# FAN8039D3

## 5-CH Motor Driver

### Features

- 1 Phase, Full-wave, Linear DC Motor Driver
- Built-in 5-CH Balanced TransFormerless (BTL) Driver
- Built-in thermal shut down circuit (TSD)
- Built-in Variable Regulator With Power Tr.
- Built-in Power Save Circuit
- Built-in stand by mode circuit
- Wide Operating Supply Voltage : 4.5 ~ 13.2V

### Description

The FAN8039D3 is a monolithic integrated circuit suitable for a 5-ch motor driver which drives the tracking actuator, focus actuator, sled motor, tray motor, spindle motor of the DVDP/CAR-CD systems.

28-SSOPH-375SG2

### Typical Applications

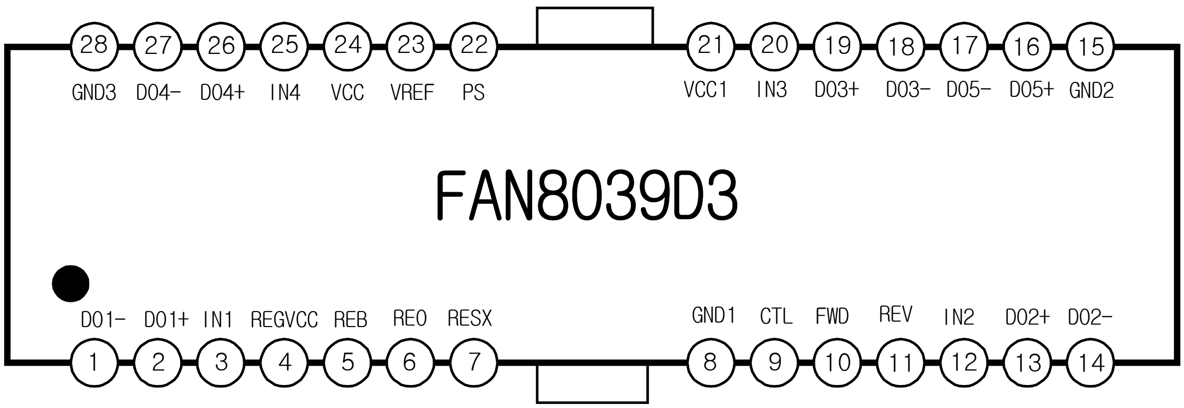
- Compact disk player
- Video compact disk player
- Car compact disk player
- Mixing with compact disk player and mini disk player
- DVDP

### Ordering Information

| Device | Package | Operating Temp |
|---|---|---|
| FAN8039D3 | 28-SSOPH-375SG2 | –35°C ~ 85°C |
| FAN8039D3TF | 28-SSOPH-375SG2 | –35°C ~ 85°C |

