

## Driver for Digital Still Camera

# 1-2ch Lens Drivers for SLRs(Single-lens Reflex)



## BD6376GUL

## General Description

The BD6376GUL motor driver provides 1 Full-On Driver H-Bridge channel.

This driver features wide range operating from 2.0V and low power consumption by fast switching speed.

In addition, in a compact surface mount package adopt small mobile system, home appliance, and amusement system etc.

## Features

- Low ON-Resistance Power DMOS output  
Upper & lower total: 0.45Ω(Typ.)
- Range of motor power supply voltage: 2.0 to 9.0V
- Charge pump-less type with p-channel DMOS for the upper side transistor
- Maximum output current for H-bridge: 1.0A (DC)
- High-speed switching:  
Turn On Time: 200ns, Turn Off Time: 60ns(Typ.)
- With built-in Under Voltage Locked Out protection and Thermal Shut Down circuit
- Stand-by current: 0μA (Typ.)

## Applications

- Small mobile system
- Home appliance
- Amusement system, etc

## Key Specifications

- Power supply voltage range( $V_{CC}$ ): 2.5 to 3.6V
- Motor power supply voltage range( $V_M$ ): 2.0 to 9.0V
- Circuit Current (Open Mode): 360μA (Typ.)
- Stand-by Current: 1μA(Max.)
- Control input voltage: 0 to  $V_{CC}$ V
- Logic input frequency: 200kHz(Max.)
- Minimum logic input pulse width: 0.5μs(Min.)
- Turn On Time: 200ns(Typ.)
- Turn Off Time: 60ns(Typ.)
- Output ON-Resistance (Total): 0.45Ω(Typ.)
- Operating temperature range: -30 to +85°C

## Package

VCSP50L1

W(Typ.) x D(Typ.) x H(Max.)  
1.60mm x 1.60mm x 0.55mm



## Ordering Information

<b>B</b>	<b>D</b>	<b>6</b>	<b>3</b>	<b>7</b>	<b>6</b>	<b>G</b>	<b>U</b>	<b>L</b>
Part Number								
Package GUL: VCSP50L1								

<b>E 2</b>
Packaging and forming specification E2: Embossed tape and reel

## ●Block Diagram / Application Example

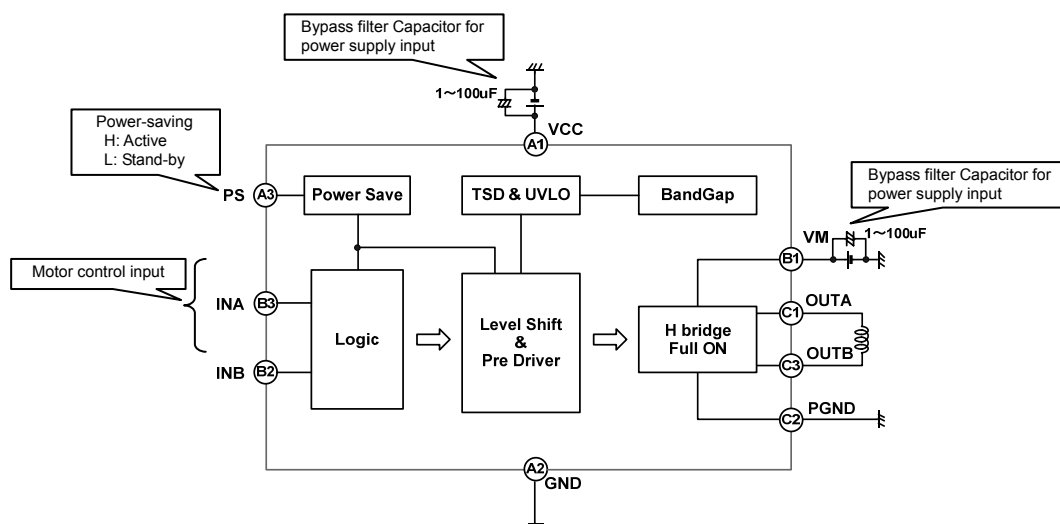


Figure 1. Block Diagram / Application Example

## ●Pin Configuration

	1	2	3
A	VCC	GND	PS
B	VM	INB	INA
C	OUTA	PGND	OUTB

Figure 2. Pin Configuration (Top View)

