

Stepping Motor Driver series

# High Voltage Series Stepping Motor Drivers



BD6422EFV (PARALLEL-IN type)  
BD6425, BD6423EFV (CLK-IN type)

No.12009EAT06

## ●Description

These products are a low power consumption PWM constant current-drive driver of bipolar stepping motor with power supply's rated voltage of 45V and rated output current of 1.0A, 1.5A.

## ●Feature

- 1) Power supply: one system drive (rated voltage of 45V)
- 2) Rated output current: 1.0A, 1.5A
- 3) Low ON resistance DMOS output
- 4) CLK-IN drive mode (BD6425/6423EFV)
- 5) Parallel IN drive mode (BD6422EFV)
- 6) PWM constant current control (other oscillation)
- 7) Built-in spike noise blanking function (external noise filter is unnecessary)
- 8) FULL STEP & HALF STEP (two kinds), applicable to QUARTER STEP
- 9) Current decay mode switching function (4 kinds of FAST/SLOW DECAY ratio)
- 10) Normal rotation & reverse rotation switching function (BD6425/6423EFV)
- 11) Power save function
- 12) Built-in logic input pull-down resistor
- 13) Power-on reset function(BD6425/6423EFV)
- 14) Thermal shutdown circuit (TSD)
- 15) Over current protection circuit (OCP)
- 16) Under voltage lock out circuit (UVLO)
- 17) Malfunction prevention at the time of no applied power supply (Ghost Supply Prevention)
- 18) Electrostatic discharge: 8kV (HBM specification)
- 19) Microminiature, ultra-thin and high heat-radiation (exposed metal type) HTSSOP package

## ●Application

serial dot impact printer, sewing machine etc.

## ●Absolute maximum ratings(Ta=25°C)

| Item                          | Symbol      | BD6425EFV          | BD6423/6422EFV    | Unit    |
|-------------------------------|-------------|--------------------|-------------------|---------|
| Supply voltage                | $V_{CC1,2}$ | -0.2~+45.0         | -0.2~+45.0        | V       |
| Power dissipation             | Pd          | 1.45 <sup>*1</sup> | 1.1 <sup>*3</sup> | W       |
|                               |             | 4.70 <sup>*2</sup> | 4.0 <sup>*4</sup> | W       |
| Input voltage for control pin | $V_{IN}$    | -0.2~+5.5          | -0.2~+5.5         | V       |
| RNF maximum voltage           | $V_{RNF}$   | 0.7                | 0.7               | V       |
| Maximum output current        | $I_{OUT}$   | 1.5 <sup>*5</sup>  | 1.0 <sup>*5</sup> | A/phase |
| Operating temperature range   | $T_{opr}$   | -25~+85            | -25~+85           | °C      |
| Storage temperature range     | $T_{stg}$   | -55~+150           | -55~+150          | °C      |
| Junction temperature          | $T_{jmax}$  | +150               | +150              | °C      |

\*1 70mm × 70mm × 1.6mm glass epoxy board. Derating in done at 11.6mW/°C for operating above Ta=25°C.

\*2 4-layer recommended board. Derating in done at 37.6mW/°C for operating above Ta=25°C.

\*3 70mm × 70mm × 1.6mm glass epoxy board. Derating in done at 8.8mW/°C for operating above Ta=25°C.

\*4 4-layer recommended board. Derating in done at 32.0mW/°C for operating above Ta=25°C.

\*5 Do not, however exceed Pd, ASO and Tjmax=150°C.

## ●Operating conditions (Ta= -25~+85°C)

| Item                        | Symbol             | BD6425EFV         | BD6423/6422EFV    | Unit    |
|-----------------------------|--------------------|-------------------|-------------------|---------|
| Supply voltage              | V <sub>CC1,2</sub> | 19~42             |                   | V       |
| Maximum Output current (DC) | I <sub>OUT</sub>   | 1.2* <sup>6</sup> | 0.7* <sup>6</sup> | A/phase |

