

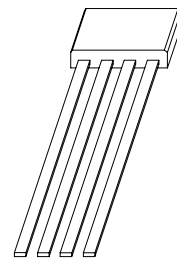
## General Description

The FS220, a 1-chip composed of hall sensor and output coil drivers, applied to a 2-phase DC motor. The high sensitivity of Hall effect sensor is suitable for motors from mini-type CPU coolers to blowers and DC fans. Typical operation current is 0.45A and operating voltage range is from 2.8V ~ 28V.

Using few external components, FS220, a high performance integrated IC, is designed for a single-phase DC motor circuit. The circuit diagram of the typical application example is as below.

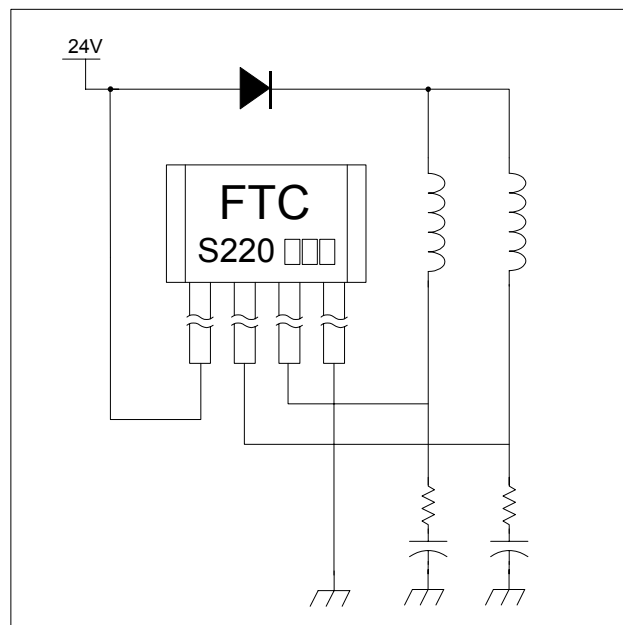
## Features

- 1 chip hall sensor/drivers
- Wide operating voltage range: 2.8V~28V
- Output sink current up to 0.45A
- Package : TO-92SP-4

