H-Bridge Drivers for DC Brush Motors

Single H-Bridge Driver High-Speed Switching Type

BD63573NUV

General Description

The BD63573NUV provides a single H-bridge motor driver which features wide range of motor power supply voltage from 2.0V to 16.0V and low power consumption to switch low ON-Resistance DMOS transistors at high speed. This small surface mounting package is most suitable for mobile system, home appliance and various applications.

Features

- Low ON-Resistance Power DMOS Output
- Charge Pump-Less with PDMOS High-Side Driver
- Drive Mode Switch Function
- Control Input Voltage Range Fit 1.8V Controller
- Under Voltage Locked Out Protection & Thermal Shut Down Function

Applications

- Mobile System
- Home Appliance
- Amusement System, etc

Key Specifications

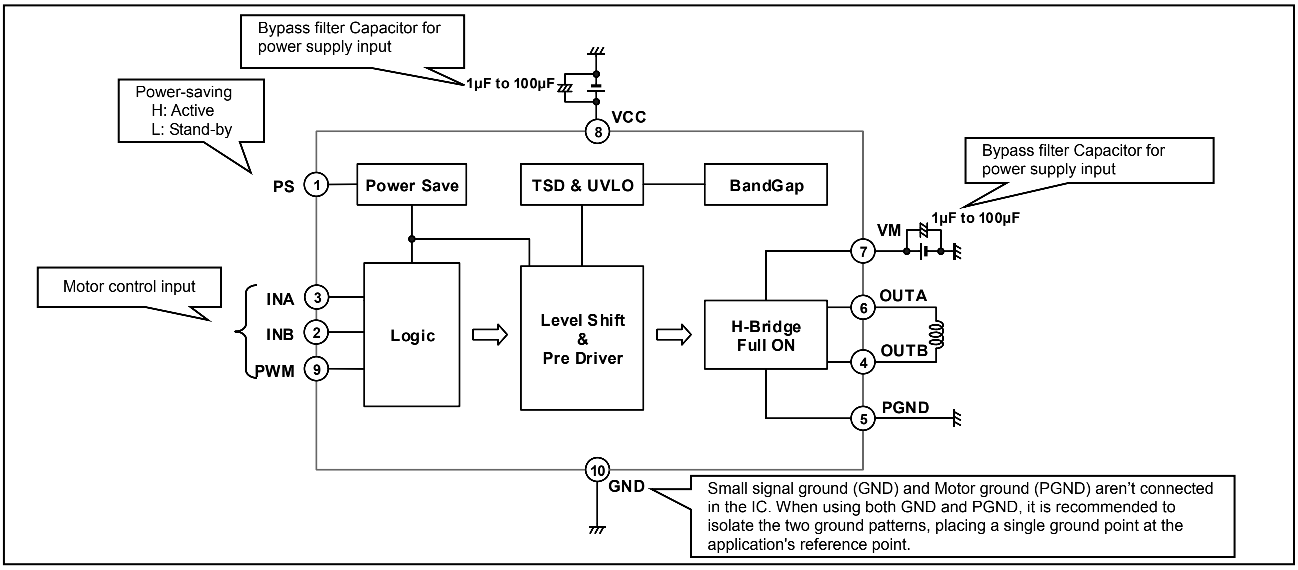
- Power Supply Voltage Range: 2.5V to 5.5V
- Motor Power Supply Voltage Range: 2.0V to 16.0V
- Circuit Current (Open Mode): 0.65mA(Typ)
- Stand-By Current: 1μA (Max)
- Control Input Voltage Range: 0V to V_{CC}V
- Logic Input Frequency: 500kHz(Max)
- Minimum Logic Input Pulse Width: 0.5μs(Min)
- Turn On Time: 250ns(Typ)
- Turn Off Time: 80ns(Typ)
- H-Bridge Output Current (DC): -1.2A to +1.2A
- H-Bridge Output Current (Peak): -3.2A to +3.2A
- Output ON-Resistance (Total): 0.38Ω(Typ)
- Operating Temperature Range: -30°C to +85°C