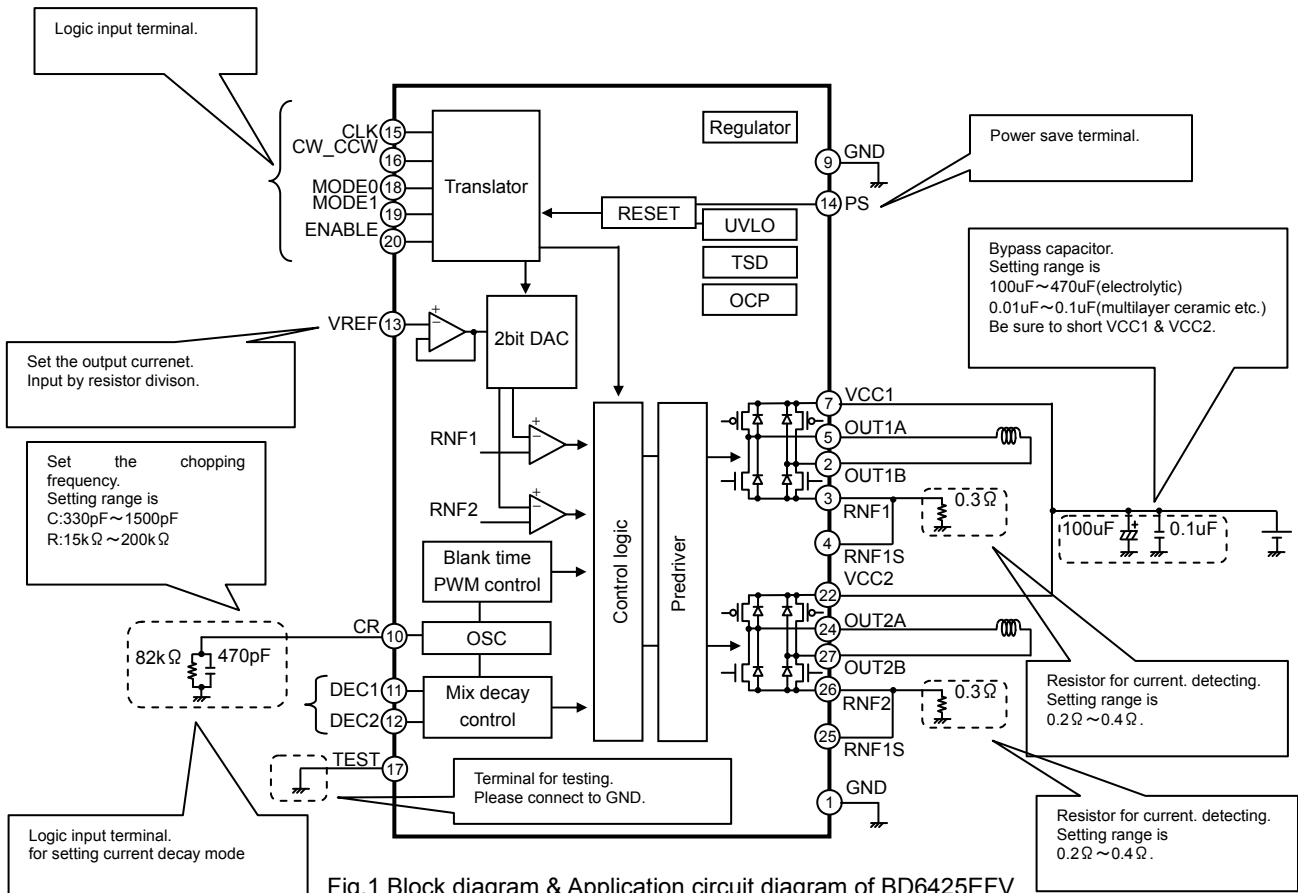
\*<sup>6</sup> Do not however exceed Pd, ASO.●Electrical characteristics (Unless otherwise specified Ta=25°C, V<sub>CC1,2</sub>=37V)

