### Automotive IPD Series

# 2ch Low Side Switch IC
# BM2LB150FJ-C

## Features

- Built-in overcurrent limiting circuit(OCP)
- Built-in thermal shutdown circuit (TSD)
- Direct control enabled from CMOS logic IC, etc.
- Low On resistance $R_{DS(ON)}$ up to 150 mΩ (when $V_{IN}$=5V, $I_D$=0.5A, $T_j$=25°C)
- Monolithic power management IC with the control block (CMOS) and power MOS FET mounted on a single chip
- Surface mount package SOP-J8
- AEC-Q100 Qualified (Note 1)

(Note 1) Grade1

## Product Summary

| | |
|---|---|
| On-state resistance ($T_j$ =25°C, Typ) | 150mΩ |
| Overcurrent limit ($T_j$ =25°C, Typ) | 10A |
| Output clamp voltage (Min) | 42V |
| Active clamp energy ($T_j$ =25°C) | 165mJ |

**Package** W(Typ) x D(Typ) x H(Max)
SOP-J8 4.90mm x 6.00mm x 1.65mm

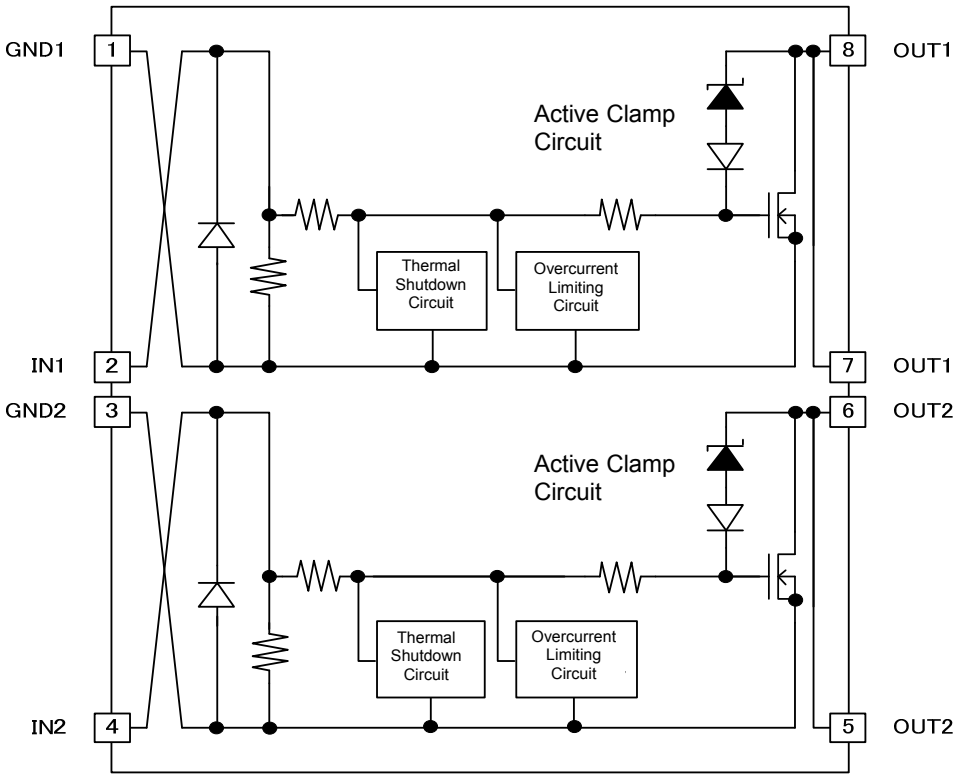

## General Description

The BM2LB150FJ-C is an automotive 2ch low side switch IC, which has built-in overcurrent limiting circuit, thermal shutdown circuit, and overvoltage (active clamp) protection circuit.

## Applications

2ch low side switch for driving resistive, inductive load, Capacitive load

## Block Diagram



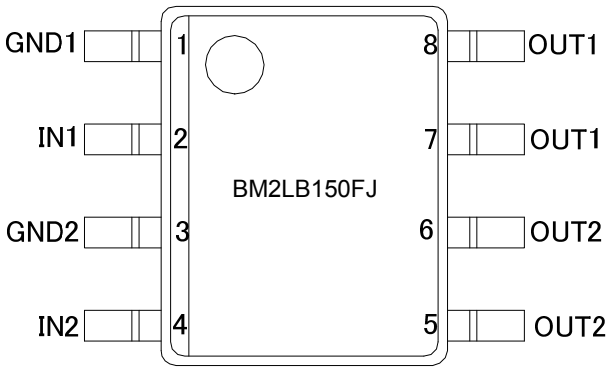

○Product structure: Silicon monolithic integrated circuit ○This product is not designed to protect it from radiation

### Pin Descriptions

| Pin No. | Symbol | Function |
|---|---|---|
| 1 | GND1 | GND pin1 |
| 2 | IN1 | Input pin1 (Note1) |
| 3 | GND2 | GND pin2 |
| 4 | IN2 | Input pin2 (Note1) |
| 5 | OUT2 | Output pin2 |
| 6 | OUT2 | Output pin2 |
| 7 | OUT1 | Output pin1 |
| 8 | OUT1 | Output pin1 |

(Note1) Input pin is used to internally connect a pull-down resistor.