Package

Package	W(Typ) x D(Typ) x H(Max)
VSON010V3030	3.00mm x 3.00mm x 1.00mm

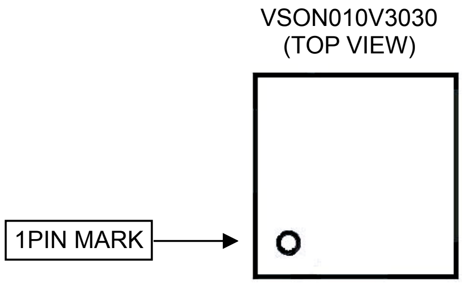
VSON010V3030

Typical Application Circuit



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

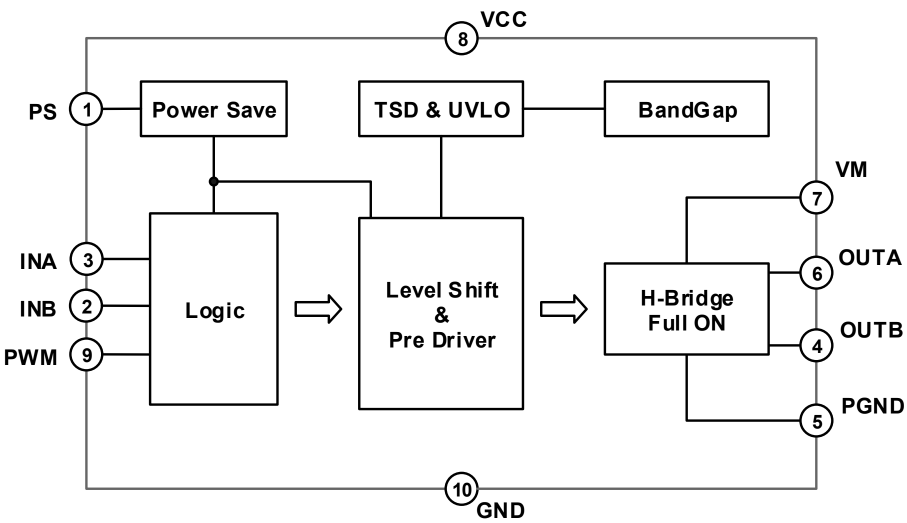
Pin Configuration



Pin Description

Pin No.	Pin Name	Function
1	PS	Power-saving terminal
2	INB	Control input terminal B
3	INA	Control input terminal A
4	OUTB	H-bridge output terminal B
5	PGND	Motor ground terminal
6	OUTA	H-bridge output terminal A
7	VM	Motor power supply terminal
8	VCC	Power supply terminal
9	PWM	Drive mode selection terminal
10	GND	Ground terminal

Block Diagram



Description of Blocks

1. Power-Saving Function
   A power-saving function is included, which allows the system to save power when not driving the motor. The voltage level on this pin should be set high so as to keep the operation mode. (See the Electrical Characteristics; p.4/14)

2. Motor Control Input
   (a) INA and INB Pins
   Logic level controls the output logic of H-Bridge.
   (See the Electrical Characteristics; p.4/14, and I/O Truth Table; p.7/14)

   (b) PWM Pin
   Logic level sets the IN/IN or EN/IN drive mode.
   (See the Electrical Characteristics; p.4/14 and I/O Truth Table; p.7/14)

Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Rating	Unit
Power Supply Voltage	V_{CC}	-0.3 to +7.0	V
Motor Power Supply Voltage	V_M	-0.3 to +20.0	V
Control Input Voltage	V_{IN}	-0.3 to +V_{CC}+0.3	V
Power Dissipation	Pd	0.70 (Note 1)	W
		1.27 (Note 2)	
		3.02 (Note 3)	
H-bridge Output Current (DC)	I_{OUT}	-1.2 to +1.2 (Note 4)	A
H-bridge Output Current (Peak (Note 5))	I_{OUTP}	-3.2 to +3.2 (Note 4)	A
Storage Temperature Range	Tstg	-55 to +150	°C
Junction Temperature	Tjmax	+150	°C

(Note 1) Reduced by 5.6mW/°C over 25°C, when mounted on a glass epoxy 1-layer board (74.2mm x 74.2mm x 1.6mm)
In surface layer copper foil area: 10.29mm^2
(Note 2) Reduced by 10.1mW/°C over 25°C, when mounted on a glass epoxy 4-layer board (74.2mm x 74.2mm x 1.6mm)
In surface & back layers copper foil area: 10.29mm^2, 2&3 layers copper foil area: 5505mm^2
(Note 3) Reduced by 24.1mW/°C over 25°C, when mounted on a glass epoxy 4-layer board (74.2mm x 74.2mm x 1.6mm)
In all 4-layers copper foil area: 5505mm^2
(Note 4) Must not exceed Pd, ASO, or Tjmax of 150°C
(Note 5) PEAK=100ms (Duty≤20%)
Caution: 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.