| Item                                       | Symbol              | Limit |      |      | Unit | Condition                                      |
|--|---------------------|-------|------|------|------|--|
|  |                     | Min.  | Typ. | Max. |      |  |
| <b>Whole</b>                               |                     |       |      |      |      |  |
| Circuit current at standby                 | I <sub>CCST</sub>   | -     | 1.0  | 2.5  | mA   | PS=L   |
| Circuit current                            | I <sub>CC</sub>     | -     | 2.0  | 5.0  | mA   | PS=H, VREF=3V                                  |
| <b>Control input</b>                       |                     |       |      |      |      |  |
| H level input voltage                      | V <sub>INH</sub>    | 2.0   | -    | -    | V    |  |
| L level input voltage                      | V <sub>INL</sub>    | -     | -    | 0.8  | V    |  |
| H level input current                      | I <sub>INH</sub>    | 35    | 50   | 100  | μA   | V <sub>IN</sub> =5V                            |
| L level input current                      | I <sub>INL</sub>    | -10   | 0    | -    | μA   | V <sub>IN</sub> =0V                            |
| <b>Output (OUT1A, OUT1B, OUT2A, OUT2B)</b> |                     |       |      |      |      |  |
| Output ON resistance(BD6425EFV)            | R <sub>ON</sub>     | -     | 1.10 | 1.43 | Ω    | I <sub>OUT</sub> =1.0A, Sum of upper and lower |
| Output ON resistance(BD6423/6422EFV)       | R <sub>ON</sub>     | -     | 2.00 | 2.60 | Ω    | I <sub>OUT</sub> =0.5A, Sum of upper and lower |
| Output leak current                        | I <sub>LEAK</sub>   | -     | -    | 10   | μA   |  |
| <b>Current control</b>                     |                     |       |      |      |      |  |
| RNFXS input current (BD6425EFV)            | I <sub>RNFS</sub>   | -2.0  | -0.1 | -    | μA   | RNFXS=0V                                       |
| RNFx input current                         | I <sub>RNF</sub>    | -40   | -20  | -    | μA   | RNFx=0V  |
| VREF input current                         | I <sub>VREF</sub>   | -2.0  | -0.1 | -    | μA   | VREF=0V  |
| VREF input voltage range                   | V <sub>REF</sub>    | 0     | -    | 3.0  | V    |  |
| Minimum on time (Blank time)               | t <sub>ONMIN</sub>  | 0.5   | 1.5  | 3.0  | μs   | C=470pF, R=82kΩ                                |
| <b>BD6425/6423EFV</b>                      |                     |       |      |      |      |  |
| Comparator threshold                       | V <sub>CTH</sub>    | 0.57  | 0.60 | 0.63 | V    | VREF=3V  |
| <b>BD6422EFV</b>                           |                     |       |      |      |      |  |
| Comparator threshold 100%                  | V <sub>CTH100</sub> | 0.57  | 0.60 | 0.63 | V    | VREF=3V, (I0X,I1X)=(L,L)                       |
| Comparator threshold 67%                   | V <sub>CTH67</sub>  | 0.38  | 0.40 | 0.42 | V    | VREF=3V, (I0X,I1X)=(H,L)                       |
| Comparator threshold 33%                   | V <sub>CTH33</sub>  | 0.18  | 0.20 | 0.22 | V    | VREF=3V, (I0X,I1X)=(L,H)                       |

● Terminal function and Application circuit diagram

1) BD6425EFV

| Pin No. | Pin name | Function   | Pin No. | Pin name | Function   |
|---------|----------|--|---------|----------|--|
| 1       | GND      | Ground terminal  | 15      | CLK      | Clock input terminal for advancing the electrical angle.     |
| 2       | OUT1B    | H bridge output terminal                                     | 16      | CW_CCW   | Motor rotating direction setting terminal                    |
| 3       | RNF1     | Connection terminal of resistor for output current detection | 17      | TEST     | Terminal for testing (used by connecting with GND)           |
| 4       | RNF1S    | Input terminal of current limit comparator                   | 18      | MODE0    | Motor excitation mode setting terminal                       |
| 5       | OUT1A    | H bridge output terminal                                     | 19      | MODE1    | Motor excitation mode setting terminal                       |
| 6       | NC       | Non connection   | 20      | ENABLE   | Power supply terminal  |
| 7       | VCC1     | Power supply terminal  | 21      | NC       | Non connection   |
| 8       | NC       | Non connection   | 22      | VCC2     | Power supply terminal  |
| 9       | GND      | Ground terminal  | 23      | NC       | Non connection   |
| 10      | CR       | Connection terminal of CR for setting chopping frequency     | 24      | OUT2A    | H bridge output terminal                                     |
| 11      | DEC1     | Current decay mode setting terminal                          | 25      | RNF2S    | Input terminal of current limit comparator                   |
| 12      | DEC2     | Current decay mode setting terminal                          | 26      | RNF2     | Connection terminal of resistor for output current detection |
| 13      | VREF     | Output current value setting terminal                        | 27      | OUT2B    | H bridge output terminal                                     |
| 14      | PS       | Power save terminal  | 28      | NC       | Non connection   |



