Reversible Motor Driver IC Series for Brush Motors

Reversible Motor Driver for Output 1.0A or more 2 Motors

BA6246/N,BA6247FP-Y,BA6239A,BA6238A/AN

●Description

The reversible motor driver for output 1.0A or more for 2 motors drives a brush type DC motor and incorporates one and a half circuits of reversible motor driver. A logic input section necessary for controlling each motor can be easily connected to the control logic such as CMOS, etc. In addition, since the output section can control voltage applied to motors by output High voltage setting terminal (VR) voltage, the torque at the time of driving motors can be varied.

●Features

1) Built-in one and a half circuits of a reversible motor driver
2) Minimal external parts
3) Input can be directly connected to CMOS (however, when CMOS output is 5V or more, protection resistor is required).
4) Built-in power transistor for motor driver
5) Built-in thermal shutdown circuit
6) Output voltage can be optionally set by output High voltage setting terminal.

●Applications

VTR, tape deck, audio equipment in general, OA equipment in general

●Absolute maximum ratings (Ta=25℃)

Parameter	Symbol	Ratings				Unit
		BA6246/N	BA6247FP-Y	BA6239A	BA6238A/AN	
Supply Voltage	VCC1、VCC2	20				V
Power dissipation	Pd	*2.5/**1.19	***1.45	*2.5	*2.5/**1.19	W
Operating temperature	Topr	-25～+75				℃
Storage temperature	Tstg	-55～+150	-55～+125			℃
Output current	IOUT	****1000		*****1200	****1600	mA

* When used at Ta=25°C or higher, derated at 20mW/°C.
** When used at Ta=25°C or higher, derated at 9.52mW/°C.
*** with 90 mm x 50 mm x 1.6 mm glass epoxy substrate mounted. When used at Ta=25°C or higher, derated at 11.6mW/°C.
**** However, do not allow current to exceed Pd and ASO. Output duty:1/50, 50msec
*****However, do not allow current to exceed Pd and ASO. Output duty:1/100, 500 μS

●Recommended operating range (Ta＝25℃)

Parameter	Symbol	Range				Unit
		BA6246/N	BA6247FP-Y	BA6239A	BA6238A/AN	
Supply voltage	VCC1	8～18	8～18	8～18	8～18	V
Supply voltage	VCC2	8～18	8～18	8～18	8～18	V
VR voltage	VR	0～18	0～18	8～18	0～18	V

Apr. 2005

●Electrical characteristics

BA6246/N(Unless otherwise specified, Ta=25℃ VCC1=12V VCC2=12V)

Parameter	Symbol	Limits			Unit	Conditions
		Min.	Typ.	Max.		
Supply current	Icc	—	7	15	mA	IN1,IN2,IN3=OPEN
Input threshold voltage H	V_{IL}	—	—	1.0	V	
Input threshold voltage L	V_{IH}	3.5	—	—	V	
Output voltage L	V_{OL}	—	0.9	1.5	V	I_O=0.5A
Output voltage H	V_{OH}	10	10.5	—	V	I_O=0.5A,VR=OPEN
Output leak current	I_{OL}	—	—	1	mA	IN1,IN2,IN3＝L VCC2 current
Output offset voltage	Vofs	-0.5	0	0.5	V	VR=6V. I_O=0.5A (V_{OH}-VR)
VR bias current	I_8	0.5	0.8	1.6	mA	VR=6V. I_O=0.5A

BA6247FP-Y(Unless otherwise specified, Ta=25℃ VCC1=12V VCC2=12V)

Parameter	Symbol	Limits			Unit	Conditions
		Min.	Typ.	Max.		
Supply current	Icc	—	10	20	mA	IN1,IN2,IN3=OPEN
Input threshold voltage H	V_{IL}	—	—	1.0	V	
Input threshold voltage L	V_{IH}	3.5	—	—	V	
Output voltage L	V_{OL}	—	0.9	1.5	V	I_O=0.5A
Output voltage H	V_{OH}	10	10.5	—	V	I_O=0.5A,VR=OPEN
Output leak current	I_{OL}	—	—	1	mA	IN1,IN2,IN3＝L VCC2 current
Output offset voltage	Vofs	-0.5	0	0.5	V	VR=6V. I_O=0.5A (V_{OH}-VR)
VR bias current	I_8	0.5	0.8	1.6	mA	VR=6V. I_O=0.5A

