

# FAN8000D (KA9268D)

## 4-CH Motor Driver

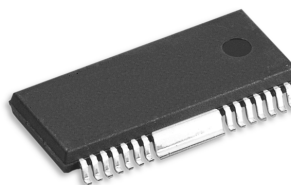
### Features

- Built in 4-CH balanced transformerless(BTL) driver
- Output gain adjustable
- Built in normal OP-amp
- Built in mute function
- Built in level shift circuit
- Built in thermal shutdown function
- Operating range 4.5~13.2V

### Description

The FAN8000D is a monolithic integrated circuit, suitable for 4-CH motor driver which drives tracking actuator, focus actuator, sled motor and tray motor of CD/CD-ROM/DVD system.

28-SSOPH-375



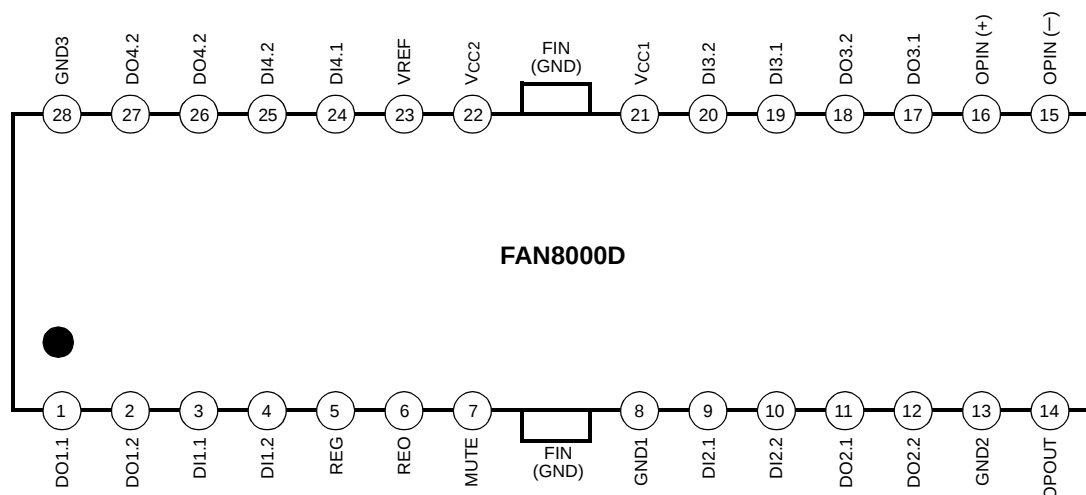
### Target Application

- Compact disk player
- Video compact disk player
- Digital Video Disk Player
- Car compact disk player

### Ordering Information

| Device     | Package      | Operating Temp. |
|------------|--------------|-----------------|
| FAN8000D   | 28-SSOPH-375 | -40°C ~ +85°C   |
| FAN8000DTF | 28-SSOPH-375 | -40°C ~ +85°C   |