### Pin Configurations



**Absolute Maximum Ratings** ($T_j$ =25°C)

| Parameter | Symbol | Rating | Unit |
|---|---|---|---|
| Drain-Source voltage in output block | $V_{DS}$ | -0.3 to +42 (Note1) | V |
| Input voltage | $V_{IN}$ | -0.3 to +7 | V |
| Output current (DC) | $I_D$ | 6.5(internally limited) (Note2) | A |
| Active clamp energy (Single pulse) $T_{j(start)}$ = 25°C (Note3) | $E_{AS(25°C)}$ | 165 | mJ |
| Active clamp energy (Single pulse) $T_{j(start)}$ = 150°C (Note3) (Note4) | $E_{AS(150°C)}$ | 60 | |
| Operating temperature range | $T_j$ | -40 to +150 | °C |
| Storage temperature range | $T_{stg}$ | -55 to +150 | °C |
| Maximum junction temperature | $T_{jmax}$ | 150 | °C |

(Note1) Please refer to P.12 “Operation Notes”, when is used at less than -0.3V.
(Note2) Internally limited by the overcurrent limiting circuit.
(Note3) Min Active clamp energy, using single non-repetitive pulse of 1.0A.

$$E_{AS} = \frac{1}{2} LI_{AR}^2 \cdot \left(1 - \frac{V_B}{V_B - V_{CL}}\right)$$

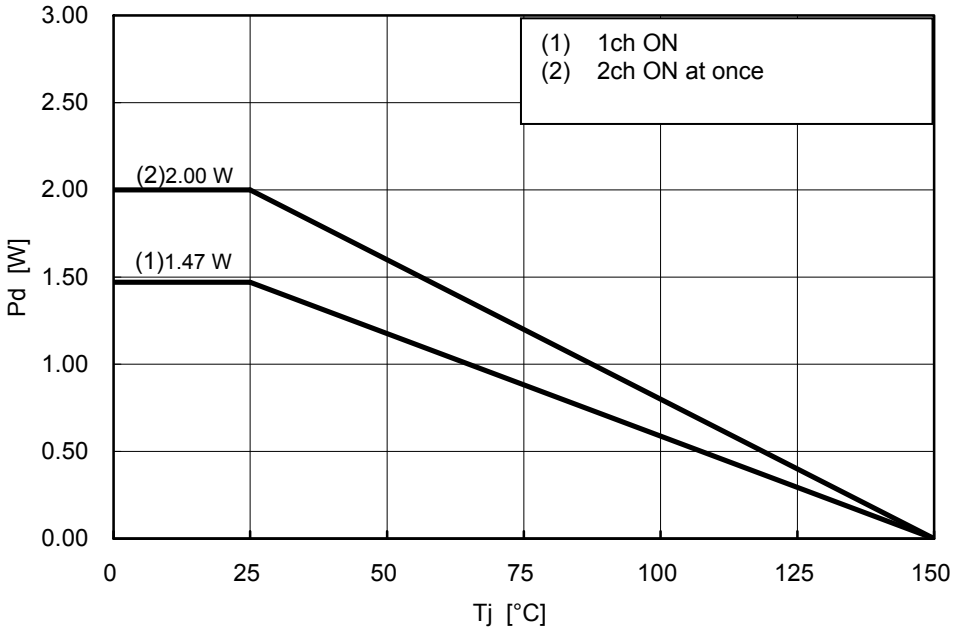
(Note4) Not 100% tested.

**Thermal resistance**

| Parameter | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Power dissipation (Note5) | (1ch ON) | $P_{D(1)}$ | 1.47 | W |
| | (2ch ON at once) | $P_{D(2)}$ | 2.00 | W |

(Note5) When mounted on a PCB (two-layer glass epoxy board measuring 76.2 × 114.3 [mm], 1.6 [mm] thick, with a copper foil area of 74.2 × 74.2 [mm])