BA6239A(Unless otherwise specified, Ta=25℃ VCC1=12V VCC2=12V)

Parameter	Symbol	Limits			Unit	Conditions
		Min.	Typ.	Max.		
Supply current	Icc	—	12	24	mA	R_L=∞ IN1,IN2,IN3=L
Input threshold voltage H	V_{IL}	—	—	1.0	V	
Input threshold voltage L	V_{IH}	4.0	—	—	V	
Output voltage L	V_{OL}	—	0.8	1.5	V	R_L=100Ω
Output voltage H	V_{OH}	10.5	11.2	—	V	R_L=100Ω
Output leak current	I_{OL}	—	—	1	mA	IN1,IN2,IN3=L R_L=∞ VCC2 current

BA6238A/AN(Unless otherwise specified, Ta=25℃ VCC1=12V VCC2=12V)

Parameter	Symbol	Limits			Unit	Conditions
		Min.	Typ.	Max.		
Supply current	Icc	—	12	24	mA	R_L=∞ IN1,IN2,IN3=L
Input threshold voltage H	V_{IL}	—	—	1.0	V	
Input threshold voltage L	V_{IH}	4.0	—	—	V	
Output voltage L	V_{OL}	—	0.8	1.5	V	VR=OPEN, I_O=0.5A
Output voltage H	V_{OH}	10.0	10.5	—	V	VR=OPEN, I_O=0.5A
Output leak current	I_{OL}	—	—	1	mA	IN1,IN2,IN3=L R_L=∞ VCC2 current
Output offset voltage	Vofs	-0.5	0	0.5	V	VR=6V. I_O=0.5A (V_{OH}-VR)
VR bias current	I_8	0.2	0.6	1.5	mA	VR=6V. I_O=0.5A

●Thermal derating curves

BA6246, BA6239A, BA6238A

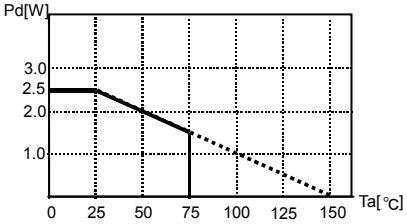


Fig.1

BA6246N, BA6238AN

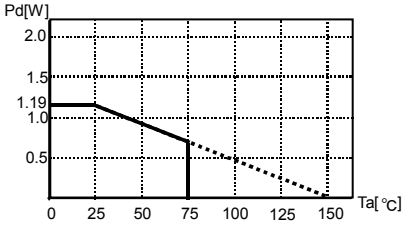


Fig.2

BA6247FP-Y

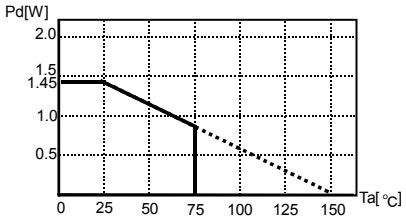


Fig.3

●Reference data

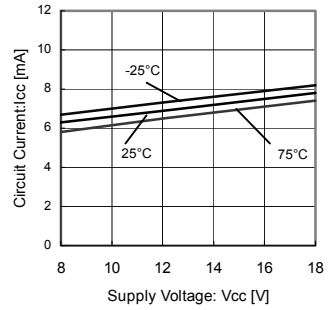


Fig.4 Supply current (BRK)
(BA6246/N)

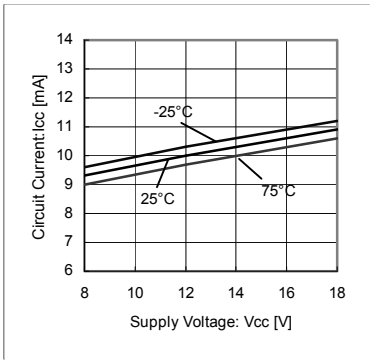


Fig.5 Supply current (BRK)
(BA6247FP-Y)