## Pin Assignments



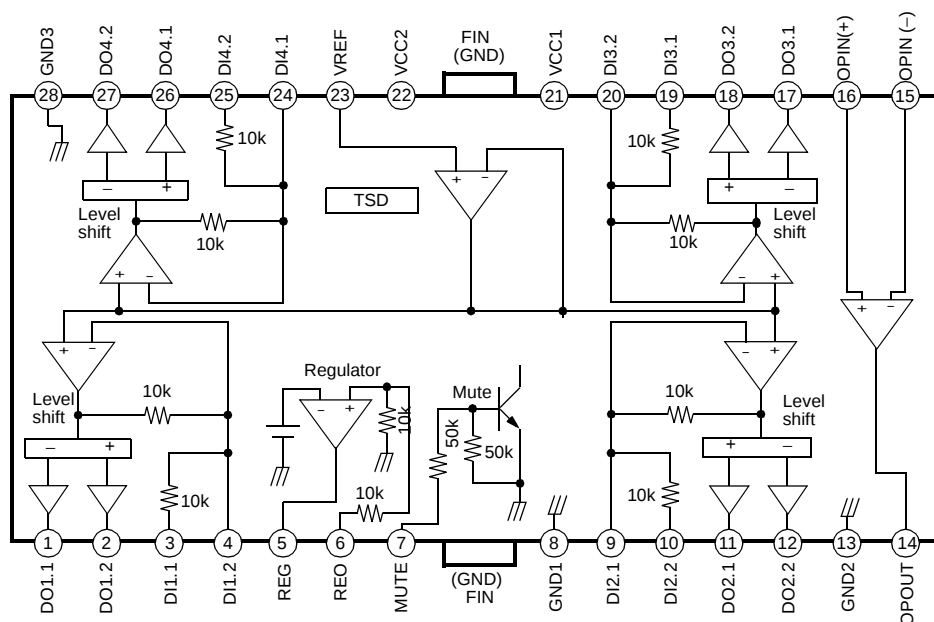
## Pin Definitions

| Pin Number | Pin Name | I/O | Pin Function Description |
|------------|----------|-----|--------------------------|
| 1          | DO1.1    | O   | Drive output             |
| 2          | DO1.2    | O   | Drive output             |
| 3          | DI1.1    | I   | Drive input              |
| 4          | DI1.2    | I   | Drive input              |
| 5          | REG      | -   | Regulator                |
| 6          | REO      | O   | Regulator output         |
| 7          | MUTE     | I   | Mute                     |
| 8          | GND1     | -   | Ground 1                 |
| 9          | DI2.1    | I   | Drive input              |
| 10         | DI2.2    | I   | Drive input              |
| 11         | DO2.1    | O   | Drive output             |
| 12         | DO2.2    | O   | Drive output             |
| 13         | GND2     | -   | Ground 2                 |
| 14         | OPOUT    | O   | Op-amp output            |
| 15         | OPIN(-)  | I   | Op-amp input (-)         |
| 16         | OPIN(+)  | I   | Op-amp input (+)         |
| 17         | DO3.1    | O   | Drive output             |
| 18         | DO3.2    | O   | Drive output             |
| 19         | DI3.1    | I   | Drive input              |
| 20         | DI3.2    | I   | Drive input              |
| 21         | VCC1     | -   | Supply voltage           |
| 22         | VCC2     | -   | Supply voltage           |
| 23         | VREF     | I   | 2.5V bias voltage        |
| 24         | DI4.1    | I   | Drive input              |

## Pin Definitions (Continued)

| Pin Number | Pin Name | I/O | Pin Function Description |
|------------|----------|-----|--------------------------|
| 25         | DI4.2    | I   | Drive input              |
| 26         | DO4.1    | O   | Drive output             |
| 27         | DO4.2    | O   | Drive output             |
| 28         | GND3     | -   | Ground 3                 |

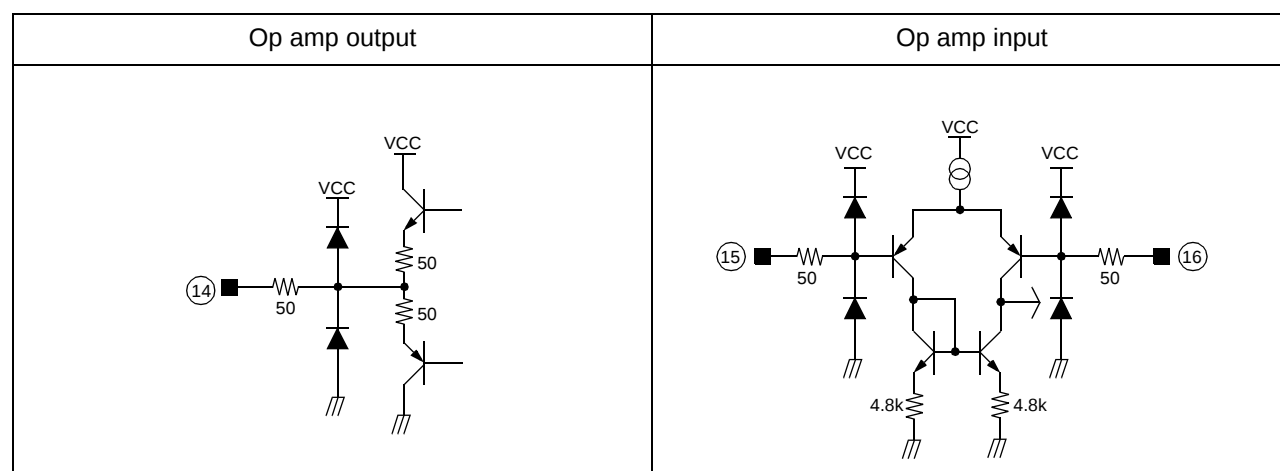
## Internal Block Diagram



Equivalent Circuits

| Driver input | Driver output    |
|--------------|------------------|
|              |                  |
| Regulator    | Regulator output |
|              |                  |
| Mute input   | Bias input       |
|              |                  |

