Motor Driver IC Series for Printers

DC Brush Motor Driver for Paper Feed or Carriage Use

BA6920FP-Y, BA6219BFP-Y

Pb Free ROHM Electronic Components RoHS Directive Compliance

●Description

The BA6920FP-Y and BA6219BFP-Y are full-on drivers for motors with DC brushes. They operate in forward rotation mode, reverse rotation mode, stop (idling) mode, or brake mode, that are selectable according to the input logic (two inputs). The output voltage can be set through the output voltage setting pin.

●Features

1) Large output current. (BA6219BFP-Y)
2) Built-in thermal shutdown circuit
3) The output voltage can be set flexibly through the output voltage setting pin.
4) Built-in standby (stop) circuit. (BA6920FP-Y)

●Applications

Devices that use DC brush motors, such as photo printers, scanners, mini printers, and fax machines.

●Absolute maximum ratings

Parameter	Symbol	Limit		Unit
		BA6219BFP-Y	BA6920FP-Y	
Applied voltage	VCC1, 2,	24	-	V
	VM, VCC	-	36	V
Power dissipation	Pd	*1450	*1450	mW
Operating temperature range	Topr	-25～+75	-30～+85	℃
Storage temperature range	Tstg	-55～+150	-55～+150	℃
Output current	IOmax	2200**	1000**	mA
Junction temperature	Tjmax	150	150	℃

* Reduced by 11.6 mW/°C over 25°C, when mounted on a glass epoxy board (70 mm × 70 mm × 1.6 mm).
** Must not exceed Pd or ASO.
500 μs pulses at a duty of 1/100.

●Operating conditions

BA6219BFP-Y

Parameter	Symbol	Operating voltage	Unit
Power supply voltage	Vcc1,2	8～18	V

BA6920FP-Y

Parameter	Symbol	Operating voltage	Unit
Power supply voltage	Vcc	6.5～34	V
	VM	6.5～34	V

Ver.B Oct.2005

●Electrical characteristics

BA6219BFP-Y (Unless otherwise specified, Ta=25°C, VCC1=12 V, VCC2=12 V)

Parameter	Symbol	Limit			Unit	Conditions
		Min.	Typ.	Max.		
Circuit current 1	ICC1	-	1.2	2.5	mA	Standby mode (stop)
Circuit current 2	ICC2	-	16	35	mA	Forward rotation or reverse mode
Circuit current 3	ICC3	-	25	60	mA	Brake mode
High-level input voltage	VIH	3.0	-	VCC	V	
Low-level input voltage	VIL	0	-	1.0	V	
VR bias current	IVREF	0.6	1.2	2.4	mA	RL=60Ω
CD1 constant-current value	ICD1	0.7	1.5	3.0	mA	(IN1, IN2) = (H, L): Current from CD1 to GND
CD2 constant-current value	ICD2	0.7	1.5	3.0	mA	(IN1, IN2) = (H, L): Current from CD2 to GND
Output leak current	IOL	-	-	1	mA	(IN1, IN2) = (L, L): Current flowing into VCC2
FOUT high output voltage	VHF	6.5	-	-	V	RL=60Ω VR=6.8V
FOUT low output voltage	VLF	-	-	1.2	V	RL=60Ω VR=6.8V
ROUT high output voltage	VHR	6.5	-	-	V	RL=60Ω VR=6.8V
ROUT low output voltage	VLR		-	1.2	V	RL=60Ω VR=6.8V

BA6920FP-Y (Unless otherwise specified, Ta=25°C, VCC1=12 V, VM=12 V)

Parameter	Symbol	Limit			Unit	Conditions
		Min.	Typ.	Max.		
Circuit current 1	ICC1	5	8	12	mA	Forward rotation or reverse mode
Circuit current 2	ICC2	3	5	8	mA	Brake mode
Circuit current during standby mode	IST	-	-	15	μA	Standby mode
High-level input voltage	VIH	3.0	-	-	V	
Low-level input voltage	VIL	-	-	0.8	V	
High-level input current	IIH	100	200	300	μA	VIN=3.0V
Output saturation voltage	VCE	-	2.2	3.3	V	Io = 200 mA: Total voltage of both high and low sides of output transistor
Power saving off voltage	VPS OFF	-	-	0.8	V	Operating mode
Power saving on voltage	VPS ON	2.0	-	-	V	Standby mode
REF bias current	IREF		12	35	μA	VREF=6V,Io=100mA