2) BD6423EFV

| Pin No. | Pin name | Function   | Pin No. | Pin name | Function   |
|---------|----------|--|---------|----------|--|
| 1       | GND      | Ground terminal  | 13      | CLK      | Clock input terminal for advancing the electrical angle.     |
| 2       | OUT1B    | H bridge output terminal                                     | 14      | CW_CCW   | Motor rotating direction setting terminal                    |
| 3       | RNF1     | Connection terminal of resistor for output current detection | 15      | TEST     | Terminal for testing (used by connecting with GND)           |
| 4       | OUT1A    | H bridge output terminal                                     | 16      | MODE0    | Motor excitation mode setting terminal                       |
| 5       | VCC1     | Power supply terminal  | 17      | MODE1    | Motor excitation mode setting terminal                       |
| 6       | NC       | Non connection   | 18      | ENABLE   | Output enable terminal                                       |
| 7       | GND      | Ground terminal  | 19      | NC       | Non connection   |
| 8       | CR       | Connection terminal of CR for setting PWM frequency          | 20      | VCC2     | Power supply terminal  |
| 9       | DEC1     | Current decay mode setting terminal                          | 21      | OUT2A    | H bridge output terminal                                     |
| 10      | DEC2     | Current decay mode setting terminal                          | 22      | RNF2     | Connection terminal of resistor for output current detection |
| 11      | VREF     | Output current value setting terminal                        | 23      | OUT2B    | H bridge output terminal                                     |
| 12      | PS       | Power save terminal  | 24      | NC       | Non connection   |