## Equivalent Circuits (Continued)

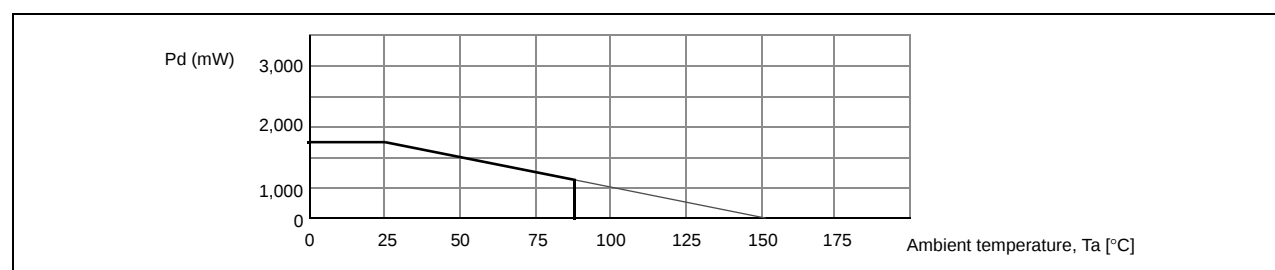


## Absolute Maximum Ratings ( Ta=25°C)

| Parameter              | Symbol            | Value               | Unit |
|------------------------|-------------------|---------------------|------|
| Supply voltage         | VCC               | 18                  | V    |
| Power dissipation      | P <sub>D</sub>    | 1.7 <sup>note</sup> | W    |
| Operating temperature  | T <sub>OPR</sub>  | -40 ~ +85           | °C   |
| Storage temperature    | T <sub>STG</sub>  | -55 ~ +150          | °C   |
| Maximum output current | I <sub>OMAX</sub> | 1                   | A    |

### Notes:

- When mounted on 76.2mm × 114mm × 1.57mm PCB (Phenolic resin material).
- Power dissipation reduces 13.6mW / °C for using above Ta=25°C
- Do not exceed P<sub>d</sub> and SOA (Safe Operating Area).



## Recommended Operating Condition ( Ta=25°C)

| Parameter                | Symbol | Value      | Unit |
|--------------------------|--------|------------|------|
| Operating supply voltage | VCC    | 4.5 ~ 13.2 | V    |

## Electrical Characteristics

(Unless otherwise specified, Ta = 25 °C, VCC = 8V, RL=8Ω)

### REGULATOR CIRCUIT

| Parameter                | Symbol | Conditions           | Min.  | Typ. | Max. | Units |
|--------------------------|--------|----------------------|-------|------|------|-------|
| Regulator output voltage | VREG   | IL=100mA             | 4.75  | 5    | 5.25 | V     |
| Load regulation          | ΔVRL   | IL=0 ~ 200mA         | -40.0 | 0    | 10.0 | mV    |
| Line regulation          | ΔVCC   | IL=200mA, VCC=6 ~ 9V | -10.0 | 0    | 20.0 | mV    |

### DRIVE CIRCUIT

| Parameter                 | Symbol  | Conditions         | Min. | Typ. | Max. | Units  |
|---------------------------|---------|--------------------|------|------|------|--------|
| Quiescent circuit current | ICCQ    | VI=0               | 5.5  | 9.5  | 13.5 | mA     |
| Input offset voltage      | VOF     | -                  | -5.0 | 0    | 5.0  | mV     |
| Output offset voltage     | VOO     | -                  | -30  | 0    | 30   | mV     |
| Maximum sink current      | ISINK   | RL=4Ω, VCC         | 0.5  | 0.8  | -    | A      |
| Maximum source current    | ISOURCE | RL=4Ω, GND         | 0.5  | 0.8  | -    | A      |
| Maximum output voltage    | VOM     | VI=2VRMS, 1kHz     | 2.5  | 3.0  | -    | V      |
| Closed loop voltage gain  | AVF     | VI=0.1VRMS, 1kHz   | 10.5 | 12.0 | 13.5 | dB     |
| Ripple rejection ratio    | RR      | VI=-20dB, 120Hz    | 60.0 | 80.0 | -    | dB     |
| Slew rate                 | SR      | 100Hz, Square wave | 1.0  | 2.0  | -    | V / μs |

