Load Switch IC

BD6524HFV

●General Description

Power switch for memory card Slot (BD6524HFV) is a high side switch IC which has one circuit of N-channel Power MOS FET. The switch has 200mΩ (Typ.) ON resistance. Operations from low input voltage ($V_{IN} \geq$ 3.0V) can be used for various switch applications.
The switch turns on slowly by the built-in charge pump, therefore, it is possible to reduce inrush current at switch on. There is no parasitic diode between the drain and the source, reverse current flowing at switch off is prevented. Furthermore, it has a discharge circuit that discharges electric charge from capacitive load at switch off.
The BD6524HFV is available in a space-saving HVSOF6 package.

●Key Specifications

- Input voltage range: 3.0V to 5.5V
- ON resistance : (V_{IN}=5V) 200mΩ(Typ.)
  (V_{IN}=3.3V) 250mΩ(Typ.)
- Continuous current: 0.5 A
- Standby current: 0.1µA (Typ.)
- Operating temperature range: -25℃ to +75℃

●Package

	W(Typ.)	D(Typ.)	H (Max.)
HVSOF6	1.60mm x	3.00mm x	0.75mm

HVSOF6

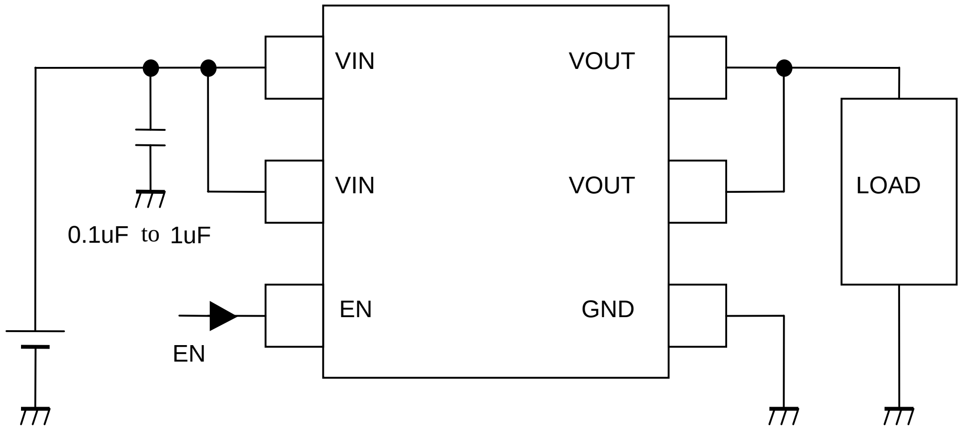
●Features

- Low on resistance (200mΩ, Typ.) N-MOS switch built in
- Maximum output current : 500mA
- Soft start circuit
- Under voltage lockout (UVLO) circuit
- Discharge circuit built in : operations at switch off, UVLO
- Reverse current flow blocking at switch off

●Applications

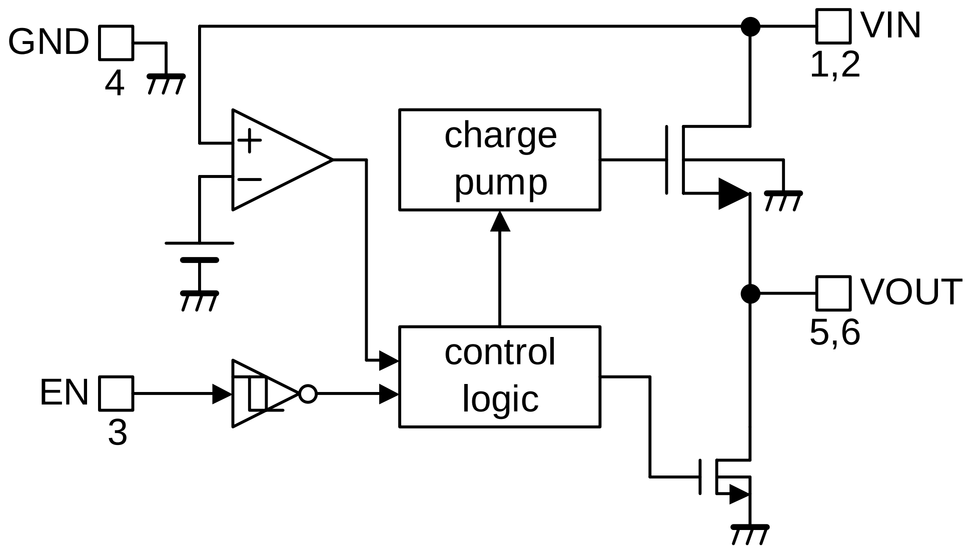
Memory card slots for notebook PC, digital still camera, portable music player, compact portable devices such as PDA and so forth

●Typical Application Circuit

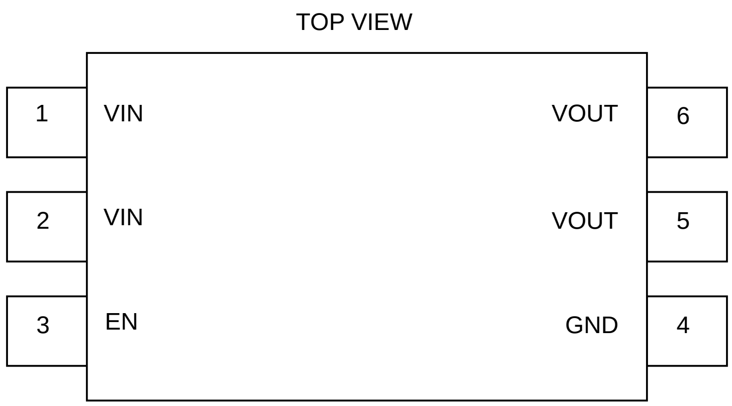


○Product structure：Silicon monolithic integrated circuit ○This product has no designed protection against radioactive rays

● **Block Diagram**



● **Pin Configuration**



● **Pin Description**

Pin No.	Symbol	Pin Function
1	VIN	Switch input pin. At use, connect each pin outside.
2		
3	EN	Switch control input pin (hysteresis input) Switch ON at High.
4	GND	Ground
5	VOUT	Switch output pin At use, connect each pin outside.
6		

●Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Supply Voltage	V_{IN}	-0.3 to 6.0	V
Control input voltage	V_{EN}	-0.3 to V_{IN} + 0.3	V
Switch output voltage	V_{OUT}	-0.3 to 6.0	V
Storage temperature	T_{STG}	-55 to 150	℃
Power dissipation	Pd	510 *1	mW

*1 Derating : 4.08mW/℃ for operation above Ta = 25℃.

