ROHM SEMICONDUCTOR

Technical Note

Power Management Switch ICs for PCs and Digital Consumer Products

Load Switch ICs for Portable Equipment

BD6528HFV,BD6529GUL

No.11029ECT19

●Description

Power switch for memory card Slot (BD6528HFV, BD6529GUL) is a high side switch IC having one circuit of N-channel Power MOSFET. This switch IC achieves ON resistance of 100mΩ with BD6529GUL; and 110mΩ with BD6528HFV. Operations from low input voltage (VIN≦2.7V) is possible; made for use of various switch applications. BD6524HFV is available in a space-saving HVSOF6 package. BD6529GUL is available in a space-saving VCSP-6 package.

●Features

1) Single channel of Low On-Resistance (Typ. = 100mΩ) N-channel MOSFET built in
2) 500mA output current
3) Low voltage switch capability
4) Soft-start function
5) Output discharge circuit
6) Reverse current flow blocking at switch off
7) HVSOF6 package for BD6528HFV
   VCSP50L1 package for BD6529GUL

●Applications

Memory card slots of Mobile phone, Digital still camera, PDA, MP3 player, PC, etc.

●Line up matrix

Part Number	ON resistance	Output current	Discharge circuit	Logic Control Input	Package
BD6528HFV	110mΩ	500mA	○	High	HVSOF6 1.6 x 3.0 mm
BD6529GUL	100mΩ	500mA	○	High	VCSP50L1 1.5 x 1.0 mm

●Absolute maximum ratings

Parameter	Symbol	Ratings	Unit
Supply voltage	VDD	-0.3 ～ 6.0	V
VIN voltage	VIN	-0.3 ～ 6.0	V
EN voltage	VEN	-0.3 ～ VDD + 0.3	V
VOUT voltage	VOUT	-0.3 ～ 6.0	V
Storage temperature	TSTG	-55 ～ 150	℃
Power dissipation	Pd	849 *1 (BD6528HFV) 575 *2 (BD6529GUL)	mW

*1 Mounted on 70mm * 70mm * 1.6mm Glass-epoxy PCB. Derating: 6.8mW /℃ at Ta > 25℃
*2 Mounted on 50mm * 58mm * 1.75mm Glass-epoxy PCB. Derating: 4.6mW / ℃ at Ta > 25℃
* This product is not designed for protection against radioactive rays.
* Operation is not guaranteed.

●Operating conditions

Parameter	Symbol	Ratings			Unit
		Min.	Typ.	Max.	
Operating voltage	VDD	2.7	3.3	4.5	V
Switch input voltage	VIN	0	1.2	2.7	V
Operation temperature	TOPR	-25	25	85	℃
Output current	ILO	0	-	500	mA

●Electrical characteristics

○BD6528HFV(unless otherwise specified, V_{DD} =3.3V, V_{IN} = 1.2V, Ta = 25℃)

Parameter	Symbol	Limits			Unit	Condition
		Min.	Typ.	Max.		
[Current consumption]						
Operating current	I_{DD}	-	20	30	μA	V_{EN} = 1.2V
Standby current	I_{STB}	-	0.01	1	μA	V_{EN} = 0V
[I/O]						
EN input voltage	V_{ENH}	1.2	-	-	V	High level input
	V_{ENL}	-	-	0.4	V	Low level input
EN input current	I_{EN}	-1	-	1	μA	V_{EN} = 0V or V_{EN} = 1.2V
[Power switch]						
On-resistance	R_{ON}	-	110	-	mΩ	I_{OUT} = 500mA
Switch leakage current	I_{LEAK}	-	0.01	10	μA	V_{EN} = 0V, V_{OUT} = 0V
Output rise time	T_{ON1}	-	0.5	1	ms	R_L = 10Ω, V_{OUT} 10% → 90%
Output turn-on time	T_{ON2}	-	0.6	2	ms	R_L = 10Ω, V_{EN} High →V_{OUT} 90%
Output fall time	T_{OFF1}	-	1	20	μs	R_L = 10Ω, V_{OUT} 90% → 10%
Output turn-off time	T_{OFF2}	-	15	100	μs	R_L = 10Ω, V_{EN} Low →V_{OUT} 10%
[Discharge circuit]						
Discharge on-resistance	R_{DISC}	-	70	110	Ω	I_{OUT} = -1mA, V_{EN} = 0V
Parameter	I_{DISC}	-	15	20	mA	V_{OUT} = 3.3V, V_{EN} = 0V

○BD6529GUL(unless otherwise specified, V_{DD} =3.3V, V_{IN} = 1.2V, Ta = 25℃)