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Power Supply Voltage	V_{CC}	2.5	-	5.5	V
Motor Power Supply Voltage	V_M	2.0	-	16.0	V
Control Input Voltage	V_{IN}	0	-	V_{CC}	V
Logic Input Frequency	F_{IN}	0	-	500	kHz
Minimum Logic Input Pulse Width (Note 5)	T_{IN}	0.5	-	-	μs
Operating Temperature Range	Topr	-30	-	+85	°C

Electrical Characteristics (Unless otherwise specified V_{CC}=3.0V, V_M=5.0V, Ta=25°C)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
All Circuits						
Stand-by Current	I_{CCST}	-	0	1	µA	V_{PS}=0V
Circuit Current 1	I_{CC1}	0.32	0.65	1.10	mA	V_{PS}=3V, Open Mode
Circuit Current 2	I_{CC2}	0.35	0.70	1.20	mA	V_{PS}=3V, CW & CCW Mode
Circuit Current 3	I_{CC3}	0.37	0.75	1.30	mA	V_{PS}=3V, Short Brake Mode
PS Input (PS)						
High-Level Input Voltage	V_{PSH}	1.45	-	V_{CC}	V	
Low-Level Input Voltage	V_{PSL}	0	-	0.5	V	
High-Level Input Current	I_{PSH}	15	30	60	µA	V_{PS}=3V
Low-Level Input Current	I_{PSL}	-1	0	+1	µA	V_{PS}=0V
Control Input (IN=INA, INB, PWM)						
High-Level Input Voltage	V_{INH}	1.45	-	V_{CC}	V	
Low-Level Input Voltage	V_{INL}	0	-	0.5	V	
High-Level Input Current	I_{INH}	15	30	60	µA	V_{IN}=3V
Low-Level Input Current	I_{INL}	-1	0	+1	µA	V_{IN}=0V
Under Voltage Locked Out (UVLO)						
UVLO Voltage	V_{UVLO}	2.0	-	2.4	V	
Full ON Type H-Bridge Driver						
Output On-Resistance	R_{ON}	-	0.38	0.56	Ω	I_{OUT}=±500mA, High & Low-side total
Turn On Time	T_{ON0}	-	250	400	ns	20Ω Loading
Turn Off Time	T_{OFF0}	-	80	200	ns	20Ω Loading

Typical Performance Curves (Reference Data)

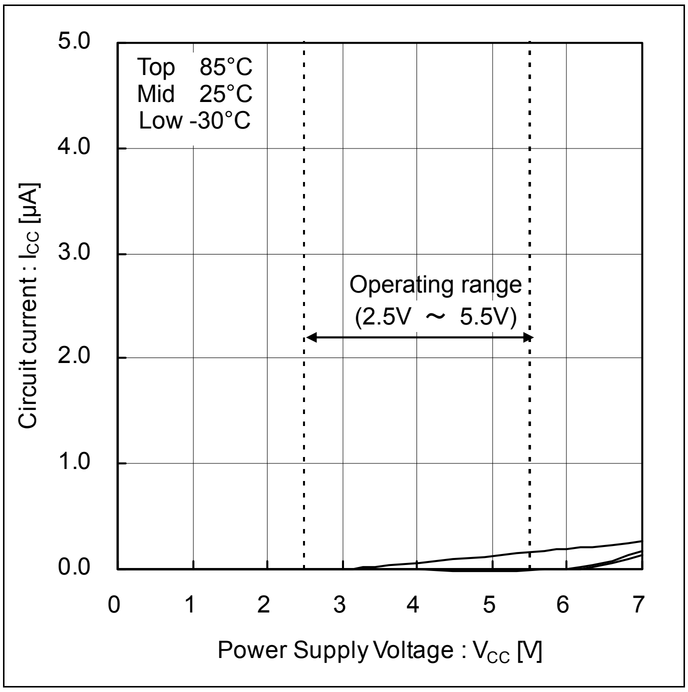


Figure 1.
Circuit Current vs Power Supply Voltage
(Stand-by Mode)

