

- **Structure** Silicon Monolithic IC
- **Product** High-Side Switch for Universal Serial Bus (USB)
- **Type** **BD2224G**
- **Features**
  - Low On-Resistance (Typ. 150mΩ) N-channel MOSFET Built-in
  - 500mA Continuous Load Current
  - Over-Current Protection
  - Thermal Shutdown
  - Open-Drain Fault Flag Output
  - Under-Voltage Lockout
  - Soft-Start Circuit
  - Input Voltage Range: 2.7V ~ 5.5V
  - Active-High Control Logic
  - SSOP5 Package

• **Absolute Maximum Ratings** (TA= 25°C)

| Parameter              | Symbol | Rating           | Unit |
|------------------------|--------|------------------|------|
| VIN Supply Voltage     | VIN    | -0.3 ~ 6.0       | V    |
| EN Input Voltage       | VEN    | -0.3 ~ 6.0       | V    |
| /OC Voltage            | V/OC   | -0.3 ~ 6.0       | V    |
| /OC Sink Current       | I/OC   | 5                | mA   |
| VOUT Voltage           | VOUT   | -0.3 ~ VIN + 0.3 | V    |
| Storage Temperature    | TSTG   | -55 ~ 150        | °C   |
| Power Dissipation (*1) | PD     | 675              | mW   |

(\*1) Mounted on 70mm x 70mm x 1.6mm glass epoxy board. Reduce 5.4mW per 1°C above 25°C.

• **Operating Conditions**

| Parameter               | Symbol | Min. | Typ. | Max. | Unit |
|-------------------------|--------|------|------|------|------|
| VIN Operating Voltage   | VIN    | 2.7  | 5.0  | 5.5  | V    |
| Operating Temperature   | TOPR   | -40  | -    | 85   | °C   |
| Continuous Load Current | IOUT   | 0    | -    | 500  | mA   |

This IC is not designed to be radiation-proof.

## • Electrical Characteristics

VIN= 5V, TA= 25°C, unless otherwise specified.

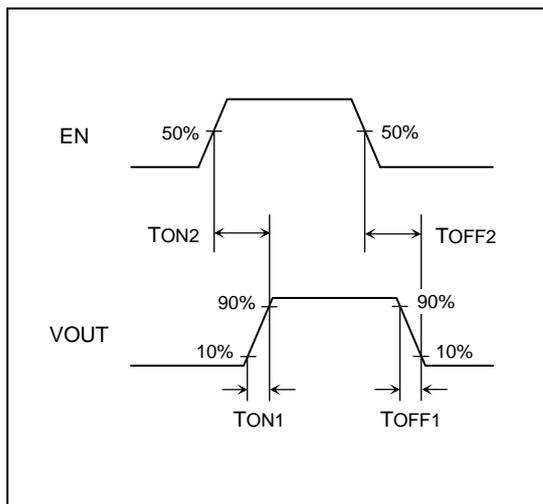
### DC Characteristics

| Parameter                    | Symbol           | Min. | Typ. | Max. | Unit | Conditions                                    |
|------------------------------|------------------|------|------|------|------|---|
| Operating Current            | I <sub>DD</sub>  | -    | 110  | 160  | μA   | V <sub>EN</sub> = 5V, V <sub>OUT</sub> = open |
| Standby Current              | I <sub>STB</sub> | -    | 0.01 | 5    | μA   | V <sub>EN</sub> = 0V, V <sub>OUT</sub> = open |
| EN Input Voltage             | V <sub>EN</sub>  | 2.0  | -    | -    | V    | High input                                    |
|                              | V <sub>EN</sub>  | -    | -    | 0.8  | V    | Low input                                     |
| EN Input Leakage             | I <sub>EN</sub>  | -1   | 0.01 | 1    | μA   | V <sub>EN</sub> = 0V or 5V                    |
| On-Resistance                | R <sub>ON</sub>  | -    | 150  | 200  | mΩ   | I <sub>OUT</sub> = 50mA                       |
| Over-Current Threshold       | I <sub>TH</sub>  | 550  | 780  | 1000 | mA   |   |
| Short Circuit Output Current | I <sub>SC</sub>  | 350  | -    | -    | mA   | V <sub>OUT</sub> = 0V, RMS                    |
| /OC Output Low Voltage       | V <sub>/OC</sub> | -    | -    | 0.4  | V    | I <sub>/OC</sub> = 0.5mA                      |
| UVLO Threshold               | V <sub>TUV</sub> | 2.1  | 2.3  | 2.5  | V    | V <sub>IN</sub> increasing                    |
|                              |                  | 2.0  | 2.2  | 2.4  | V    | V <sub>IN</sub> decreasing                    |