Parameter	Symbol	Limits			Unit	Condition
		Min.	Typ.	Max.		
[Current consumption]						
Operating current	I_{DD}	-	20	30	μA	V_{EN} = 1.2V
Standby current	I_{STB}	-	0.01	1	μA	V_{EN} = 0V
[I/O]						
EN input voltage	V_{ENH}	1.2	-	-	V	High level input
	V_{ENL}	-	-	0.4	V	Low level input
EN input current	I_{EN}	-1	-	1	μA	V_{EN} = 0V or V_{EN} = 1.2V
[Power switch]						
On Resistance	R_{ON}	-	100	-	mΩ	I_{OUT} = 500mA
Switch leakage current	I_{LEAK}	-	0.01	10	μA	V_{EN} = 0V, V_{OUT} = 0V
Output turn on rise time	T_{ON1}	-	0.5	1	ms	R_L = 10Ω, V_{OUT} 10% → 90%
Output turn on time	T_{ON2}	-	0.6	2	ms	R_L = 10Ω, V_{EN} High →V_{OUT} 90%
Output turn off fall time	T_{OFF1}	-	0.1	4	μs	R_L = 10Ω, V_{OUT} 90% → 10%
Output turn off time	T_{OFF2}	-	1	6	μs	R_L = 10Ω, V_{EN} Low →V_{OUT} 10%
[Discharge circuit]						
Discharge on-resistance	R_{DISC}	-	70	110	Ω	I_{OUT} = -1mA, V_{EN} = 0V
Discharge current	I_{DISC}	-	15	20	mA	V_{OUT} = 3.3V, V_{EN} = 0V

