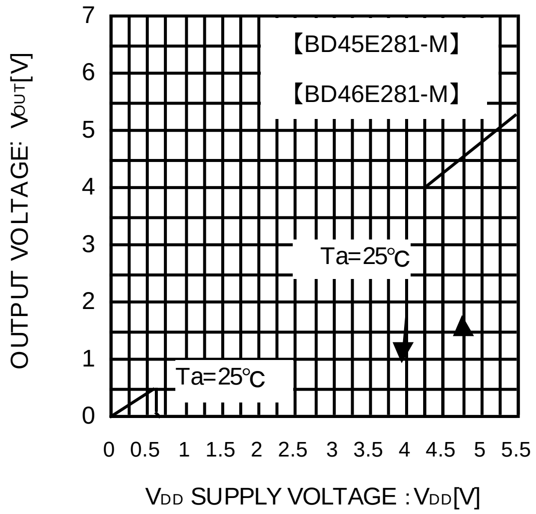


Fig.6 I/O Characteristics

●**Typical Performance Curves – continued**

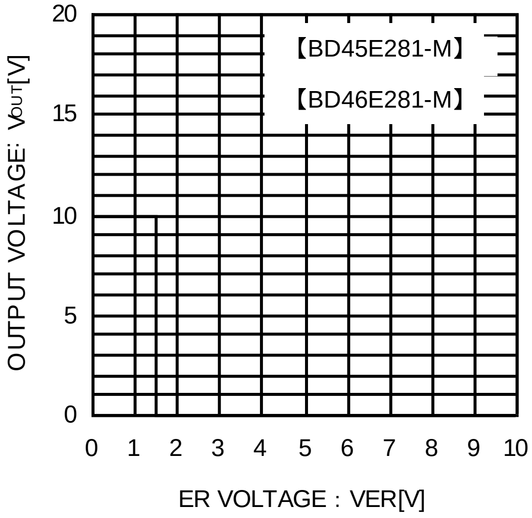


Fig.7 ER Terminal Threshold Voltage

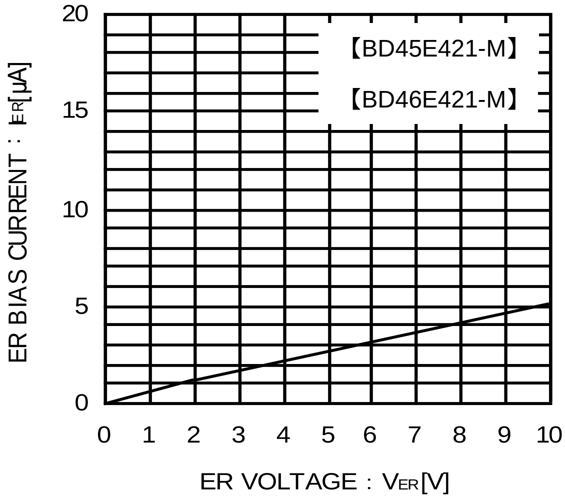


Fig.8 ER Terminal Input Current

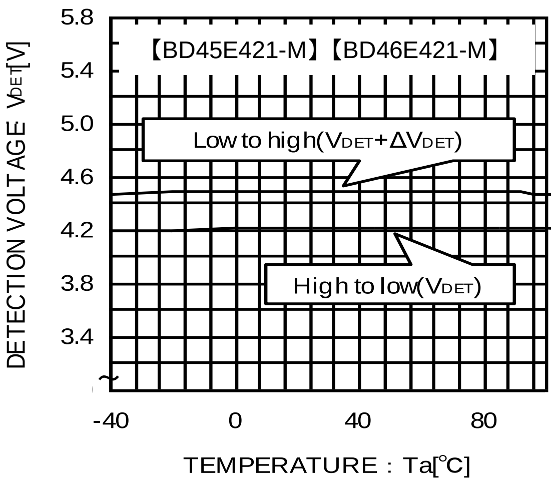


Fig.9 Detection Voltage
Release Voltage

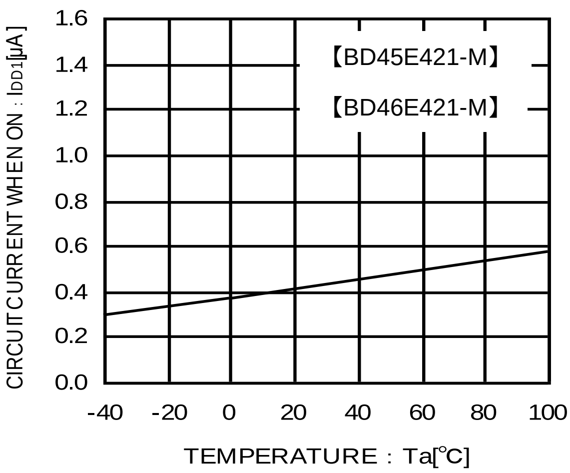


Fig.10 Circuit Current when ON
(V_{DET}-0.2V)