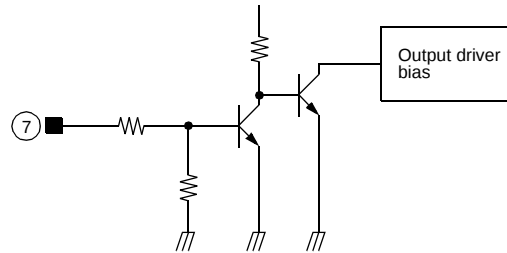
### OP AMP CIRCUIT

| Parameter                   | Symbol   | Conditions                   | Min. | Typ. | Max. | Units  |
|-----------------------------|----------|------------------------------|------|------|------|--------|
| Input offset voltage        | VOF1     | -                            | -5   | -    | +5   | mV     |
| Input bias current          | IB1      | -                            | -    | -    | 300  | nA     |
| High level output voltage   | VOH1     | -                            | 6    | -    | -    | V      |
| Low level output voltage    | VOL1     | -                            | -    | -    | 1.8  | V      |
| Output sink current         | ISINK1   | RL=50Ω, GND                  | 10   | 40   | -    | mA     |
| Output source current       | ISOURCE1 | RL=50Ω, VCC                  | 10   | 50   | -    | mA     |
| Open loop voltage gain      | GVO1     | VIN=-75dB, f=1kHz            | 65   | 78   | -    | dB     |
| Ripple rejection ratio      | RR1      | VIN=-20dB, f=120kHz          | 50   | 70   | -    | dB     |
| Slew Rate                   | SR1      | Square, VOUT=2Vp-p, f=120kHz | 0.5  | 1    | -    | V / μs |
| Common mode rejection ratio | CMRR1    | VIN=-20dB, f=1kHz            | 70   | 84   | -    | dB     |

## Application Information

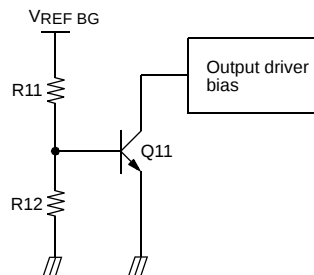
### 1. MUTE

| Pin #7 | Mute circuit |
|--------|--------------|
| High   | Turn-off     |
| Low    | Turn-on      |
| Open   | Turn-on      |



- When the pin7 is open or the voltage of the pin7 is below 0.5V, the mute circuit is activated so that the output circuit is muted.
- When the voltage of the pin7 is above 2V, the mute circuit is deactivated and the output circuit operates normally.
- If the chip temperature rises above 175°C, then the TSD (Thermal Shutdown) circuit is activated and the output circuit is muted.

### 2. TSD (THERMAL SHUTDOWN)

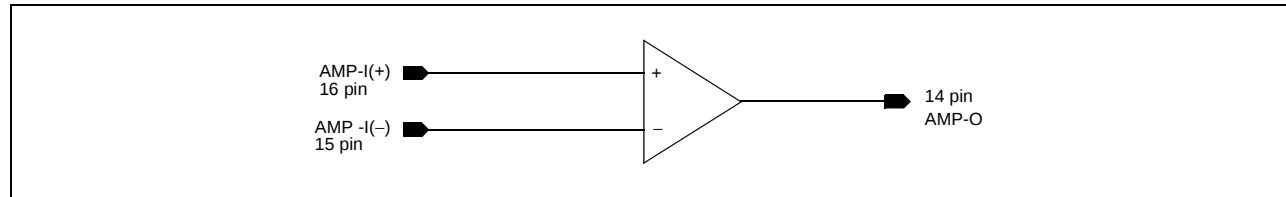


- The  $V_{REF\ BG}$  is the output voltage of the band-gap-referenced biasing circuit and acts as the input voltage of the TSD circuit.
- The base-emitter voltage of the TR, Q11 is designed to turn-on at below voltage.  

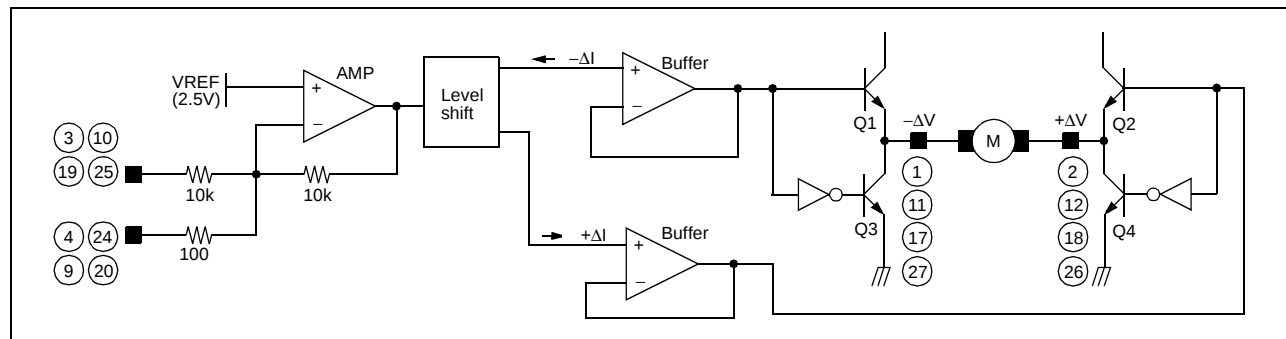
$$V_{BE} = V_{REF\ BG} \times R12 / (R11 + R12) = 460mV$$
- When the chip temperature rises up to 175°C, then the turn-on voltage of the Q11 would drop down to 460mV. (Hysteresis: 25°C)  
 Hence, the Q11 would turn on so the output circuit will be muted.