●Test circuit

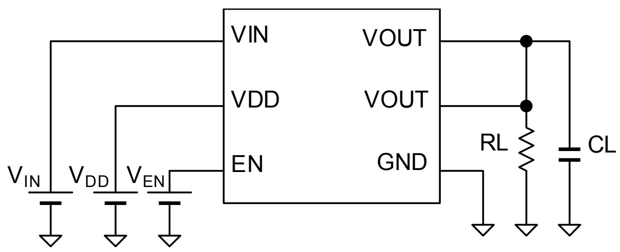


Fig.1 Measurement circuit

●Switch output turn ON/OFF timing

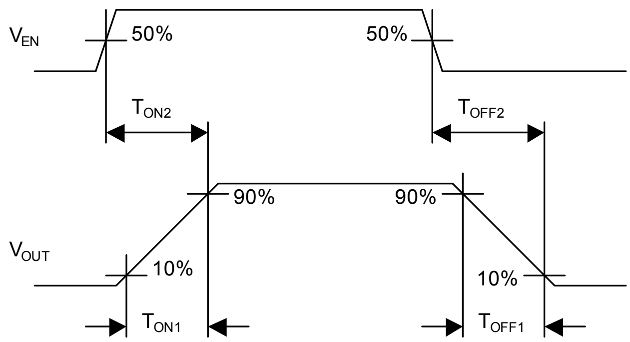


Fig.2 Timing diagrams

●Reference data

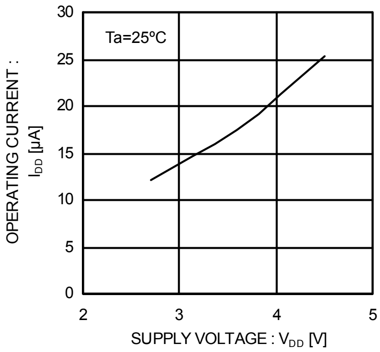


Fig.3 Operating current
EN enable

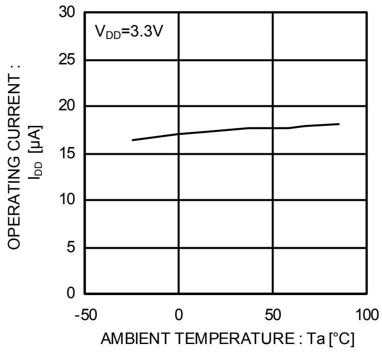


Fig.4 Operating current
EN enable

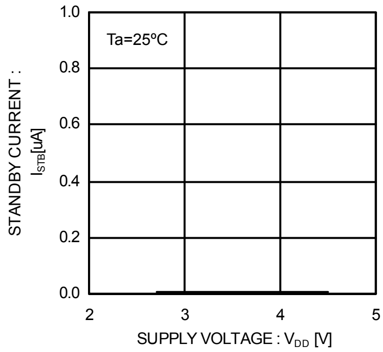


Fig.5 Standby current
EN disable

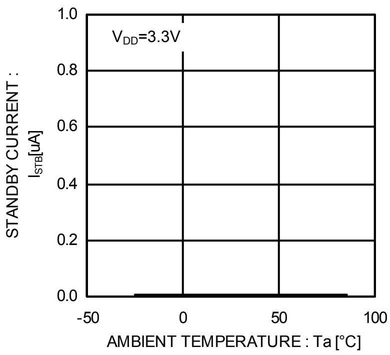


Fig.6 Standby current
EN disable

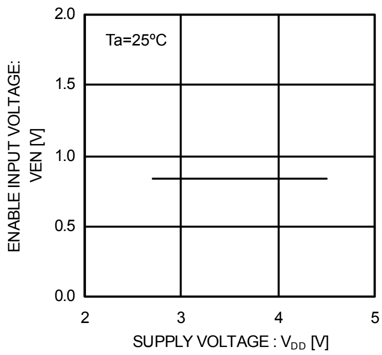


Fig.7 EN input voltage

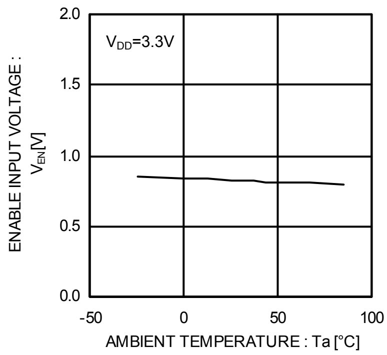


Fig.8 EN input voltage

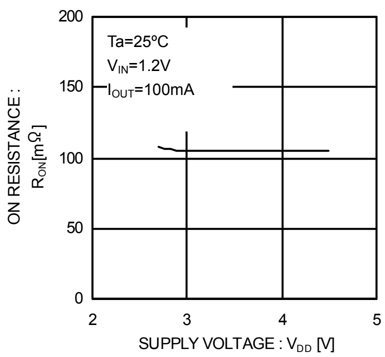


Fig.9 On-resistance vs. VDD
(BD6528HFV)

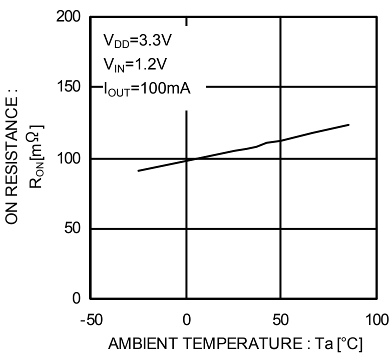


Fig.10 On-resistance vs. temperature
(BD6528HFV)

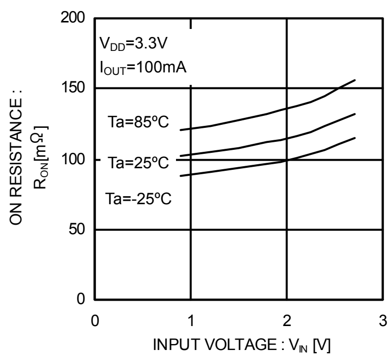


Fig.11 On-resistance vs. VIN
(BD6528HFV)

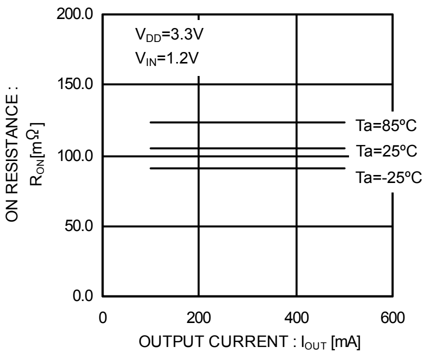


Fig.12 On-resistance vs. IOUT
(BD6528HFV)

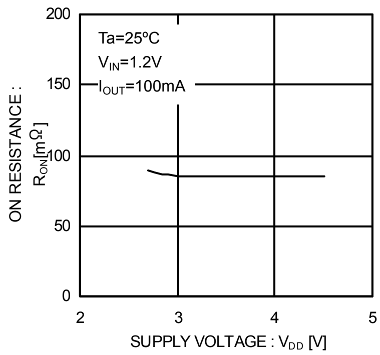


Fig.13 On-resistance vs. VDD
(BD6529GUL)

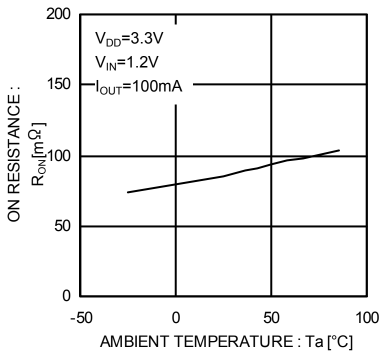


Fig.14 On-resistance vs. temperature
(BD6529GUL)