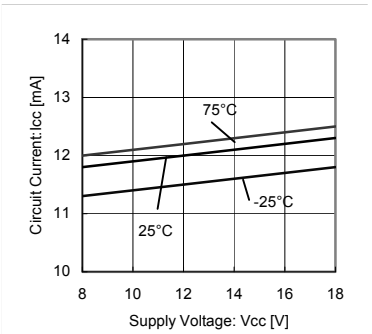


Fig.6 Supply current (BRK)
(BA6239A)

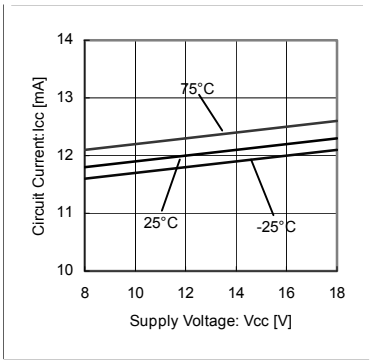


Fig.7 Supply current (BRK)
(BA6238A/AN)

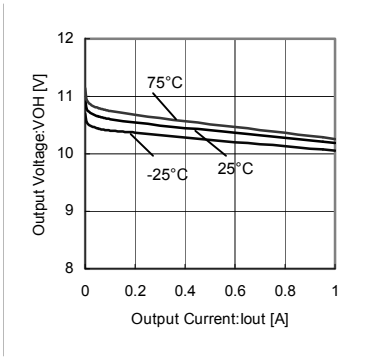


Fig.8 Output saturation voltage H
(BA6246/N)

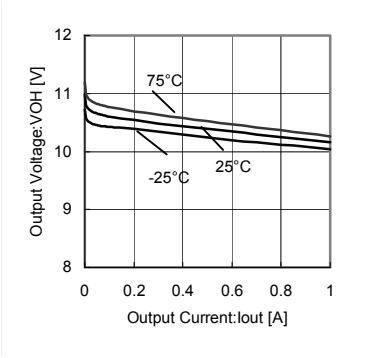


Fig.9 Output saturation voltage H
(BA6247FP-Y)

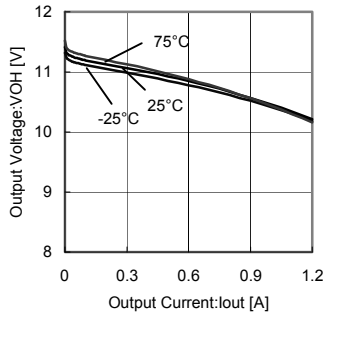


Fig.10 Output saturation voltage H
(BA6239A)

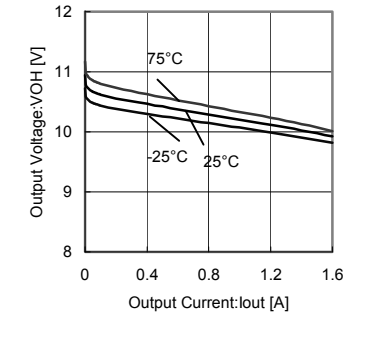


Fig.11 Output saturation voltage H
(BA6238A/AN)

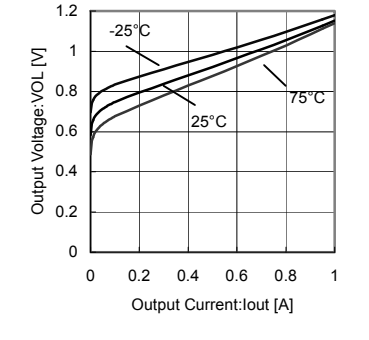


Fig.12 Output saturation voltage L
(BA6246/N)

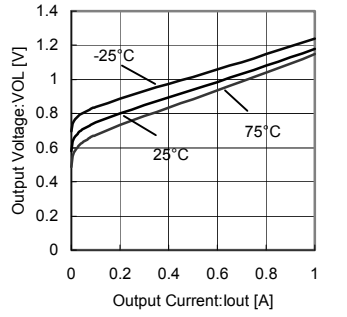


Fig.13 Output saturation voltage L
(BA6247FP-Y)