●I/O Logic table

BA6219BFP-Y

IN1	IN2	OUT1	OUT2	Mode
H	L	H	L	Forward rotation
L	H	L	H	Reverse rotation
H	H	L	L	Brake
L	L	OPEN(Hi-Z)	OPEN(Hi-Z)	Stop

BA6920FP-Y

FIN	RIN	POWER SAVE	OUT1	OUT2	Mode
H	L	L	H	L	Forward rotation
L	H	L	L	H	Reverse rotation
H	H	L	L	L	Brake
L	L	L	OPEN (Hi-Z)	OPEN (Hi-Z)	Stop
Don't Care	Don't Care	H	OPEN (Hi-Z)	OPEN (Hi-Z)	Power saving mode (Output stop)

Note: When the POWERSAVE pin is at high level, OUT1 and OUT2 will be open regardless of the FIN or RIN logic.

●Reference data

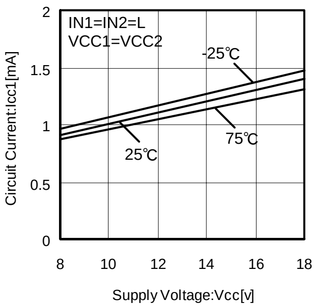


Fig. 1 Circuit current 1 (Standby)
(BA6219BFP-Y)

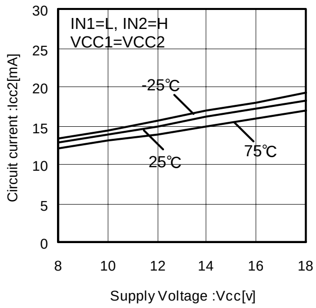


Fig. 2 Circuit current 2 (Reverse rotation)
(BA6219BFP-Y)

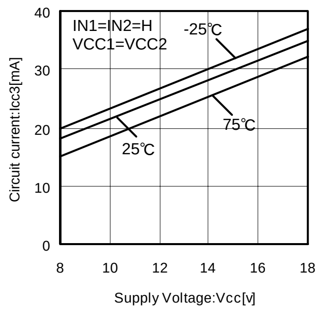


Fig. 3 Circuit current 3 (Brake)
(BA6219BFP-Y)

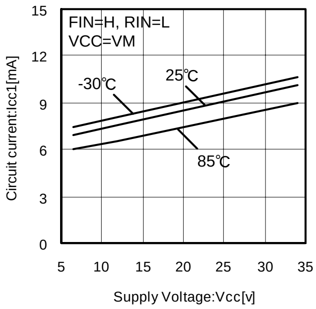


Fig. 4 Circuit current 1 (Forward rotation)
(BA6920FP-Y)

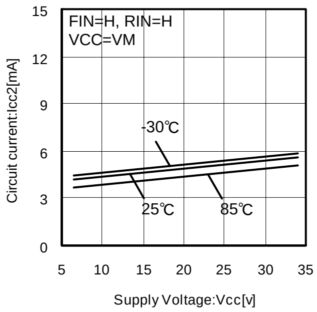


Fig. 5 Circuit current 2 (Brake)
(BA6920FP-Y)

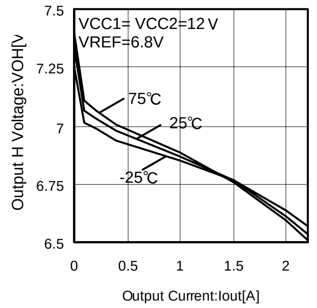


Fig. 6 High Output vs Output Current
(BA6219BFP-Y)

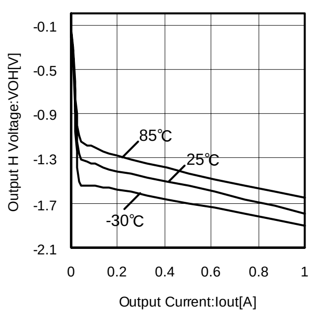


Fig. 7 High Output vs Output Current
(BA6920BFP-Y)

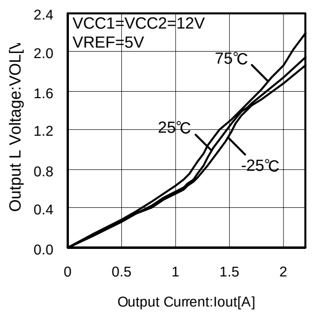


Fig. 8 Low Output vs Output Current
(BA6219BFP-Y)