●Recommended Operating Ratings

Parameter	Symbol	Ratings	Unit
Supply voltage	V_{IN}	3.0 to 5.5	V
Operating Temperature	T_{OPR}	-25 to 75	℃
Switch current	I_{OUT}	500	mA

●Electrical Characteristics Unless otherwise specified, Ta = 25℃, V_{IN} = 5V,

Parameter	Symbol	Limits Min.	Limits Typ.	Limits Max.	Unit	Condition
Operating current	I_{DD}	-	50	75	µA	V_{EN} = 5V, V_{OUT} = Open
Standby current	I_{STB}	-	0.1	1	µA	V_{EN} = 0V, V_{OUT} = Open
EN input voltage	V_{ENH}	-	-	2.5	V	High level input voltage
	V_{ENL}	0.7	-	-	V	Low level input voltage
EN input leak current	I_{EN}	-1	0.01	1	µA	
Switch on resistance	R_{ON}	-	200	255	mΩ	V_{IN} = 5V
		-	250	335	mΩ	V_{IN} = 3.3V
Switch leak current	I_{LEAK}	-	-	10	µA	At switch OFF
Switch rise time	T_{ON1}	-	0.4	0.8	ms	RL=10Ω. Refer to the timing diagram in Figure 2.
Switch rise delay time	T_{ON2}	-	0.5	1.0	ms	RL=10Ω. Refer to the timing diagram in Figure 2.
Switch fall time	T_{OFF1}	-	1	2	us	RL=10Ω. Refer to the timing diagram in Figure 2.
Switch fall delay time	T_{OFF2}	-	2	4	us	RL=10Ω. Refer to the timing diagram in Figure 2.
UVLO threshold voltage	V_{UVLO}	1.9	2.2	2.5	V	V_{IN} increasing
		1.8	2.1	2.4	V	V_{IN} decreasing
Discharge resistance	R_{DISC}	-	200	350	Ω	V_{EN} = 0V, I_L = 1mA
Discharge current	I_{DISC}	0.8	1.8	-	mA	V_{EN} = 0V,V_{IN} = V_{OUT} = 1.8V

●Measurement Circuit

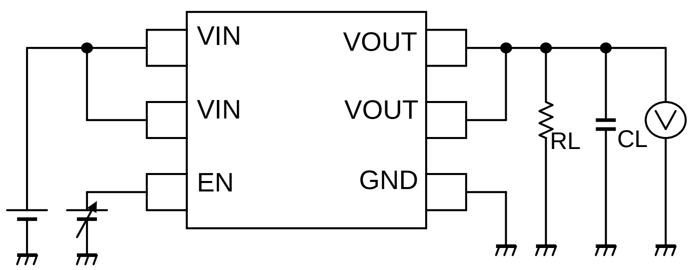


Figure 1. Measurement circuit

●Timing Diagram

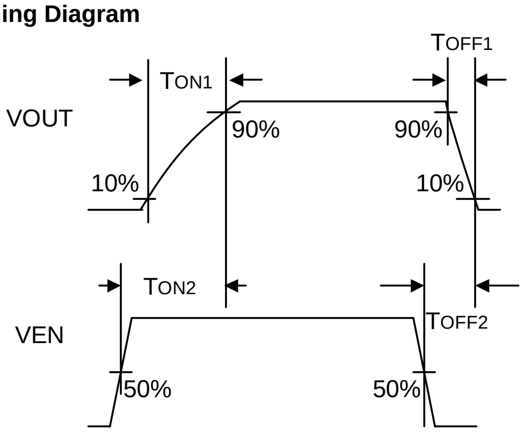


Figure 2. Timing diagram

●Typical Performance Curves

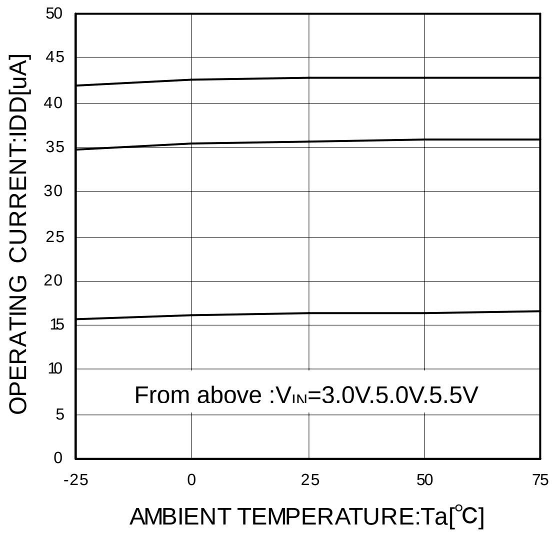


Figure 3. Operating current

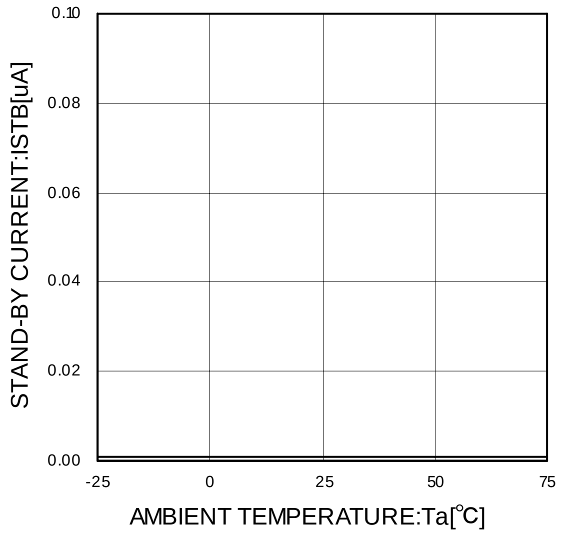


Figure 4. Standby current

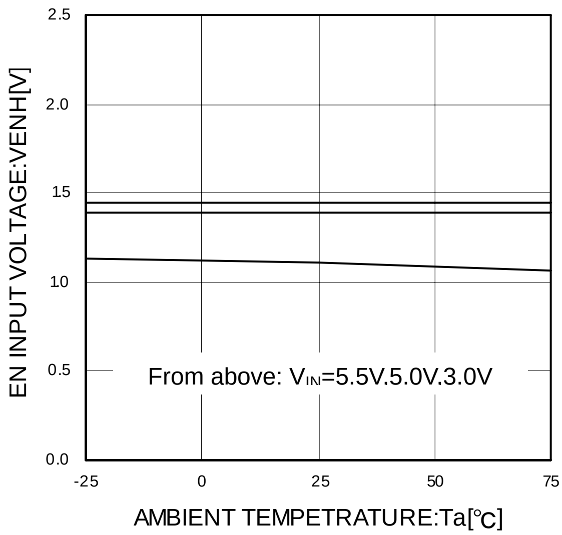


Figure 5. EN threshold voltage
(High level input voltage)