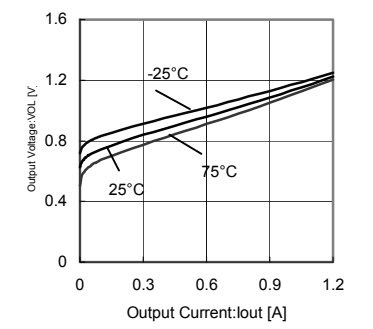


Fig.14 Output saturation voltage L
(BA6239A)

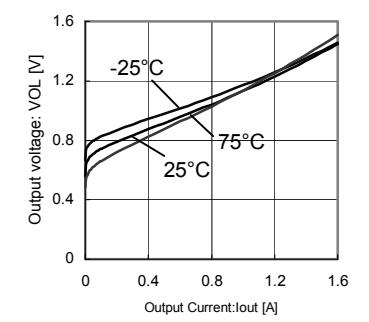


Fig.15 Output saturation voltage L
(BA6238A/AN)

●Block diagram, application circuit

BA6246/N,BA6238A/AN, BA6247FP-Y

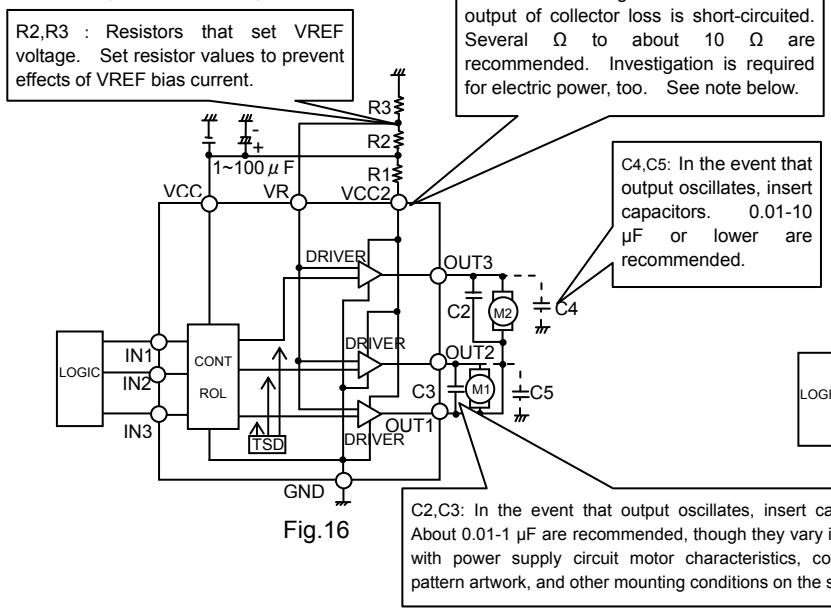


Fig.16

BA6239A

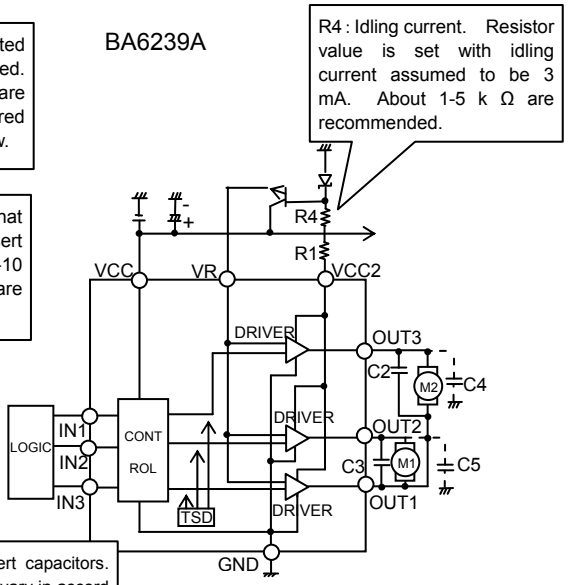


Fig.17

Note) Power W is generated in the driver as shown in the following equation.

W=(VM-VOH+VOL)×I

= {VM-VR+Vsat(Q1)+VF(Q2)+VOL} ×I VOH: Output voltage H VOL: Output voltage L

When the High-side output voltage setting is carried out, take IC heat generation into account.

In addition, inserting a resistor across VM terminal and power supply as illustrated in Fig.16,17 R1 as an application circuit can suppress IC heat generation by lowering the VM voltage as shown in the following equation.