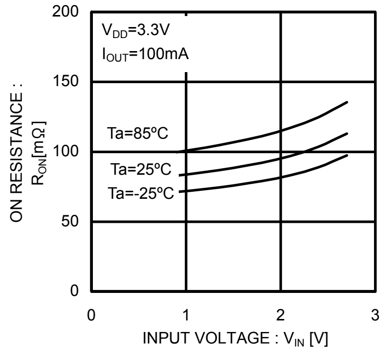


Fig.15 On-resistance vs. VIN (BD6529GUL)

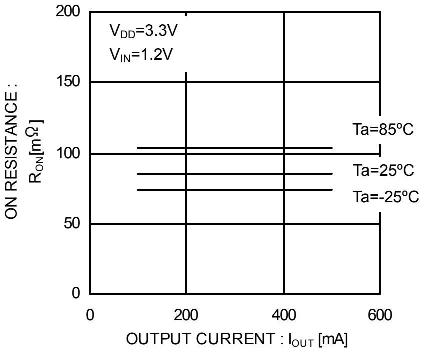


Fig.16 On-resistance vs. IOUT (BD6529GUL)

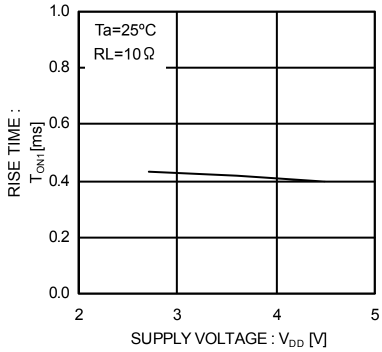


Fig.17 Output rise time

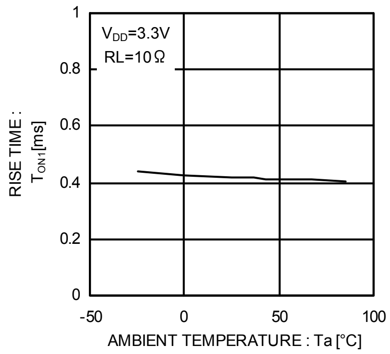


Fig.18 Output rise time

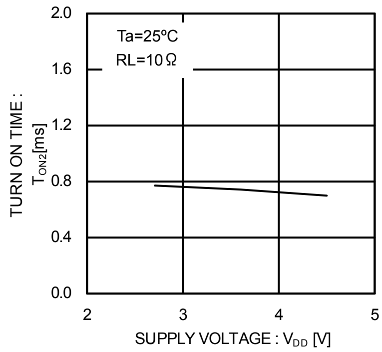


Fig.19 Output turn-on time

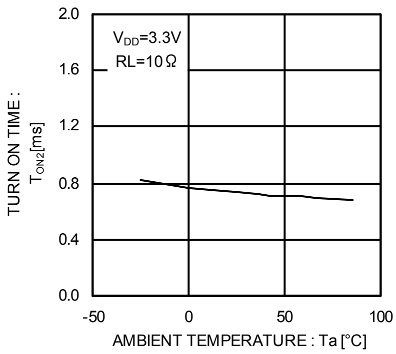


Fig.20 Output turn-on time

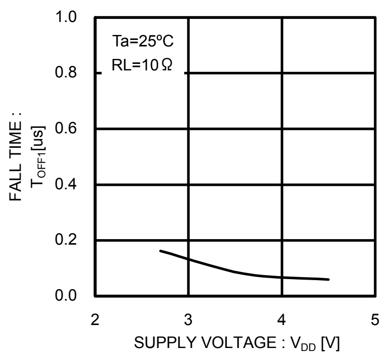


Fig.21 Output fall time

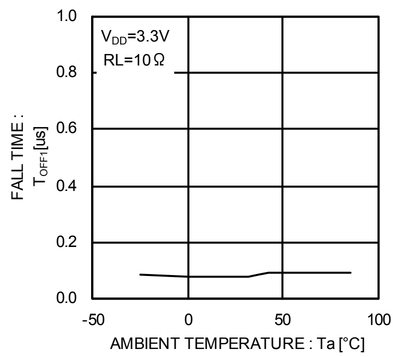


Fig.22 Output fall time

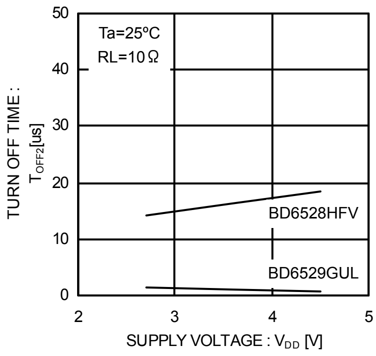


Fig.23 Output turn-off time

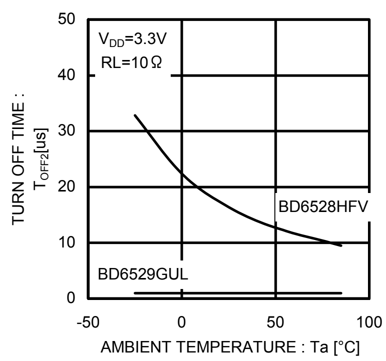


Fig.24 Output turn-off time

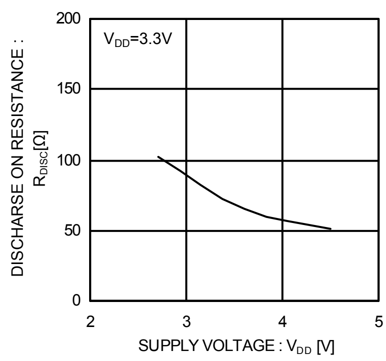


Fig.25 Discharge on-resistance

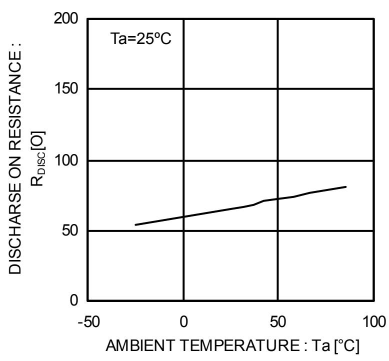


Fig.26 Discharge on-resistance

●Waveform data

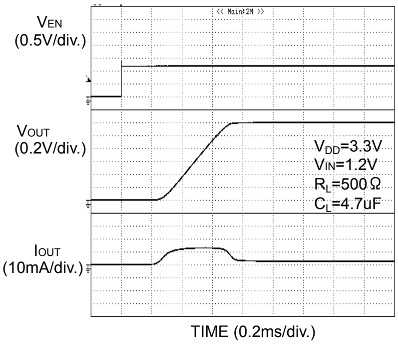