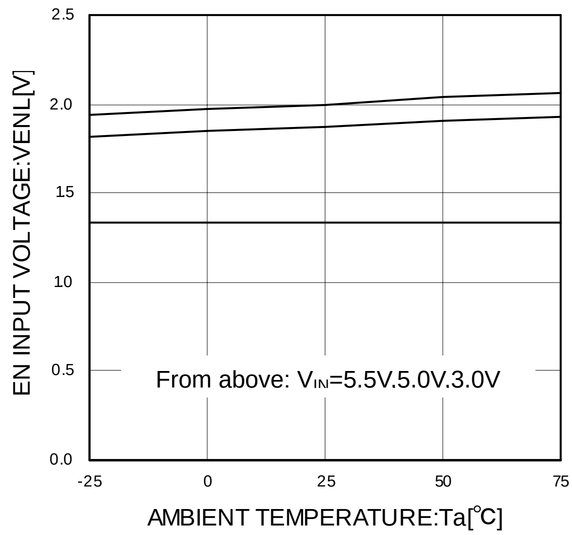


Figure 6. EN threshold voltage
(Low level input voltage)

●Typical Performance Curves - continued

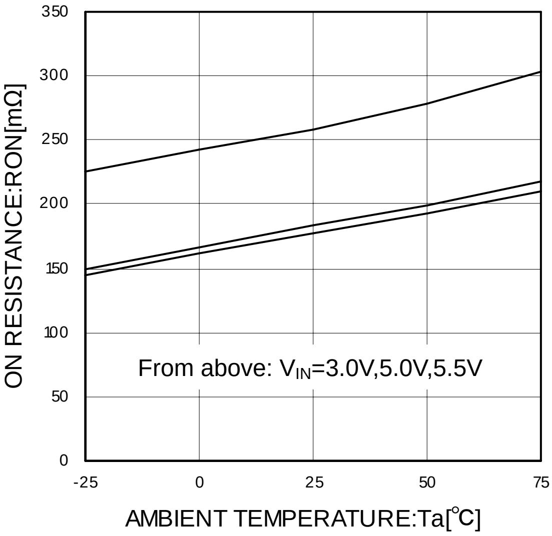


Figure 7. Switch on resistance

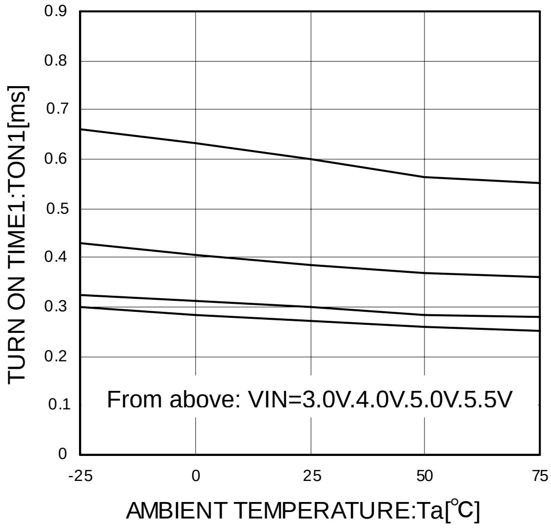


Figure 8. Switch rise time

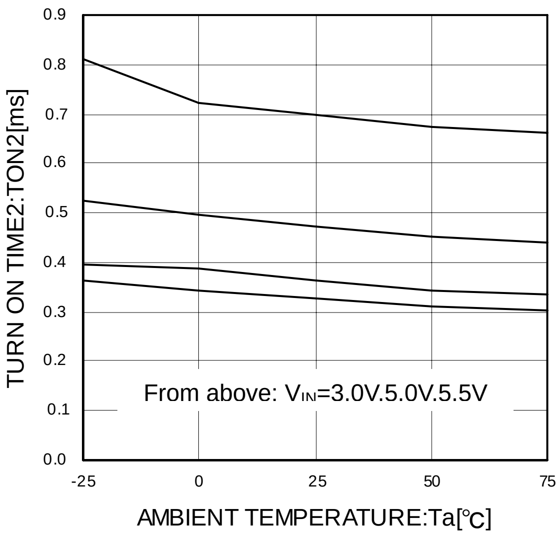


Figure 9. Switch rise delay time

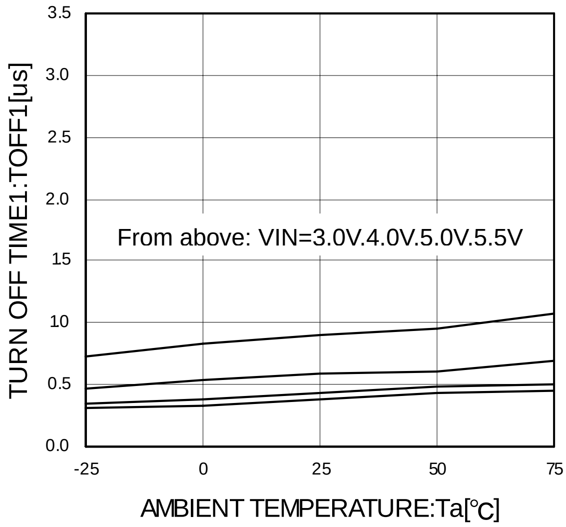


Figure 10. Switch fall time

●**Typical Performance Curves - continued**

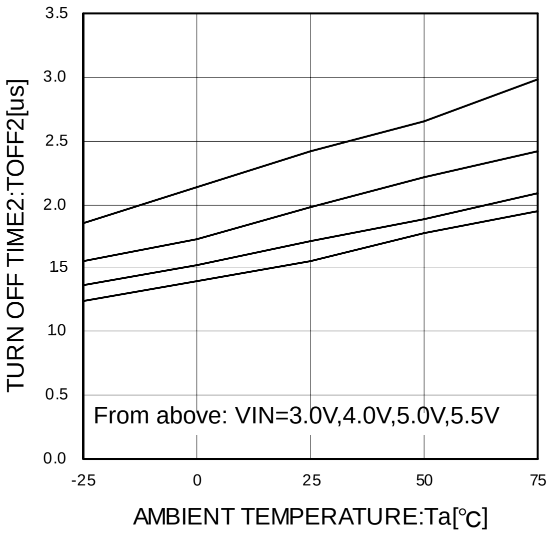


Figure 11. Switch fall delay time

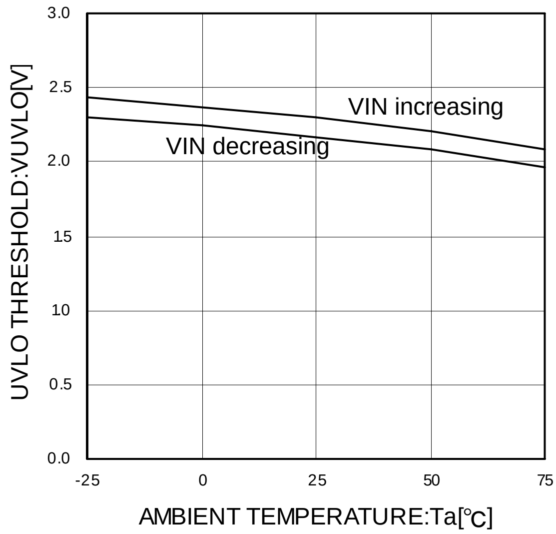


Figure 12. UVLO threshold voltage

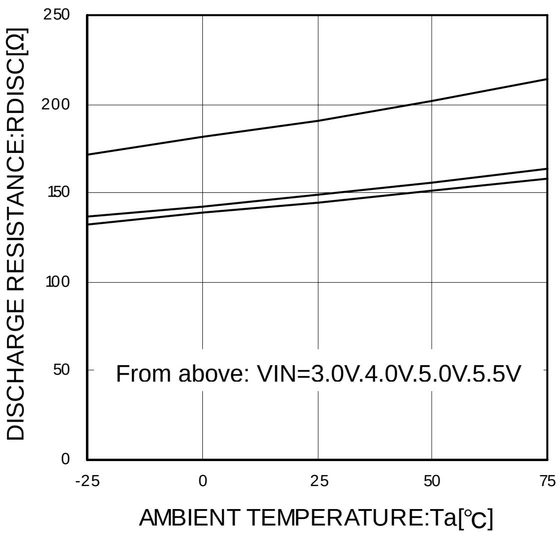


Figure 13. Discharge resistance