VM'=VM-I×R1 VM' : VM terminal voltage VM : VM terminal external power supply voltage

I : Current that flows in motor

BA6247FP-Y

Pin No.	Pin name	Function
1	OUT3	Driver output
5	IN1	Control logic input
6	IN2	Control logic input
7	GND	Ground
8	IN3	
9	VCC1	Power supply for small signal
14	VR	Output high voltage setting pin
16	VCC2	Power supply for motor
18	OUT1	Driver output
19	GND	Ground
20	GND	Ground
22	OUT2	Driver output
FIN	GND	Ground

BA6246/N,BA6239A,BA6238A/AN

Pin No.	Pin name	Function
1	GND	Ground
2	OUT2	Driver output
3	OUT3	Driver output
4	IN1	Control logic input
5	IN2	Control logic input
6	IN3	Control logic input
7	VCC1	Power supply for small signal
8	VR	Output high voltage setting pin
9	VCC2	Power supply for motor
10	OUT1	Driver output

Note)2～4、10～13、15、17、21、23～25Pins are NC.

●Truth table

BA6239A,BA6238A/AN,BA6947FP-Y

Input			Output			Mode
IN1	IN2	IN3	OUT1	OUT2	OUT3	
L	L	L	L	L	L	Brake
		H				
H	L	L	H	L	OPEN	OUT1→OUT2 Motor 1(FWD)
H	L	H	L	H	OPEN	OUT2→OUT1 Motor 1(REV)
L	H	L	H	OPEN	L	OUT1→OUT3 Motor 2(FWD)
L	H	H	L	OPEN	H	OUT3→OUT1 Motor 2(REV)
H	H	L	L	L	L	Brake
		H				

Input			Output			Mode
4pin IN1	5pin IN2	6pin IN3	10pin OUT1	2pin OUT2	3pin OUT3	
L	L	L	L	L	L	Brake
		H				
H	L	L	H	L	OPEN	OUT1→OUT2 Motor 1(FWD)
H	L	H	L	H	OPEN	OUT2→OUT1 Motor 1(REV)
L	H	L	H	OPEN	L	OUT1→OUT3 Motor 2(FWD)
L	H	H	L	OPEN	H	OUT3→OUT1 Motor 2(REV)
H	H	L	OPEN	OPEN	OPEN	Idle
		H				

●Input conditions

○Input

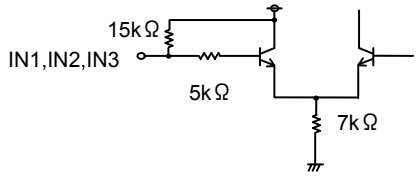


Fig.18

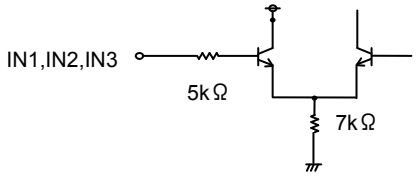


Fig.19

○Output BA6246/N,BA6247FP-Y,BA6238A/AN

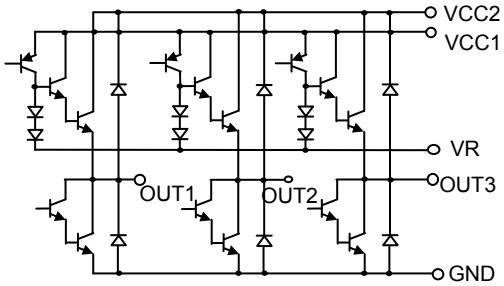


Fig.20

BA6239A

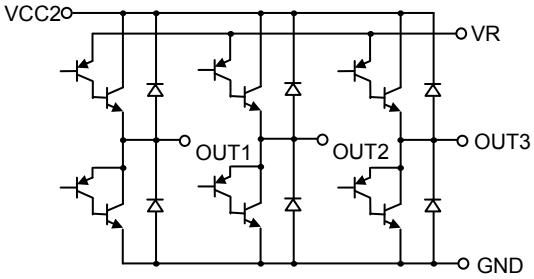


Fig.21

●Operations

1) Input conditions

The motor output varies in accord with the input logic table (P5, 6).