**Heat Dissipation Characteristic**



**Electrical Characteristics** (Unless otherwise specified, −40°C≤$T_j$≤+150°C and $V_{IN}$=3.0V to 5.5V)

| Parameter | Symbol | Limit | | | Unit | Conditions |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| Output clamp voltage | $V_{CL}$ | 42 | 48 | 54 | V | $V_{IN}$=0V,$I_D$=1mA |
| On-state resistance 1 (at 25°C) | $R_{ON1}$ | - | 150 | 190 | mΩ | $V_{IN}$=5V,$I_D$=0.5A,Tj=25°C |
| On-state resistance 1 (at 150°C) | $R_{ON2}$ | - | 260 | 320 | mΩ | $V_{IN}$=5V,$I_D$=0.5A,Tj=150°C |
| On-state resistance 2 (at 25°C) | $R_{ON3}$ | - | 200 | 250 | mΩ | $V_{IN}$=3V,$I_D$=0.5A, Tj=25°C |
| On-state resistance 2 (at 150°C) | $R_{ON4}$ | - | 340 | 420 | mΩ | $V_{IN}$=3V,$I_D$=0.5A,Tj=150°C |
| Leakage current (at 25°C) | $V_{IL1}$ | - | 0 | 4 | μA | $V_{IN}$=0V,$V_{DS}$=18V,Tj=25°C |
| Leakage current (at 150°C) | $V_{IL_2}$ | - | 2 | 25 | μA | $V_{IN}$=0V,$V_{DS}$=18V,Tj=150°C |
| Turn-ON time | $t_{ON}$ | - | - | 80 | μs | $V_{IN}$=0V/5V, $R_L$=15Ω, $V_B$=12V, Tj=25°C |
| Turn-OFF time | $t_{OFF}$ | - | - | 80 | μs | $V_{IN}$=0V/5V, $R_L$=15Ω, $V_B$=12V, Tj=25°C |
| Slew rate on | $SR_{ON}$ | - | 0.5 | 1.0 | V/μs | $V_{IN}$=0V/5V, $R_L$=15Ω, $V_B$=12V, Tj=25°C |
| Slew rate off | $SR_{OFF}$ | - | 1.0 | 2.0 | V/μs | $V_{IN}$=0V/5V, $R_L$=15Ω, $V_B$=12V, Tj=25°C |
| Input threshold voltage | $V_{TH}$ | 1.1 | - | 2.7 | V | $I_D$=1mA |
| High-level input current | $I_{INH1}$ | - | 150 | 300 | μA | $V_{IN}$=5V |
| High-level input current (in abnormal operation) | $I_{INH2}$ | - | 250 | 450 | μA | $V_{IN}$=5V |
| Low-level input current | $I_{INL}$ | -10 | 0 | 10 | μA | $V_{IN}$=0V |
| Overcurrent detection current | $I_{OCP}$ | 6.5 | 10.0 | 13.5 | A | $V_{IN}$=5V, $T_j$=25°C |
| TSD detection temperature(Note1) | $T_{jd}$ | 150 | 175 | - | °C | $V_{IN}$=5V |
| TSD release temperature(Note1) | $T_{jr}$ | 130 | - | - | °C | $V_{IN}$=5V |
| TSD hysteresis(Note1) | $\Delta T_{jd}$ | - | 15 | - | °C | $V_{IN}$=5V |

(Note1) Not 100% tested.

**Terms**

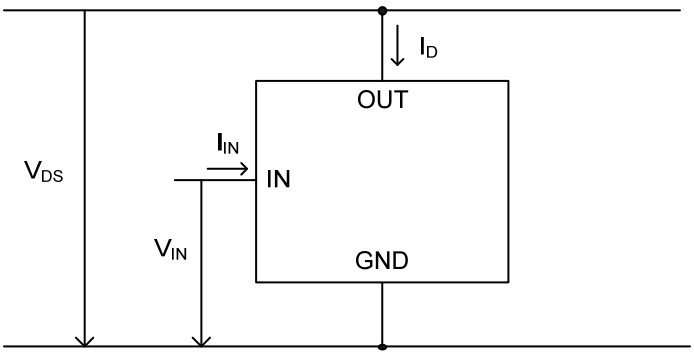



Figure 1. Terms

### Measuring circuit

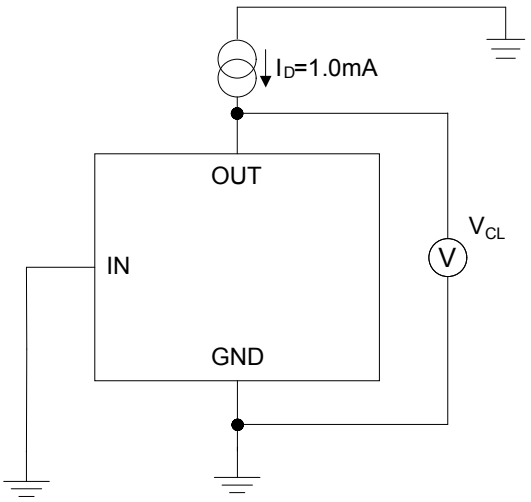



Figure 2. Output clamp voltage measuring circuit

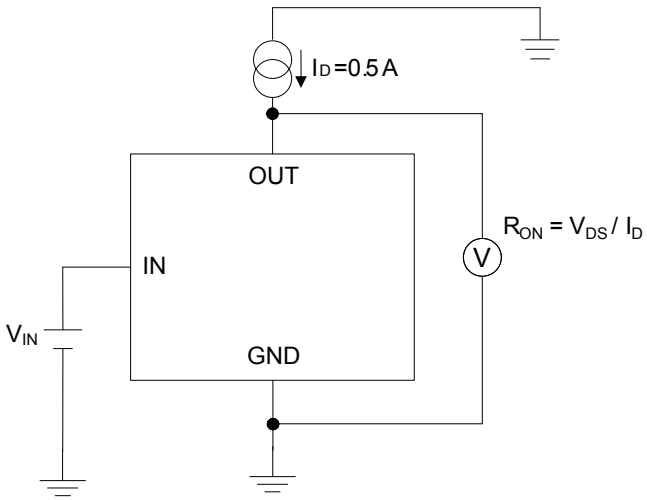



Figure 3. On-state resistance measuring circuit

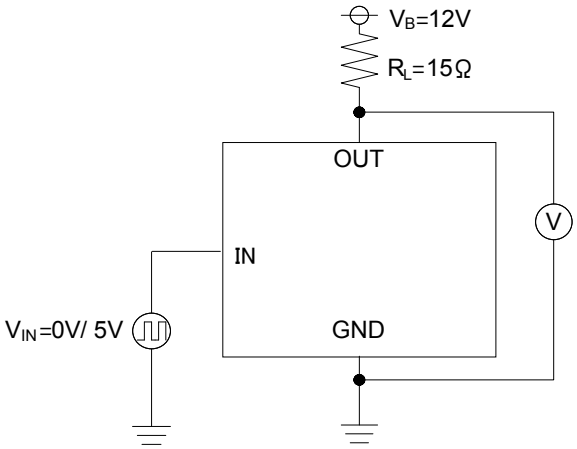



Figure 4. $t_{ON}$ · $t_{OFF}$ measuring circuit

### I/O Pin Truth Table

| Operating Status | Input Signal | Output Level | Output Status |
|---|---|---|---|
| Normal | H | L | ON |
| | L | H | OFF |
| Overcurrent | H | Clamp | Current Limiting |
| | L | H | OFF |
| Overheat | H | H | OFF |
| | L | H | OFF |