### 3. OP-AMP

OP-amp is integrated in the IC for user's convenience.

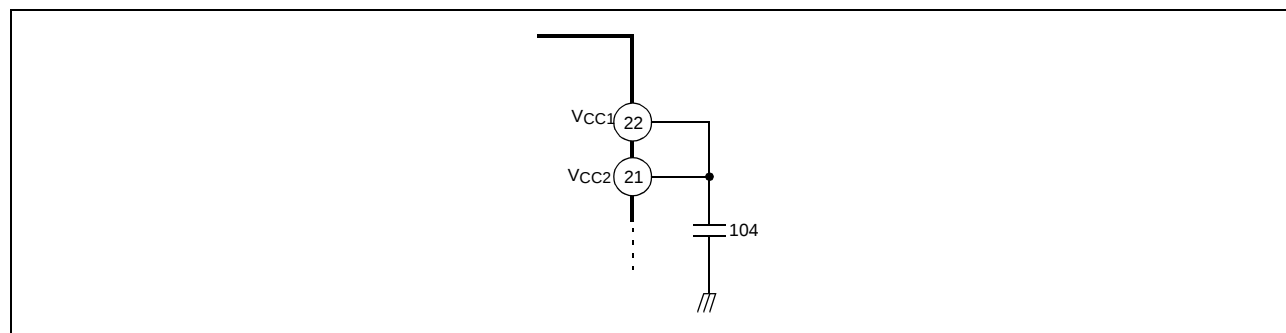


### 4. DRIVER



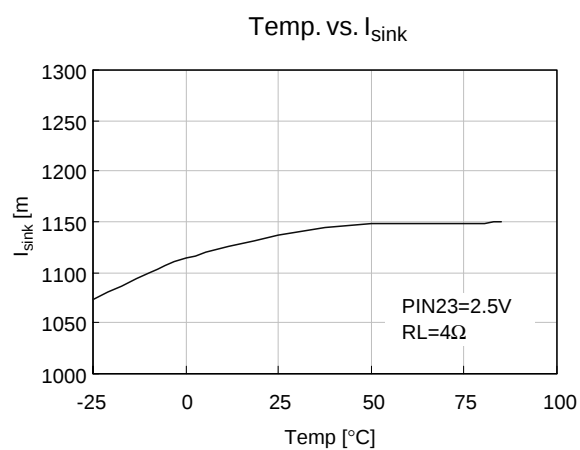
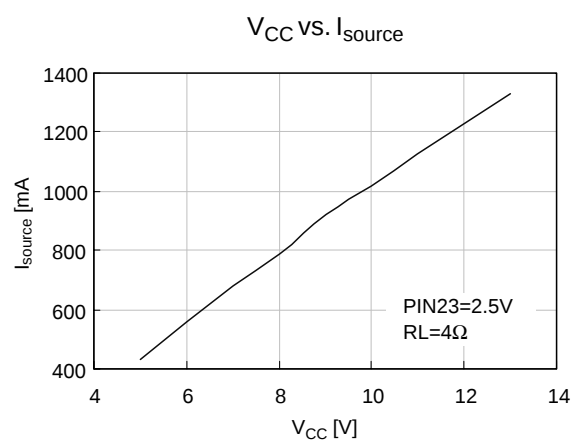
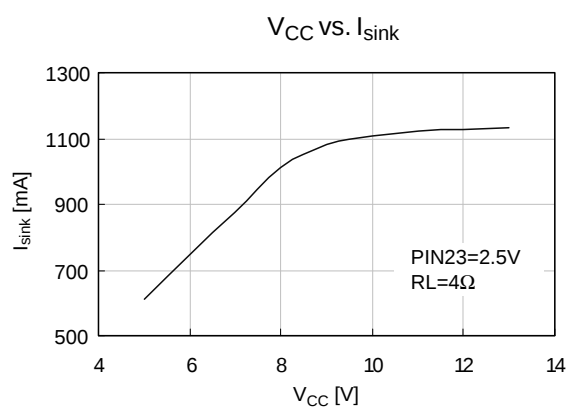
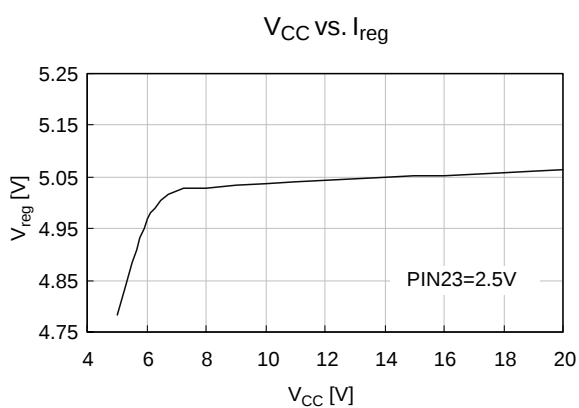
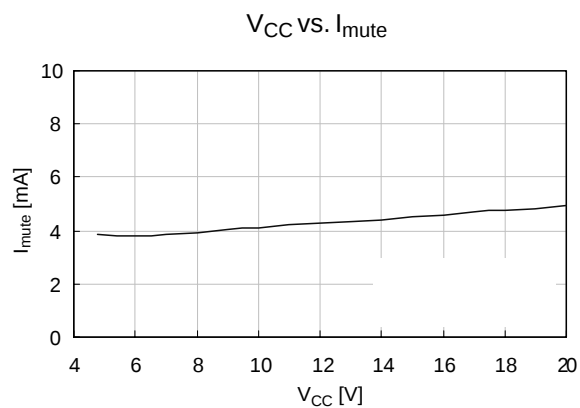
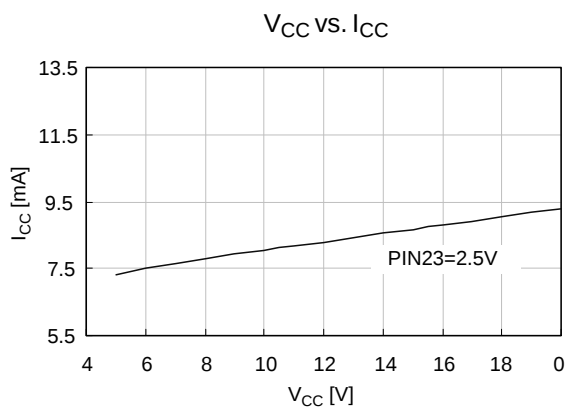
- The voltage,  $V_{REF}$ , is the reference voltage given by the bias voltage of the pin23.
- The input signal through the pin3 is amplified by 10k/10k times and then fed to the level shift.
- The level shift produces the current due to the difference between the input signal and the arbitrary reference signal. The current produced as  $+\Delta I$  and  $-\Delta I$  is fed into the driver buffer.
- Driver Buffer drives the power TR of the output stage according to the input signal.
- The output stage is the BTL driver and the motor is rotating in forward direction by operating TR Q1 and TR Q4. On the other hand, if TR Q2 and TR Q3 is operating, the motor is rotating in reverse direction.
- When the input voltage through the pin3 is below the  $V_{REF}$ , the motor rotates in forward direction.
- When the input voltage through the pin3 is above the  $V_{REF}$ , the motor rotates in reverse direction.
- To change the gain, pin4 or 24 can be used.