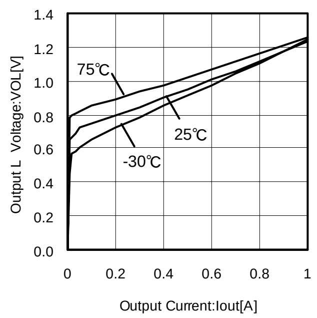


Fig. 9 Low Output vs Output Current
(BA6920AFP-Y)

●Pin assignment

BA6219BFP-Y

BA6920FP-Y

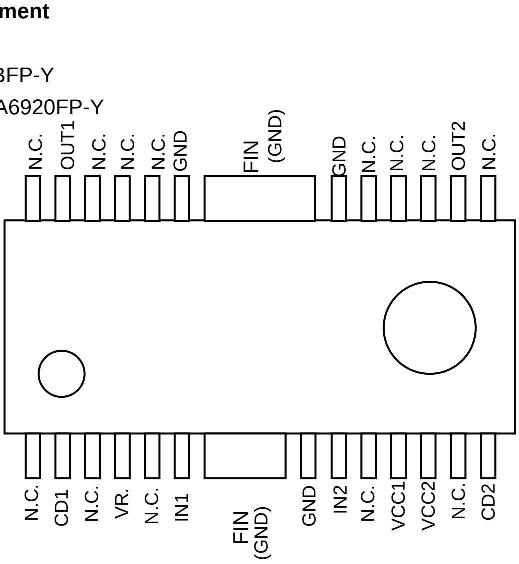


Fig.10

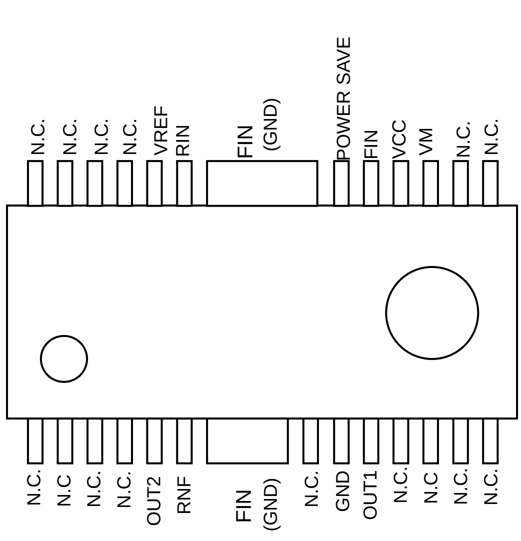


Fig.11

●Block diagram

BA6219BFP-Y

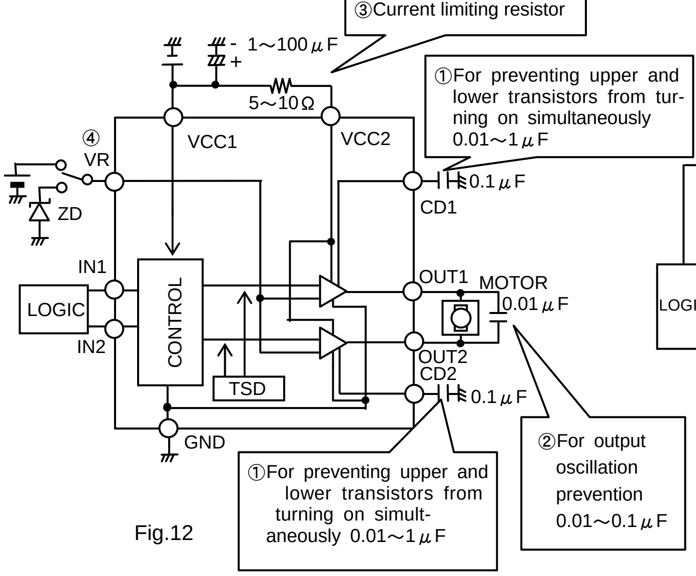


Fig.12

BA6920FP-Y

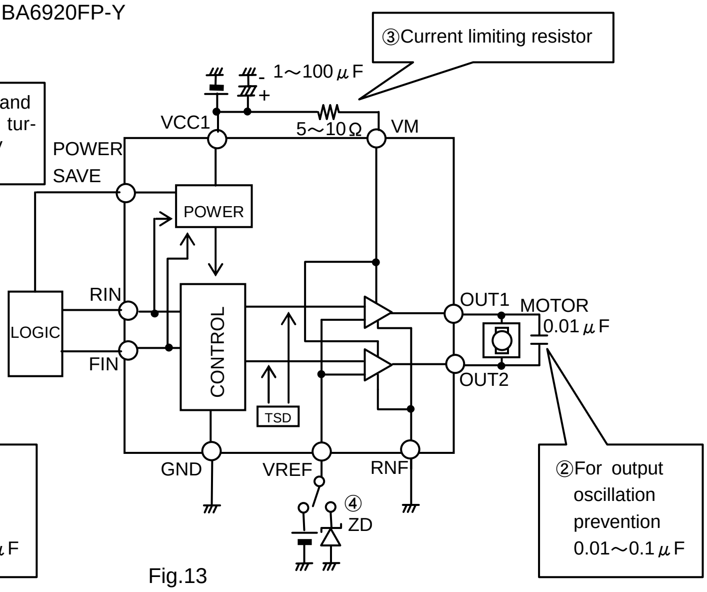


Fig.13

●Explanation of external components

① Capacitors that prevent upper and lower transistors from turning on simultaneously (Capacitors to connect to CD1 and CD2 pins in the case of BA6219BFP-Y).

The rising of the base potential of the transistor at high-level output is delayed to prevent both transistors from turning on simultaneously. Set the capacitance between 0.01μF and 1μF and ensure that a penetration current does not flow during output mode changes, since the transistors do not turn on simultaneously.

② Capacitor for output oscillation prevention

The output pin may generate noise or oscillate, depending on the set mounting conditions, such as the power supply circuit, motor characteristics, and PCB pattern artwork. Connect a capacitor with a capacitance value of 0.01μF to 0.1μF to prevent noise oscillation.

③ Resistance for current limiting

A resistor used to prevent collector loss and limit the current of output shorting. Although the required resistance varies with the supply voltage, a resistance of approximately 5Ω to 10Ω should be selected. When designing the circuit, pay utmost attention to voltage reduction resulting from a rush current that flows when the driving of the motor starts.

④ Zener diode for output voltage setting

Zener diode for high output voltage VR (VREF) setting. The zener voltage can be set almost equal to high output voltage.

BA6219BFP-Y

PIN No.	Pin Name	Function
2	CD1	Capacitor connection pin for prevention of upper and lower transistors to turn on simultaneously