**Typical Performance Curves** (Unless otherwise specified, Tj=25°C, $V_{IN}$=5.0V)

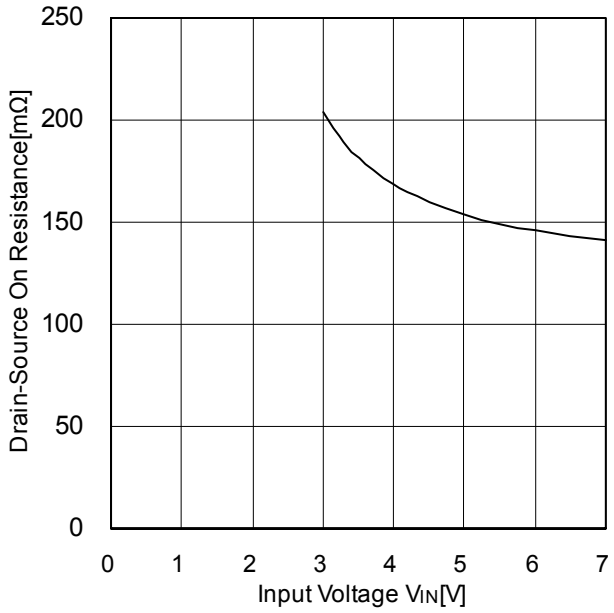



Figure 5. On-state Resistance Characteristics
[Input Voltage Characteristics]

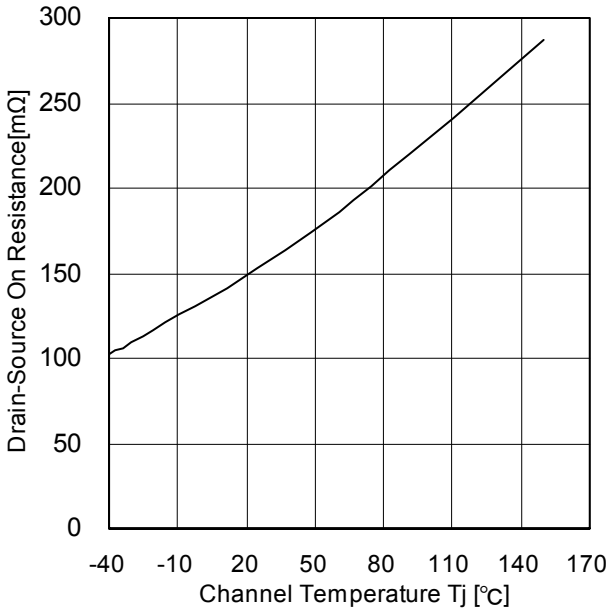



Figure 6. On-state Resistance Characteristics
[Temperature Characteristics]

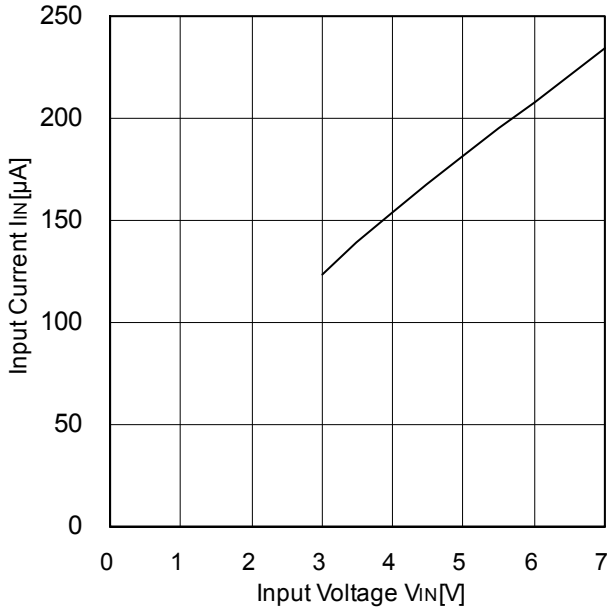



Figure 7. Input Current Characteristics
[Input Voltage Characteristics]

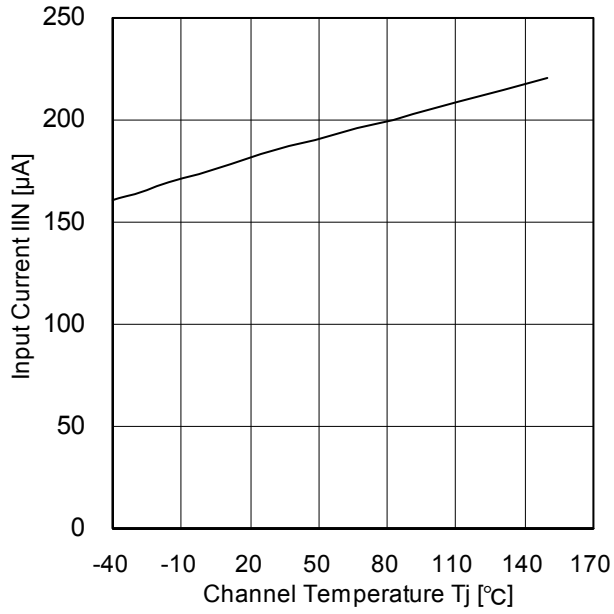



Figure 8. Input Current Characteristics
[Temperature Characteristics]