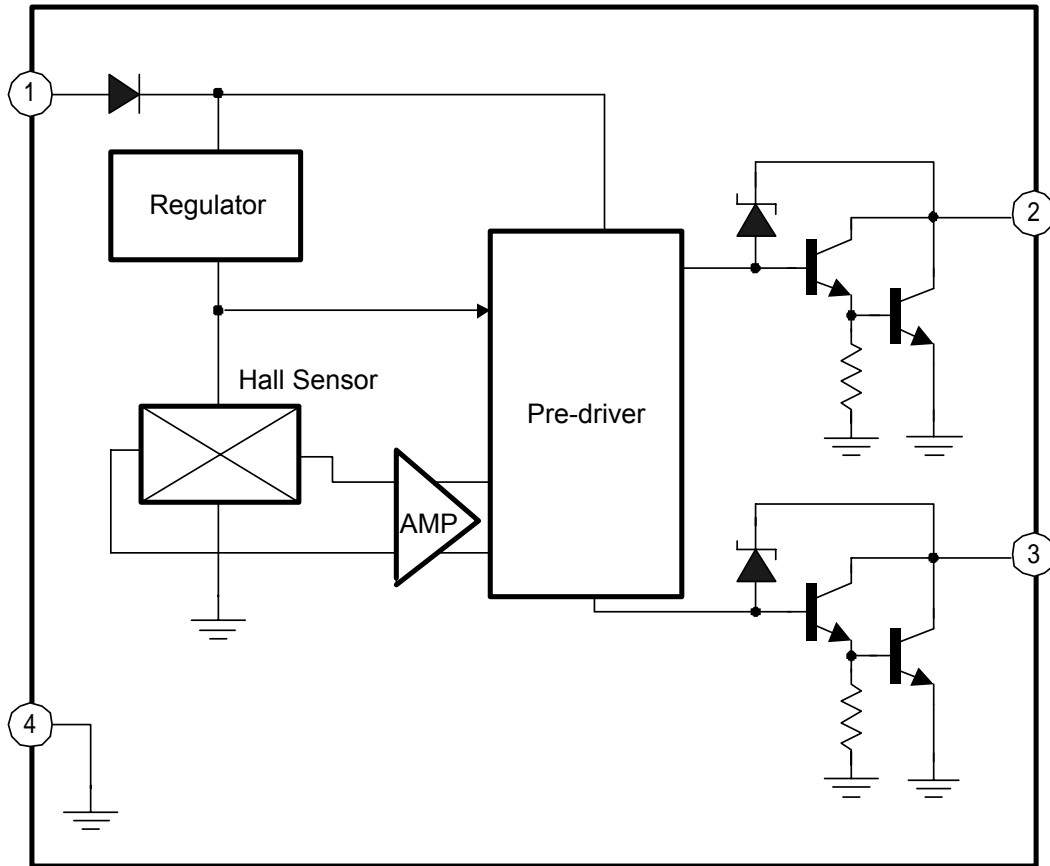


TO-92SP-4

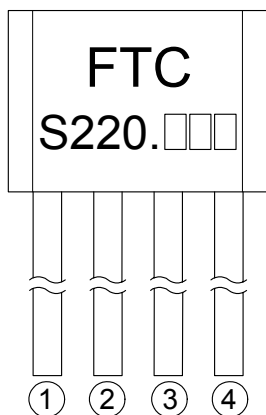
## Typical Application Circuit



**Functional Block Diagram**



**MARK VIEW**

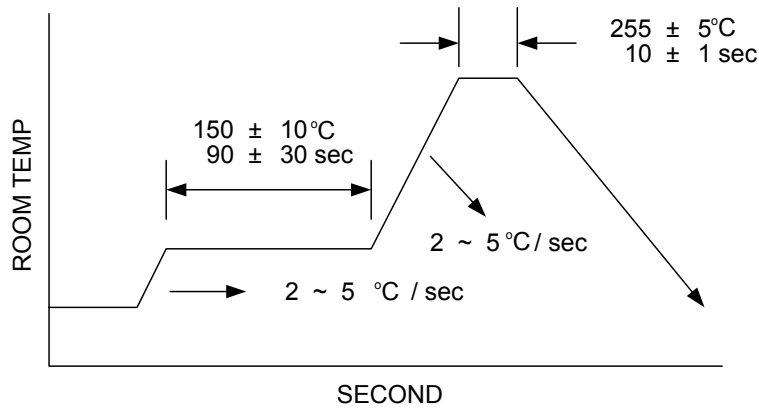


**PIN DESCRIPTION**

| NAME | NO. | STATUS | DESCRIPTION  |
|------|-----|--------|--|
| VCC  | 1   | P      | IC Power Supply  |
| NO   | 2   | O      | Coil driver output<br>It is low state during the N magnetic field. |
| SO   | 3   | O      | Coil driver output<br>It is low state during the S magnetic field. |
| GND  | 4   | P      | IC Ground  |

**Absolute Maximun Ratings** ( at Ta = 25 °C )

|  |                   |
|--|-------------------|
| Zener Breakdown Voltage (Vz) -----             | up 60V            |
| NO/SO Pin Voltage(off) -----                   | 28V               |
| VCC Pin Voltage -----                          | 28V               |
| Peak Sink Current (Io)                         |                   |
| Peak Current-----                              | 1A ≤ 100us        |
| Hold Current-----                              | 800mA             |
| Continuous Current -----                       | 450mA             |
| Power Dissipation                              |                   |
| Ta=25 °C -----                                 | 700mW             |
| Ta=95 °C -----                                 | 350mW             |
| Thermal Resistance                             |                   |
| Θ <sub>ja</sub> = -----                        | 0.195 °C/mW       |
| Operating Temperature Range -----              | -20 °C to +85 °C  |
| Storage Temperature Range -----                | -65 °C to +150 °C |
| <br>Junction Temperature -----                 | <br>+160 °C       |
| <br>Lead Temperature (Soldering, 10 sec) ----- | <br>+260 °C       |