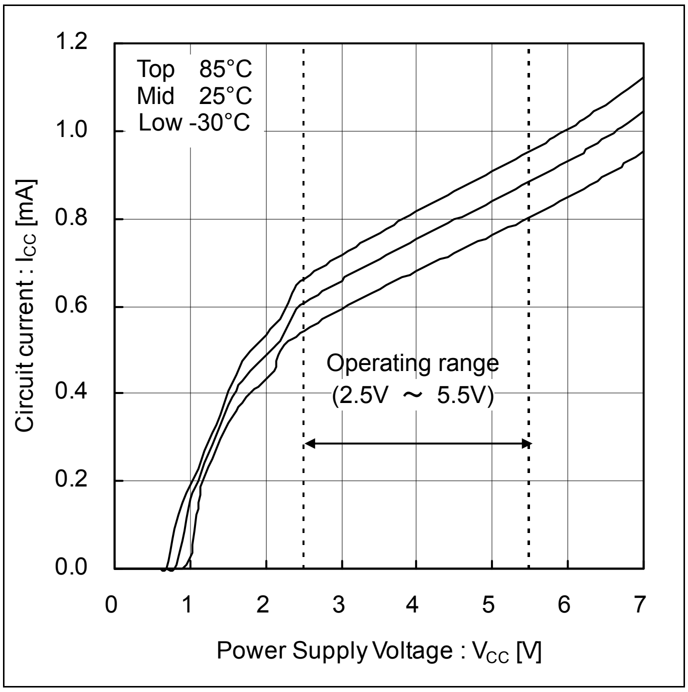


Figure 2.
Circuit Current vs Power Supply Voltage
(Open Mode)

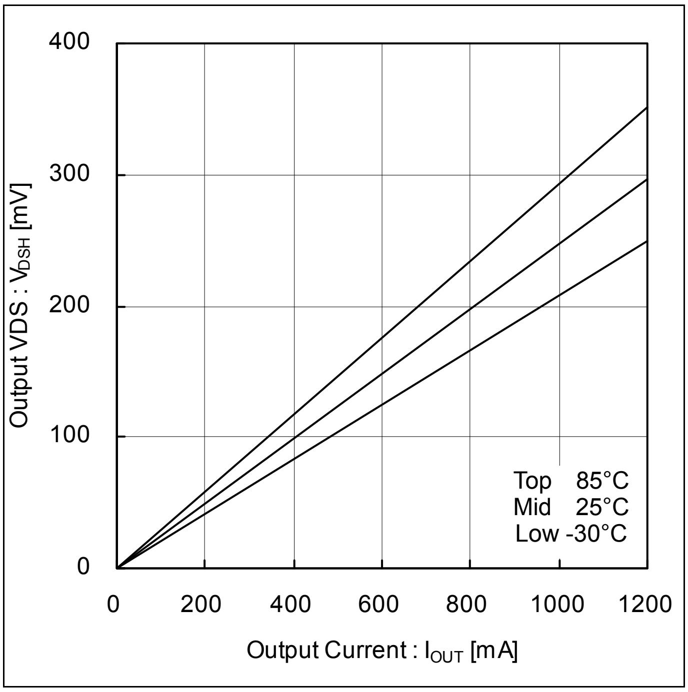


Figure 3.
Output VDS vs Output Current
(Output On-Resistance on high-side, V_M=5V, V_{CC}=3V)

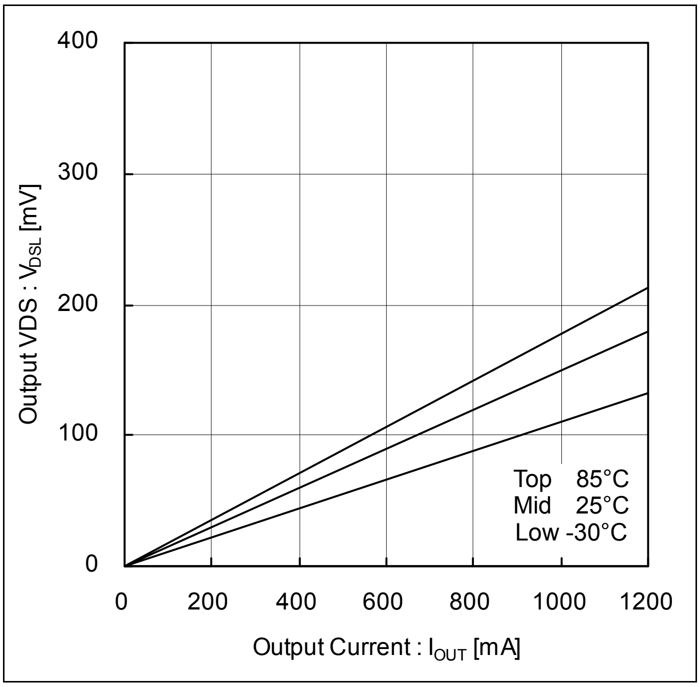


Figure 4.
Output VDS vs Output Current
(Output On-Resistance on low-side, V_M=5V, V_{CC}=3V)