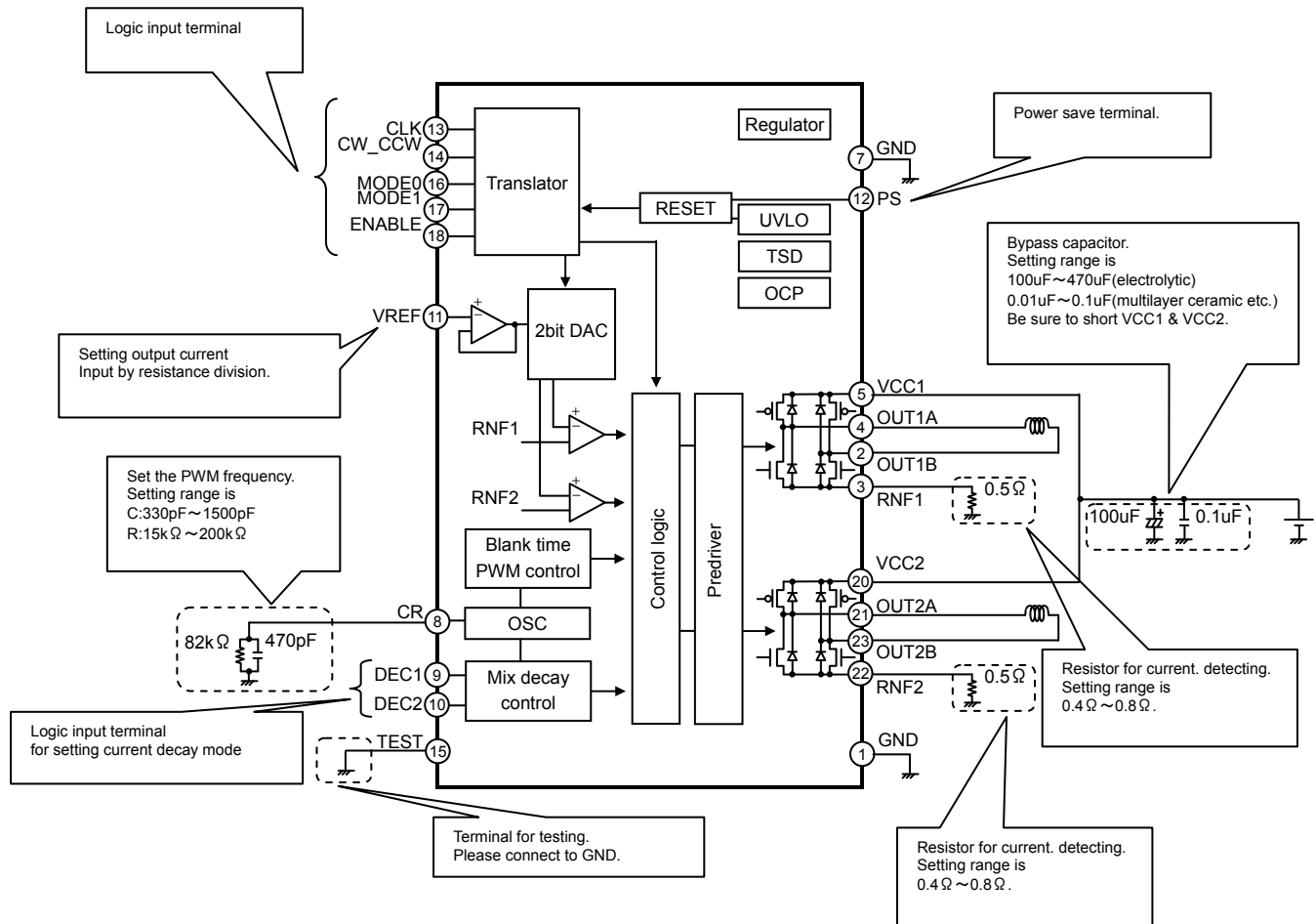


Fig.2 Block diagram & Application circuit diagram of BD6423EFV

3) BD6422EFV

| Pin No. | Pin name | Function   | Pin No. | Pin name | Function   |
|---------|----------|--|---------|----------|--|
| 1       | GND      | Ground terminal  | 13      | PHASE1   | Phase selection terminal                                     |
| 2       | OUT1B    | H bridge output terminal                                     | 14      | I01      | VREF division ratio setting terminal                         |
| 3       | RNF1     | Connection terminal of resistor for output current detection | 15      | I11      | VREF division ratio setting terminal                         |
| 4       | OUT1A    | H bridge output terminal                                     | 16      | PHASE2   | Phase selection terminal                                     |
| 5       | VCC1     | Power supply terminal  | 17      | I02      | VREF division ratio setting terminal                         |
| 6       | NC       | Non connection   | 18      | I12      | VREF division ratio setting terminal                         |
| 7       | GND      | Ground terminal  | 19      | NC       | Non connection   |
| 8       | CR       | Connection terminal of CR for setting PWM frequency          | 20      | VCC2     | Power supply terminal  |
| 9       | DEC1     | Current decay mode setting terminal                          | 21      | OUT2A    | H bridge output terminal                                     |
| 10      | DEC2     | Current decay mode setting terminal                          | 22      | RNF2     | Connection terminal of resistor for output current detection |
| 11      | VREF     | Output current value setting terminal                        | 23      | OUT2B    | H bridge output terminal                                     |
| 12      | PS       | Power save terminal  | 24      | NC       | Non connection   |