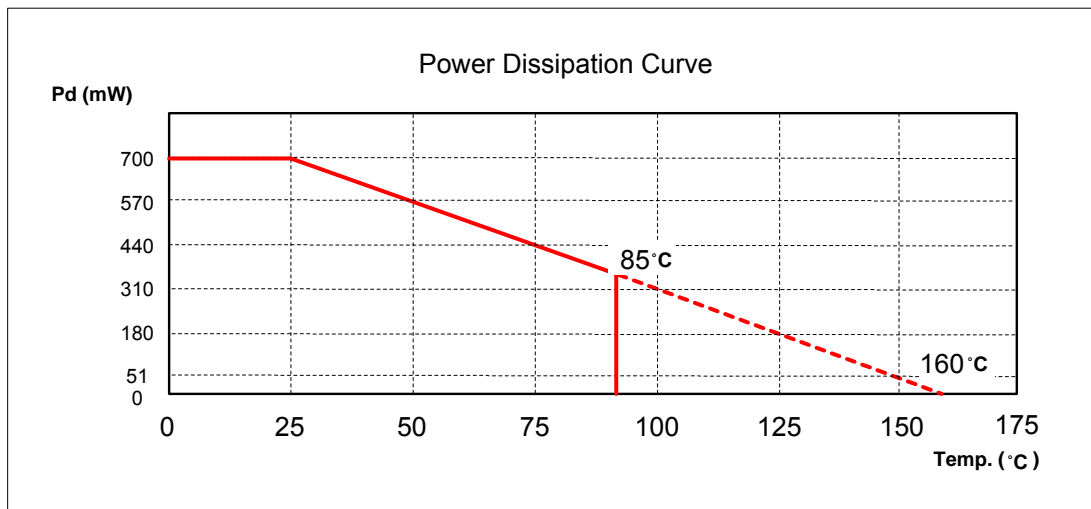
**Soldering Condition**

**DC Electrical Characteristics** (at Ta = 25°C)

| PARAMETER                | SYMBOL           | TEST CONDITIONS   | MIN | TYP  | MAX | UNIT |
|--------------------------|------------------|---|-----|------|-----|------|
| Operating Voltage        | V <sub>CC</sub>  | No use pin is open (Fig1)                               | 2.8 | -    | 28  | V    |
| Quiescent Supply current | I <sub>CC</sub>  | No use pin is open V <sub>cc</sub> : 2.8V to 28V (Fig1) | -   | 3.6  | 5   | mA   |
| Output Leakage current   | I <sub>OFF</sub> | V <sub>cc</sub> =24V, V <sub>ce</sub> =24V              | -   | <0.1 | 10  | uA   |
| NO/SO Saturation Voltage | V <sub>SAT</sub> | I <sub>o</sub> = 450mA                                  | -   | -    | 1.2 | V    |

**AC Electrical Characteristics**

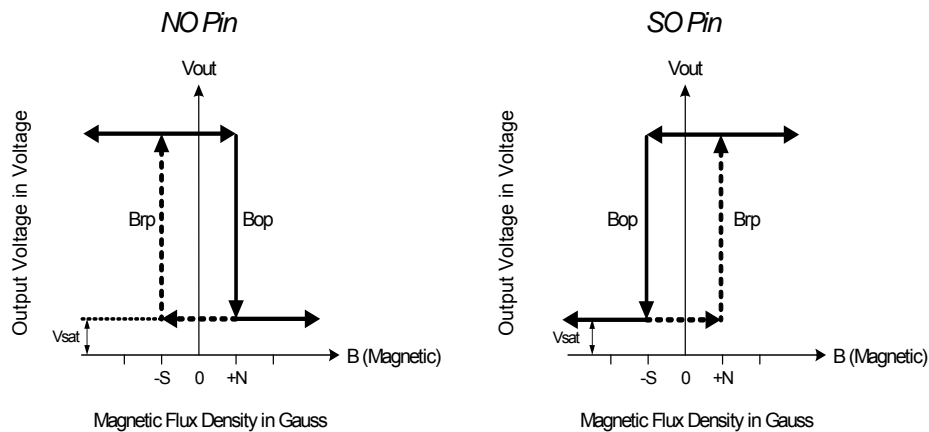
| PARAMETER | SYMBOL            | TEST CONDITIONS              | MIN | TYP | MAX | UNIT |
|-----------|-------------------|------------------------------|-----|-----|-----|------|
| Rise time | (t <sub>r</sub> ) | RL=100ohm(5w) CL=20pF (Fig1) | 0.1 |     | 0.3 | uS   |
| Fall time | (t <sub>f</sub> ) | RL=100ohm(5w) CL=20pF (Fig1) | 100 |     | 180 | nS   |



**Magnetic Characteristics** (1mT = 10Gauss)

| <i>FS220LF-A</i> |        | <i>Ta = -20°C to +85°C</i> |     |      |       |
|------------------|--------|----------------------------|-----|------|-------|
| Parameter        | Symbal | Min.                       | Typ | Max. | Unit  |
| Operate Point    | Bop    | +5                         |     | +65  | Gauss |
| Release Point    | Brp    | -65                        |     | -5   | Gauss |
| Hysteresis       | Bhys   |                            | 60  |      | Gauss |
| <i>FS220LF-B</i> |        | <i>Ta = -20°C to +85°C</i> |     |      |       |
| Parameter        | Symbal | Min.                       | Typ | Max. | Unit  |
| Operate Point    | Bop    |                            |     | +95  | Gauss |
| Release Point    | Brp    | -95                        |     |      | Gauss |
| Hysteresis       | Bhys   |                            | 60  |      | Gauss |
| <i>FS220LF-C</i> |        | <i>Ta = -20°C to +85°C</i> |     |      |       |
| Parameter        | Symbal | Min.                       | Typ | Max. | Unit  |
| Operate Point    | Bop    |                            |     | +120 | Gauss |
| Release Point    | Brp    | -120                       |     |      | Gauss |
| Hysteresis       | Bhys   |                            | 60  |      | Gauss |