4	VR	High output voltage setting pin
6	IN1	Logic input pin
7	GND	GND
8	IN2	Logic input pin
10	VCC1	Power supply pin for small signal block
11	VCC2	Power supply pin for motor output
13	CD2	Capacitor connection pin for prevention of upper and lower transistors to turn on simultaneously
15	OUT2	Motor output pin
19	GND	GND
20	GND	GND
24	OUT1	Motor output pin
FIN	GND	Note: Be sure to connect the heat dissipation fin to the GND pin.

Note: Pins 1, 3, 5, 9, 12, 14, 16 to 18, 21 to 18, 21 to 23, and 25 are NC pins.

BA6920FP-Y

Pin No	Pin name	Function
5	OUT2	Motor output pin
6	RNF	Connection pin for output current detection on the GND pin of the output block
8	GND	GND
9	OUT1	Motor output pin
16	VM	Motor power supply
17	Vcc	Power supply pin
18	FIN	Logic input pin
19	POWER SAVE	Power saving input pin
20	RIN	Logic input pin
21	VREF	High output voltage setting pin
FIN	GND	Note: Be sure to connect the heat dissipation fin to the GND pin.

Note: Pins 1 to 4, 7, 10 to 14, and 20 to 24 are NC pins.

●IC Operation

BA6920FP-Y(BA6219BFP-Y)

1) I/O mode of input block FIN (IN1) and RIN (IN2)

A pin where control signals are input. Each mode operates as explained below.

When the FIN (IN1) is set to high and RIN (IN2) is set to low, the forward rotation mode will be set and a current will flow from OUT1 to OUT2. When the FIN (IN1) is set to low and RIN (IN2) is set to high, the reverse rotation mode will be set and a current will flow from OUT2 to OUT1. When both FIN (IN1) and RIN (IN2) are set to high, the brake mode will be set. At that time, the output transistor on the high side will be turned off to stop the supply of the motor drive current while the output transistor on the low side will be turned on to absorb the motor back EMF to brake the motor. When both FIN (IN1) and RIN (IN2) are set to low, OUT1 and OUT2 will be both open potential and the motor will stop.