## ●Pin Description

Table 1. Pin Description

No.	Name	Function
A1	VCC	Power supply terminal
A2	GND	Ground terminal
A3	PS	Power-saving terminal
B1	VM	Motor power supply terminal
B2	INB	Control input terminal B
B3	INA	Control input terminal A
C1	OUTA	H-bridge output terminal A
C2	PGND	Motor ground terminal
C3	OUTB	H-bridge output terminal B

### ●Absolute Maximum Ratings(Ta=+25°C)

Parameter	Symbol	Limit	Unit
Power supply voltage	V <sub>CC</sub>	-0.3 to +4.5	V
Motor power supply voltage	V <sub>M</sub>	-0.3 to +10.0	V
Control input voltage	V <sub>IN</sub>	-0.3 to V <sub>CC</sub> +0.3	V
Power dissipation	P <sub>d</sub>	725 <sup>*1</sup>	mW
H-bridge output current (DC)	I <sub>OUT</sub>	±1.0 <sup>*2</sup>	A
Storage temperature range	T <sub>stg</sub>	-55 to +150	°C
Junction temperature	T <sub>jmax</sub>	+150	°C

\*1 Reduced by 5.8mW/°C over 25°C, when mounted on a glass epoxy 8 layers board (50mm × 58mm × 1.75mm)

\*2 Must not exceed P<sub>d</sub>, A<sub>SO</sub>, or T<sub>jmax</sub> of 150°C.

### ●Recommended Operating Ratings

Parameter	Symbol	Limit	Unit
Power supply voltage	V <sub>CC</sub>	2.5 to 3.6	V
Motor power supply voltage	V <sub>M</sub>	2.0 to 9.0	V
Control input voltage	V <sub>IN</sub>	0 to V <sub>CC</sub>	V
Logic input frequency	F <sub>IN</sub>	0 to 200	kHz
Min. logic input pulse width	T <sub>IN</sub>	0.5	μs
Operating temperature range	T <sub>opr</sub>	-30 to +85	°C

●Electrical Characteristics (Unless otherwise specified Ta=+25°C, V<sub>CC</sub>=3.0V, V<sub>M</sub>=5.0V)

Parameter	Symbol	Limit			Unit	Condition
		Min.	Typ.	Max.		
All Circuits						
Stand-by Current	I <sub>CCST</sub>	-	0	1	μA	V <sub>PS</sub> =0V
Circuit Current 1	I <sub>CC1</sub>	180	360	550	μA	V <sub>PS</sub> =3V, Open Mode
Circuit Current 2	I <sub>CC2</sub>	180	375	550	μA	V <sub>PS</sub> =3V, CW & CCW Mode
Circuit Current 3	I <sub>CC3</sub>	180	375	550	μA	V <sub>PS</sub> =3V, Short Brake Mode
PS Input (PS)						
High-level input voltage	V <sub>PSH</sub>	2.0	-	V <sub>CC</sub>	V	
Low-level input voltage	V <sub>PSL</sub>	0	-	0.7	V	
High-level input current	I <sub>PSH</sub>	6	15	30	μA	V <sub>PS</sub> =3V
Low-level input current	I <sub>PSL</sub>	-1	0	1	μA	V <sub>PS</sub> =0V
Control Input (INA, INB)						
High-level input voltage	V <sub>INH</sub>	2.0	-	V <sub>CC</sub>	V	
Low-level input voltage	V <sub>INL</sub>	0	-	0.7	V	
High-level input current	I <sub>INH</sub>	6	15	30	μA	V <sub>IN</sub> =3V
Low-level input current	I <sub>INL</sub>	-1	0	1	μA	V <sub>IN</sub> =0V
Under Voltage Locked Out (UVLO)						
UVLO Voltage	V <sub>UVLO</sub>	2.0	-	2.4	V	
Full ON type H-Bridge Driver						
Output ON-Resistance	R <sub>ON</sub>	-	0.45	0.60	Ω	I <sub>OUT</sub> =±500mA, Upper & Lower total
Turn On Time	T <sub>ON</sub>	-	200	400	ns	20Ω Loading
Turn Off Time	T <sub>OFF</sub>	-	60	400	ns	20Ω Loading