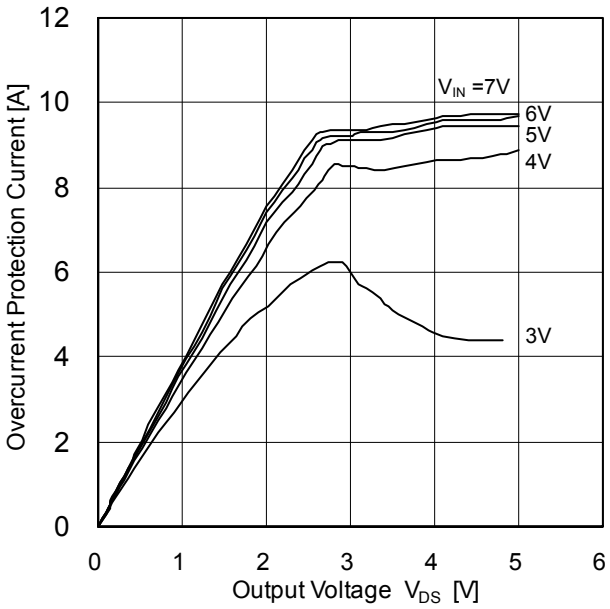



Figure 9. Overcurrent Detection Current Characteristics
[Input Voltage Characteristics]

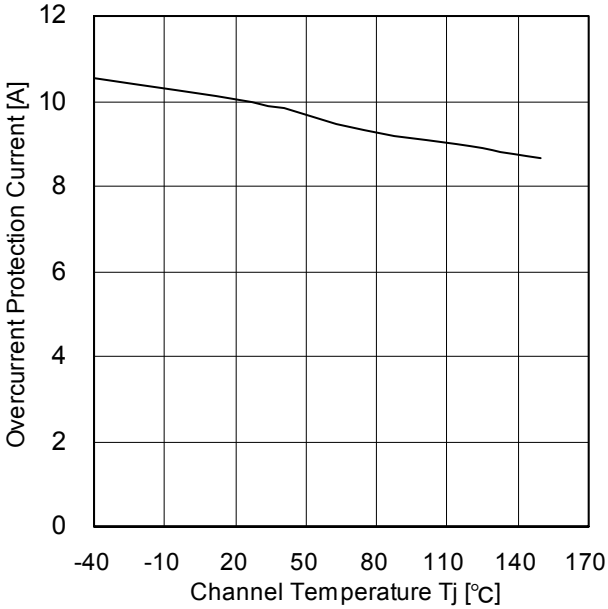



Figure 10. Overcurrent Detection Current Characteristics
[Temperature Characteristics]

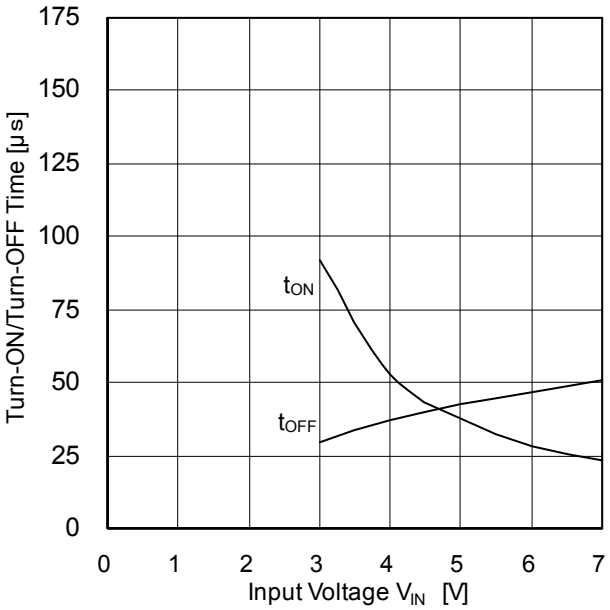



Figure 11. Turn-ON/Turn-OFF Time Characteristics
[Input Voltage Characteristics]

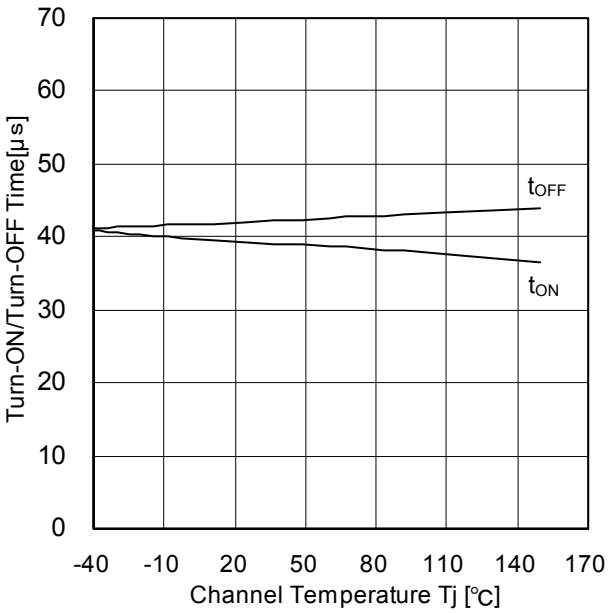



Figure 12. Turn-ON/Turn-OFF Time Characteristics
[Temperature Characteristics]