Fig.27 Output turn-on response
BD6528HFV

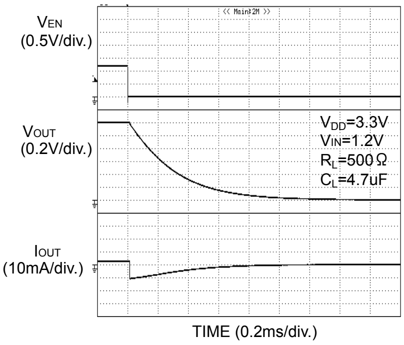


Fig.28 Output turn-off response
BD6528HFV

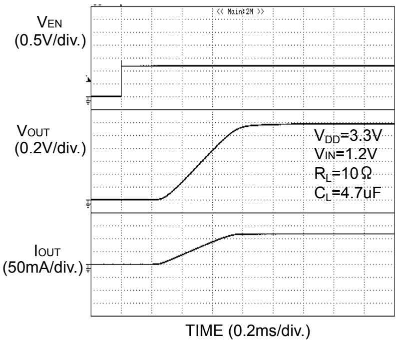


Fig.29 Output turn-on response
BD6528HFV

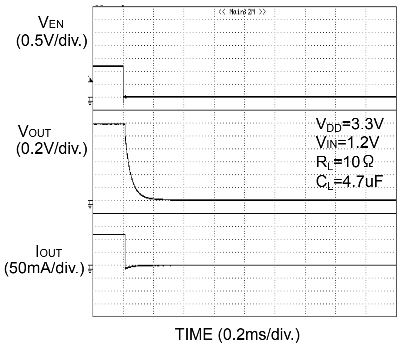


Fig.30 Output turn-off response
BD6528HFV

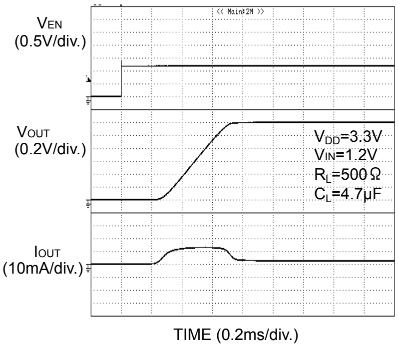


Fig.31 Output turn-on response
BD6529GUL

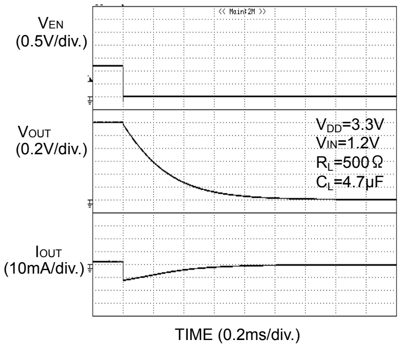


Fig.32 Output turn-off response
BD6529GUL

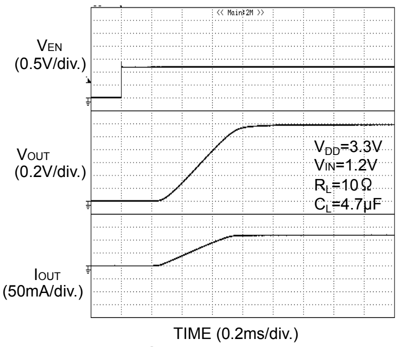


Fig.33 Output turn-on response
BD6529GUL

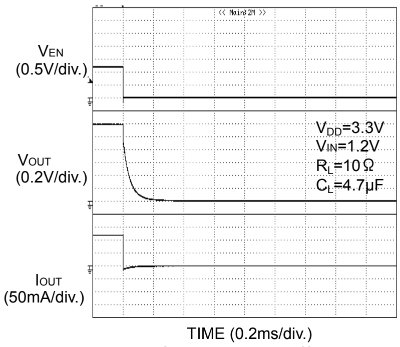


Fig.34 Output turn-off response
BD6529GUL

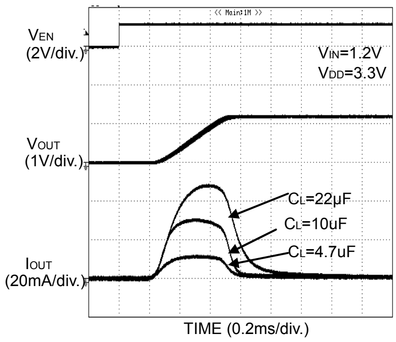


Fig.35 Rush current response

●Block diagram

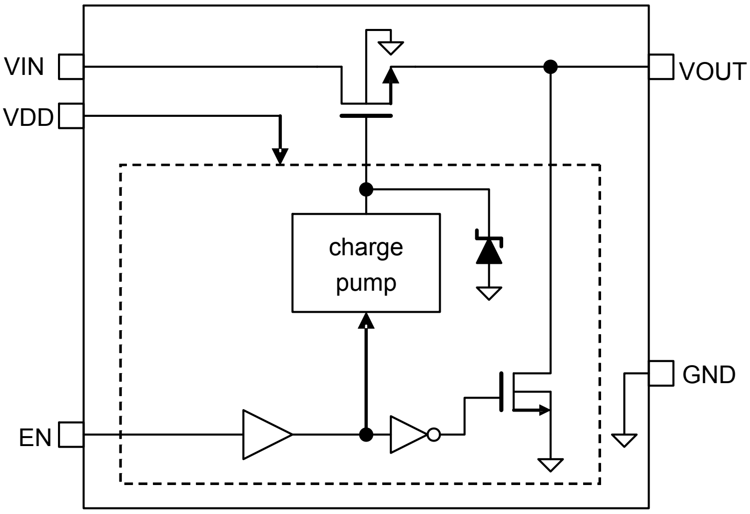


Fig.36 Block diagram

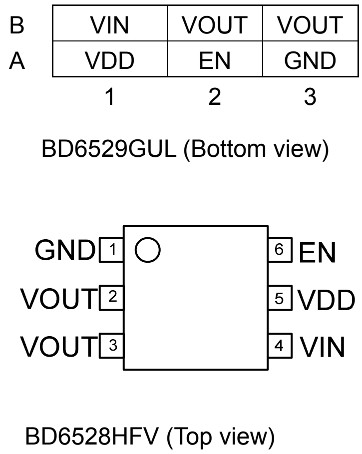
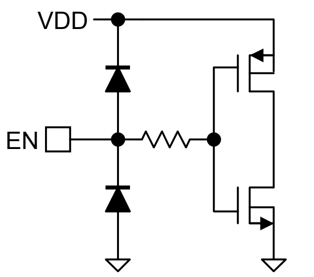
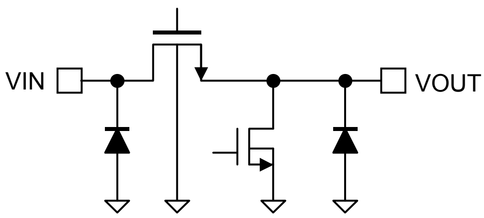


Fig.37 Pin configuration

●Pin description

Pin number	Pin name	Pin function
1 (A3)	GND	Ground
2, 3 (B2, B3)	VOUT	Switch output (connect each pin externally)
4 (B1)	VIN	Switch input
5 (A1)	VDD	Power supply (for switch control and drive circuit)
6 (A2)	EN	Enable input (Active-High Switch on input)

●I/O equivalent circuit

Pin name	Pin number	Equivalent circuit
EN	6 (A2)	
VIN VOUT	4 (B1) 2, 3 (B2, B3)	

●Operation description

1. Switch operation

Each VIN and VOUT pins are connected to MOSFET’s drain and source. By setting EN input to High level, the internal charge pump operates and turns on MOSFET.
When MOSFET is turned on, the switch becomes bidirectional characteristics. Consequently, in case of VIN < VOUT, the current is flowing from VOUT to VIN.
Since there is no parasitic diode between switch’s drain and source, it prevents the reverse current flow from VOUT to VIN during switch off stage.