Typical Performance Curves (Reference Data) - continued

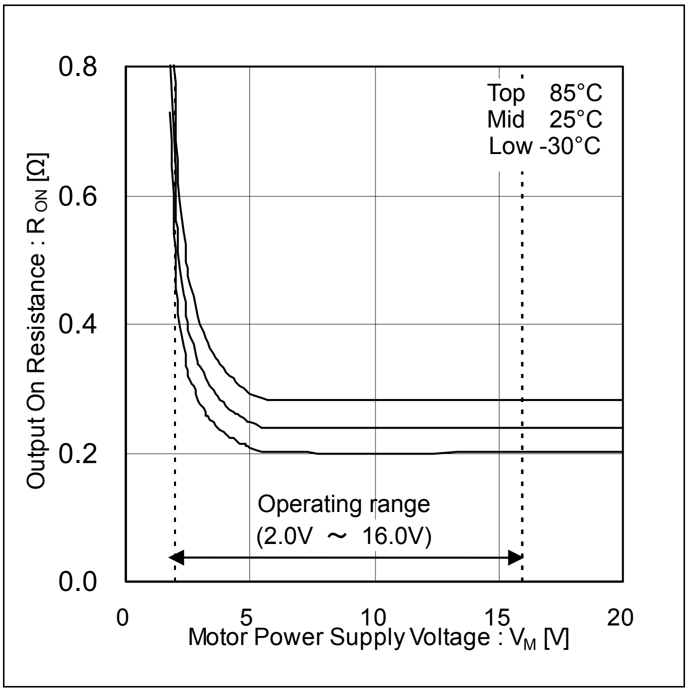


Figure 5.
Output On-Resistance vs Motor Power Supply Voltage
(Output On-Resistance on high-side V_M Dependency, V_{CC}=3V)

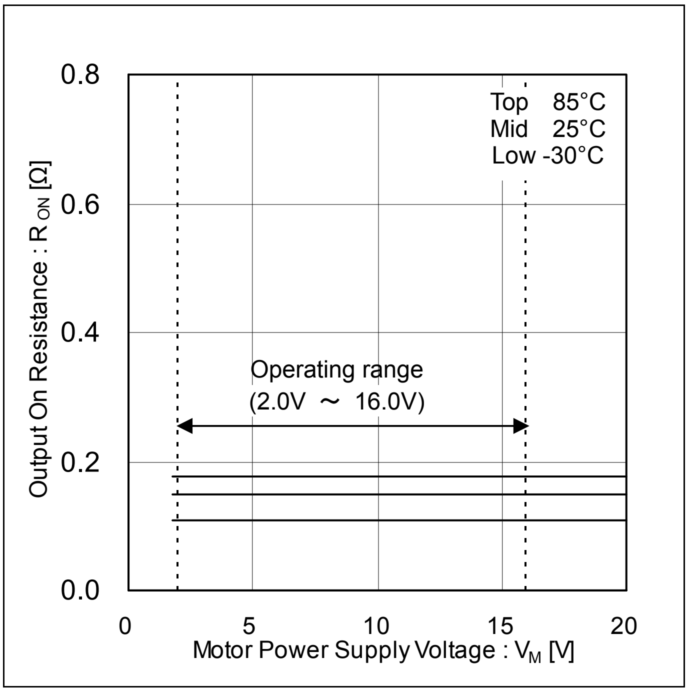


Figure 6.
Output On-Resistance vs Motor Power Supply Voltage
(Output On-Resistance on low-side V_M Dependency, V_{CC}=3V)

Timing Chart

Table 1. I/O Truth Table

Input Mode	INPUT				OUTPUT		
	PS(Note 6)	PWM	INA	INB	OUTA	OUTB	Output Mode(Note 7)
EN/IN	H	H	L	X	L	L	Short Brake
			H	L	H	L	CW
			H	H	L	H	CCW
IN/IN		L	L	L	Z	Z	Open
			H	L	H	L	CW
			L	H	L	H	CCW
			H	H	L	L	Short Brake
-	L	X	X	X	Z	Z	Open