● Typical Performance Curves (reference data)

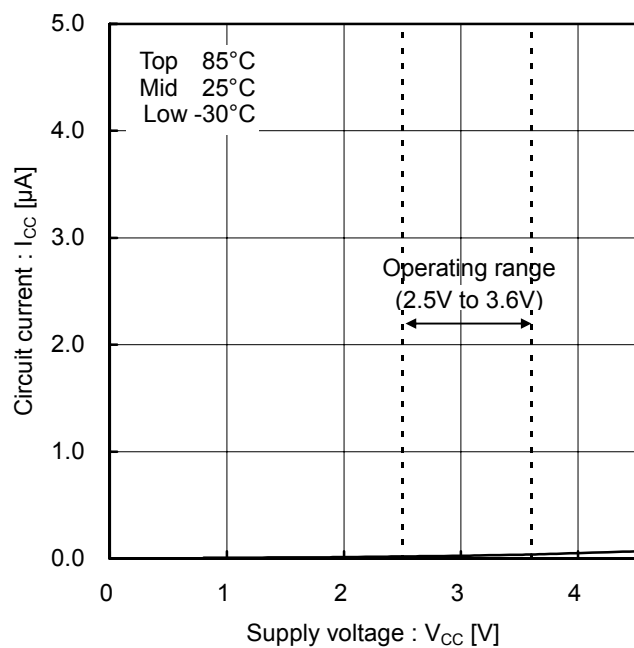


Figure 3. Circuit Current(Stand-by Mode)

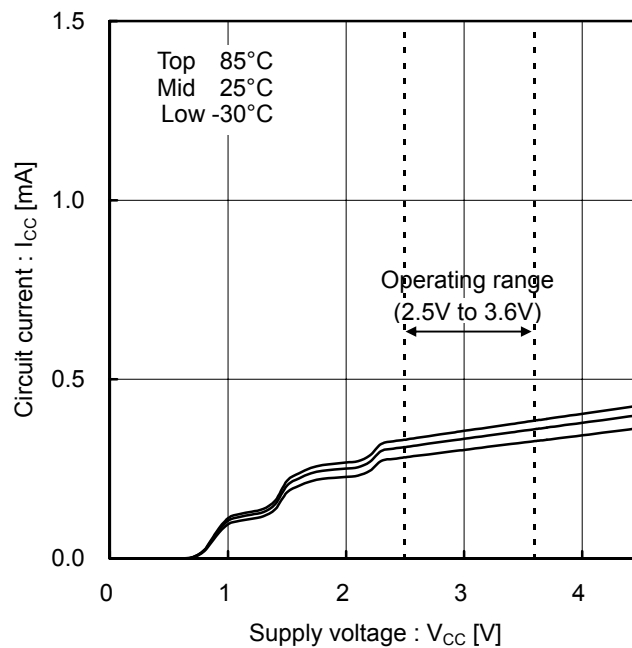


Figure 4. Circuit Current(Open Mode)

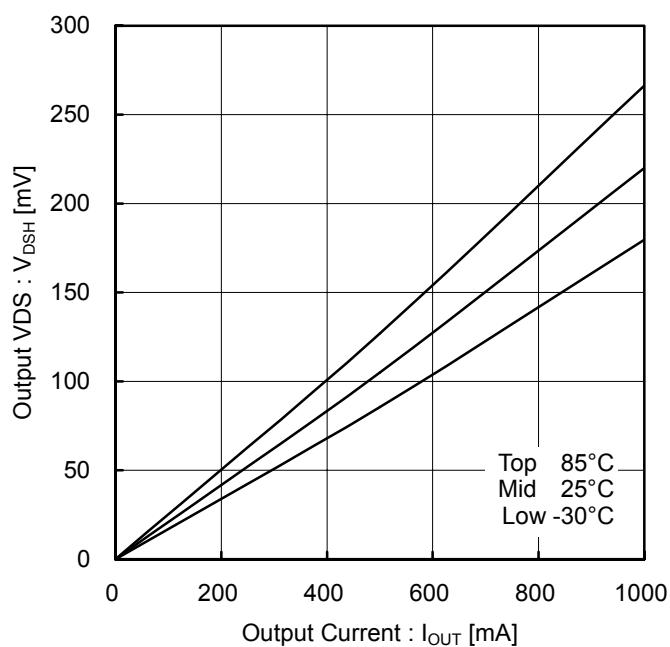


Figure 5. Output ON-Resistance on high-side  
( $V_M=5V$ ,  $V_{CC}=3V$ )