### 5. Connect a by-pass capacitor, 0.1 $\mu$ F between the supply voltage source.

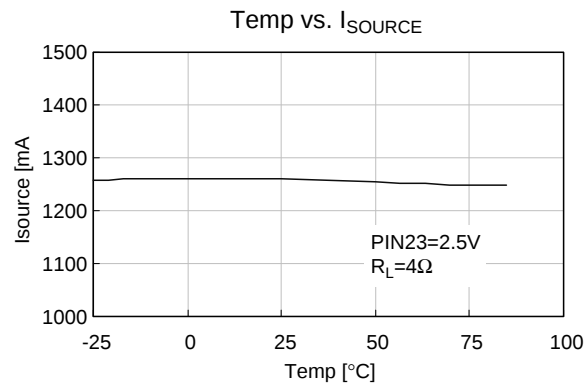
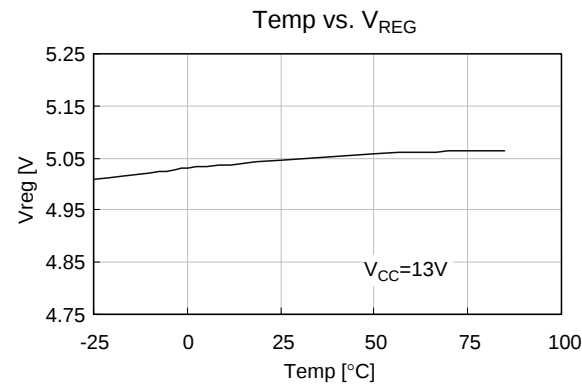
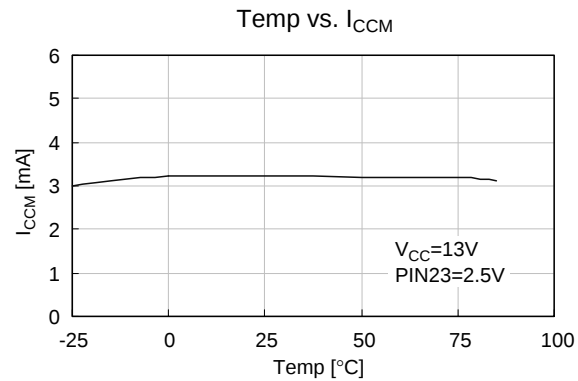
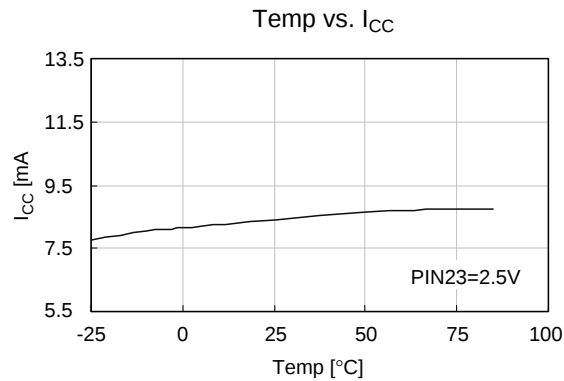