Rev 1.0.0

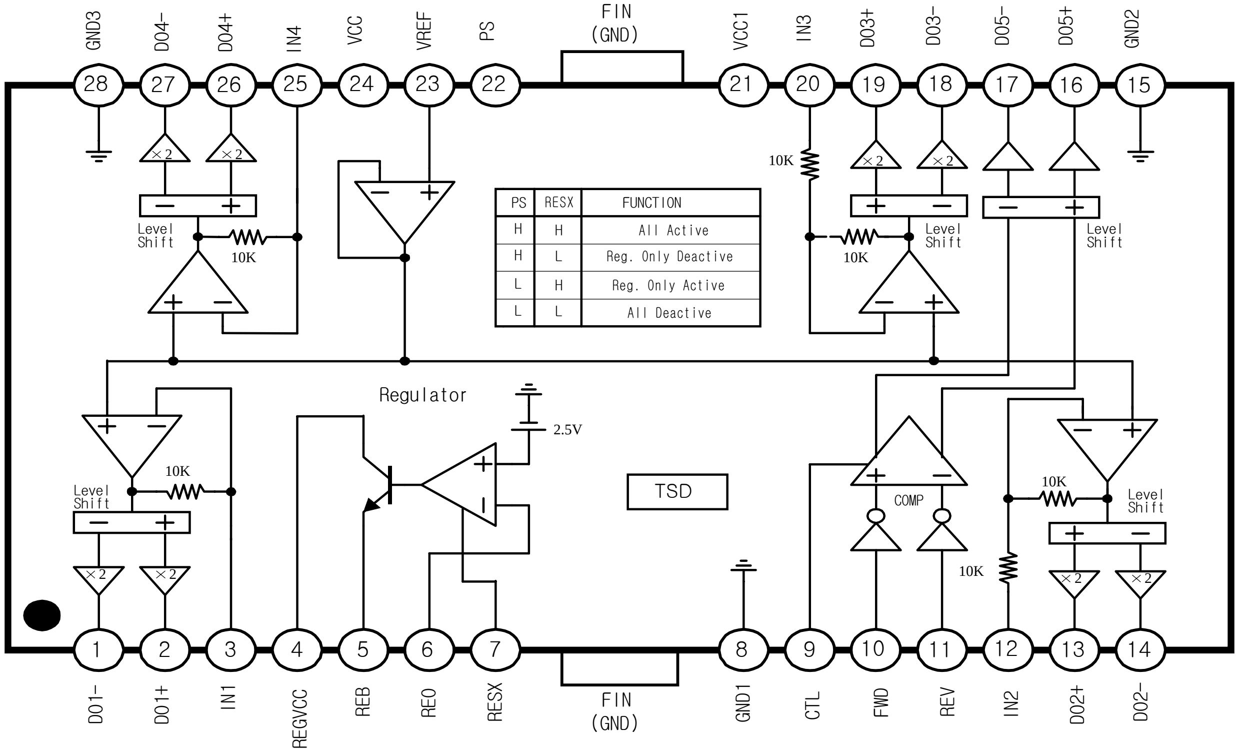
## Pin Assignments



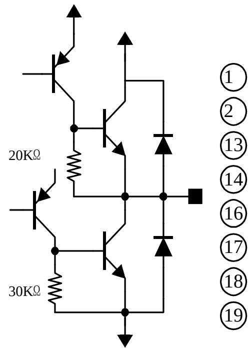
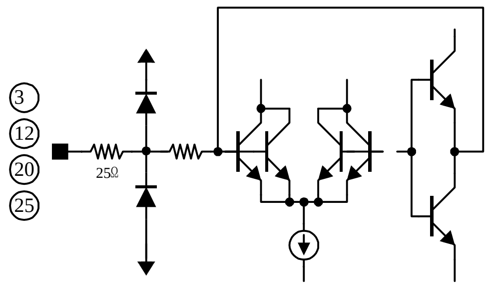
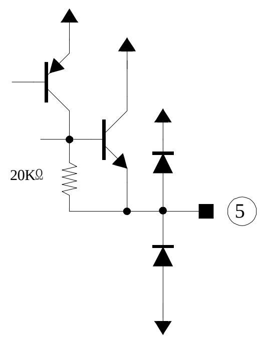
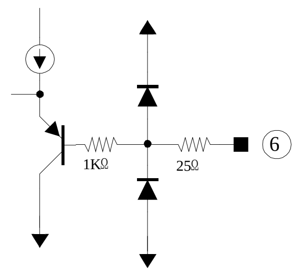
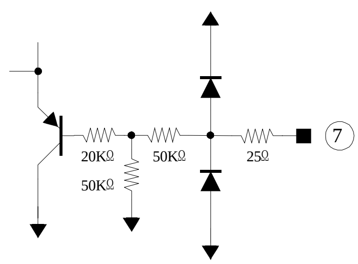
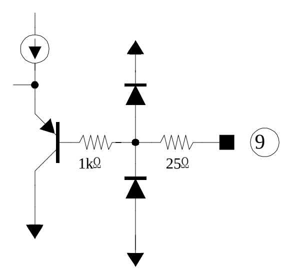

## Pin Definitions

| NO | Symbol | Description | NO | Symbol | Description |
|---|---|---|---|---|---|
| 1 | DO1- | CH1 Drive Output (-) | 15 | GND2 | Power Ground1 (CH 2,3,5) |
| 2 | DO1+ | CH1 Drive Output (+) | 16 | DO5+ | CH5 Drive Output (+) |
| 3 | IN1 | CH1 Drive Input | 17 | DO5- | CH5 Drive Output(-) |
| 4 | REGVCC | Regulator Supply Voltage | 18 | DO3- | CH3 Drive Output(-) |
| 5 | REB | Regulator Output | 19 | DO3+ | CH3 Drive Output (+) |
| 6 | REO | Regulator Feedback Input | 20 | IN3 | CH3 Drive Input |
| 7 | RESX | Regulator Reset | 21 | VCC1 | Supply Voltage1 |
| 8 | GND1 | Signal Ground | 22 | PS | Power Save |
| 9 | CTL | CH5 Motor Speed Control | 23 | VREF | Bias Voltage |
| 10 | FWD | CH5 Forward Input | 24 | VCC | Supply Voltage |
| 11 | REV | CH5 Reverse Input | 25 | IN4 | CH4 Drive Input |
| 12 | IN2 | CH2 Drive Input | 26 | DO4+ | CH4 Drive Output (+) |
| 13 | DO2+ | CH2 Drive Output (+) | 27 | DO4- | CH4 Drive Output (-) |
| 14 | DO2- | CH2 Drive Output (-) | 28 | GND3 | Power Ground2 (CH 1,4) |

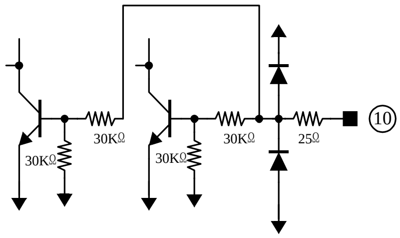
# Internal Block Diagram

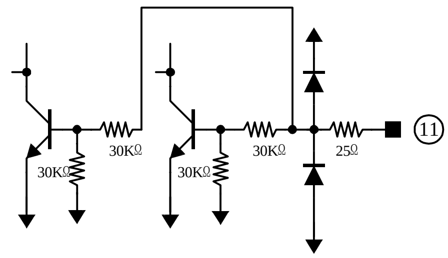


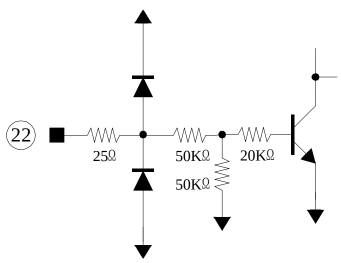
# Equivalent Circuits

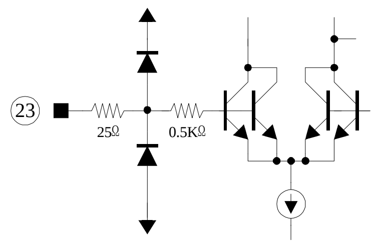
<table>
<tr><th>BTL DRVER OUTPUT</th><th>BTL DRIVE INPUT</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><th>REGULATOR OUTPUT</th><th>REGULATOR FEEDBACK INPUT</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><th>REGULATOR RESET</th><th>MOTOR SPEED CONTROL</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