(1) The input threshold voltage has a positive temperature relation and is expressed by:

$$\frac{\triangle V_{IH}}{\triangle T} = +2.8mV/℃ \quad \frac{\triangle V_{IL}}{\triangle T} = +1.6mV/℃$$

(2) The input terminal is pulled up at about 15 k Ω (see Fig. 22).
In order to secure the input level, set the interface with current sink capability of not less than 700 μA (5V/15kx2).

(3) The maximum input voltage is 6V (BA6246/N, BA6247FP-Y) and 5V (BA6238A/AN, BA6239A), respectively.
Set input voltage with care not to exceed the maximum input voltage.

VREG≒5V(BA6246/N, BA6247FP-T)
≒4V(BA6238A/AN, BA6239A)

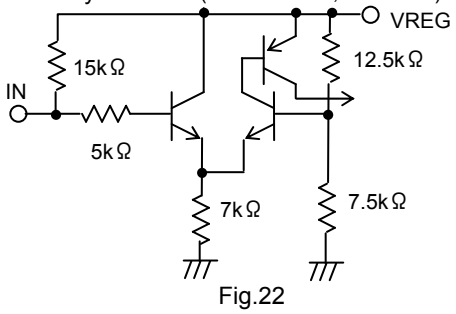


Fig.22

2) Output voltage control

Output H voltage can be set by VR terminal applied voltage. By varying the output H voltage, motor speed can be adjusted.

In the case of BA6246/N, BA6247FP-Y, and BA6338A/AN:

The circuit configuration of each output terminal and VR terminal is shown as per the illustration on the right (Fig. 23).

From the VR terminal, constant current determined inside IC:

$I_{VR}=I_C-I_B \fallingdotseq I_C$

flows out.

Output H voltage is expressed by:

$V_{OH}[V]=VR+\{V_F(Q4)+V_F(Q5)-V_F(Q2)-V_F(Q3)\}$

$\fallingdotseq VR$

VR : VR terminal applied voltage

VF : 0.75V [reference value]

For output voltage VOL, see reference data (3/8).

In addition, the VR voltage range to which output H voltage setting is enabled is;
0 ＜VR＜VCC1-Vsat(Q1)- VF(Q4)-VF(Q5) ≒VCC1-1.7V
0 ＜VR＜VCC2-Vsat(Q3)+ VF(Q3)+VF(Q2)-VF(Q4)-VF(Q5) ≒VCC2-0.1V

VOH outside the output H voltage setting range is
VR＞VCC1-Vsat(Q1)- VF(Q4)-VF(Q5) when
VOH=VCC1-Vsat(Q1)-VF(Q2)-VF(Q3)
≒VCC1-1.7V
VR＞VCC2-Vsat(Q3)+ VF(Q3)+VF(Q2)-VF(Q4)-VF(Q5) when
VOH=VCC2-Vsat(Q3)
≒VCC2-0.1V
(BA6239A)

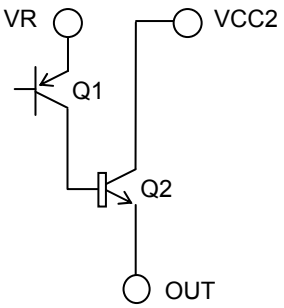


Fig.23

The circuit configuration of each output terminal and VR terminal is shown as per the illustration on the right (Fig. 24).
Output H voltage is expressed by:
VOH=VR-Vsat(Q1)-VF(Q2)

To the VR terminal, connect the power supply that can supply current according to the output current.
In addition, set VR terminal voltage not to exceed voltage of VCC1 terminal and VCC2 terminal.

3) Change-over of normal rotation to and from reverse rotation

When the motor rotating method is changed over with the motor rotated, allow the motor to temporarily go through the brake-applied condition or the open condition.
The duration of brake mode should be:
more than braking time when the mode is switched from rotation to braking：
(Braking time is defined as the time when the output L terminal becomes the potential lower than GND with brake applied.)
The duration of open mode should be 1 msec or more.