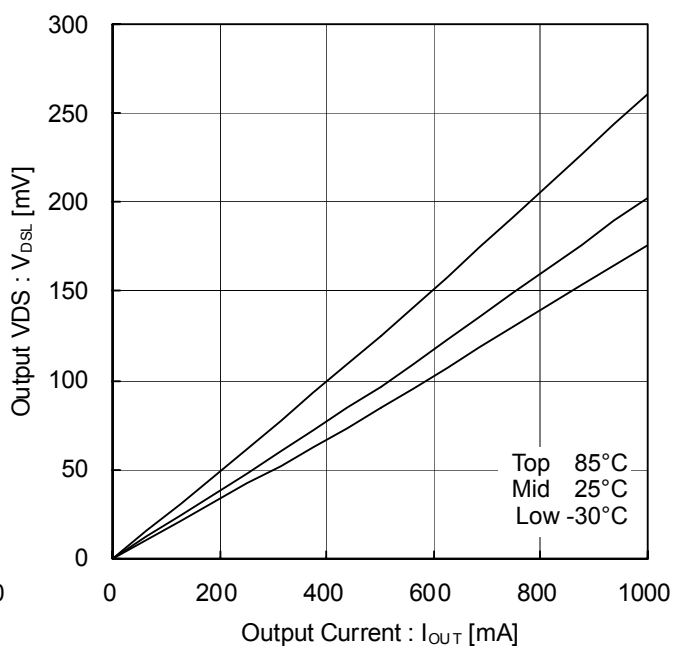


Figure 6. Output ON-Resistance on low-side  
( $V_M=5V$ ,  $V_{CC}=3V$ )

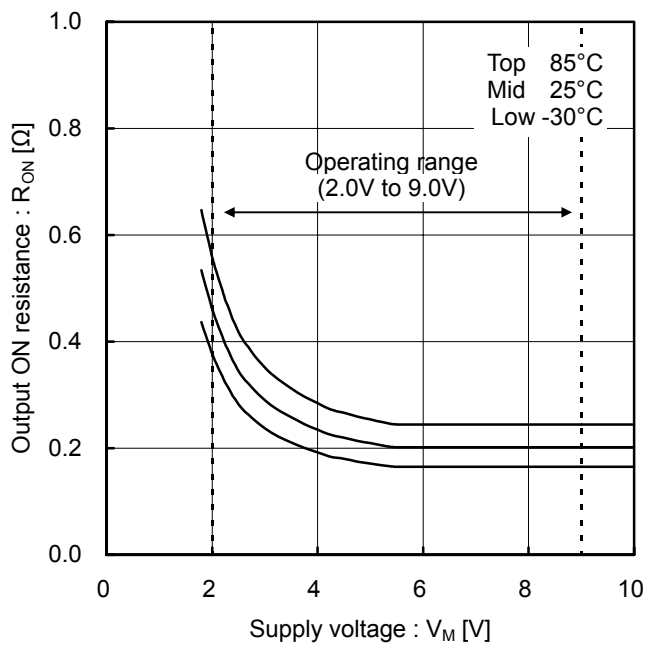


Figure 7. Output ON-Resistance on high-side ( $V_M$  Dependency,  $V_{CC}=3V$ )