## Equivalent Circuits (Continued)

<table>
<tr><th>FOWARD INPUT</th><th>REVERSE INPUT</th></tr>
<tr><td>


</td><td>


</td></tr>
<tr><th>POWER SAVE</th><th>BIAS VOLTAGE</th></tr>
<tr><td>


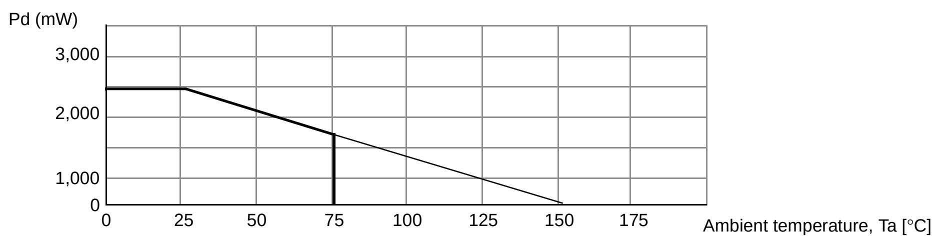
</td><td>


</td></tr>
</table>

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

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Maximum Supply Voltage | VCC | 18 | V |
| Power Dissipation | $P_D$ | 2.5note | W |
| Operating Temperature | $T_{OPR}$ | –35 ~ +85 | °C |
| Storge Temperature | $T_{STG}$ | –55 ~ +150 | °C |
| Maximum output current | $I_{OMAX}$ | 1 | A |
| Regulator Maximum output current | $I_{ROMAX}$ | 400 | mA |

**Notes:**
1. When mounted on 70mm × 70mm × 1.6mm PCB
2. Power dissipation reduces 20mW/°C for using above $T_A$ = 25°C
3. Do not exceed $P_D$ and SOA (Safe Operating Area)




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

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Operating Supply Voltage | VCC | 4.5 | - | 13.2 | V |

## Electrical Characteristics

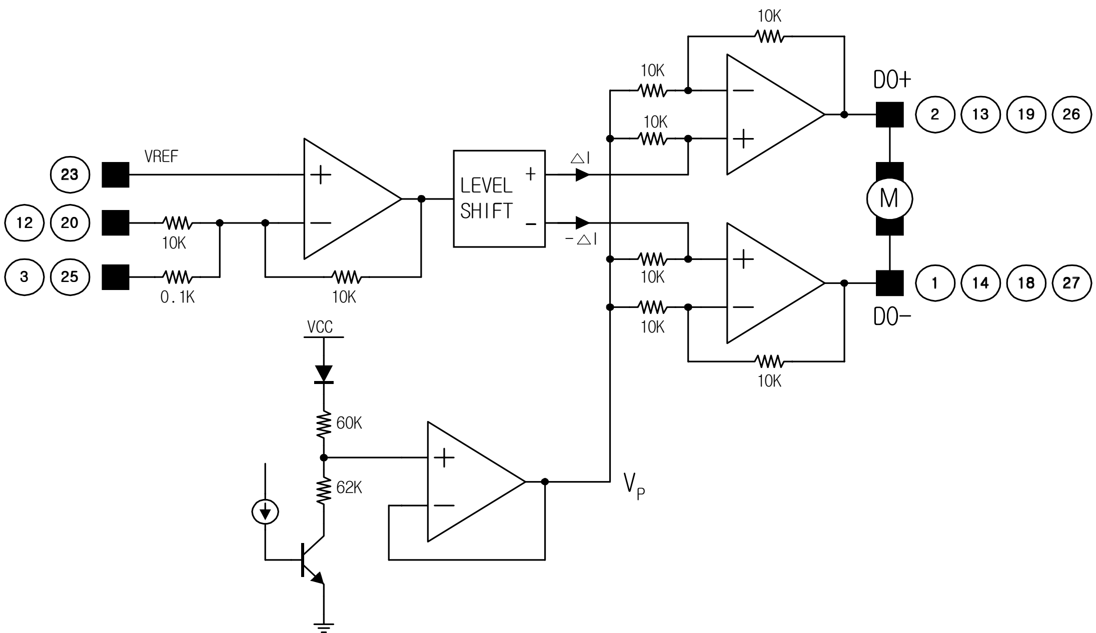
($V_{CC}$ = $V_{CC1}$ = 8V, $T_A$ = 25°C, unless otherwise specified)