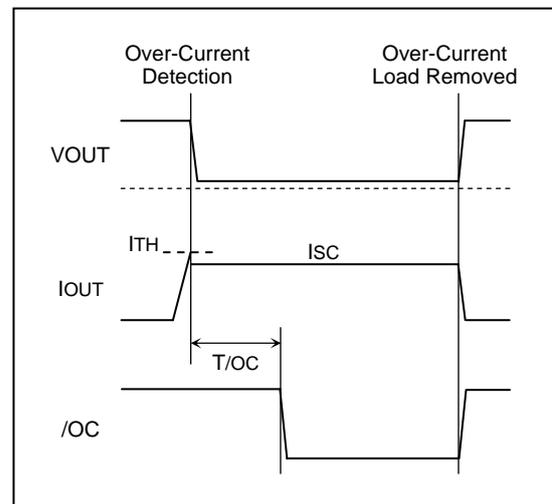
### AC Characteristics

| Parameter           | Symbol            | Min. | Typ. | Max. | Unit | Conditions           |
|---------------------|-------------------|------|------|------|------|----------------------|
| Turn-on Rise Time   | T <sub>ON1</sub>  | -    | 1    | 6    | ms   | R <sub>L</sub> = 20Ω |
| Turn-on Delay Time  | T <sub>ON2</sub>  | -    | 1.5  | 10   | ms   | R <sub>L</sub> = 20Ω |
| Turn-off Fall Time  | T <sub>OFF1</sub> | -    | 1    | 20   | μs   | R <sub>L</sub> = 20Ω |
| Turn-off Delay Time | T <sub>OFF2</sub> | -    | 3    | 40   | μs   | R <sub>L</sub> = 20Ω |
| /OC Delay Time      | T <sub>/OC</sub>  | 10   | 15   | 20   | ms   |                      |