● **Typical Performance Curves – continued**

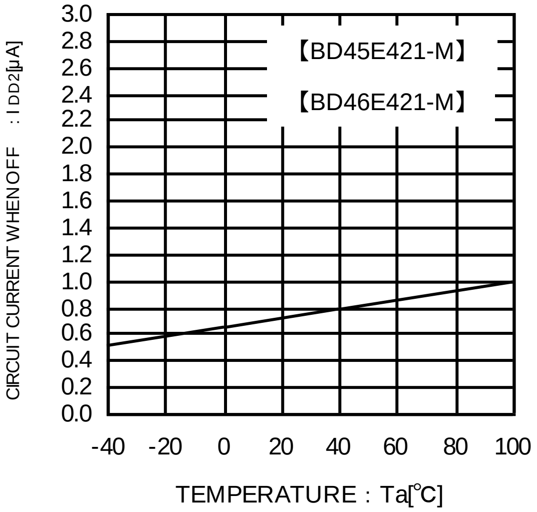


Fig.11 Circuit Current when OFF

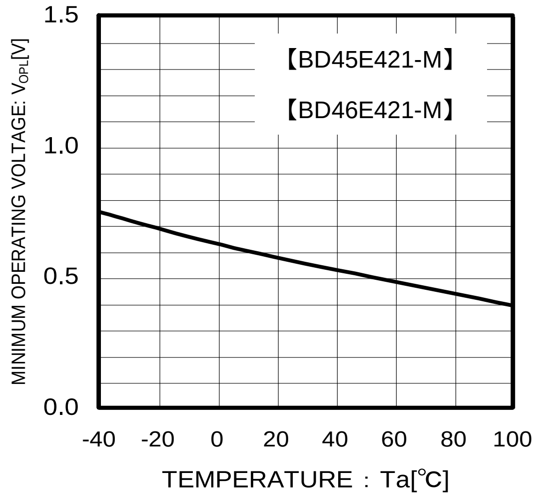


Fig.12 Operating Limit Voltage

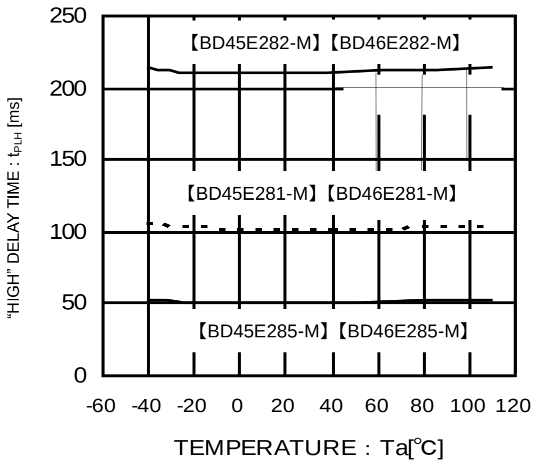


Fig.13 Output Delay Time
"Low"→"High"

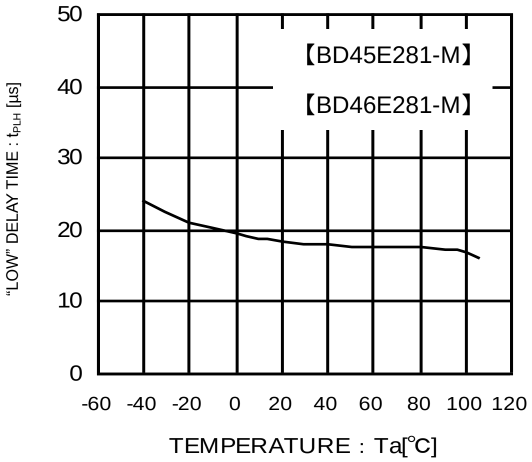


Fig.14 Output Delay Time
"High"→"Low"

●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 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 BD45Exxxx-M series uses an open drain output type, it is necessary to connect a pull-up resistor to V_{DD} or another power supply if needed [The output “High” voltage (V_{OUT}) in this case becomes V_{DD} or the voltage of the other power supply].