| Characteristics | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Quiescent Circuit Current | $I_{CCQ}$ | Under no - load | - | 20 | - | mA |
| Power Save On Current | $I_{PS}$ | Pin7=GND | - | 1 | 2 | mA |
| Power Save On Voltage | $V_{PSON}$ | Pin7=Variation | - | - | 0.5 | V |
| Power Save Off Voltage | $V_{PSOFF}$ | Pin7=Variation | 2 | - | - | V |
| **VARIABLE REGULATOR PART** | | | | | | |
| Load Regulation | $\Delta V_{RL}$ | $I_L$ = 0mA → 200mA | -40 | 0 | 10 | mV |
| Line Regulation | $\Delta V_{CC}$ | $I_L$ = 200mA, $V_{CC}$=6V → 9V | -20 | 0 | 30 | mV |
| Regulator Output Voltage 1 | $V_{REG1}$ | $I_L$ = 100mA | 4.75 | 5 | 5.25 | V |
| Regulator Output Voltage 2 | $V_{REG2}$ | $I_L$ = 100mA | 3.135 | 3.3 | 3.465 | V |
| *Regulator Output Peak Current | $I_{PK}$ | Tj = 25°C | | 700 | | mA |
| **BLT DRIVER PART** | | | | | | |
| Output Offset Voltage | $V_{OO}$ | $V_{IN}$=2.5V | -40 | 0 | 40 | mV |
| Maximum Output Voltage1 | $V_{OM1}$ | $V_{CC}$=Vcc1=8V, RL = 12Ω | 5.5 | 6.5 | - | V |
| Maximum Output Voltage2 | $V_{OM2}$ | $V_{CC}$=Vcc1=13V, RL = 24Ω | 10.5 | 11.5 | - | V |
| Close Loop Voltage Gain | $AV_F$ | $V_{IN}$=0V, 1Vrms, f = 1KHz | 10.5 | 12 | 13.5 | dB |
| Slew rate | SR | $V_{OUT}$=4$V_{P-P}$, f = 120KHz, Square | - | 2 | - | V/µs |
| **LOADING MOTOR DRIVER PART** | | | | | | |
| Input High Level Voltage | $V_{IH}$ | - | 2 | - | - | V |
| Input Low Level Voltage | $V_{IL}$ | - | - | - | 0.5 | V |
| Output Voltage1 | $V_{O1}$ | $V_{CC}$=$V_{CC1}$=8V, $V_{CTL}$=OPEN, RL=12Ω | 5.5 | 6.5 | - | V |
| Output Voltage2 | $V_{O2}$ | $V_{CC}$=$V_{CC1}$=12V, $V_{CTL}$=OPEN, RL=24Ω | 9.5 | 10.5 | - | V |
| Output Offset Voltage1 | $V_{OO1}$ | $V_{IN}$=5V , 5V | -40 | - | 40 | mV |
| Output Offset Voltage2 | $V_{OO2}$ | $V_{IN}$=0V , 0V | -40 | - | 40 | mV |

*.Pulse Testing with Low Duty.

# Application Information

## 1. Driver (Except For Loading Motor Driver)




The voltage, VREF is the reference voltage given by the external bias voltage of the pin #23. The input signal (VIN) through pin #12,20 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 arbitary reference signal. The current produced as + ΔI and -ΔI is fed into the driver Amp. The driver Amp. operates the power TR. of the output stage as the 2 times gain(1+10k/10k) according to the state of the input signal.

$$V_{IN} = V_{REF} + \Delta V \Delta I = \frac{\Delta V}{10K}$$

$$DO+ = V_P + \Delta I \bullet 10K \bullet \left(1 + \frac{10K}{10K}\right) = V_P + 2\Delta V$$

$$DO- = V_P - \Delta I \bullet 10K \bullet \left(1 + \frac{10K}{10K}\right) = V_P - 2\Delta V$$

$$V_{OUT} = (DO+) - (DO-) = 4\Delta V$$

$$GAIN = 20\log\left(\frac{V_{OUT}}{\Delta V}\right) = 12dB$$

If it is desired to change the gain, then the pin #3 or 25 can be used.
The output stage is the balanced transformerless (BTL) driver.
The bias voltage VP is expressed as

$$V_P = (VCC - V_{BE} - V_{CE(SAT)}) \times \frac{62K}{60K + 62K} + V_{CE(SAT)}$$

$$= \frac{VCC - V_{BE} - V_{CE(SAT)}}{1.97} + V_{CE(SAT)}$$

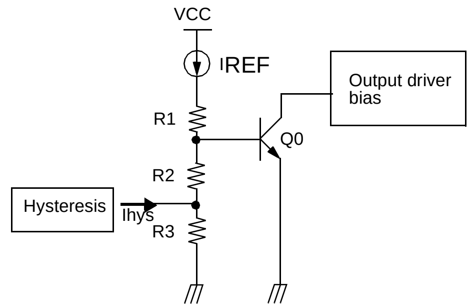
## 2. Thermal Shutdown

When the chip temperature reaches to 175°C, then the TSD circuit is activated.

This shuts down the bias current of the output drivers, and all the output drivers are in cut-off state. Thus the chip temperature begins to decrease.

when the chip temperature falls to 150°C, the TSD circuit is deactivated and the output drivers are normally operated.

The TSD circuit has the hysteresis temperature of 25°C.



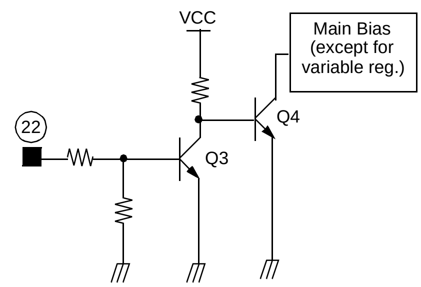

## 3. Power Save Function

When the pin22 is high, the TR Q3 is  turned on and Q4 is off, so the bias circuit is enabled. On the other hand, when the  pin22 is Low (GND) , the TR Q3 is turned off and Q4 is on,  so the bias  circuit is disabled.