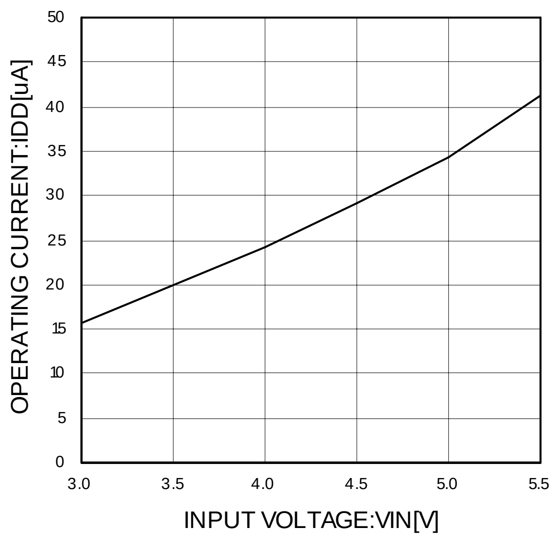


Figure 14. Operating current

●Typical Performance Curves - continued

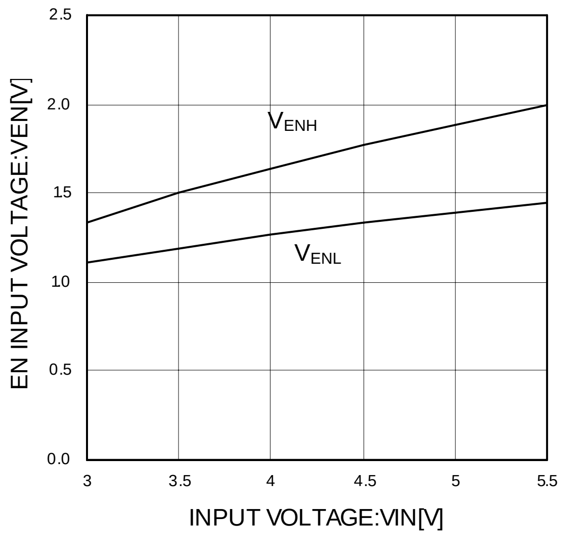


Figure 15. EN threshold voltage

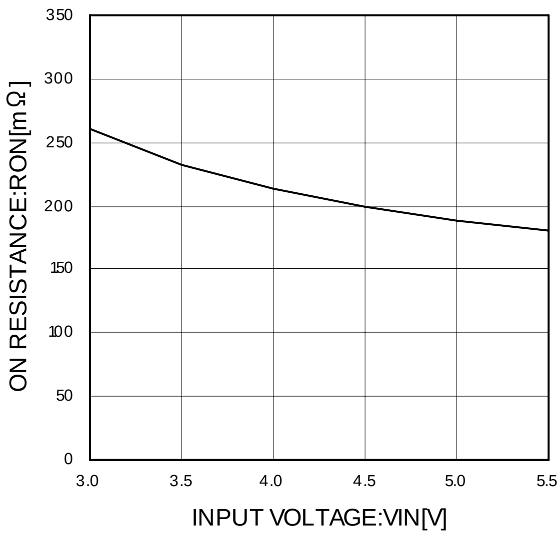


Figure 16. Switch on resistance

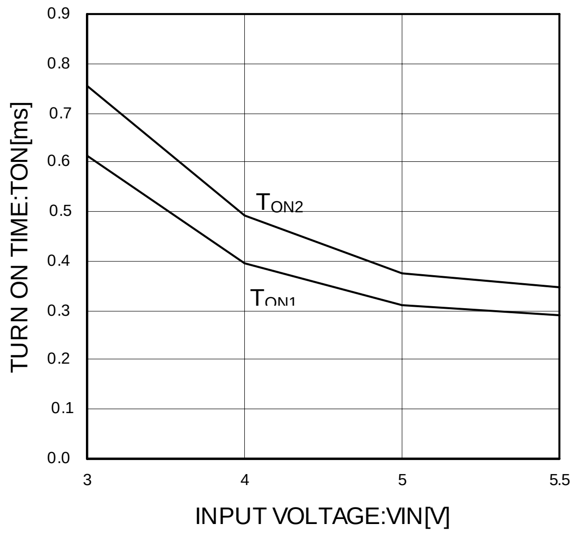


Figure 17. Switch rise time

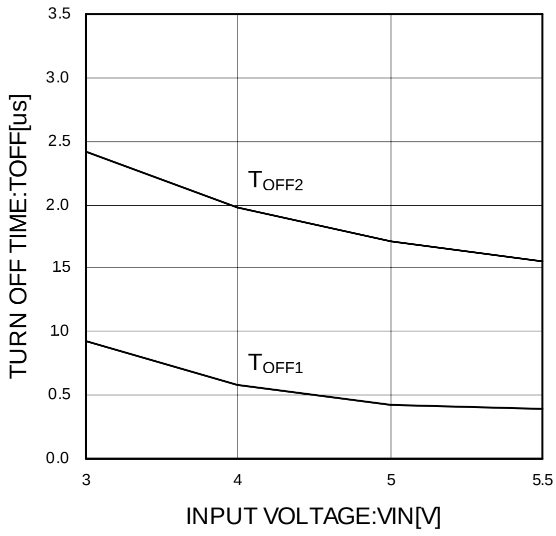


Figure 18. Switch fall time

●Typical Performance Curves - continued

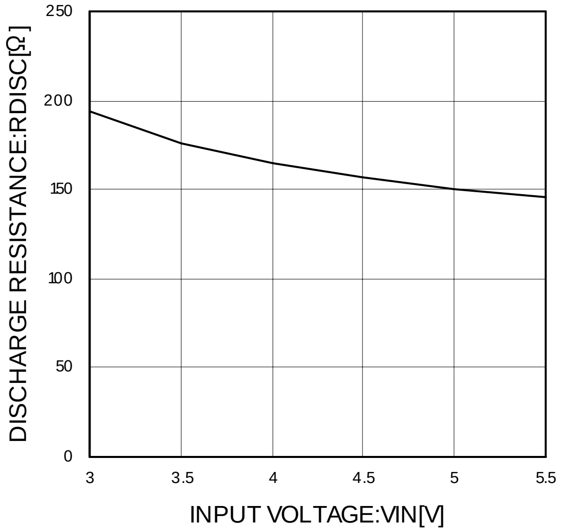


Figure 19. Discharge resistance

●**Typical Wave Forms**

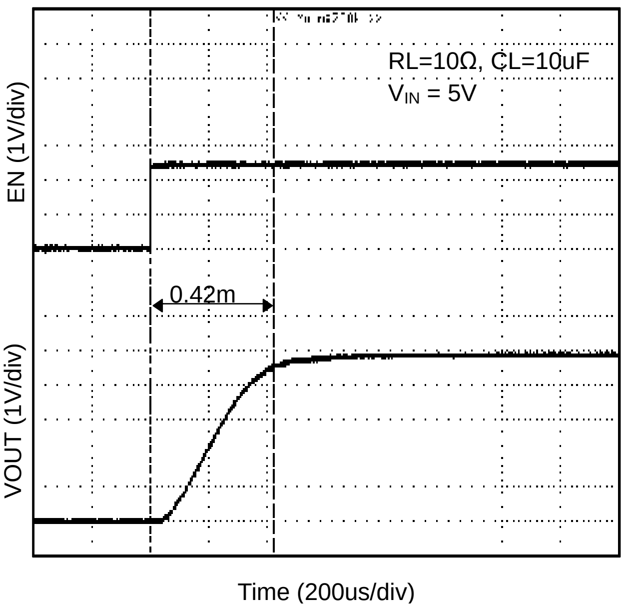


Figure 20. Switch rise time

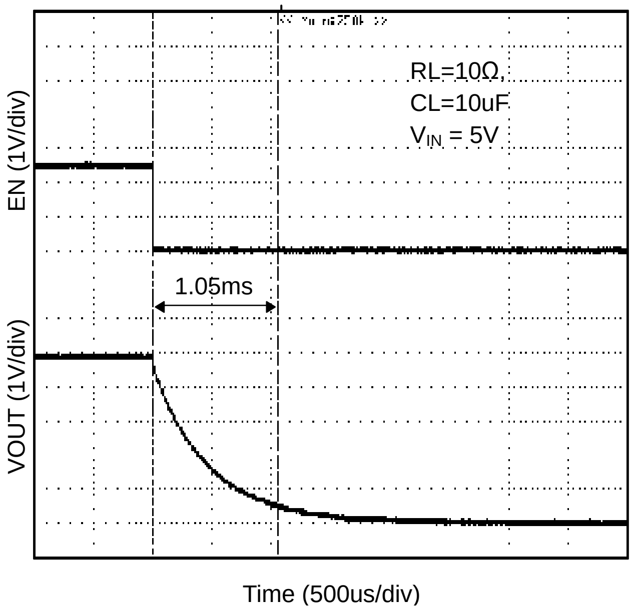


Figure 21. Switch fall time