2) High output voltage setting function

With this function, the output voltage can be set through the high output voltage setting pin in order to control the rotation speed of the motor. If the high output voltage is set to a lower value, the power consumption of the IC will become high. Consider the power dissipation (Pd) of the IC under actual operating conditions, and implement thermal designing with a sufficient margin.

2-1. BA6219BF-Y (See Fig.14)

○High output voltage is expressed by the following equation.

VoutH (high output voltage) = VR + {VF(Q5) + VF (Q6) + VF (Q7) - VF (Q2) -VF (Q3) - VF (Q4)}

≒VR + ΔVF

(VF is the base-emitter voltage in the forward direction)

Although ΔVF depends on the output current, Vo is almost VR.

The maximum value VoutHmax of high output voltage that can be set is as follows.

VoutHmax < VCC1 - Vsat (Q1) - VF (Q2) - VF (Q3) - VF (Q4)

≒VCC1 - 2.5 V

○Relation of VCC1, VCC2, and VR

VCC1, VCC2, and VR should be set as follows.

VR < VCC2 - Vsat (Q3) + VF (Q3) + VF (Q2) - {VF (Q5) + (Q6) + (Q7)}

≒VCC2 - 1 V

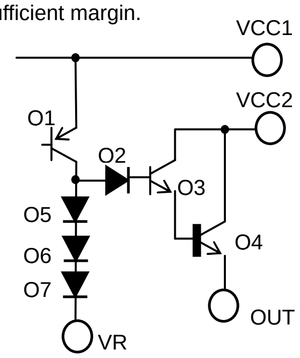
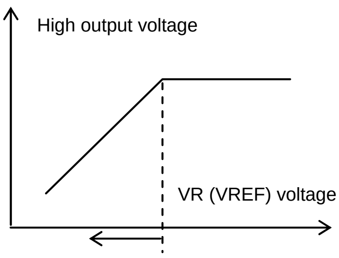


Fig.14

Operating Conditions

Pin	Voltage	Unit
VCC1	8 ～ 18	V
VCC2	8 ～ 18	V
VR	Shown above	-



Output Voltage Control Range
Fig.15

2-2. BA6920FP-Y (See Fig. 16)

○High output voltage is expressed by the following equation:

VoutH (high output voltage) = Vref voltage + {VF (Q2) + VF(Q3)} - {VF(Q4) + VF (Q5)}

≒Vref voltage + ΔVF

(VF is the base-emitter voltage in the forward direction)

Although ΔVF depends on the output current, Vo is almost VR.

The VOH is beyond control if the Vref value is higher than the above, and determined by the voltage condition of VCC and VM.

For example, when Vref = VCC = VM,

VOH≒VCC - Vsat (Q1) - VF (Q4) -VF (Q5)

≒VCC - 1.7 V

○Relation of VCC, VM, and VREF

VCC1, VCC2, and VR should be set as follows.

VREF < VM - Vsat (Q5) + VF (Q5) + VF (Q4) - {VF (Q2) + (Q3)}

≒ VM - 0.3 V

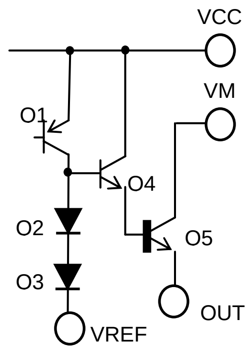


Fig.16

Operating conditions

pin	Voltage	Unit
Vcc	6.5 ～ 34	V
VM	6.5 ～ 34	V
VREF	Shown above	-

3) Selection of forward or reverse rotation

To change the rotation direction of the motor in operation, be sure to brake or open the motor current on time.

In the above case,

Braking: The braking time or over. The braking time is defined as the time of setting the output low level voltage to the GND potential or below, when the brake operates.

Opening: A period of 1 ms or over is recommended.