That is, this function will cause all the circuit blocks of the chip except for the variable regulator to be in the off state. thus the low power quiescent state is established

Truth table is as follows;

| Pin#22 | FAN8039D3 |
|---|---|
| High | Power Save Off |
| Low | Power Save On |



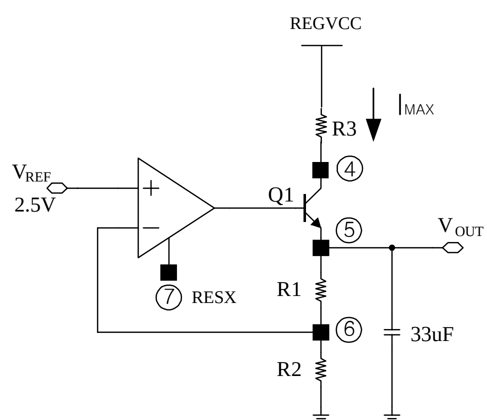

## 4. Variable Regulator

The VREF is the output voltage of the referenced biasing circuit and is the reference voltage of the regulator. (VREF=2.5V) The external circuit is composed of a capacitor, 33uF, which is used as a ripple eliminator The output voltage, VOUT is decided as follows.

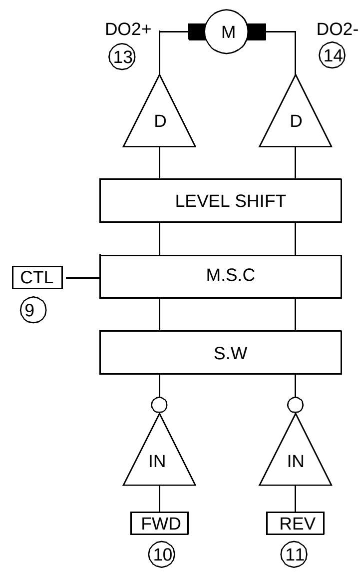
$$V_{OUT} = V_{REF} \bullet \left(1 + \frac{R_1}{R_2}\right) = 2.5 \times 2 = 5V(R1 = R2)$$

Resistor R3 should be used, it can reduce the heating problem of regulator output TR Q1. R3 value is decided as follows

$$R3 = \frac{(REGVCC - (Vout + 1.5))}{I_{MAX}}$$



## 5. Loading Motor Driver

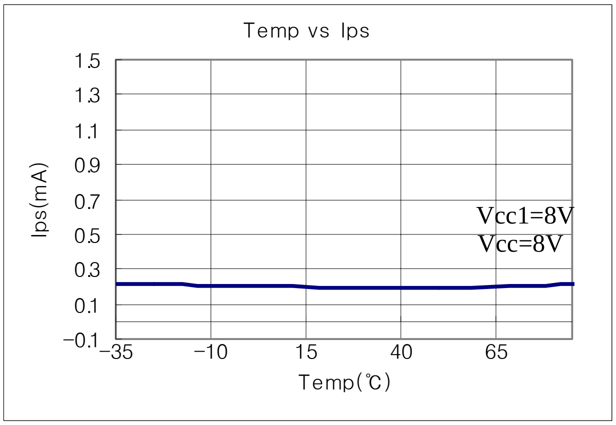


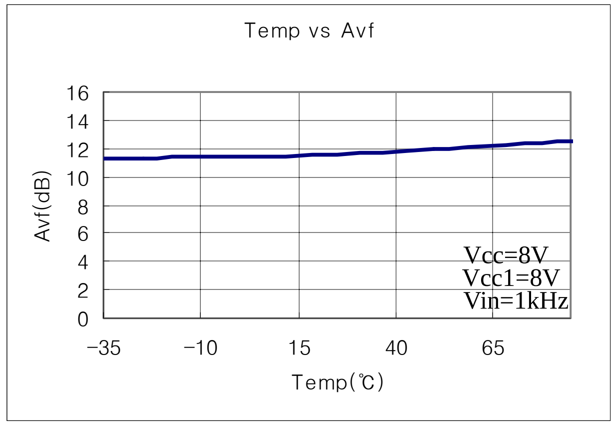

- Rotational direction control
  The forward and reverse rotational direction is controlled by FWD (pin10) and REV (pin11) and the input conditions are as follows.

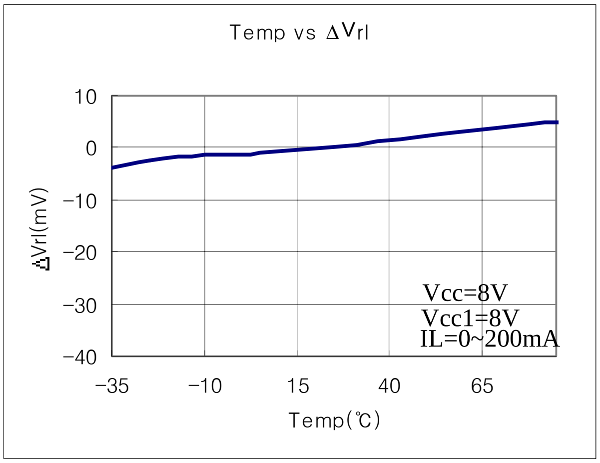
| INPUT | | OUTPUT | | |
|---|---|---|---|---|
| **FWD** | **REV** | **OUT 1** | **OUT 2** | **State** |
| H | H | Vp | Vp | High Impedence |
| H | L | H | L | Forward |
| L | H | L | H | Reverse |
| L | L | - | - | Short Brake |