● Cautions on use

1) Absolute Maximum Ratings
For the present product, thoroughgoing quality control is carried out, but in the event that applied voltage, working temperature range, and other absolute maximum rating are exceeded, the present product may be destroyed. Because it is unable to identify the short mode, open mode, etc., if any special mode is assumed, which exceeds the absolute maximum rating, physical safety measures are requested to be taken, such as fuses, etc.

2) Reverse connection of power supply connector
Reverse connection of power supply connector may destroy the IC. Take necessary measures to protect the IC from reverse connection breakage such as externally inserting diodes across power supply and IC power supply terminal as well as across power supply and motor coil.

3) Power supply line
Because return of current regenerated by Back-EMF of a motor occurs, take necessary measures such as inserting capacitors across the power supply and GND as a path for regenerated current, and determine the capacity value after thoroughly confirming that there would be no problems in various characteristics such as capacitance drop at low temperature which may occur with electrolytic capacitors. By the way, in the event that the power supply connected does not have sufficient current absorbing capability, voltage of the power supply line rises due to regenerative current and there is a fear in that the present product including the peripheral circuits exceeds the absolute maximum rating. It is therefore requested to provide physical safety measures, such as inserting a diode for voltage clamp across power supply and GND, etc.

4) Electrical potential at GND
Keep the GND terminal potential to the minimum potential under any operating condition. In addition, check if there is actually any terminal, which provides voltage below GND including transient phenomena.

5) Thermal design
Consider the power dissipation (Pd) under actual working condition and carry out thermal design with sufficient margin provided.

6) Short-circuiting between terminals, and mismounting
When mounting to PCB, care must be taken to avoid mistake in its orientation and alignment. Failure to do so may result in IC breakdown. Short-circuiting due to foreign matters entered between output terminals, or between output and power supply or GND may also cause breakdown.

7) Operation in strong electromagnetic field
The use in the strong electromagnetic field may sometimes cause malfunction, to which care must be taken.

8) ASO
When IC is used, design in such a manner that the output transistor does not exceed absolute maximum ratings and ASO.

9) Built-in thermal shutdown circuit
The thermal shutdown circuit is first and foremost intended for interrupt IC from thermal runaway, and is not intended to protect and warrant the IC. Consequently, never attempt to continuously use the IC after this circuit is activated or to use the circuit with the activation of the circuit premised.

10) Capacitor across output and GND

In the event a large capacitor is connected across output and GND, when VCC and VIN are short-circuited with 0V or GND for some kind of reasons, current charged in the capacitor flows into the output and may destroy the IC. Use a capacitor smaller than 1 μF between output and GND.

11) Inspection by set substrate

In the event a capacitor is connected to a pin with low impedance at the time of inspection with a set substrate, there is a fear of applying stress to the IC. Therefore, be sure to discharge electricity for every process. Furthermore, when the set substrate is connected to a jig in the inspection process, be sure to turn OFF power supply to connect the jig and be sure to turn OFF power supply to remove the jig. As electrostatic measures, provide grounding in the assembly process, and take utmost care in transportation and storage.

12) IC terminal input

The present IC is a monolithic IC and has P^+ isolation and a P substrate between elements to separate elements. With this P layer and N layer of each element, PN junction is formed, and various parasitic elements are formed. For example, when resistors and transistors are connected to terminals as is the case of Fig. 24, where in the case of resistor, the potential difference satisfies the relation of ground (GND)>(terminal A), and in the case of transistor (NPN), the potential difference satisfies the relation of ground (GND)>(terminal B), PN junction works as a diode. Furthermore, in the case of transistor (NPN), a parasitic NPN transistor operates by the N-layer of other elements adjacent to the parasitic diode. The parasitic element is inevitably formed because of the IC construction. The operation of the parasitic element gives rise to mutual interference between circuits and results in malfunction, and eventually, breakdown. Consequently, take utmost care not to use the IC to operate the parasitic element such as applying voltage lower than GND (P substrate) to the input terminal. In addition, when the power supply voltage is not applied to IC, do not apply voltage to the input terminal, either. Similarly, when the power supply voltage is applied, each input terminals shall be the voltage below the power supply voltage or within the guaranteed values of electrical properties.