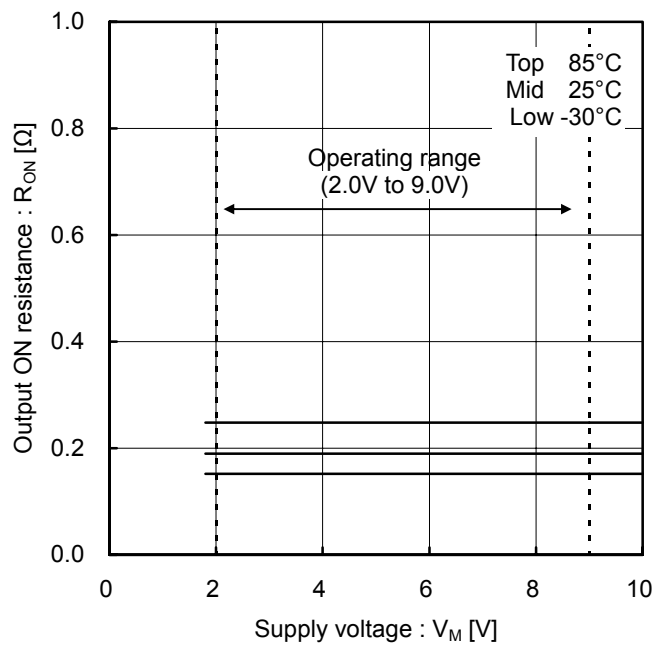


Figure 8. Output ON-Resistance on low-side ( $V_M$  Dependency,  $V_{CC}=3V$ )

### ●Description of Blocks

#### 1) Power-saving function

When Low-level voltage is applied to PS pin, the IC will be turned off internally.

During operating mode, PS pin should be High-level.

(See the Electrical Characteristics; p4/11, and Timing Chart; p7/11)

#### 2) Control input; INA and INB

These pins are used to program and control the motor drive modes.

(See the Electrical Characteristics; p4/11, and Timing Chart; p7/11)

### ●Timing Chart

Input Mode	INPUT			OUTPUT		
	PS	INA	INB	OUTA	OUTB	Output Mode
IN/IN	H	L	L	Z	Z	Open
		H	L	H	L	CW
		L	H	L	H	CCW
		H	H	L	L	Short Brake
-	L	X	X	Z	Z	Open