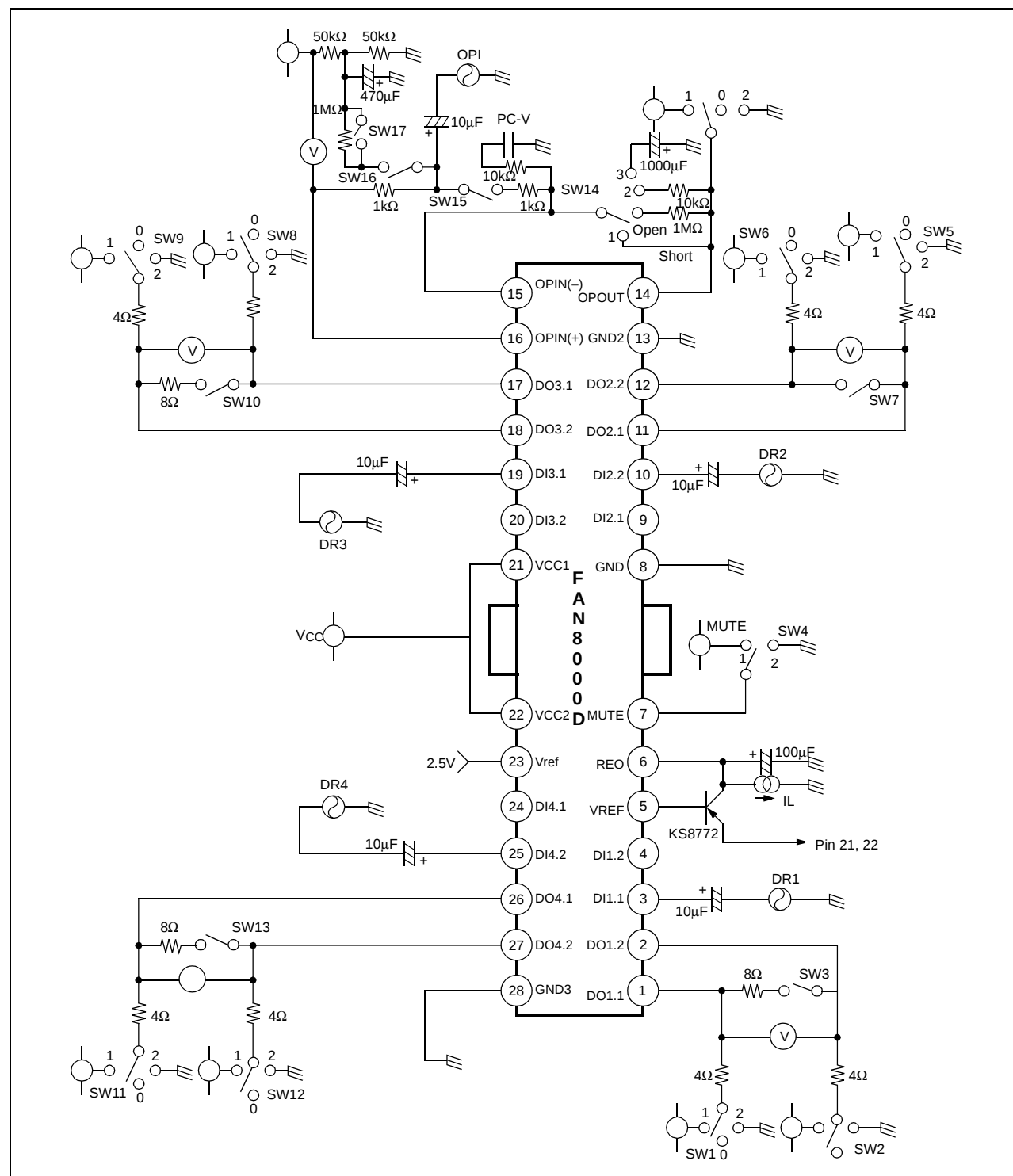
- ### 6. Radiation fin is connecting to the internal GND of the package.
- Connect the fin to the external GND.