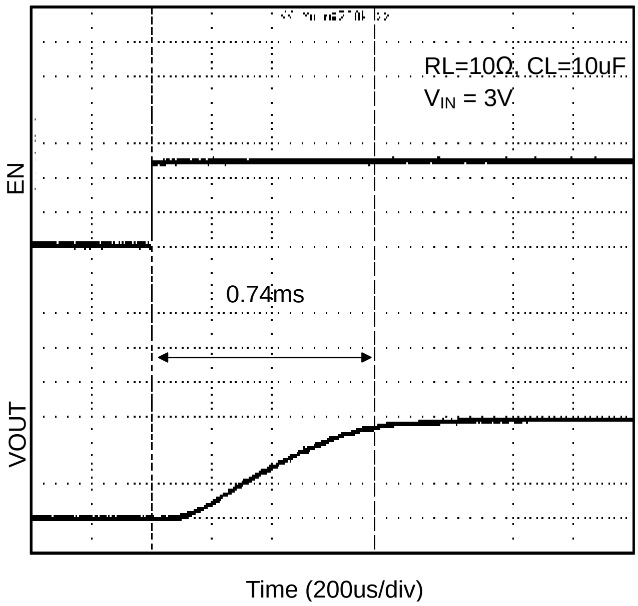


Figure 22. Switch rise time

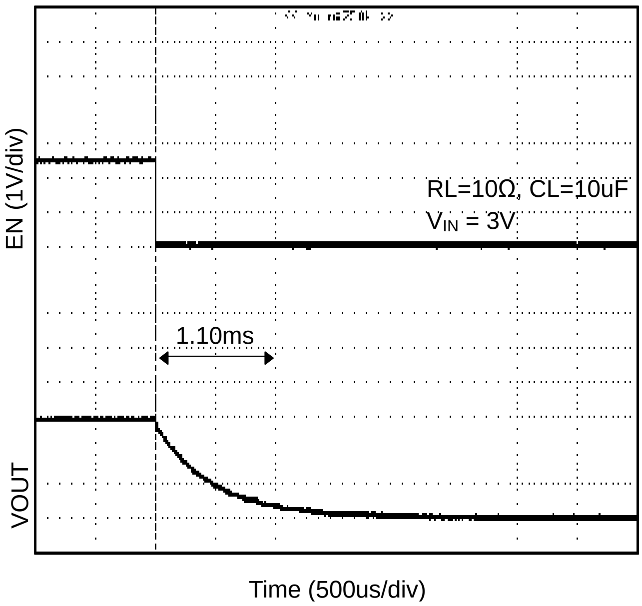


Figure 23. Switch fall time

●Typical Wave Forms – continued

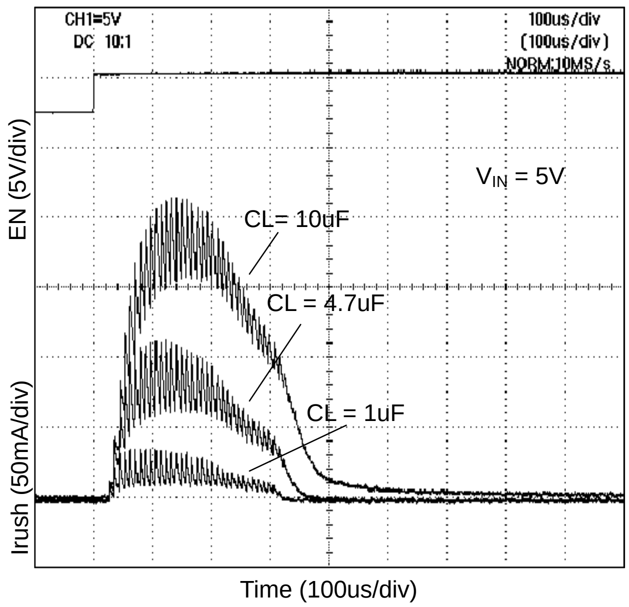


Figure 24. Inrush current

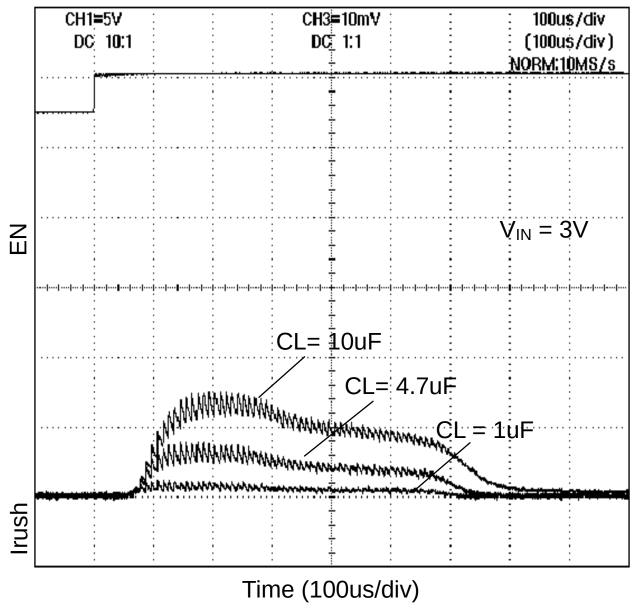


Figure 25. Inrush current

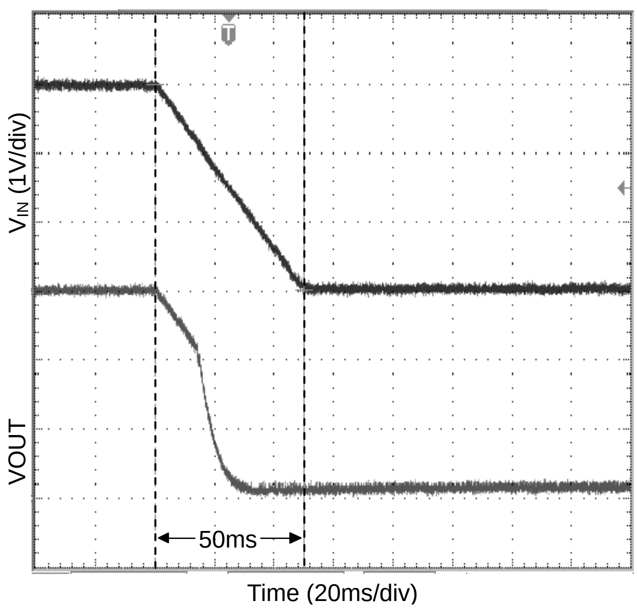


Figure 26. UVLO
CL = 10uF

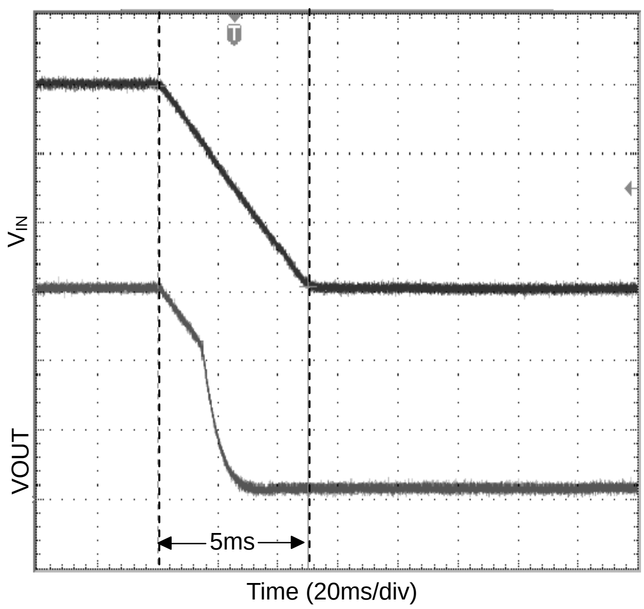
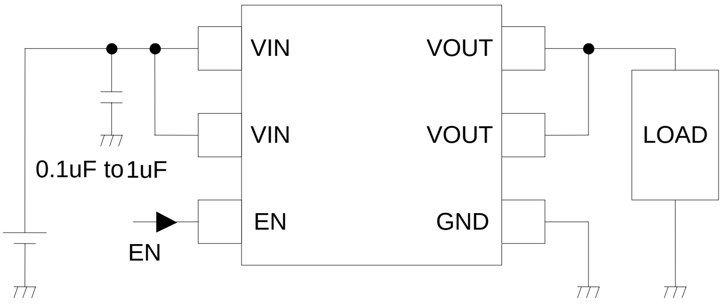


Figure 27. UVLO
CL = 1uF

●Typical Application Circuit



●Functional Description

1. Input / output

VIN pin and VOUT pin are connected to the drain and the source of N-MOS switch respectively. VIN pin is also used as power source input to internal control circuit.

When EN input is set to High level and the switch is turned on, VIN pin and VOUT pin are connected by a 200mΩ switch. In a normal condition, current flows from VIN to VOUT. If voltage of VOUT is higher than VIN, current flows from VOUT to VIN, since the switch is bidirectional. There is no parasitic diode between the drain and the source, so it is possible to prevent current from flowing reversely from VOUT pin to VIN pin when the switch is disabled.

2. Discharge circuit

When the switch between the VIN and the VOUT is OFF, the 200Ω(Typ.) discharge switch between VOUT and GND turns on. By turning on this switch, electric charge at capacitive load is discharged.