L: Low, H: High, X: Don't care, Z: High-Impedance

(Note 6)PS=High: Operation Mode, PS=Low: Stand-by Mode

(Note 7)CW: Current flows from OUTA to OUTB, CCW: Current flows from OUTB to OUTA

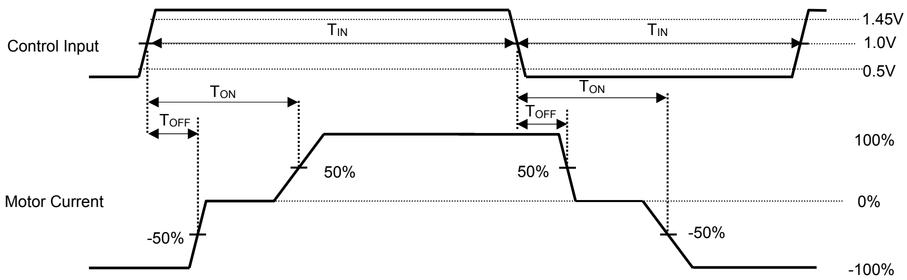
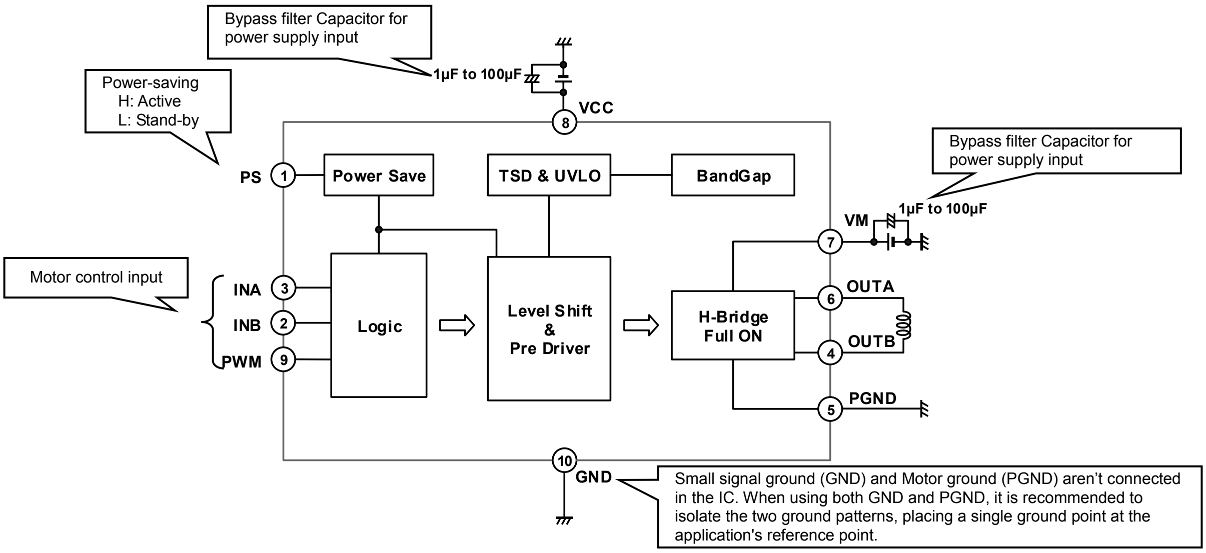


Figure 7.
Input-Output AC Characteristic

Application Example



Selection of Components Externally Connected

When using the circuit with changes to the external circuit constants, make sure to leave an adequate margin for external components including static and transitional characteristics as well as dispersion of the IC.