**FS220 Magnetic Hysteresis Characteristics**



**Test Circuits:**

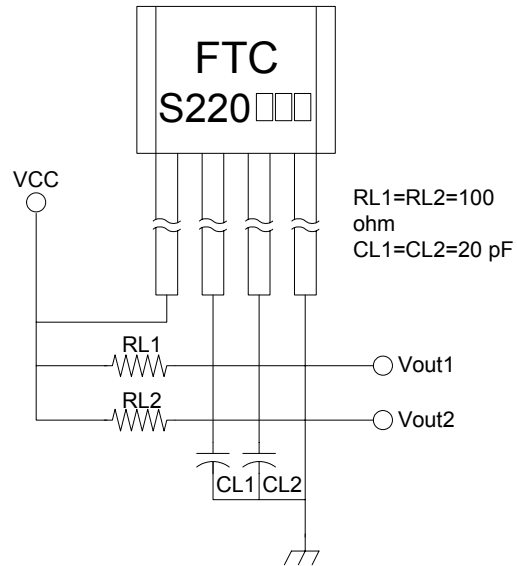


Fig 1

### Typical Characteristics

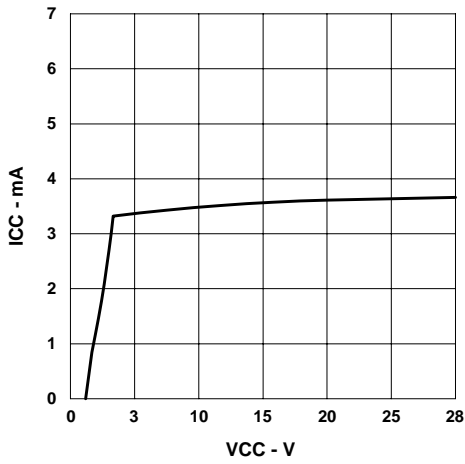


Figure 1

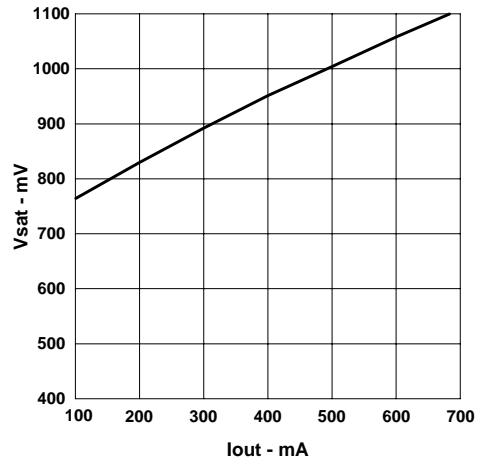


Figure 2

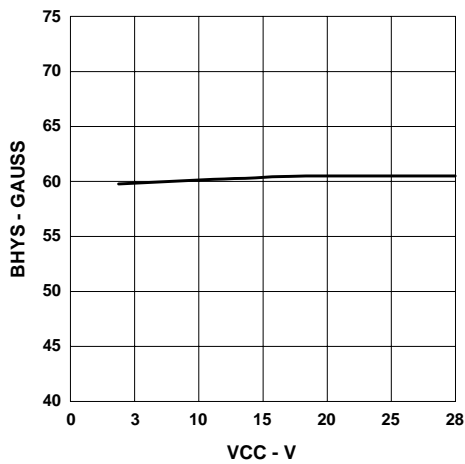


Figure 3

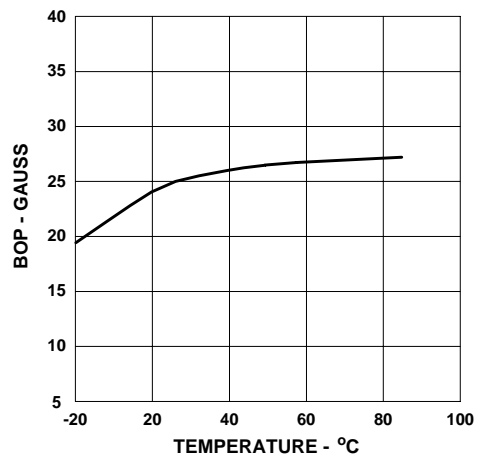


Figure 4

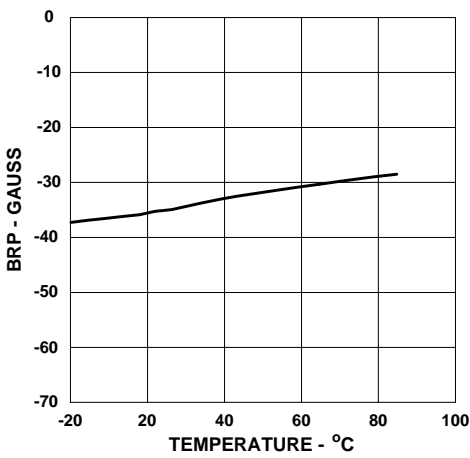


Figure 5

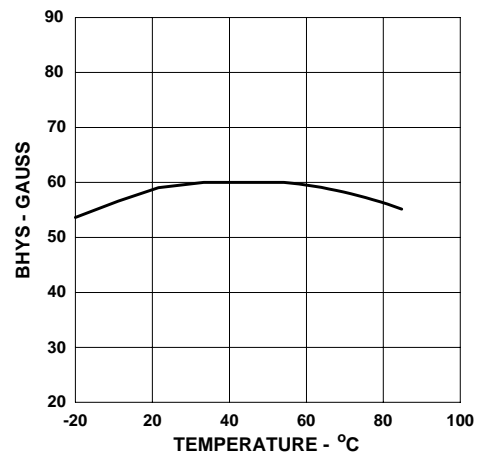


Figure 6

**Function Descriptions**

**HALL SENSOR LOCATION**

The Fig 2 is the hall sensor location, where marks the IC number. The best sensitivity, which can be intensified as much as possible, depends on the vertical distance and