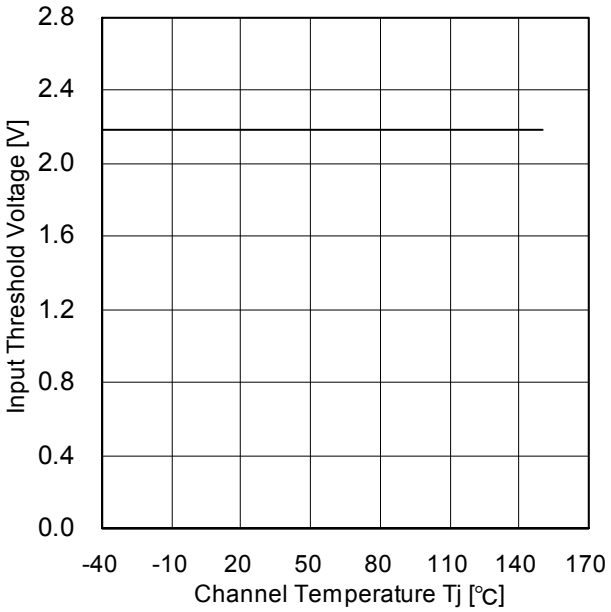



Figure 13. Input Threshold Voltage Characteristics
[Temperature Characteristics]