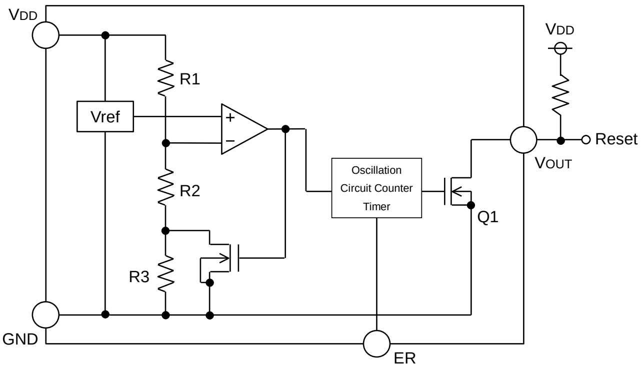


Fig.15 (BD45Exxxx-M Type Internal Block Diagram)

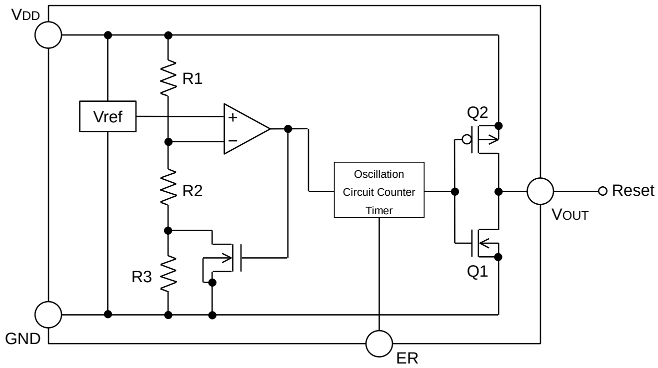


Fig.16 (BD46Exxxx-M Type Internal Block Diagram)

Reference Data

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

Part Number	t_{PLH}[ms]	t_{PHL}[µs]
BD45E275G-M	50	18
BD46E275G-M	50	18
	VDD=2.2V→3.2V	VDD=3.2V→2.2V

*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}, the output voltage V_{OUT} and ER terminal when the input power supply voltage V_{DD} is made to sweep up and sweep down (the circuits are those in Fig. 15 and 16).

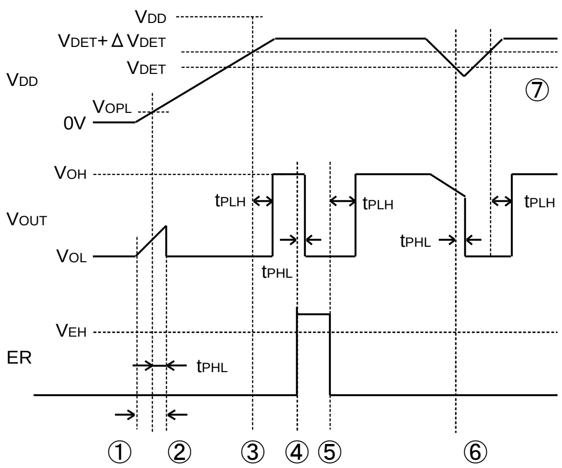


Fig.17 Timing Waveform

① When the power supply is turned on, the output is unstable from after over the operating limit voltage (V_{OPL}) until t_{PHL}. Therefore 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} + ΔV_{DET}), the output voltages will switch to Low.
③ If V_{DD} exceeds the reset release voltage (V_{DET} + ΔV_{DET}), the counter timer start and V_{OUT} switches from L to H.
④ When more than the high level voltage is supplied ER terminal, V_{OUT} comes to “L” after t_{PLH} delay time. Therefore, a time when ER terminal is “H” is necessary for 100µsec or more.
⑤ When the ER terminal switches to Low, the counter timer starts to operate, a delay of t_{PLH} occurs, and V_{OUT} switches from “L” to “H”.
⑥ 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}).
⑦ The potential difference between the detection voltage and the release voltage is known as the hysteresis width (ΔV_{DET}). The system is designed such that the output does not toggle with power supply fluctuations within this hysteresis width, thus, preventing malfunctions due to noise.

Timing may change depending on application and use. Please verify and confirm using practical applications.