●**Power Dissipation Reduction** (Common)

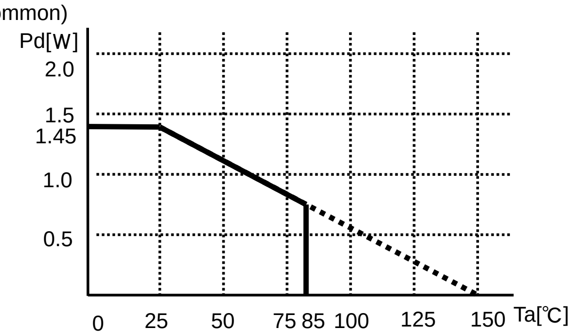


Fig.17

When mounted on a glass epoxy board with a dimension of 70 mm x 70 mm x 1.6 mm.
Reduced by 11.6 mW/°C over 25°C.
Must not exceed Pd or ASO.

●**I/O Circuit Diagram**

Input (BA6219BFP-Y)

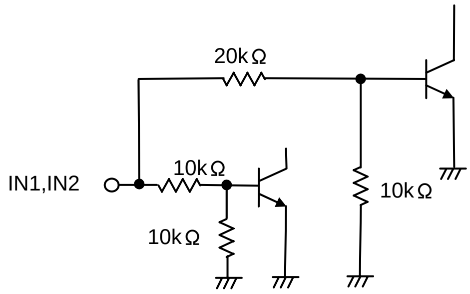


Fig.18

Input (BA6920FP-Y)

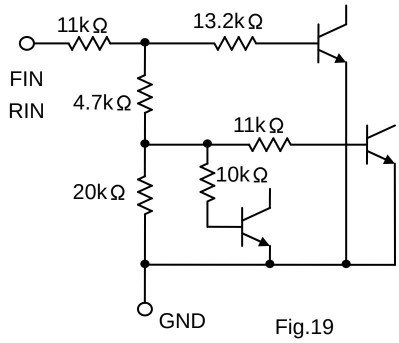


Fig.19

Output (BA6219BFP-Y)

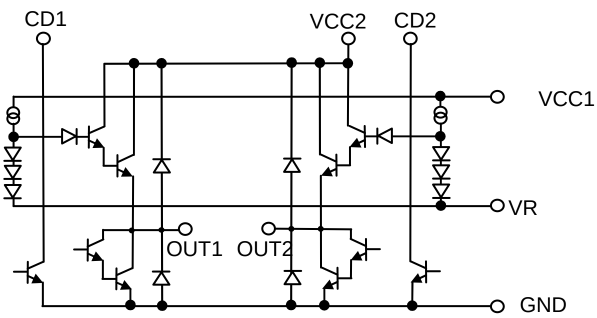


Fig.20

Output (BA6920FP-Y)

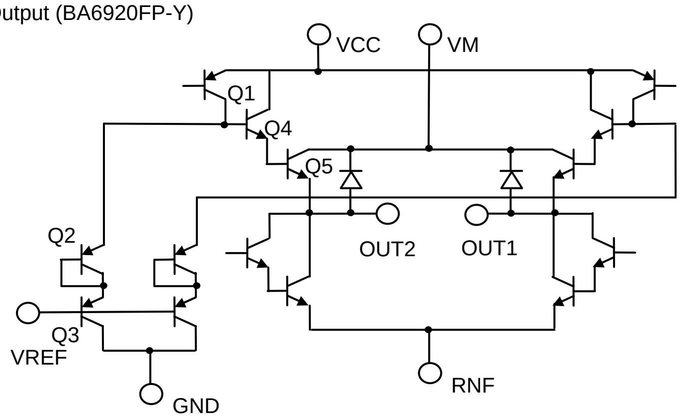


Fig.21

●**Operation Notes**

1) Absolute maximum ratings

An excess in the absolute maximum ratings, such as supply voltage, temperature range of operating conditions, etc., can break down the devices, thus making impossible to identify breaking mode, such as a short circuit or an open circuit. If any over rated values will expect to exceed the absolute maximum ratings, consider adding circuit protection devices, such as fuses.

2) Connecting the power supply connector backward

Connecting of the power supply in reverse polarity can damage IC. Take precautions when connecting the power supply lines. An external direction diode can be added.

3) Power supply lines

Design PCB layout pattern to provide low impedance GND and supply lines. To obtain a low noise ground and supply line, separate the ground section and supply lines of the digital and analog blocks. Furthermore, for all power supply terminals to ICs, connect a capacitor between the power supply and the GND terminal. When applying electrolytic capacitors in the circuit, note that capacitance characteristic values are reduced at low temperatures.