position between magnetic pole and the hall sensor (Fig 3). For the single-phase motor, this design is very important.

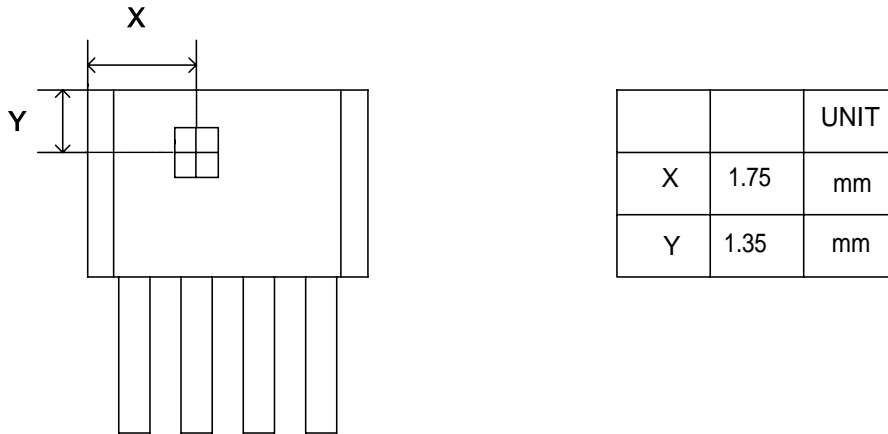


Fig 2 FS220 Hall Sensor Location

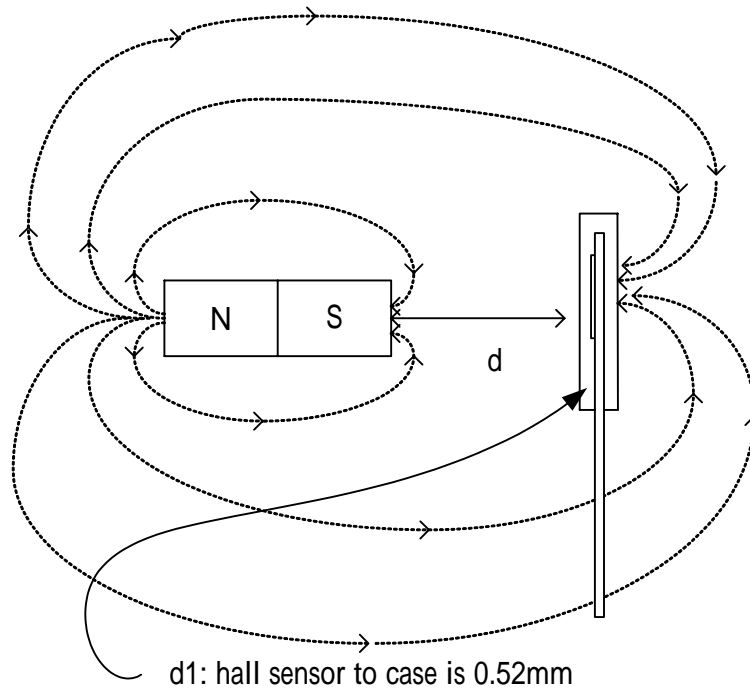


Fig 3 Magnetic Distribution and Z-axis position



### Darlington-Pair Transistor Output

The figure 4 is the circuit diagram of Darlington-pair transistor. Under the heavy current loading, the power loss of the high saturation voltage can be calculated into the following formula:

$$P_C = (V_{BEQ1} + V_{CE(SAT)Q2}) * I_o$$

According to the IC package and the curve of the power loss, the  $P_c$  should be applied to and within the safety value.