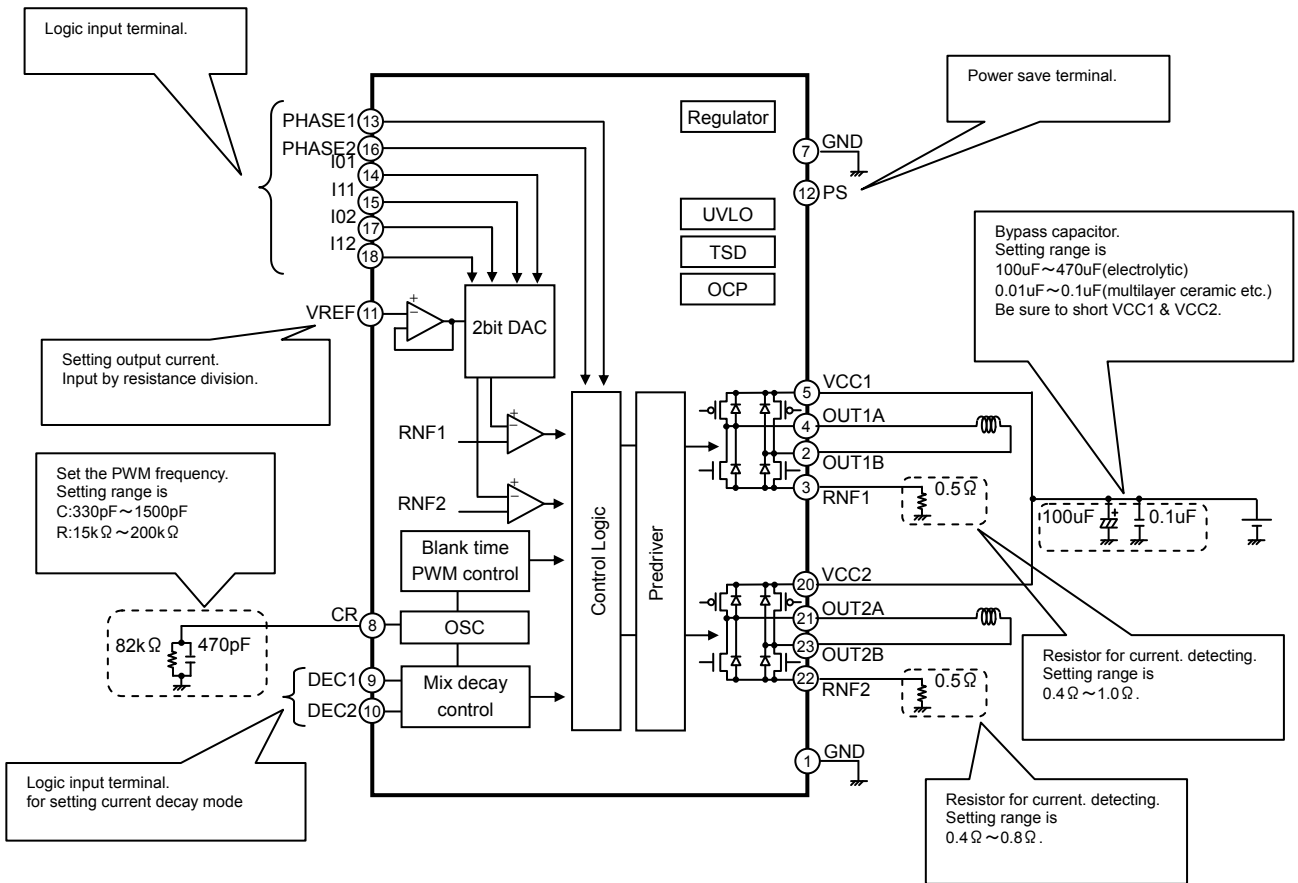


Fig.3 Block diagram & Application circuit diagram of BD6422EFV

## ● Usage 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, not that capacitance characteristic values are reduced at low temperatures.

### (4) GND Potential

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

### (5) Metal on the backside (Define the side where product markings are printed as front)

The metal on the backside is shorted with the backside of IC chip therefore it should be connected to GND. Be aware that there is a possibility of malfunction or destruction if it is shorted with any potential other than GND.

### (6) Thermal design

Use a thermal design that allows for a sufficient margin in light of the power dissipation (Pd) in actual operating conditions. Users should be aware that these products have been designed to expose their frames at the back of the package, and should be used with suitable heat dissipation treatment in this area to improve dissipation. As large a dissipation pattern should be taken as possible, not only on the front of the baseboard but also on the back surface. It is important to consider actual usage conditions and to take as large a dissipation pattern as possible.