## • Timing Chart

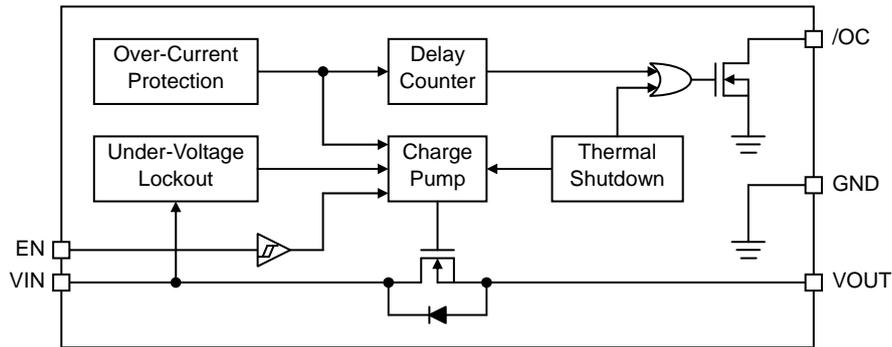


Turn-on Time and Turn-off Time



Over-Current Protection

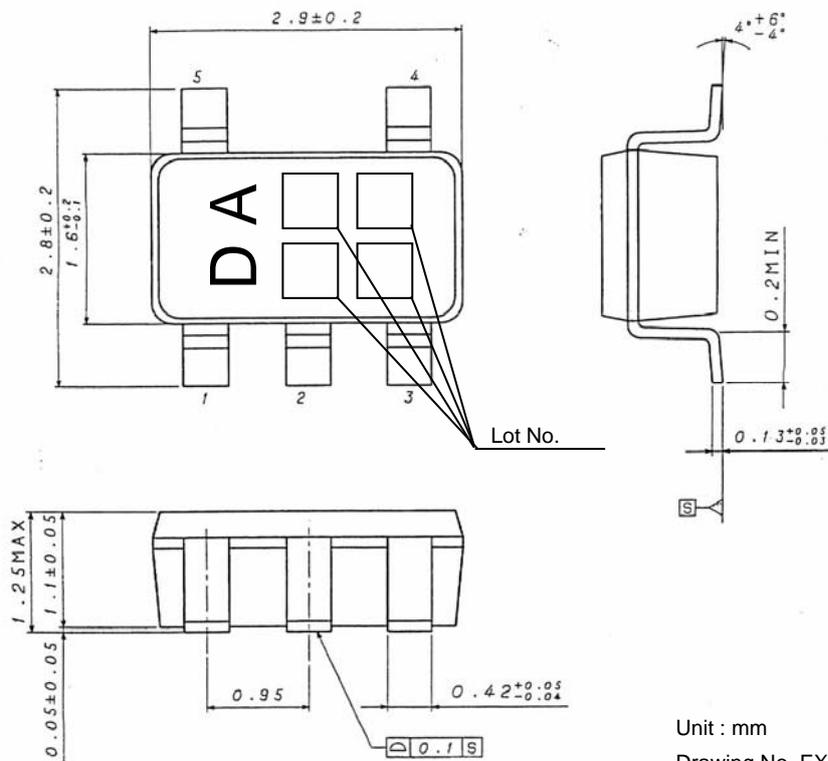
• Block Diagram



• Pin Description

| Pin No. | Name | I/O | Function  |
|---------|------|-----|---|
| 1       | VIN  | -   | Switch input and the supply voltage for the IC.   |
| 2       | GND  | -   | Ground.   |
| 3       | EN   | I   | Active-High enable input.<br>High level input turns on the switch.  |
| 4       | /OC  | O   | Over-current notification terminal.<br>Low level output during over-current or over-temperature condition.<br>Open-drain fault flag output. |
| 5       | VOUT | O   | Switch output.  |

• Package Outline



Unit : mm  
Drawing No. EX106-5001-2

Package : SSOP5

REV. B

**• Cautions on use****(1) Absolute Maximum Ratings**

An excess in the absolute maximum ratings, such as supply voltage, temperature range of operating conditions, etc., can break down devices, thus making impossible to identify breaking mode such as a short circuit or an open circuit. If any special mode exceeding the absolute maximum ratings is assumed, consideration should be given to take physical safety measures including the use of fuses, etc.

**(2) Power supply and GND line**

Design PCB pattern to provide low impedance for the wiring between the power supply and the GND lines. Pay attention to the interference by common impedance of layout pattern when there are plural power supplies and GND lines. Especially, when there are GND pattern for small signal and GND pattern for large current included the external circuits, separate each GND pattern. Furthermore, for all power supply terminals to ICs, mount a capacitor between the power supply and the GND terminal. At the same time, in order to use a capacitor, thoroughly check to be sure the characteristics of the capacitor to be used present no problem including the occurrence of capacity dropout at a low temperature, thus determining the constant.

**(3) GND voltage**

Make setting of the potential of the GND terminal so that it will be maintained at the minimum in any operating state. Furthermore, check to be sure no terminals are at a potential lower than the GND voltage including an actual electric transient.

**(4) Short circuit between terminals and erroneous mounting**

In order to mount ICs on a set PCB, pay thorough attention to the direction and offset of the ICs. Erroneous mounting can break down the ICs. Furthermore, if a short circuit occurs due to foreign matters entering between terminals or between the terminal and the power supply or the GND terminal, the ICs can break down.

**(5) Operation in strong electromagnetic field**

Be noted that using ICs in the strong electromagnetic field can malfunction them.

**(6) Input terminals**

In terms of the construction of IC, parasitic elements are inevitably formed in relation to potential. The operation of the parasitic element can cause interference with circuit operation, thus resulting in a malfunction and then breakdown of the input terminal. Therefore, pay thorough attention not to handle the input terminals, such as to apply to the input terminals a voltage lower than the GND respectively, so that any parasitic element will operate. Furthermore, do not apply a voltage to the input terminals when no power supply voltage is applied to the IC. In addition, even if the power supply voltage is applied, apply to the input terminals a voltage lower than the power supply voltage or within the guaranteed value of electrical characteristics.

**(7) External capacitor**

In order to use a ceramic capacitor as the external capacitor, determine the constant with consideration given to a degradation in the nominal capacitance due to DC bias and changes in the capacitance due to temperature, etc.

**(8) Thermal shutdown circuit (TSD)**

When junction temperatures become detected temperatures or higher, the thermal shutdown circuit operates and turns a switch OFF. The thermal shutdown circuit, which is aimed at isolating the LSI from thermal runaway as much as possible, is not aimed at the protection or guarantee of the LSI. Therefore, do not continuously use the LSI with this circuit operating or use the LSI assuming its operation.

**(9) Thermal design**

Perform thermal design in which there are adequate margins by taking into account the power dissipation (PD) in actual states of use.

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