60V is the voltage of Zener breakdown diode. However, if the voltage, excluding that of the power supply, is more than 60V under the long-time operation, the diode will be destroyed.

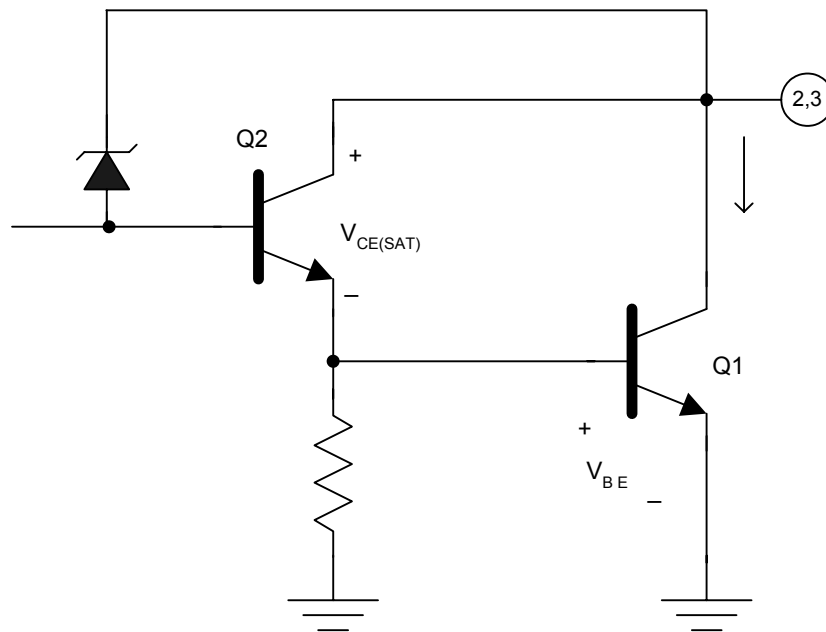


Fig.4 Darlington-pair Transistor Circuits

**APPLICATION NOTE**

**The Example of Typical Application Circuit**

Fig 5 is the example of typical application circuit. The red, yellow, and black wires are the input points of the motor system: red, the input of power supply; yellow, the output of FG; black, the ground signal.  $R_C$  is an external pull-up resistance for the use of measuring FG signal. In view of the design, the value of  $R_C$  could be decided by the transistor saturation voltage ( $V_{ON}$ ), sink current ( $I_C$ ), and off-level voltage ( $V_C$ ).

The formula is: 
$$R_C = \frac{V_C - V_{ON}}{I_C}$$

For example:

$V_C = +5V$  for TTL level.

$I_C = 10mA$  at 0.2V saturation voltage

The safety value of  $R_C = 470$

D1 is the reverse protection diode. As if the red and black wires reversely connect with the power source, the current will flow through the ground via IC and coils L1 and L2 to power supply. Under such kind of circumstances, the IC and coils are easy to be burned out. Therefore, D1, the reverse protection diode, is necessary for the design. However, D1 will also cause an extra voltage drop on the supply voltage.

C1 is a capacitor to reduce the ripple noise caused during the transient of the output stages.

The volume of the ripple noise depends on the coil impedance and characteristics.