L: Low, H: High, X: Don't care, Z: Hi impedance

PS=High; Operation Mode, PS=Low; Stand-by Mode

CW: current flows from OUTA to OUTB, CCW: current flows from OUTB to OUTA

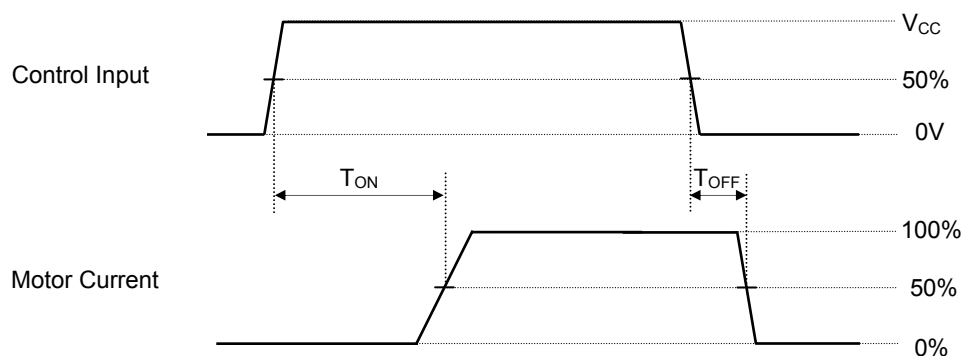


Figure 9. Input-Output AC Definition

●Power Dissipation

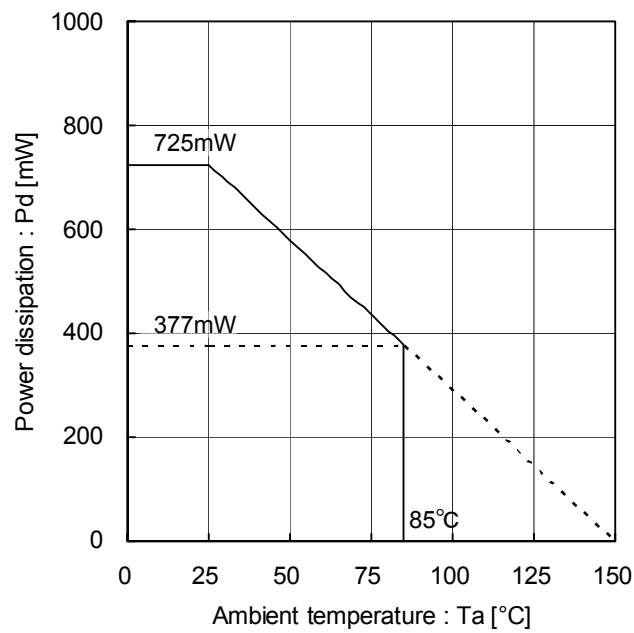


Figure 10. Power Dissipation Curve

●I/O equivalence circuit

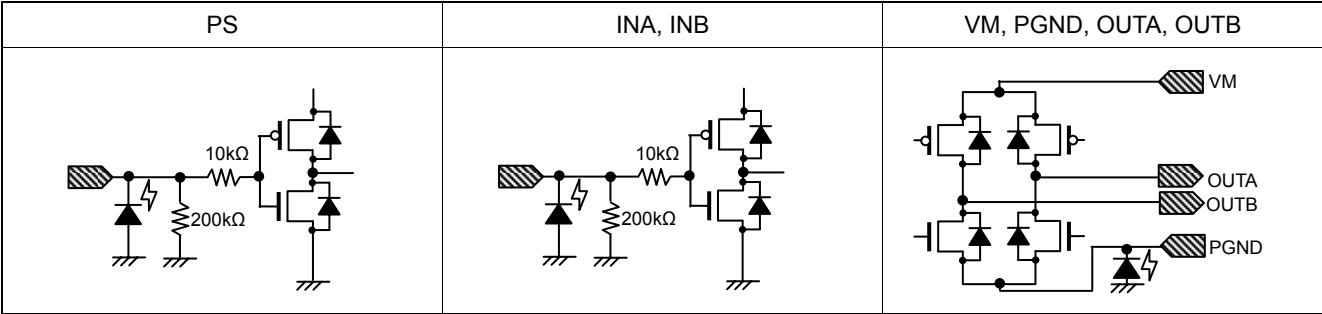


Figure 11. I/O equivalence circuit



## ●Operational Notes

- 1) Absolute maximum ratings  
Use of the IC in excess of absolute maximum ratings such as the applied voltage or operating temperature range (Topr) may result in IC damage. Assumptions should not be made regarding the state of the IC (short mode or open mode) when such damage is suffered. The implementation of a physical safety measure such as a fuse should be considered when use of the IC in a special mode where the absolute maximum ratings may be exceeded is anticipated.
- 2) Power supply pins and lines  
None of the VM line for the H-bridge is internally connected to the VCC power supply line, which is only for the control logic or analog circuit. Therefore, the VM and VCC lines can be driven at different voltages. Although these lines can be connected to a common power supply, do not open the power supply pin but connect it to the power supply externally.  
Regenerated current may flow as a result of the motor's back electromotive force. Insert capacitors between the power supply and ground pins to serve as a route for regenerated current. Determine the capacitance in full consideration of all the characteristics of the electrolytic capacitor, because the electrolytic capacitor may lose some capacitance at low temperatures. If the connected power supply does not have sufficient current absorption capacity, regenerative current will cause the voltage on the power supply line to rise, which combined with the product and its peripheral circuitry may exceed the absolute maximum ratings. It is recommended to implement a physical safety measure such as the insertion of a voltage clamp diode between the power supply and ground pins. For this IC with 2 power supplies and a part consists of the CMOS block, it is possible that rush current may flow instantaneously due to the internal powering sequence and delays, and to the unstable internal logic, respectively. Therefore, give special consideration to power coupling capacitance, width of power and ground wirings, and routing of wiring.
- 3) Ground pins and lines  
Ensure a minimum GND pin potential in all operating conditions. Make sure that no pins are at a voltage below the GND at any time, regardless of whether it is a transient signal or not.  
When using both small signal GND and large current PGND patterns, it is recommended to isolate the two ground patterns, placing a single ground point at the application's reference point so that the pattern wiring resistance and voltage variations caused by large currents do not cause variations in the small signal ground voltage. Be careful not to change the GND wiring pattern of any external components, either.  
The power supply and ground lines must be as short and thick as possible to reduce line impedance.
- 4) Thermal design  
Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions.
- 5) Actions in strong magnetic field  
Use caution when using the IC in the presence of a strong magnetic field as doing so may cause the IC to malfunction.
- 6) ASO  
When using the IC, set the output transistor for the motor so that it does not exceed absolute maximum ratings or ASO.
- 7) Thermal shutdown circuit  
This IC incorporates a TSD (thermal shutdown) circuit. If the temperature of the chip reaches the following temperature, the motor coil output will be opened. The TSD circuit is designed only to shut the IC off to prevent runaway thermal operation. It is not designed to protect the IC or guarantee its operation. Do not continue to use the IC after operating this circuit or use the IC in an environment where the operation of this circuit is assumed.