Power Dissipation

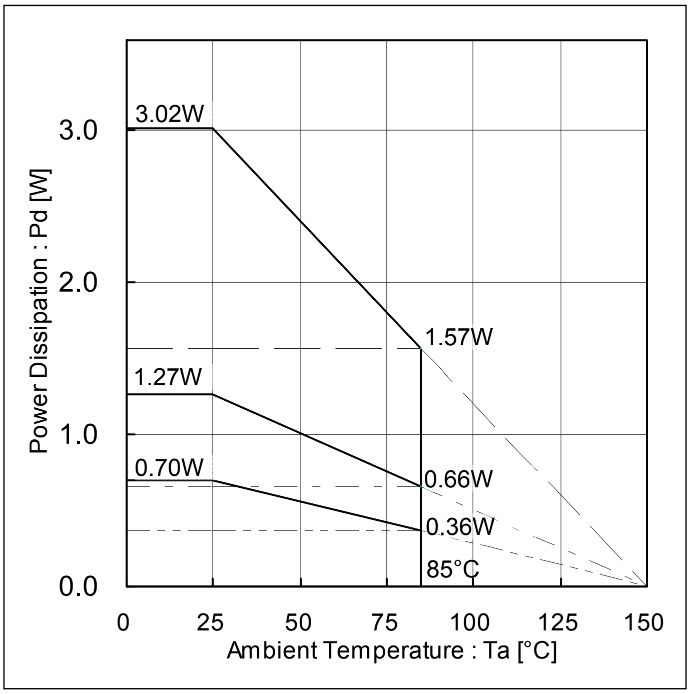
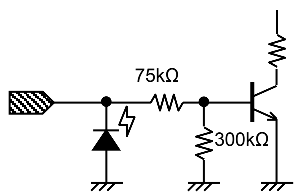
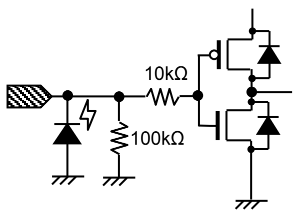
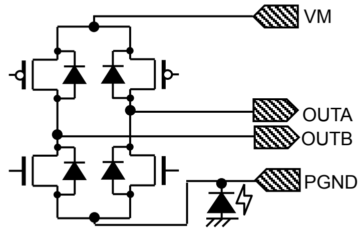


Figure 8.
Power Dissipation vs Ambient Temperature

I/O Equivalence Circuits

PS	INA, INB, PWM	VM, PGND, OUTA, OUTB
		

Operational Notes

1. **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 pins.

2. **Power Supply Lines**
   Design the PCB layout pattern to provide low impedance 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.

3. **Ground Voltage**
   Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition.

4. **Ground Wiring Pattern**
   When using both small-signal(GND) and large-current ground(PGND) 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 ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

5. **Thermal Consideration**
   Should by any chance the power dissipation rating be exceeded the rise in temperature of the chip may result in deterioration of the properties of the chip. In case of exceeding this absolute maximum rating, increase the board size and copper area to prevent exceeding the Pd rating.

6. **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.

7. **Inrush Current**
   When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

8. **Operation Under Strong Electromagnetic Field**
   Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

9. **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.

10. **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.

11. **Unused Input Pins**
    Input pins of an IC are often connected to the gate of a MOS transistor. The gate has extremely high impedance and extremely low capacitance. If left unconnected, the electric field from the outside can easily charge it. The small charge acquired in this way is enough to produce a significant effect on the conduction through the transistor and cause unexpected operation of the IC. So unless otherwise specified, unused input pins should be connected to the power supply or ground line.

Operational Notes – continued

12. Regarding the Input Pin 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.

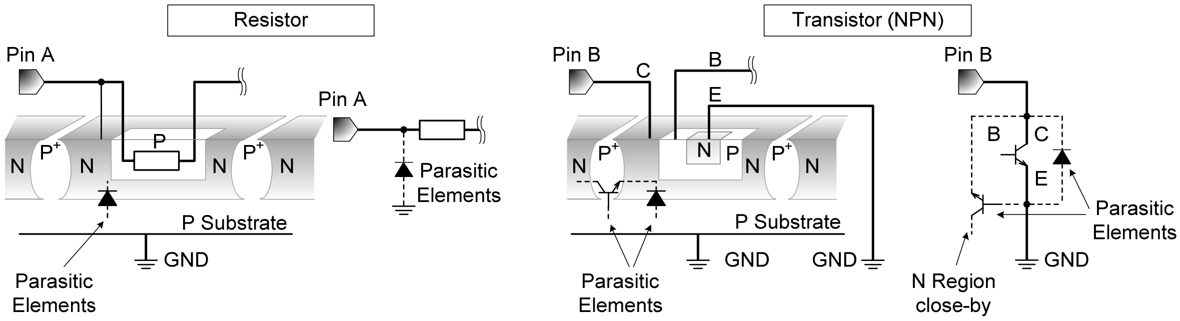


Figure 9.
Example of monolithic IC structure

13. 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.