●**Circuit Applications**

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

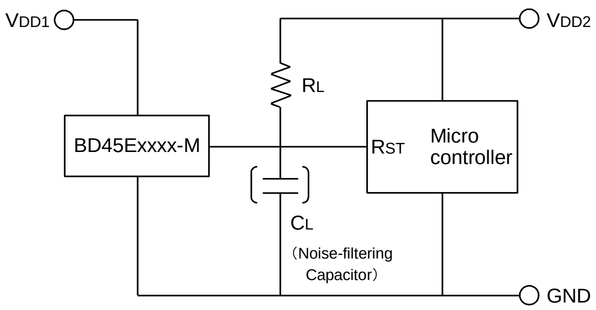


Fig.18 Open Drain Output Type

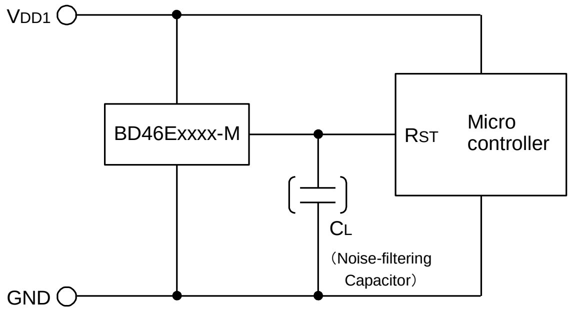


Fig.19 CMOS Output Type

Application examples of BD45Exxxx-M series (Open Drain output type) and BD46Exxxx-M series (CMOS output type) are shown below.

CASE1: Power supply of microcontroller ($V_{DD}2$) differs from the power supply of the reset detection ($V_{DD}1$). Use an open drain output Type (BD45xx series) device with a load resistance R_L as shown Fig.18.

CASE2: Power supply of the microcontroller (V_{DD1}) is same as the power supply of the reset detection (V_{DD1}). Use a CMOS output type (BD46Exxxx-M) device or an open drain output type (BD45Exxxx-M) with a pull up resistor between the output and V_{DD1}.

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}).

2) The following is an example of a circuit application in which an OR connection between two types of detection voltage resets the microcontroller.

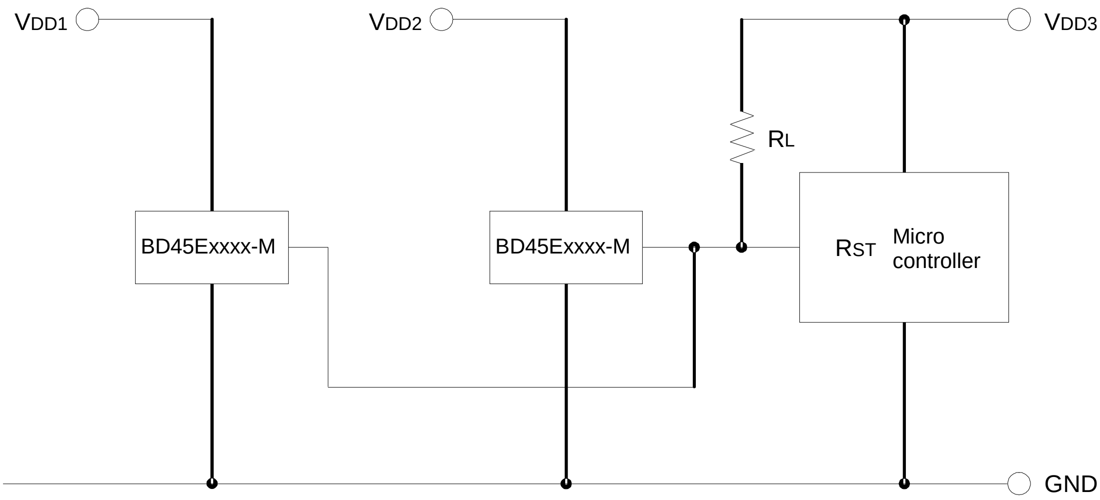


Fig. 20

To reset the microcontroller when many independent power supplies are used in the system, OR connect an open drain output type (BD45Exxxx-M series) to the microcontroller's input with pull-up resistor to the supply voltage of the microcontroller (V_{DD3}) as shown in Fig. 20. By pulling-up to V_{DD3}, output "High" voltage of micro-controller power supply is possible.

3) Examples of the power supply with resistor dividers.

In applications wherein the power supply voltage of an IC comes from a resistor divider circuit, an in-rush current will flow into the circuit when the output level switches from “High” to “Low” or vice versa. In-rush current is a sudden surge of current that flows from the power supply (VDD) to ground (GND) as the output logic changes its state. This current flow may cause malfunction in the systems operation such as output oscillations, etc.