2. Output discharge circuit

Discharge circuit operates when switch is off. When discharge circuit operates, 70Ω (Typ.) resistor is connected between VOUT pin and GND pin. This discharges the electrical charge quickly.

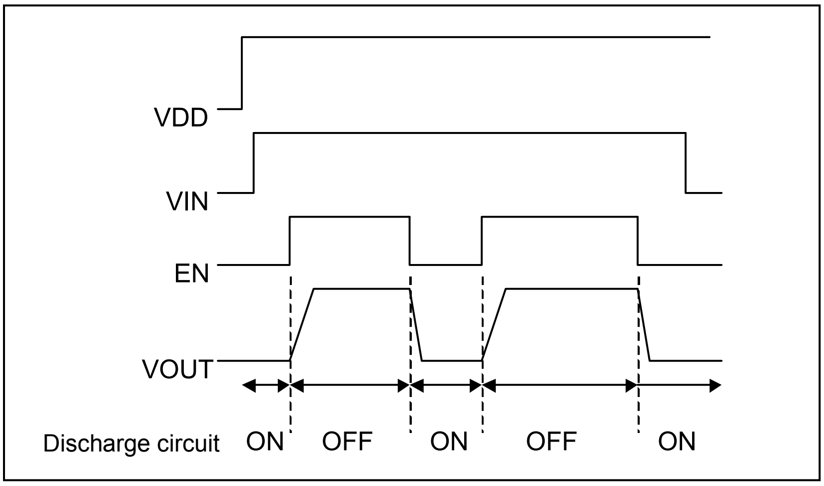


Fig.38 Operation timing

●Application circuit example

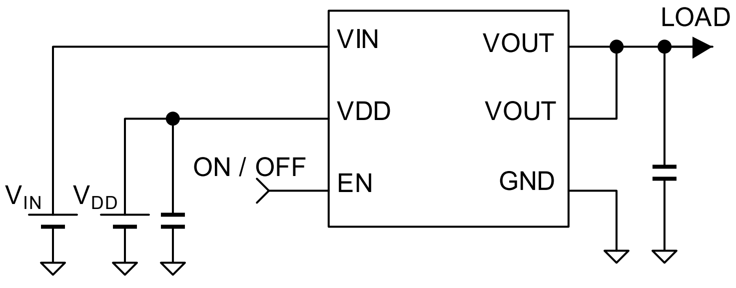


Fig.39 Application circuit example

* This application circuit does not guarantee its operation.
When the external circuit constant, etc. is changed, be sure to consider adequate margins; by taking into account external parts and/or IC’s dispersion including not only static characteristics, but also transient characteristics.

●Power dissipation characteristics

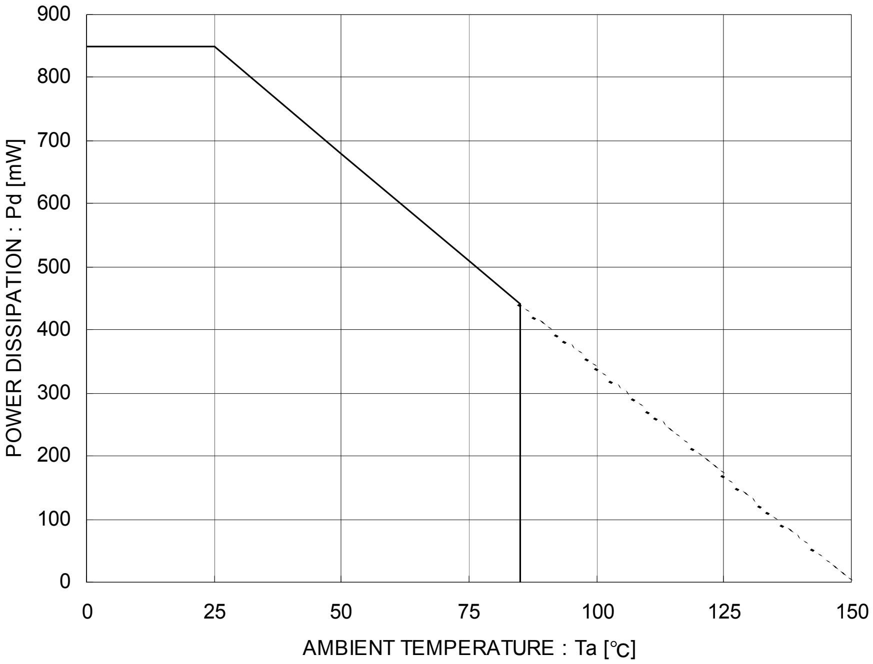


Fig.40 Power dissipation curve (Pd-Ta Curve)
(HVSOF6 package)