TSD ON temperature [°C] (Typ.)	Hysteresis temperature [°C] (Typ.)
175	20

## 8) Application example

The application circuit is recommended for use. Make sure to confirm the adequacy of the characteristics. 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.

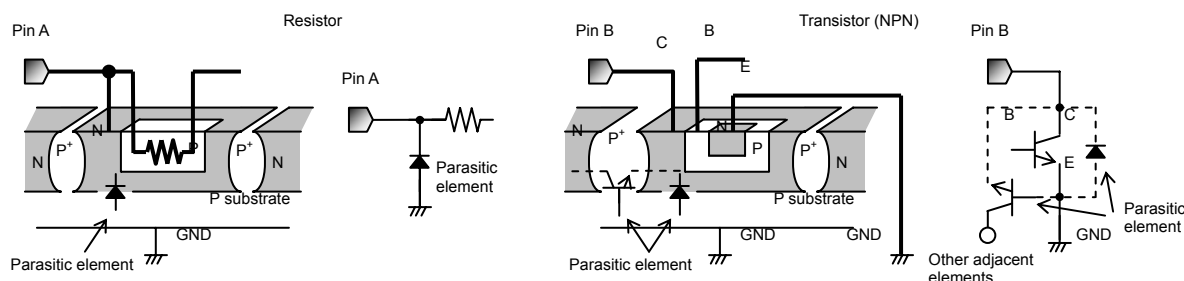


Figure 12. Example of Simple IC Architecture

## Status of this document

The Japanese version of this document is formal specification. A customer may use this translation version only for a reference to help reading the formal version.

If there are any differences in translation version of this document, formal version takes priority.

●Physical Dimension, Tape and Reel Information

VCSP50L1 (BD6376GUL)

Physical dimensions of VCSP50L1 (Unit : mm)

Top view: 1PIN MARK, Lot No., 6376, 1.6±0.05, 1.6±0.05.

Side view: 0.1±0.05, 0.55MAX, 0.06, 0.5.

Bottom view: 8-φ0.25±0.05, 0.05, A, B, C, (φ0.15)INDEX POST, 0.3±0.05, P=0.5×2, 0.3±0.05, P=0.5×2.

<Tape and Reel information>

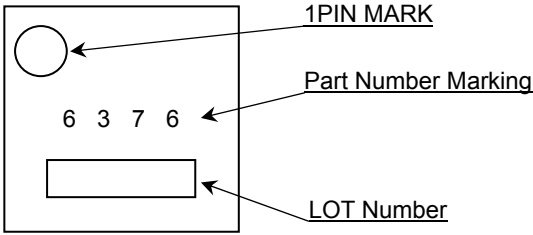
Tape	Embossed carrier tape
Quantity	3000pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)

Diagram showing the direction of feed and the 1pin location on the carrier tape. The direction of feed is indicated by an arrow pointing right. The 1pin is indicated by a dot in the first position. The reel is indicated by an arrow pointing left.

\* Order quantity needs to be multiple of the minimum quantity.

●Marking Diagram

VCSP50L1 (TOP VIEW)



## ●Revision History

Date	Revision	Changes
3.Aug.2012	001	New release

# Notice

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  - [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - [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

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- 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.
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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).

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  - [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.

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**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.