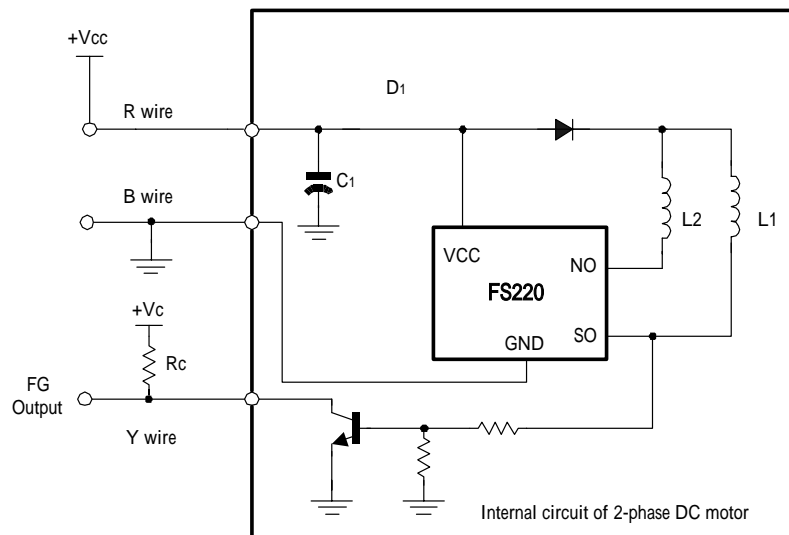
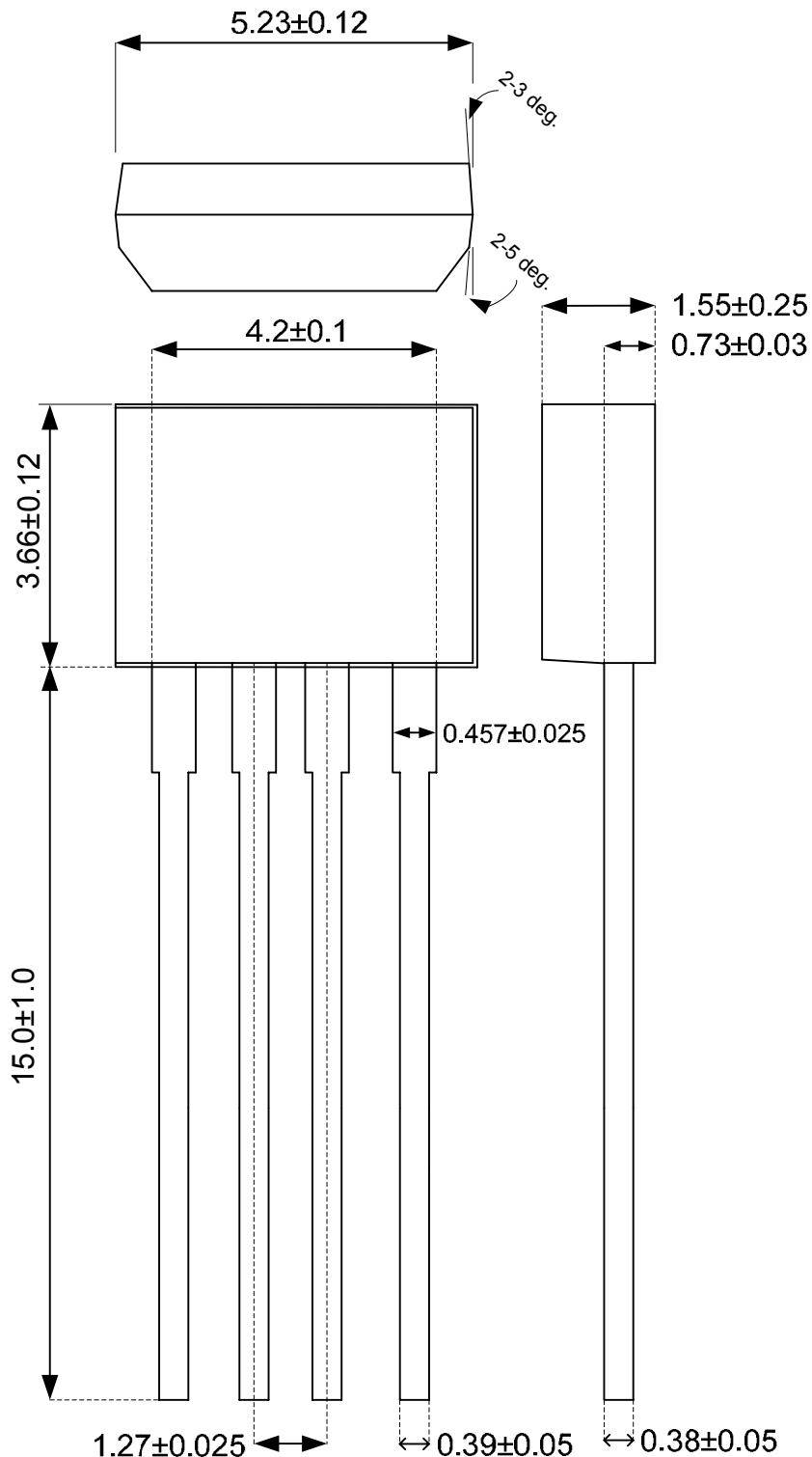


