● **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** (T_A= 25°C)

Parameter	Symbol	Rating	Unit
VIN Supply Voltage	V_{IN}	-0.3 ~ 6.0	V
EN Input Voltage	V_{EN}	-0.3 ~ 6.0	V
/OC Voltage	$V_{/OC}$	-0.3 ~ 6.0	V
/OC Sink Current	$I_{/OC}$	5	mA
VOUT Voltage	V_{OUT}	-0.3 ~ V_{IN} + 0.3	V
Storage Temperature	T_{STG}	-55 ~ 150	°C
Power Dissipation (*1)	P_D	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	V_{IN}	2.7	5.0	5.5	V
Operating Temperature	T_{OPR}	-40	-	85	°C
Continuous Load Current	I_{OUT}	0	-	500	mA

This IC is not designed to be radiation-proof.

● **Electrical Characteristics**

V_{IN}= 5V, T_A= 25°C, unless otherwise specified.

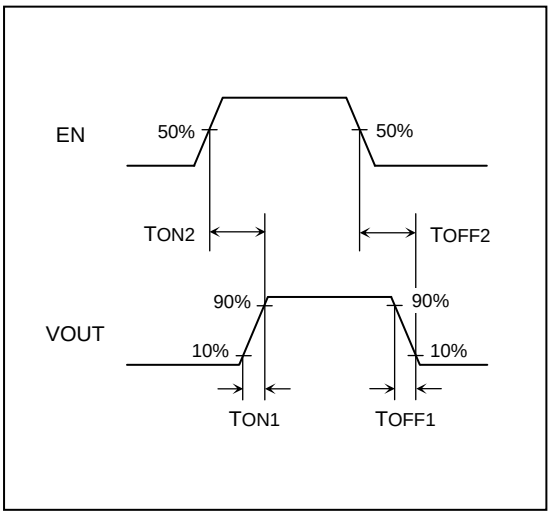
DC Characteristics

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

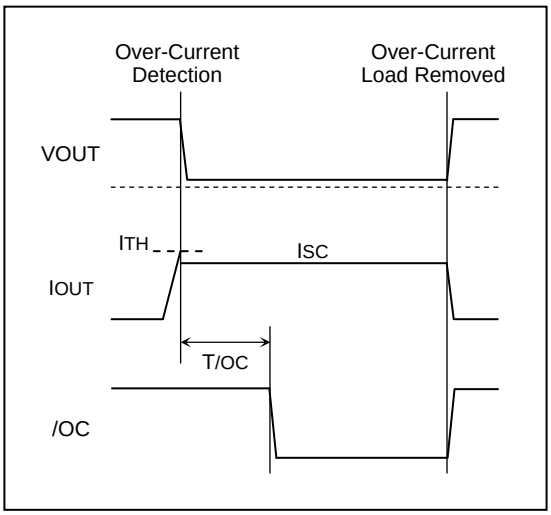
AC Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Turn-on Rise Time	T_{ON1}	-	1	6	ms	R_L= 20Ω
Turn-on Delay Time	T_{ON2}	-	1.5	10	ms	R_L= 20Ω
Turn-off Fall Time	T_{OFF1}	-	1	20	μs	R_L= 20Ω
Turn-off Delay Time	T_{OFF2}	-	3	40	μs	R_L= 20Ω
/OC Delay Time	$T_{/OC}$	10	15	20	ms	

● **Timing Chart**

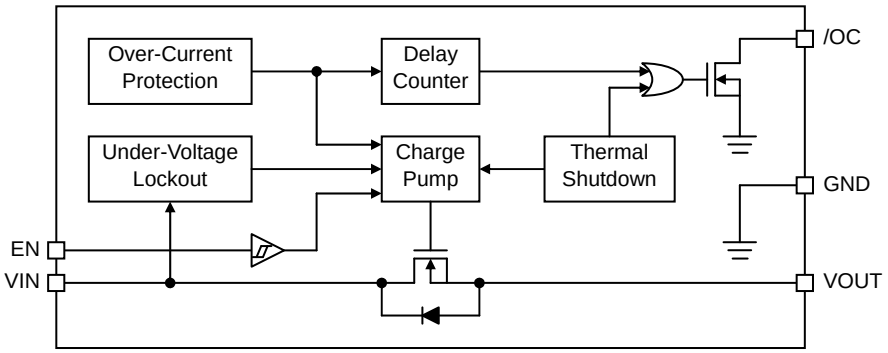


Turn-on Time and Turn-off Time



Over-Current Protection

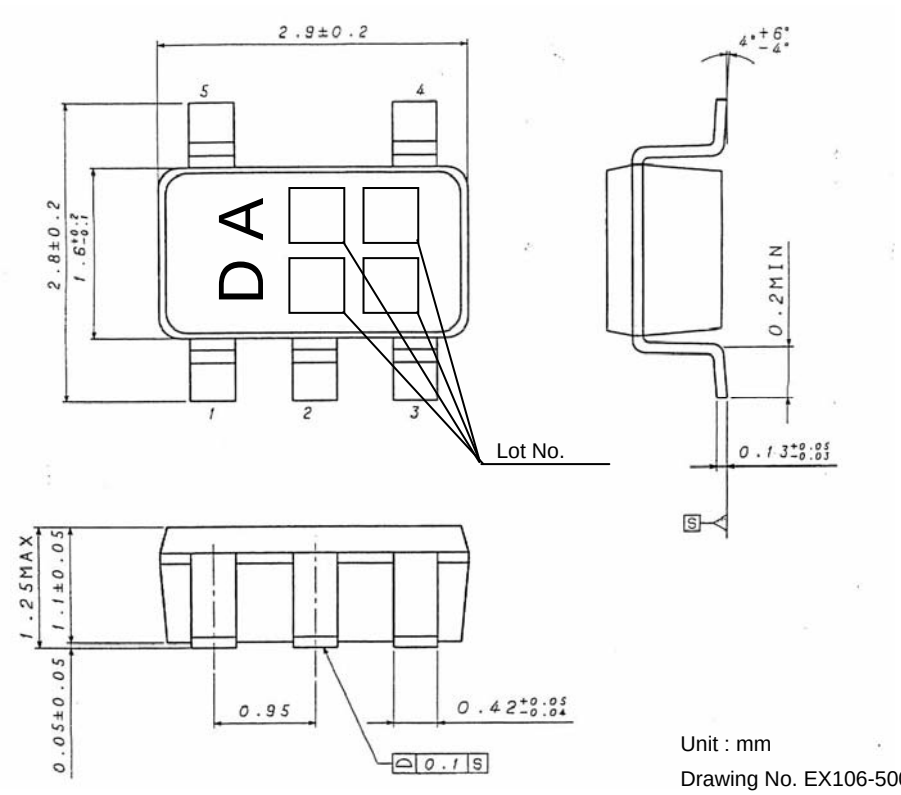
● **Block Diagram**



● **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. High level input turns on the switch.
4	/OC	O	Over-current notification terminal. Low level output during over-current or over-temperature condition. Open-drain fault flag output.
5	VOUT	O	Switch output.

● **Package Outline**



Unit : mm
Drawing No. EX106-5001-2

Package : SSOP5

● 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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