3. Under voltage lockout (UVLO)

The UVLO circuit monitors the voltage of the VIN pin, when the EN input is active. UVLO circuit prevents the switch from turning on until the VIN exceeds 2.2V(Typ.). If the VIN drops below 2.1V(Typ.) while the switch turns on, then UVLO shuts off the switch.

While the switch between the VIN pin and VOUT pin is OFF due to UVLO operations, the switch of the discharge circuit turns on. However, when the voltage of VIN declines extremely, then the VOUT pin becomes Hi-Z.

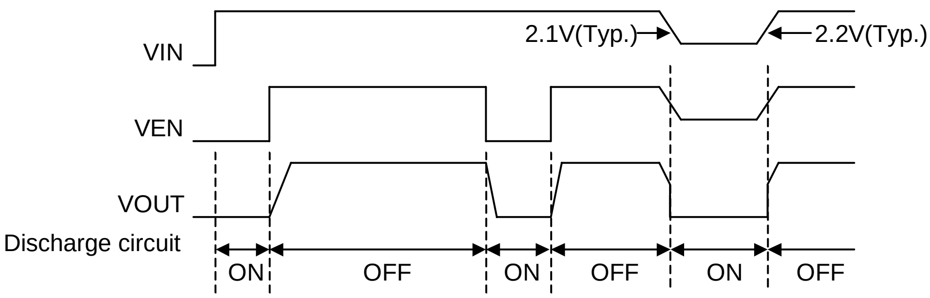


Figure 28. Operation timing

●Power Dissipation

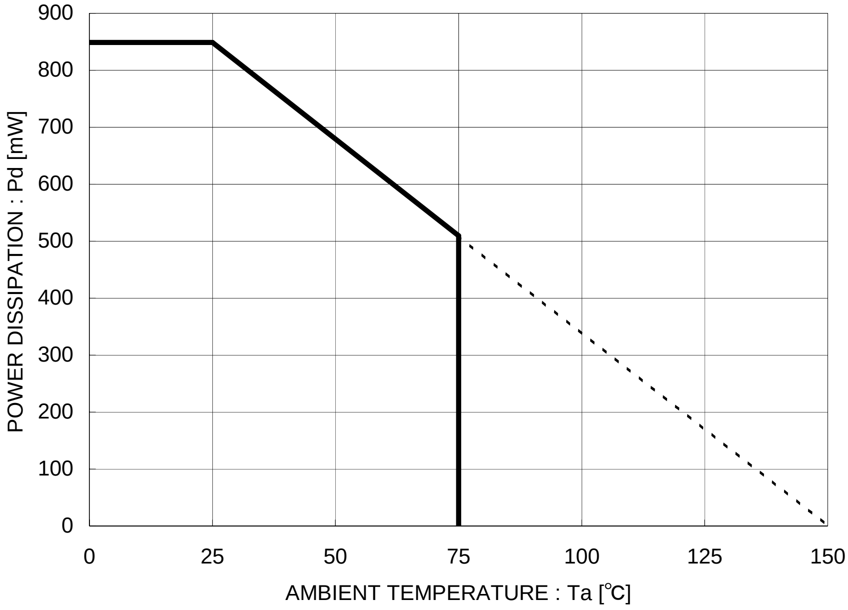
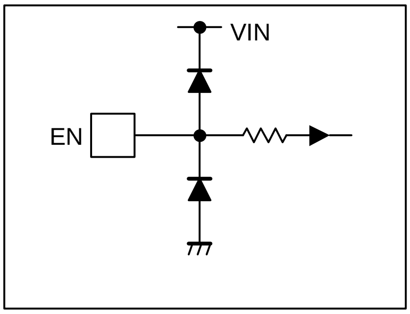
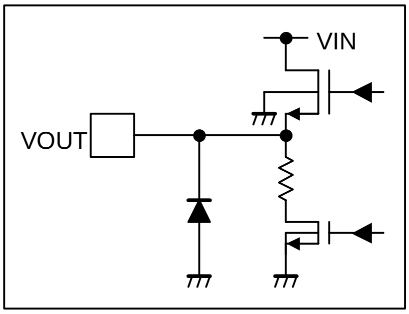


Figure 29. Power dissipation curve (Pd-Ta Curve)
(HVSOF6 package)

●I/O Equivalent Circuit





●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) 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.

(3) 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 terminals.

(4) Power supply line
Design the PCB layout pattern to provide low impedance ground and supply lines. Separate the ground and supply lines of the digital and analog blocks to prevent noise in the ground and supply lines of the digital block from affecting the analog block. 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.

(5) 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.

(6) 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.

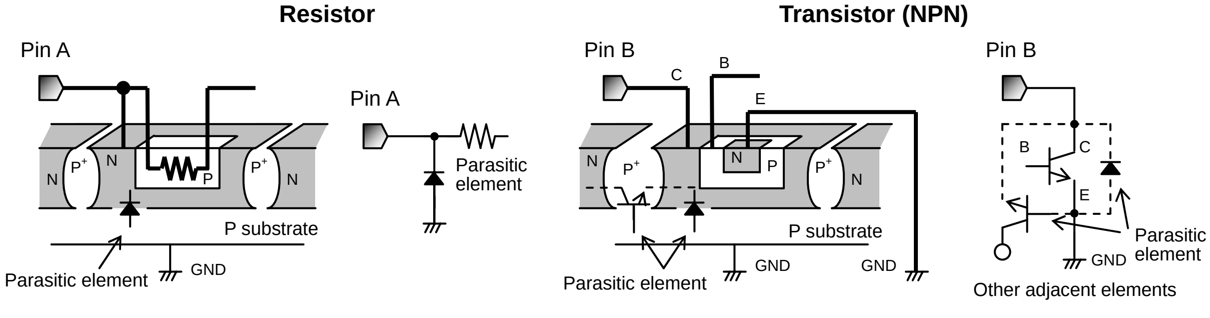
(7) Operation under strong electromagnetic field
Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

(8) 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.

(9) Regarding input pins of the IC
This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P-N junctions are formed at the intersection of the P layers with the N layers of other elements, creating a parasitic diode or transistor. For example (refer to figure below):

When GND > Pin A and GND > Pin B, the P-N junction operates as a parasitic diode.
When GND > Pin B, the P-N junction operates as a parasitic transistor.

Parasitic diodes inevitably occur in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions that cause these diodes to operate, such as applying a voltage lower than the GND voltage to an input pin (and thus to the P substrate) should be avoided.



Example of monolithic IC structure

(10) GND wiring pattern
When using both small-signal and large-current GND 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 GND traces of external components do not cause variations on the GND voltage. The power supply and ground lines must be as short and thick as possible to reduce line impedance.

(11) External 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.