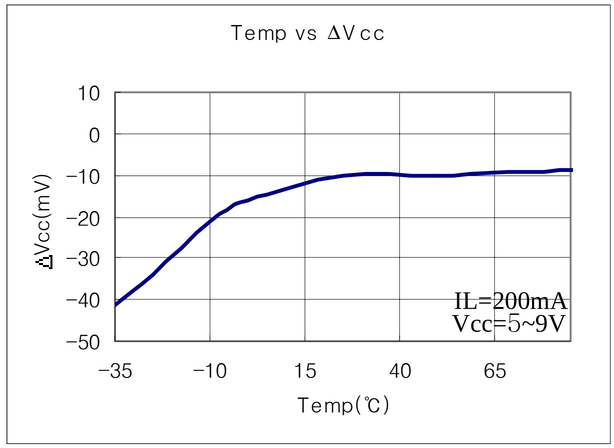
- Where Vp(Power reference voltage) is approximately about 3.75V at VCC1,VCC = 8V
- Motor speed control (When VCC=VCC1=8V)
  - The almost maximum torque is obtained when the pin 9,(CTL) is open.
  - If the voltage of the pin 9,(CTL) is 0V, the motor will not operate.

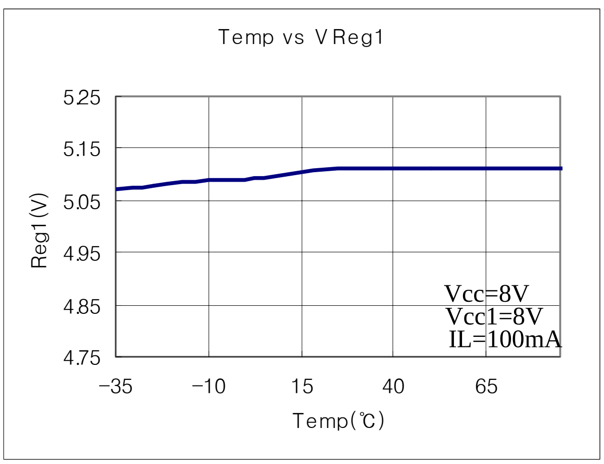
## Typical Performance Characteristics



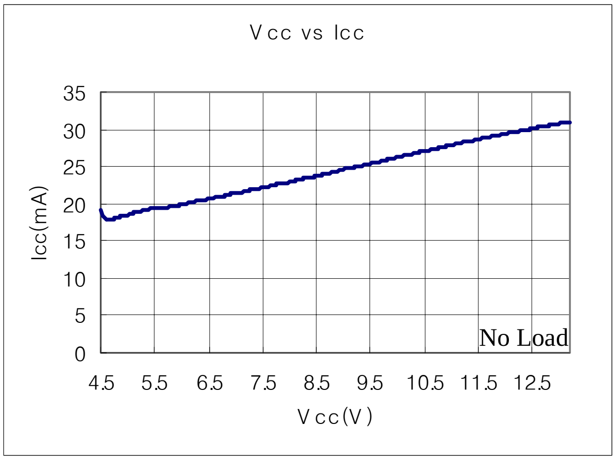



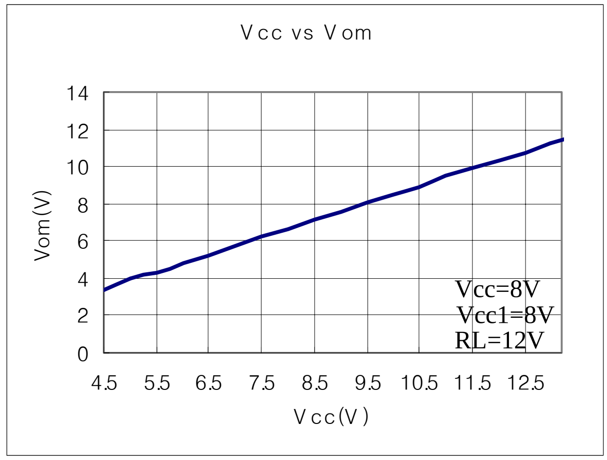



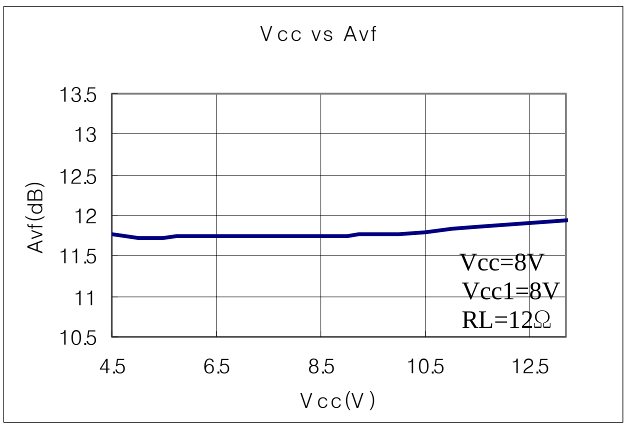



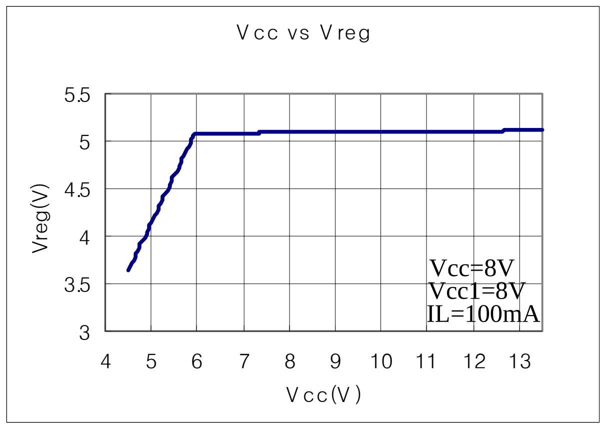



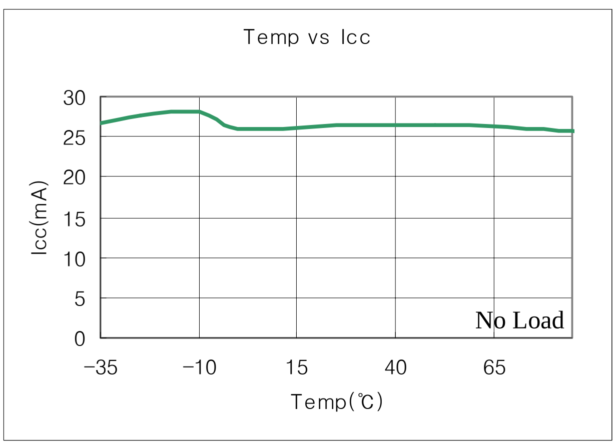
# Typical Performance Characteristics

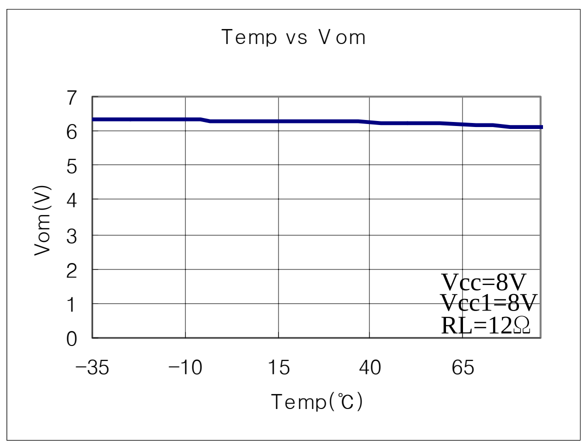