## Timing Chart

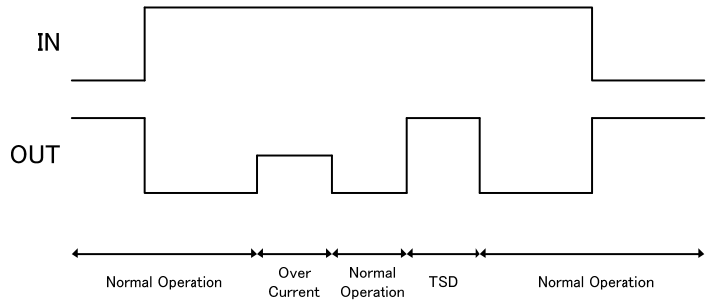



Figure 14. Behavior Sequence

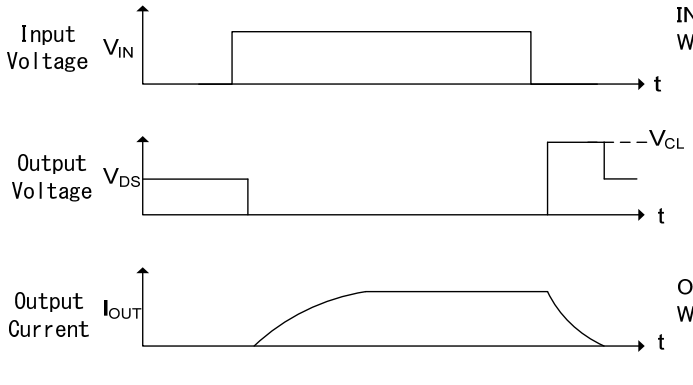



Figure 15. Inductive Load Operation

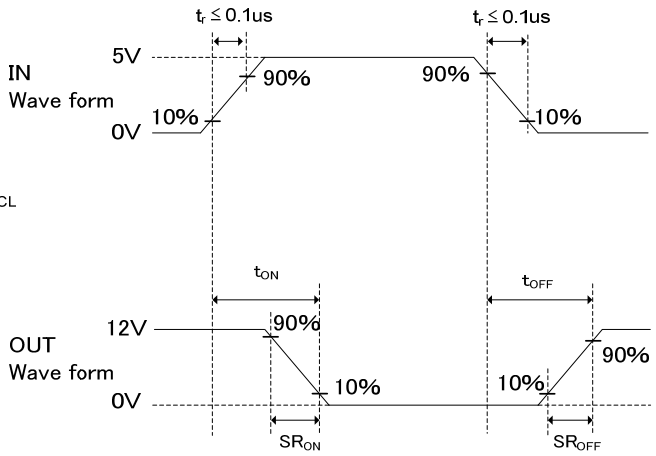



Figure 16. Switching Time

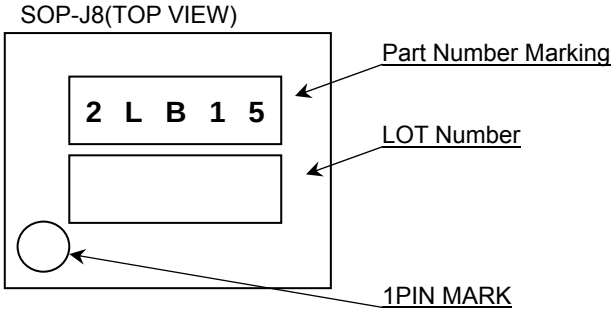
### Ordering Information

| B | M | 2 | L | B | 1 | 5 | 0 | F | J | - | CE2 |
|---|---|---|---|---|---|---|---|---|---|---|---|

Package
FJ：SOP-J8

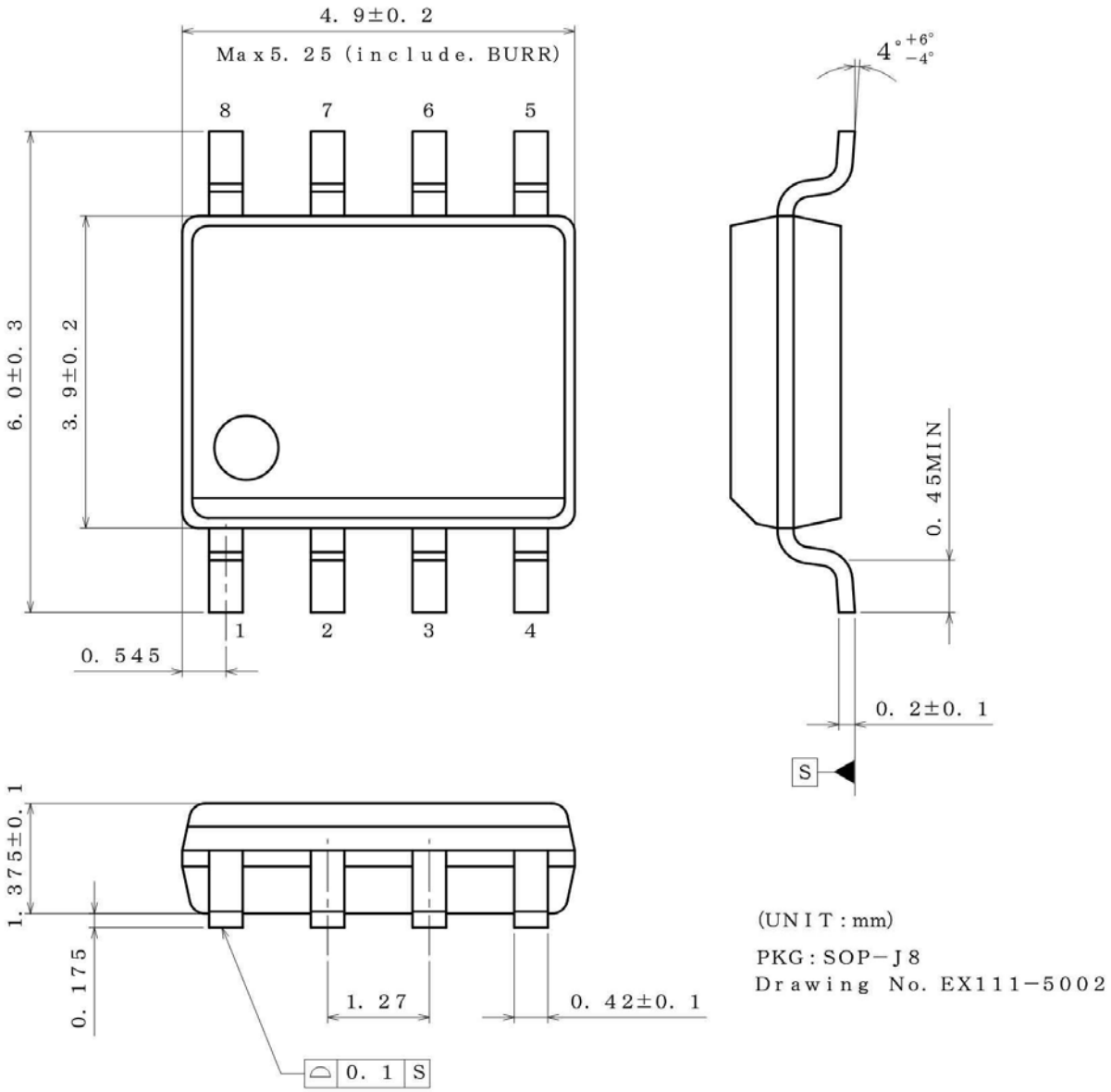
Packaging and forming specification
C: High-reliability product
E2: Embossed tape and reel

### Marking Diagram



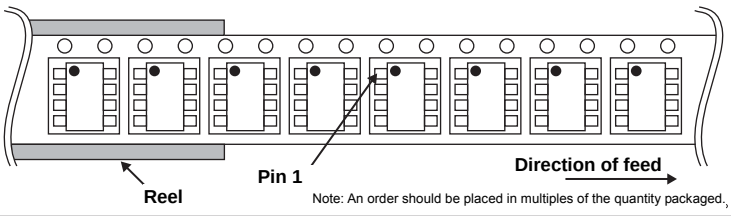
**Physical Dimension Tape and Reel Information**

| Package Name | SOP-J8 |
|---|---|




**<Packaging Specification>**

| | |
|---|---|
| Packaging style | **Embossed carrier tape** |
| Quantity packaged | 2500pcs |
| **Direction of feed** | E2<br>( Pin 1 should come to the top left when you hold the reel with your left hand and feed the tape with your right hand. ) |




Note: An order should be placed in multiples of the quantity packaged.

## Operational Notes

### 1. Grounding Interconnection Pattern

When a small-signal ground and a high-current ground are used, it is recommended to isolate the high-current grounding interconnection pattern and the small-signal grounding interconnection pattern and establish a single ground at the reference point of a set so that voltage changes due to the resistance and high current of patterned interconnects will not cause any changes in the small-signal ground voltage. Pay careful attention to prevent changes in the interconnection pattern of ground for external components.
The ground lines must be as short and thick as possible to reduce line impedance.