### (7) Inter-pin shorts and mounting errors

When attaching to a printed circuit board, pay close attention to the direction of the IC and displacement. Improper attachment may lead to destruction of the IC. There is also possibility of destruction from short circuits which can be caused by foreign matter entering between outputs or an output and the power supply or GND.

### (8) Operation in a strong electric field

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

### (9) ASO

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

### (10) Thermal shutdown circuit

The IC has a built-in thermal shutdown circuit (TSD circuit). If the chip temperature becomes  $T_{jmax}=150^{\circ}\text{C}$ , and higher, coil output to the motor will be open. The TSD circuit is designed only to shut the IC off to prevent runaway thermal operation. It is not designed to protect or indemnify peripheral equipment. Do not use the TSD function to protect peripheral equipment.

| TSD on temperature [ $^{\circ}\text{C}$ ] (Typ.) | Hysteresis Temperature [ $^{\circ}\text{C}$ ] (Typ.) |
|--|--|
| 175  | 25   |

### (11) Inspection of the application board

During inspection of the application board, if a capacitor is connected to a pin with low impedance there is a possibility that it could cause stress to the IC, therefore an electrical discharge should be performed after each process. Also, as a measure against electrostatic discharge, it should be earthed during the assembly process and special care should be taken during transport or storage. Furthermore, when connecting to the jig during the inspection process, the power supply should first be turned off and then removed before the inspection.

## (12) Input terminal of IC

This IC is a monolithic IC, and between each element there is a P+ isolation for element partition and a P substrate. This P layer and each element's N layer make up the P-N junction, and various parasitic elements are made up. For example, when the resistance and transistor are connected to the terminal as shown in figure 4,

○When GND > (Terminal A) at the resistance and GND > (Terminal B) at the transistor (NPN), the P-N junction operates as a parasitic diode.

○Also, when GND > (Terminal B) at the transistor (NPN)

The parasitic NPN transistor operates with the N layers of other elements close to the aforementioned parasitic diode.

Because of the IC's structure, the creation of parasitic elements is inevitable from the electrical potential relationship. The operation of parasitic elements causes interference in circuit operation, and can lead to malfunction and destruction. Therefore, be careful not to use it in a way which causes the parasitic elements to operate, such as by applying voltage that is lower than the GND (P substrate) to the input terminal.

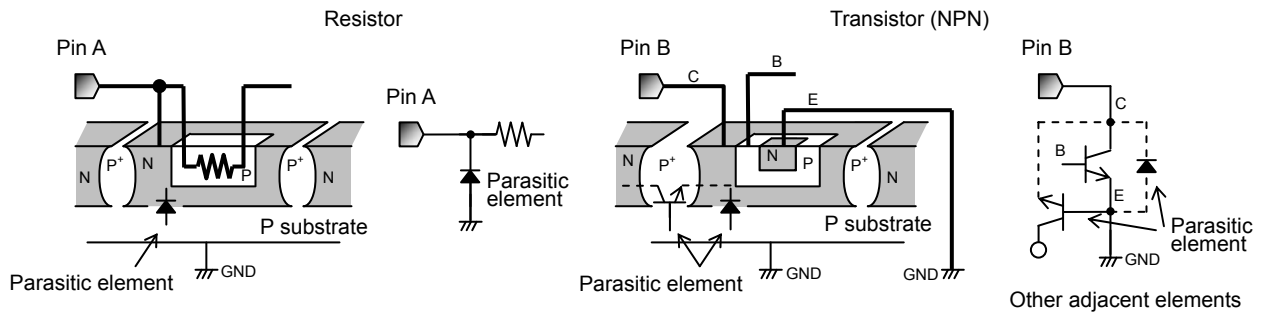


Fig. 4 Pattern Diagram of Parasitic Element

## (13) Ground Wiring Patterns

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 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 potential of any external components, either.

## (14) TEST Terminal (BD6425/6423EFV)

Be sure to connect TEST pin to GND.



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