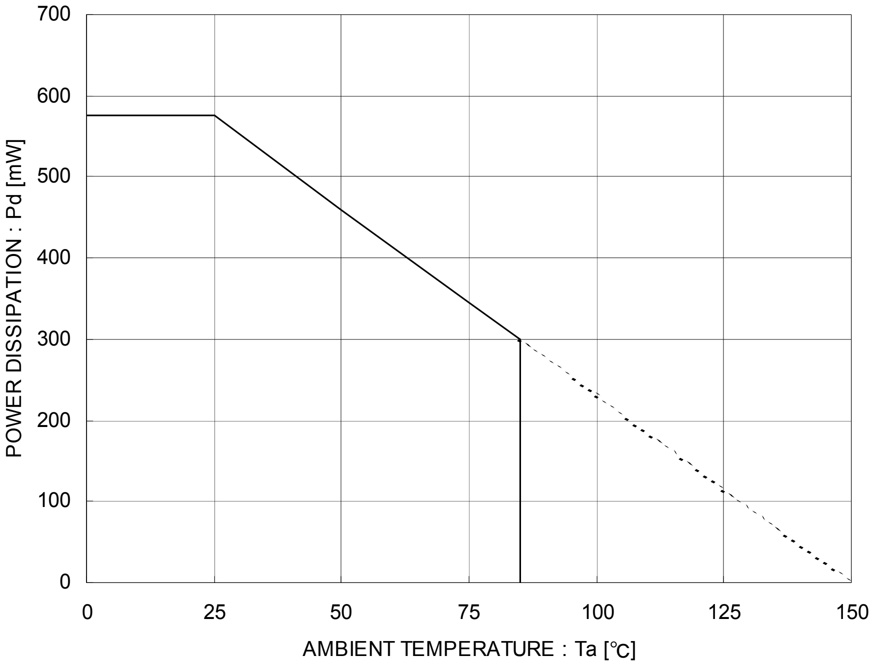


Fig.41 Power dissipation curve (Pd-Ta Curve)
(VCSP50L1 package)

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

●Ordering part number

B	D		6	5	2	8		H	F	V	-	T	R

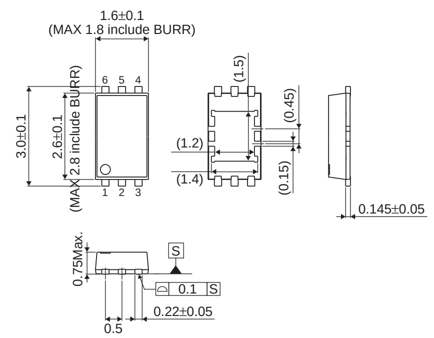
Part No.

Part No.
6528
6529

Package
HFV: HVSOF6
GUL: VCSP50L1

Packaging and forming specification
TR: Embossed tape and reel
(HVSOF6)
E2: Embossed tape and reel
(VCSP50L1)

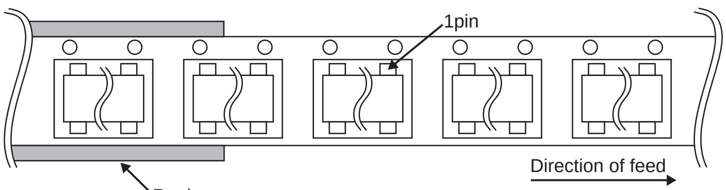
HVSOF6



(Unit : mm)

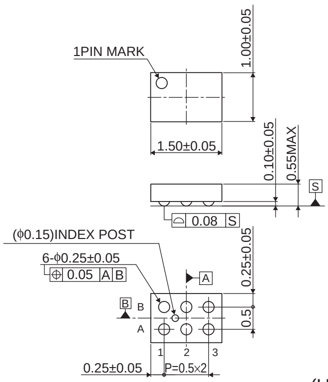
<Tape and Reel information>

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.

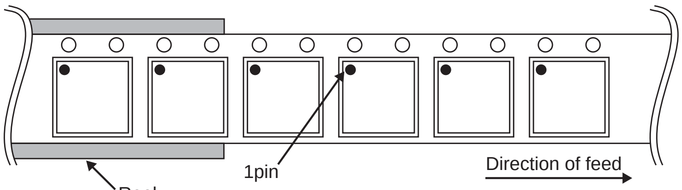
VCSP50L1(BD6529GUL)



(Unit : mm)

<Tape and Reel information>

Tape	Embossed carrier tape (heat sealing method)
Quantity	3000pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left 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.

Notes

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