4) GND voltage

The potential of GND pin must be minimum potential in all operating conditions.

5) Thermal design

Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions.

6) Inter-pin shorts and mounting errors

Use caution when positioning the IC for mounting on printed circuit boards. The IC may be damaged if there is any connection error or if pins are shorted together.

7) Actions in a strong electromagnetic field

Use caution when using the IC in the presence of a strong electromagnetic field as doing so may cause the IC to malfunction.

8) ASO

When using the IC, set the output transistor so that it does not exceed absolute maximum ratings or ASO.

9) Thermal shutdown circuit

The IC incorporates a built-in thermal shutdown circuit (TSD circuit). The thermal shutdown circuit (TSD circuit) is designed only to shut the IC off to prevent thermal runaway. 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.)
BA6680FS	175	25
BD6761FS	175	35
BD6762FV	175	23

10) PWM drive

Voltage between the output FET drain and source may exceed the absolute maximum ratings due to the fluctuation of VCC at the time of PWM driving. If there is the threat of this problem, it is recommended to take physical countermeasures for safety such as inserting the capacitor between the VCC pin of FET and the detection resistor pin.

11) Testing on application boards

When testing the IC on an application board, connecting a capacitor to a pin with low impedance subjects the IC to stress. Always discharge capacitors after each process or step. Always turn the IC's power supply off before connecting it to or removing it from a jig or fixture during the inspection process. Ground the IC during assembly steps as an antistatic measure. Use similar precaution when transporting or storing the IC.

12) Regarding input pin of the IC (Fig. 22)

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 these P layers with the N layers of other elements, creating a parasitic diode or transistor.
For example, the relation between each potential is as follows:

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 can occur inevitable in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Accordingly, methods by which parasitic diodes operate, such as applying a voltage that is lower than the GND (P substrate) voltage to an input pin, should not be used.

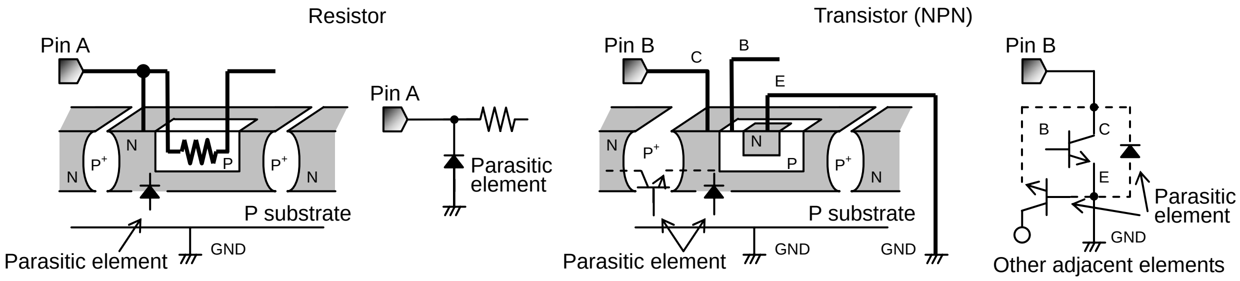


Fig.22 Example of IC structure

13) Ground Wiring Pattern

When using both small signal and large current GND patterns, it is recommended to isolate the two ground patterns, placing a single ground point at the ground potential of application 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.

●Selecting a model name when ordering

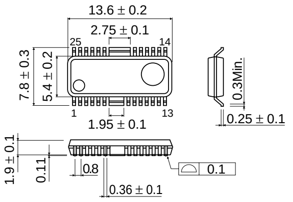
B	A		6	9	2	0		F	P	-	Y		E	2

ROHM model name — Part number — Package type — Taping type

E2 = Reel-wound embossed taping

HSOP25

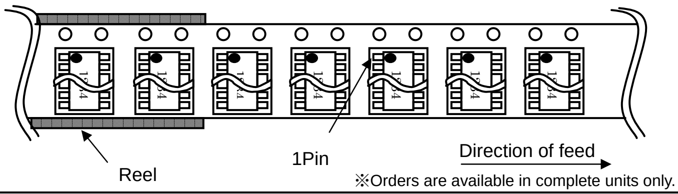
<Dimension>



(Unit:mm)

<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2000pcs
Direction of feed	E2 (Correct direction: 1pin of product should be at the upper left when you hold reel on the left hand, and you pull out the tape on the right hand)



※Orders are available in complete units only.

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