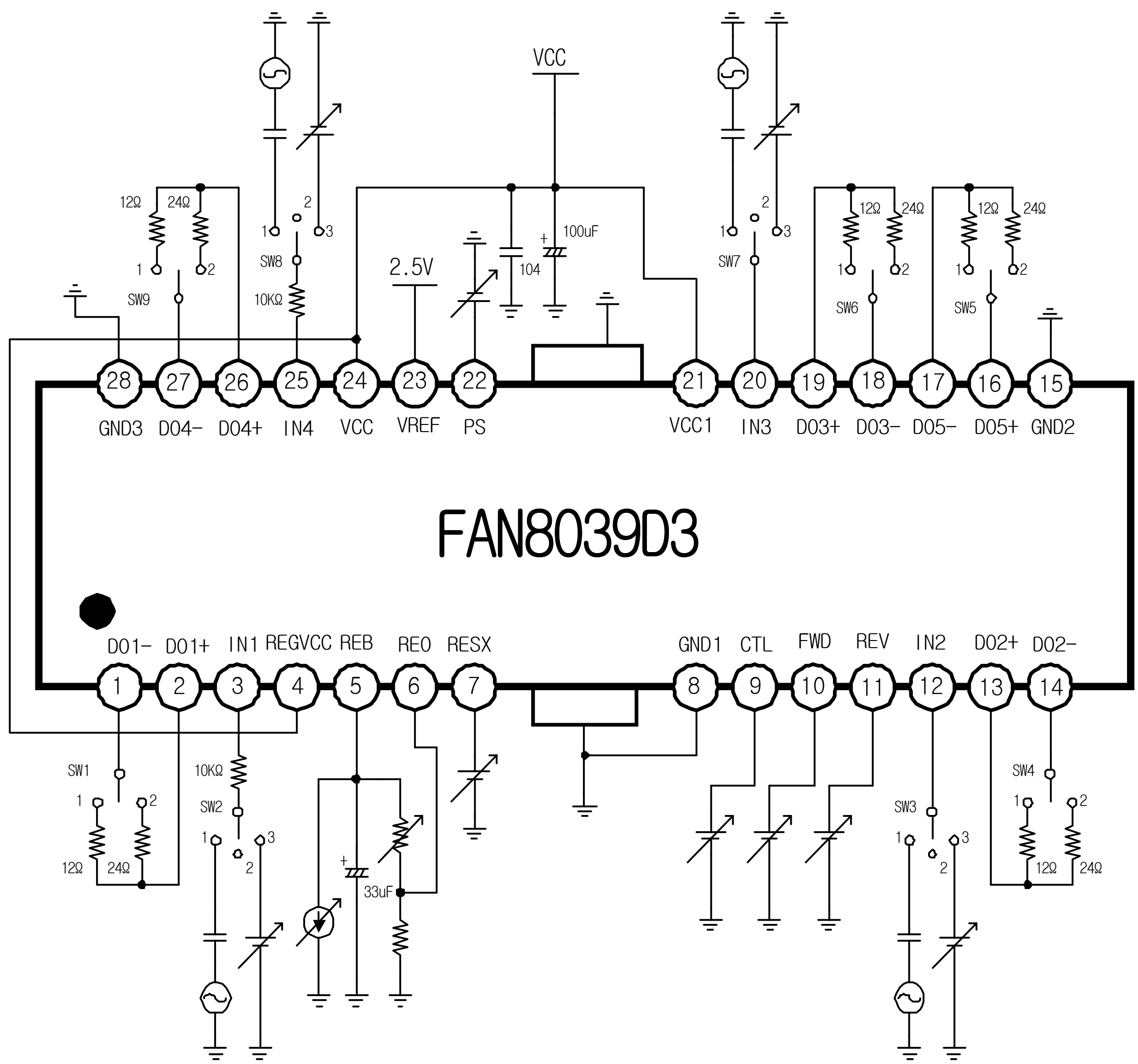



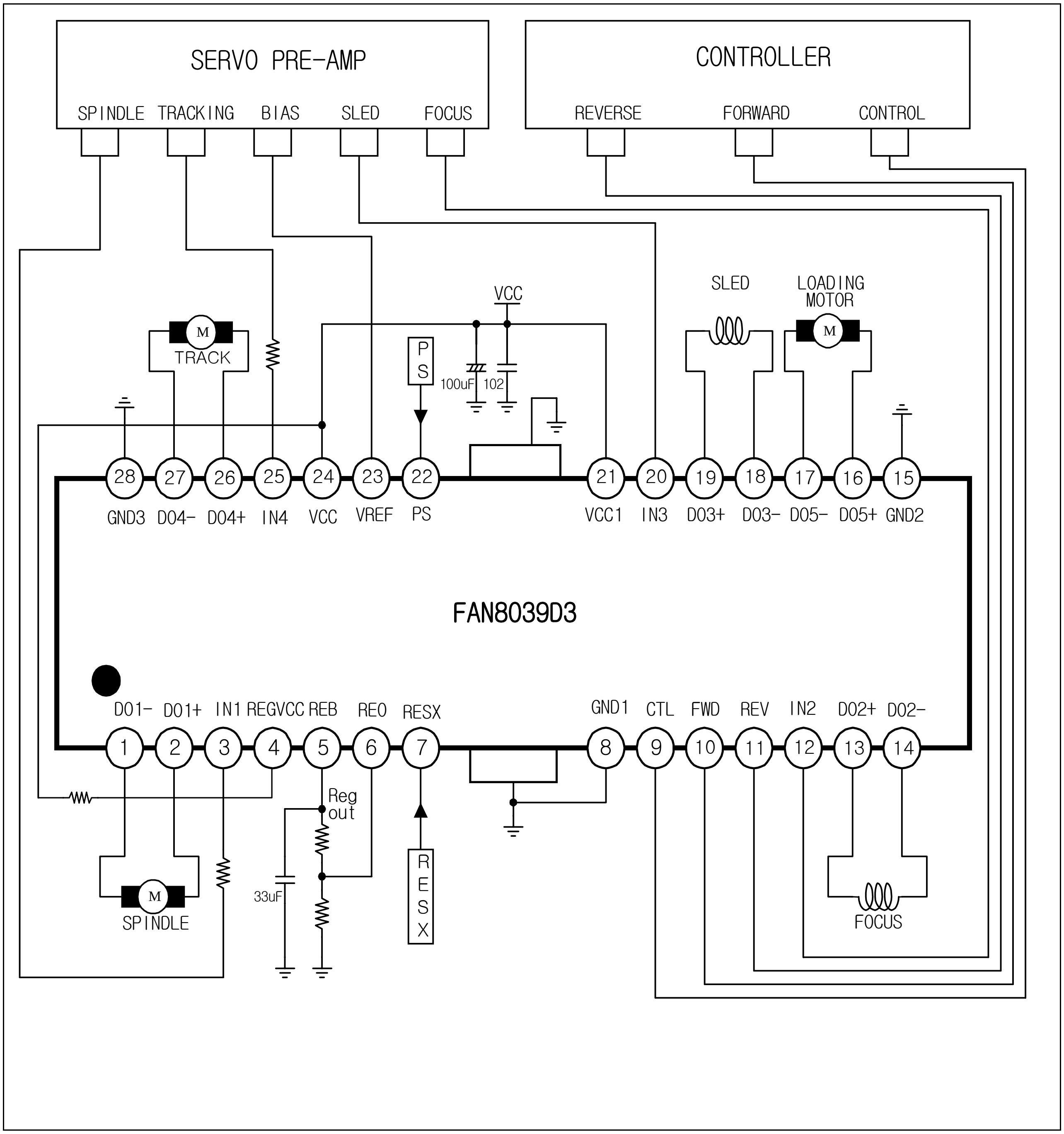



## Test Circuit



## Application Circuit



**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 CORPORATION. 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.



4/28/01 0.0m 001
Stock#DSxxxxxxxx