### 2. Thermal Design

Use a thermal design that allows for a sufficient margin by taking into account the permissible power dissipation (Pd) in actual operating conditions.

### 3. 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 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.

### 4. Inspections on Set Board

If a capacitor is connected to a low-impedance pin in order to conduct inspections of the IC on a set board, stress may apply to the IC. To avoid that, be sure to discharge the capacitor in each process. In addition, to connect or disconnect the IC to or from a jig in the testing process, be sure to turn OFF the power supply prior to connecting the IC, and disconnect it from the jig only after turning OFF the power supply. Furthermore, in order to protect the IC from static electricity, establish a ground for the IC assembly process and pay utmost attention to transport and store the IC.

### 5. 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.

### 6. Ceramic Capacitor

When using a ceramic capacitor, determine the dielectric constant considering the change of capacitance with temperature and the decrease in nominal capacitance due to DC bias and others.

### 7. Thermal Shutdown Circuit

This IC has a built-in thermal shutdown circuit as an overheat-protection measure. The circuit is designed to turn OFF output when the temperature of the IC chip exceeds 175°C (Typ) and return the IC to the normal operation when the temperature falls below 150°C (Typ).
The thermal shutdown circuit is a circuit absolutely intended to protect the IC from thermal runaway, not intended to protect or guarantee the IC. Consequently, do not operate the IC based on the subsequent continuous use or operation of the circuit.

### 8. Overcurrent Limiting Circuit

This IC incorporates an integrated overcurrent protection circuit that is activated when the load is shorted. This protection circuit is effective in preventing damage due to sudden and unexpected incidents. However, the IC should not be used in applications characterized by continuous operation or transitioning of the protection circuit.

### 9. Overvoltage (Active Clamp) Protection Function

This IC has a built-in overvoltage protection function in order for the IC to absorb counter-electromotive force energy generated when inductive load is turned OFF. Since the input voltage is clamped at 0V when the active clamp circuit is activated, the thermal shutdown circuit is disabled. Design a thermal solution so that the chip temperature will definitely come to less than 150°C.

### 10. Counter-electromotive Force

Fully ensure that the counter-electromotive force presents no problems in the operation or the IC.

## Operational Notes – continued

### 11. Negative Current of Output

When supply a negative current from DRAIN terminal in the state that supplied the voltage to IN terminal. The current pass from IN terminal to DRAIN terminal through a parasitic transistor and voltage of IN terminal descend as shown in figure.17 and figure.18.

As shown in figure.17 power MOS is turned on, set the DRAIN terminal is more than -0.3V. Because a negative current may be passed to DRAIN terminal from a power supply of the connection of the IN terminal (MCU, and so on).

As shown in figure.18 power MOS is turned off, add a restriction resistance higher than 330 Ω to IN terminal. Because a negative current may be passed to DRAIN terminal from GND of the connection of the IN terminal.

The restriction resistance value, set up in consideration of the voltage descent caused by the IN terminal current.

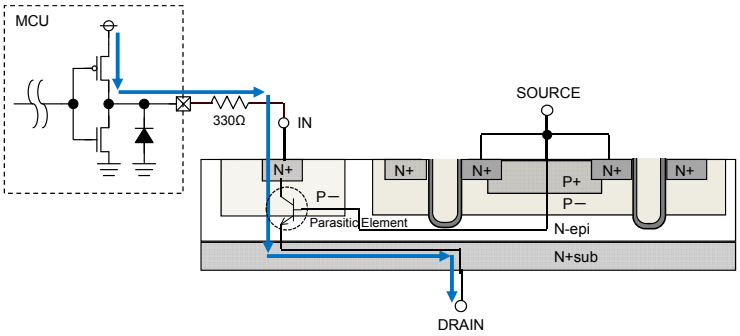



Figure 17. Negative current pass(when power MOS is turned on)

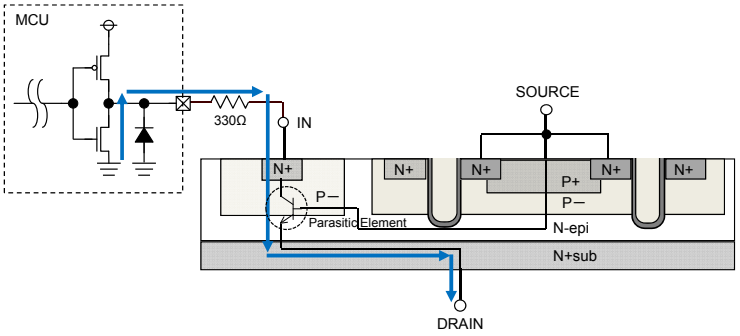



Figure 18. Negative current pass(when power MOS is turned off)

**Revision History**

| Date | Revision | Changes |
|---|---|---|
| 09.Jan.2014 | 001 | New Release |
| 25.Dec.2015 | 002 | ・General Description<br>“BM2LB180” → “BM2LB150”<br>・Ordering Information is change.<br>“BM2LB180” → “BM2LB150” |
| 01.Aug.2016 | 003 | P.1 “Features” Add “AECQ100-012 Grade”<br>P.1 “Applications” Add “Capacitive load”<br>P.1 “Package” Add “W(Typ) x D(Typ) x H(Max)”<br>P.4 ”Electrical Characteristics” Turn-ON(OFF) time UNIT change<br>P.12 “Operational Notes” Modify some sentence. |

# 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 (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 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 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.

## 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.

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