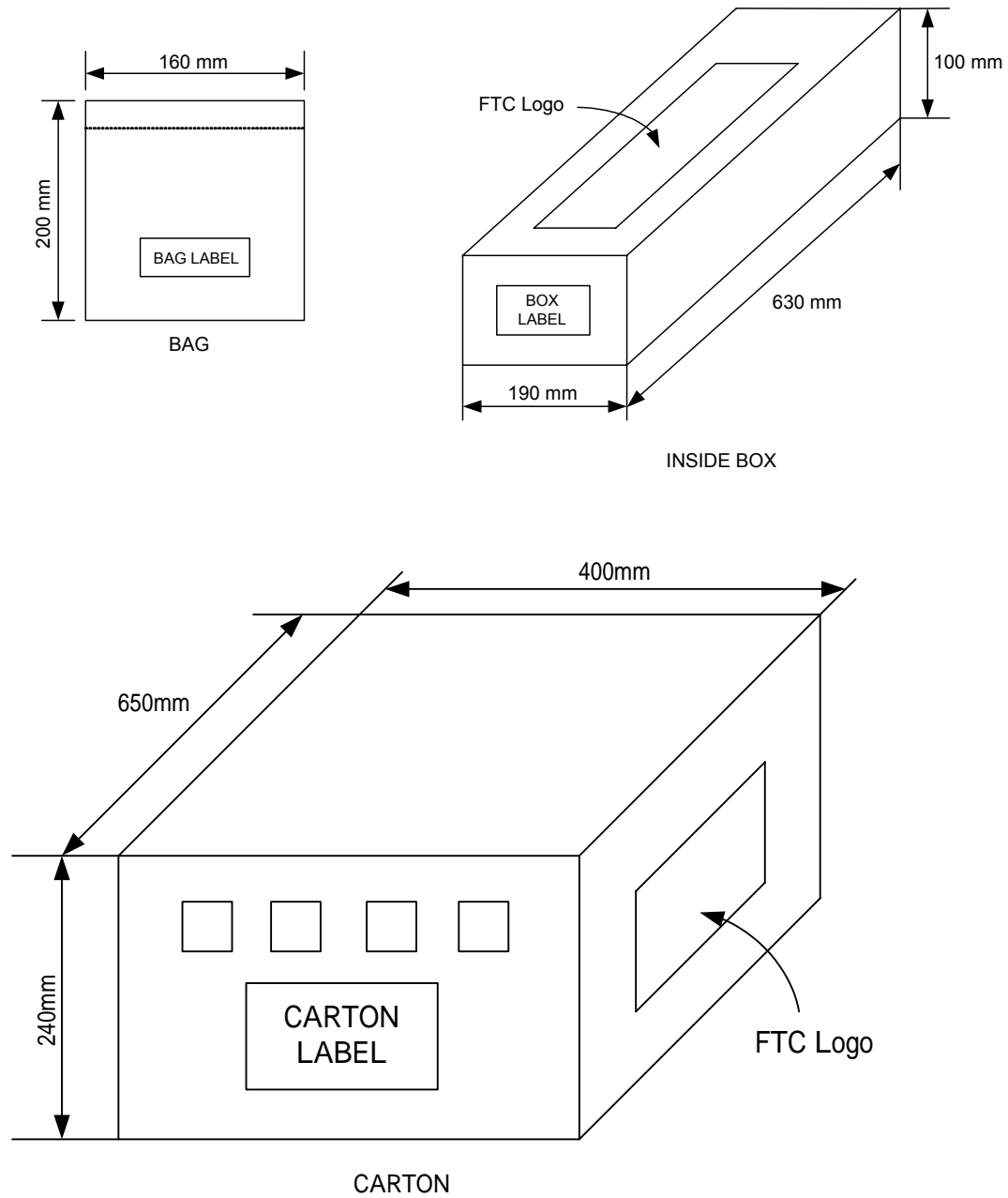
Fig 5 Application Circuit

Package Outline (LEAD FREE) Unit:mm



**PACKING SPECIFICATIONS**

**BAG & BOX DIMENSION**



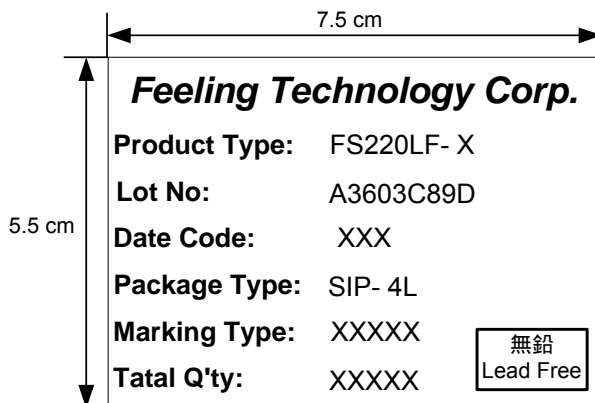
**PACKING QUANTITY SPECIFICATIONS**

1000 EA/1 BAG

25 BAGS/1 INSIDE BOX

4 INSIDE BOXES/1 CARTON

**LABEL SPECIFICATION**



BAG LABEL, INSIDE BOX & CARTON LABEL

**ORDER INFORMATION**

| Part Number | Operating Temperature | Package   | Description |
|-------------|-----------------------|-----------|-------------|
| FS220LF-A   | -20°C to 85 °C        | TO-92SP-4 | ±65G (B)    |
| FS220LF-B   | -20°C to 85 °C        | TO-92SP-4 | ±95G (B)    |
| FS220LF-C   | -20°C to 85 °C        | TO-92SP-4 | ±120G (B)   |