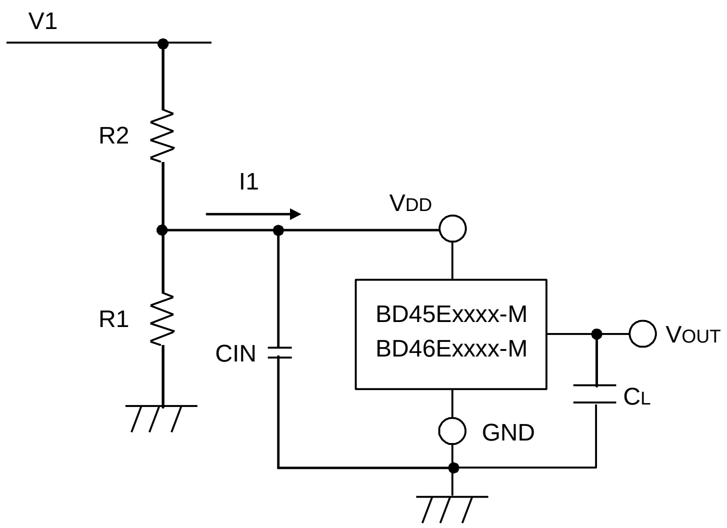


Fig. 21

When an in-rush current (I1) flows into the circuit (Refer to Fig. 21) at the time when output switches from “Low” to “High”, a voltage drop of I1×R2 (input resistor) will occur in the circuit causing the VDD supply voltage to decrease. When the VDD voltage drops below the detection voltage, the output will switch from “High” to “Low”. While the output voltage is at “Low” condition, in-rush current will stop flowing and the voltage drop will be reduced. As a result, the output voltage will switches again from “Low” to “High” which causes an in-rush current and a voltage drop. This operation repeats and will result to oscillation.

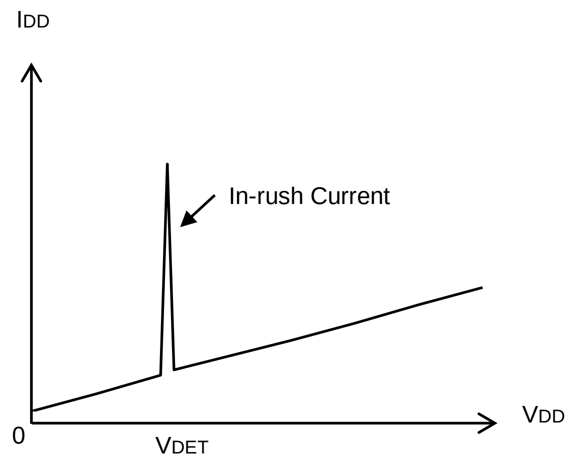


Fig. 22 Current Consumption vs. Power Supply Voltage

●Operational Notes

1) Absolute maximum ratings
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. 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.

2) Ground Voltage
The voltage of the ground pin must be the lowest voltage of all pins of the IC at all operating conditions. Ensure that no pins are at a voltage below the ground pin at any time, even during transient condition.

3) Recommended operating conditions
These conditions represent a range within which the expected characteristics of the IC can be approximately obtained. The electrical characteristics are guaranteed under the conditions of each parameter.

4) Bypass Capacitor for Noise Rejection
To help reject noise, put a 1uF capacitor between V_{DD} pin and GND and 1000pF capacitor between V_{OUT} pin and GND. Be careful when using extremely big capacitor as transient response will be affected.

5) Short between pins and mounting errors
Be careful when mounting the IC on printed circuit boards. The IC may be damaged if it is mounted in a wrong orientation or if pins are shorted together. Short circuit may be caused by conductive particles caught between the pins.

6) Operation under strong electromagnetic field
Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

7) The V_{DD} line impedance might cause oscillation because of the detection current.

8) A V_{DD} to GND capacitor (as close connection as possible) should be used in high V_{DD} line impedance condition.

9) Lower than the mininum input voltage puts the V_{OUT} in high impedance state, 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 of about 1MΩ is assumed between the ER terminal and the GND terminal, 100kΩ connection between the ER terminal and the V_{DD} terminal would be recommended. 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 RL is 50kΩ to 1MΩ. 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 VDD rise time. Please verify the behavior in the actual operation.

13) 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.

14) Rush current
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.

● **Revision History**

Date	Revision	Changes
20.Nov.2012	001	New Release
18.Dec.2012	002	Change the value of “Counter Timer Delay” from 5ms to 50ms in Table1 and Table2. Change unit of Operating Limit Voltage graph from uA to V in Typical Performance Curve.
23.May.2013	003	Change limits for VDET at VDET=2.5V,3.0V,3.3V,4.2V,4.8V
27.Aug.2013	004	Update the applications and features on page 1 and ordering information on page 2

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(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

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   [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

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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 Cl2, H2S, NH3, SO2, and NO2
   [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.

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