14. Area of Safe Operation (ASO)

Operate the IC such that the output voltage, output current, and power dissipation are all within the Area of Safe Operation (ASO).

15. Thermal Shutdown Circuit(TSD)

This IC has a built-in thermal shutdown circuit that prevents heat damage to the IC. Normal operation should always be within the IC's power dissipation rating. If however the rating is exceeded for a continued period, the junction temperature (Tj) will rise which will activate the TSD circuit that will turn OFF all output pins. When the Tj falls below the TSD threshold, the circuits are automatically restored to normal operation.
Note that the TSD circuit operates in a situation that exceeds the absolute maximum ratings and therefore, under no circumstances, should the TSD circuit be used in a set design or for any purpose other than protecting the IC from heat damage.

Ordering Information

B	D	6	3	5	7	3	N	U	V	-	E 2

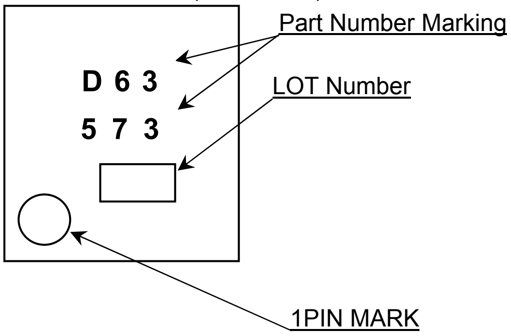
Part Number

Package
NUV :VSON010V3030

Packaging and forming specification
E2: Embossed tape and reel

Marking Diagram

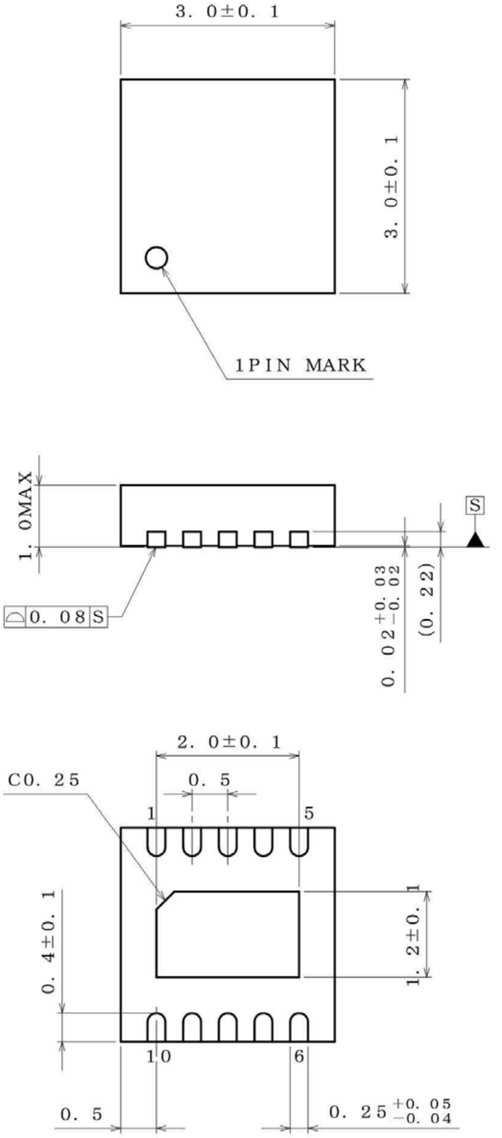
VSON010V3030 (TOP VIEW)



Part Number Marking	Package	Orderable Part Number
D63573	VSON010V3030	BD63573NUV-E2

Physical Dimension, Tape and Reel Information

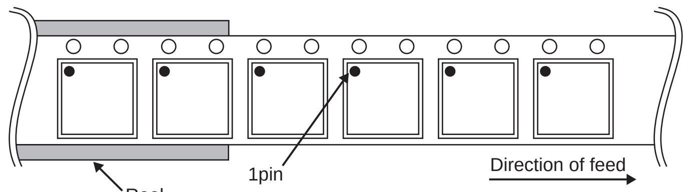
Package Name	VSON010V3030



(UNIT : mm)
PKG : VSON010V3030
Drawing No. EX184−5001−1

<Tape and Reel information>

Tape	Embossed carrier tape
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.

Revision History

Date	Revision	Changes
25.Dec.2015	001	New release

Notice

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1. Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, 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:
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   [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

QR code printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

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