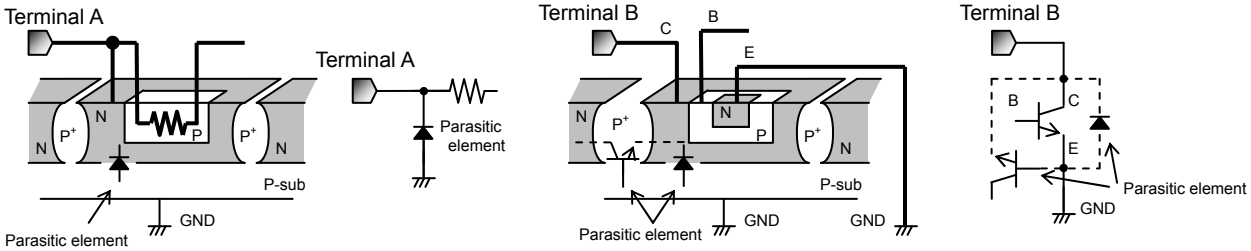


Fig.24 Example of the basic structure of a bipolar IC

13) GND wiring pattern

If there are a small signal GND and a high current GND, it is recommended to separate the patterns for the high current GND and the small signal GND and provide a proper grounding to the reference point of the set not to affect the voltage at the small signal GND with the change in voltage due to resistance component of pattern wiring and high current. Also for GND wiring pattern of the component externally connected, pay special attention not to cause undesirable change to it.

●Ordering part number

B	A	6	2	4	6				–	E	2

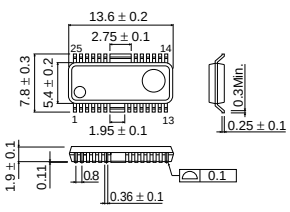
ROHM part number — Type — Package — Package specification

Package
None=HSIP10
N =SIP10
FP-Y=HSOP25

Package specification
E2 = Embossed taping
None = Tube

HSOP25

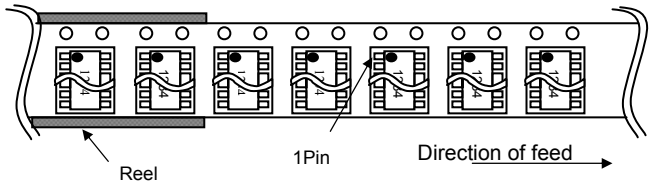
<Dimension>



(Unit:mm)

<Tape and Reel information>

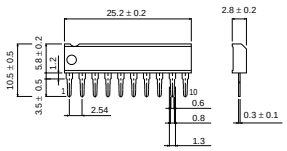
Tape	Embossed carrier tape
Quantity	2000pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



※When you order , please order in times the amount of package quantity.

SIP10

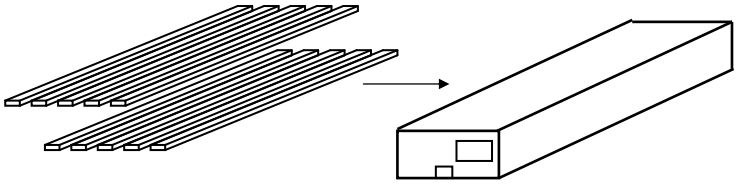
<Dimension>



(Unit:mm)

<Packing information>

Container	Tube
Quantity	600pcs
Direction of feed	Direction of products is fixed in a container tube.



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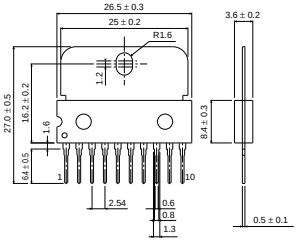
HSIP10

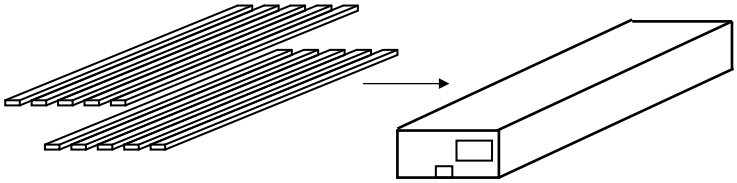
<Dimension>



(Unit:mm)

<Packing information>

Container	Tube
Quantity	500pcs
Direction of feed	Direction of products is fixed in a container tube.



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