(13) Thermal consideration
Use a thermal design that allows for a sufficient margin by taking into account the permissible power dissipation (Pd) in actual operating conditions. Consider Pc that does not exceed Pd in actual operating conditions (Pc≥Pd).

Package Power dissipation : Pd (W)=(Tjmax－Ta)/θja
Power dissipation : Pc (W)=(Vcc－Vo)×Io+Vcc×Ib

(Tjmax : Maximum junction temperature=150℃, Ta : Peripheral temperature[℃] ,
θja : Thermal resistance of package-ambience[℃/W], Pd : Package Power dissipation [W],
Pc : Power dissipation [W], Vcc : Input Voltage, Vo : Output Voltage, Io : Load, Ib : Bias Current)

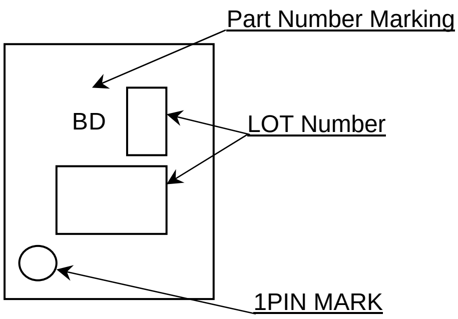
●Ordering Information

B D 6 5 2 4 H F V - T R

- Part Number
- Package
  HFV: HVSOF6
- Packaging and forming specification
  TR: Embossed tape and reel

●Marking Diagram

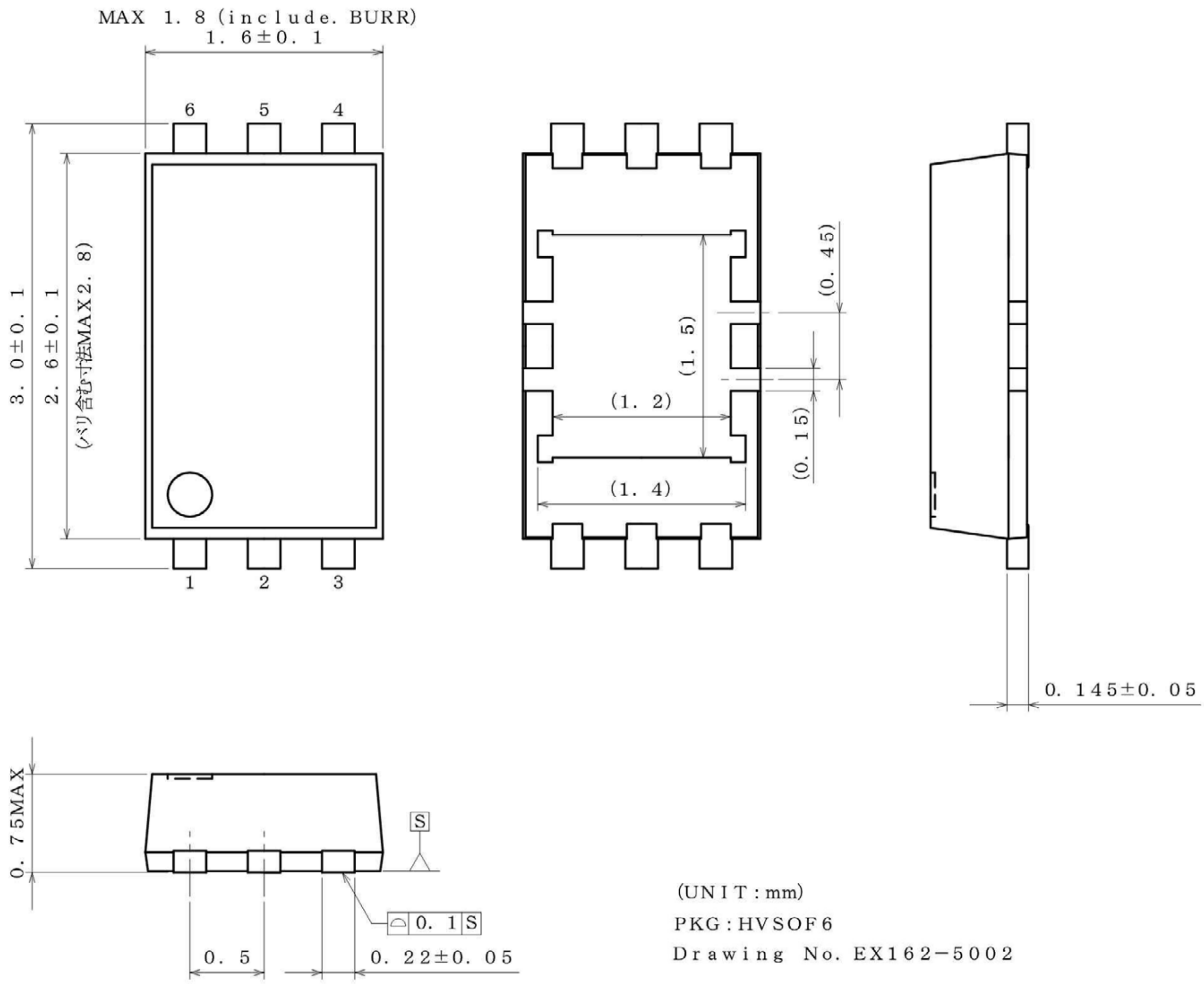
HVSOF6(TOP VIEW)



Part Number	Part Number Marking
BD6524HFV	BD

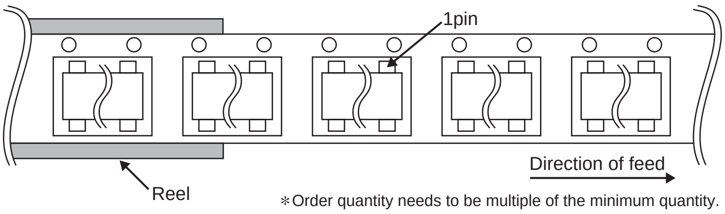
●**Physical Dimension, Tape and Reel Information**

Package Name	HVSOF6



<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.

●Revision History

Date	Revision	Changes
11.Mar.2013	001	New Release

Notice

●General Precaution

1) Before you use our Products, you are requested to carefully read this document and fully understand its contents. ROHM shall not be in any way responsible or liable for failure, malfunction or accident arising from the use of any ROHM's Products against warning, caution or note contained in this document.

2) All information contained in this document is current as of the issuing date and subject to change without any prior notice. Before purchasing or using ROHM's Products, please confirm the latest information with a ROHM sales representative.

●Precaution on using ROHM Products

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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 designed and manufactured for use under standard conditions and not 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 (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

●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

QR code 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 our Products might fall under controlled goods prescribed by the applicable foreign exchange and foreign trade act, please consult with ROHM representative in case of export.

●Precaution Regarding Intellectual Property Rights

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●Other Precaution

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