## Typical Performance Characteristics

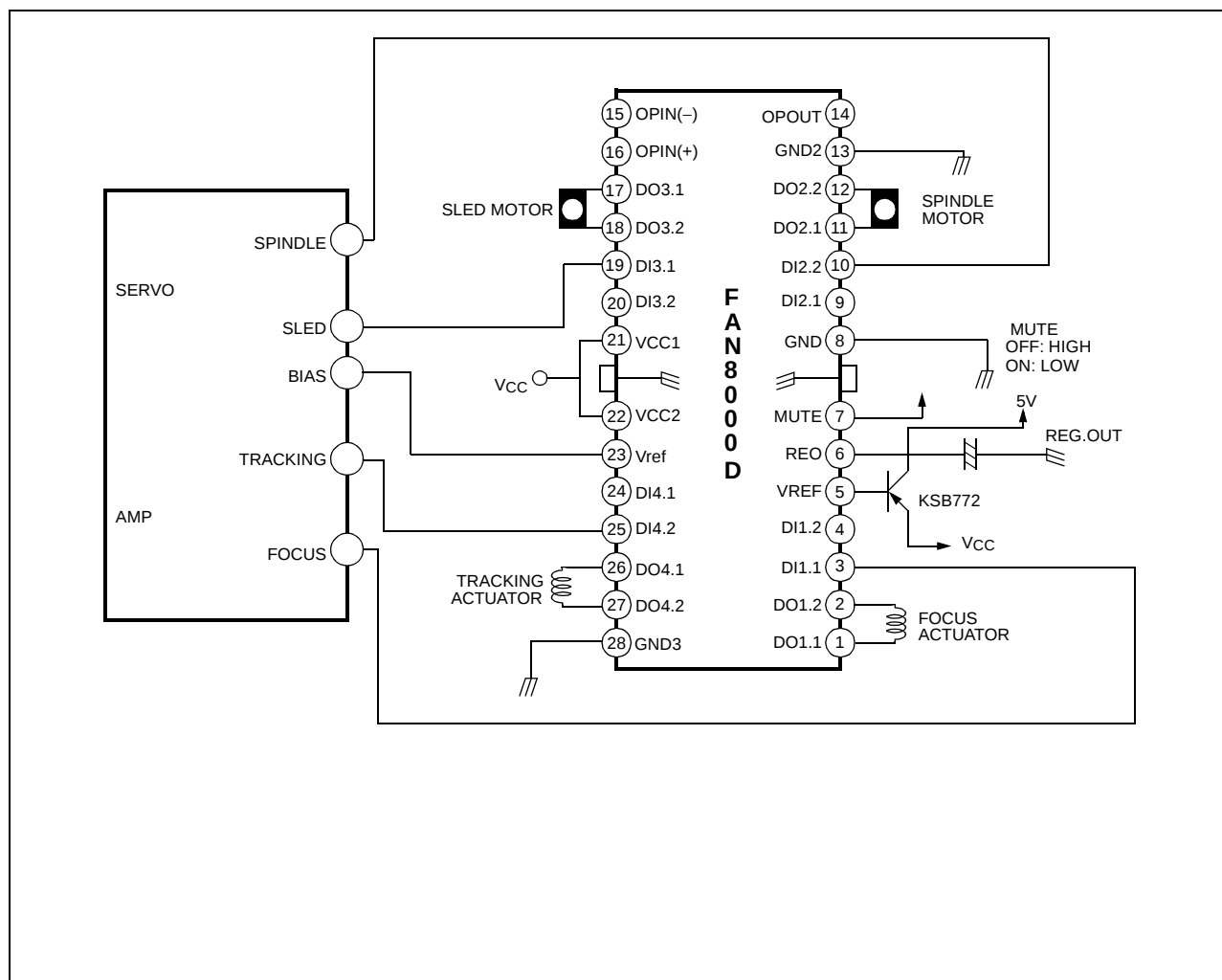


Typical Performance Characteristics (Continued)





## Application Circuits



#### **DISCLAIMER**

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS.

#### **LIFE SUPPORT POLICY**

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF FAIRCHILD SEMICONDUCTOR INTERNATIONAL. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.