FAN8039BD3

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 FAN8039BD3 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

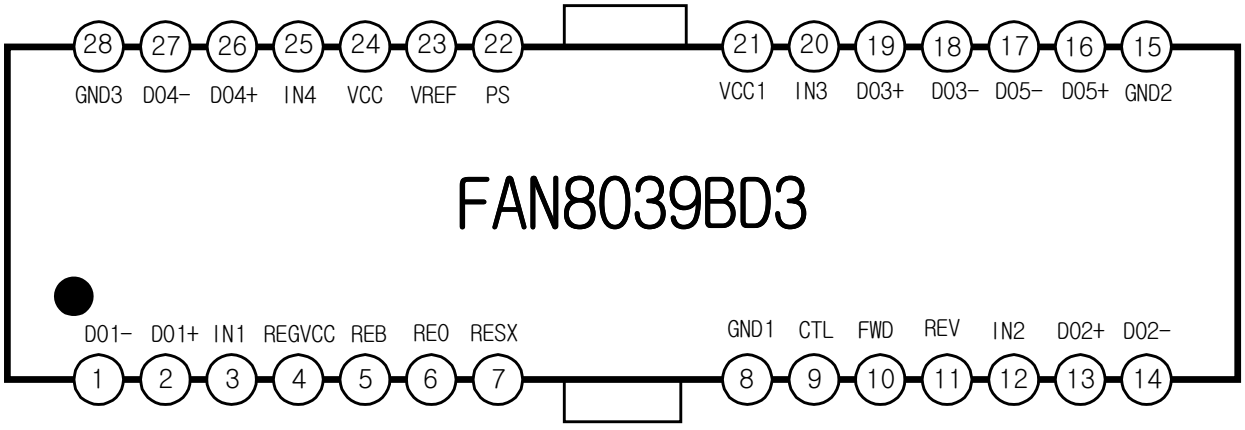
- Compact disk player
- Video compact disk player
- Car compact disk player
- Mixing with compact disk player and mini disk player
- DVDP

Ordering Information

Device	Package	Operating Temp
FAN8039BD3	28-SSOPH-375SG2	–35°C ~ 85°C
FAN8039BD3TF	28-SSOPH-375SG2	–35°C ~ 85°C

Rev 1.0.0

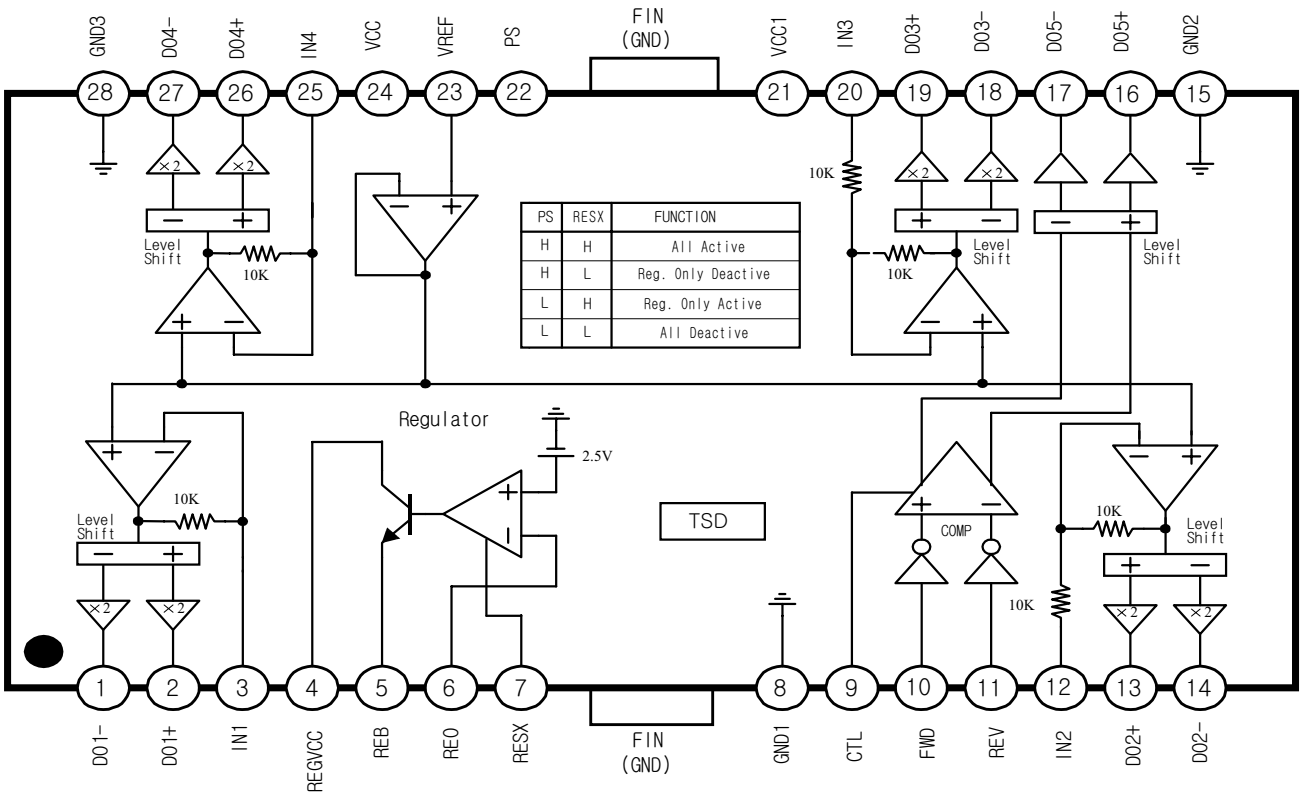
Pin Assignments



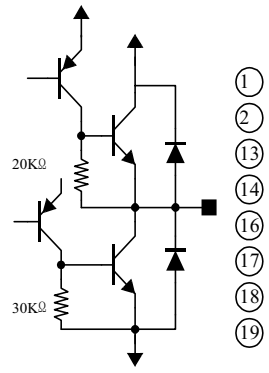
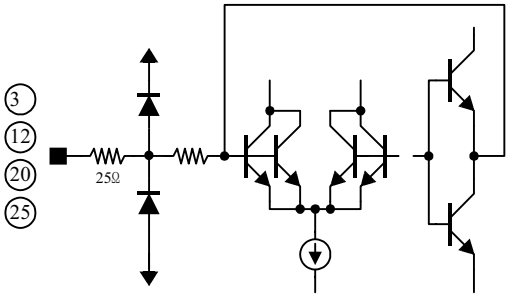
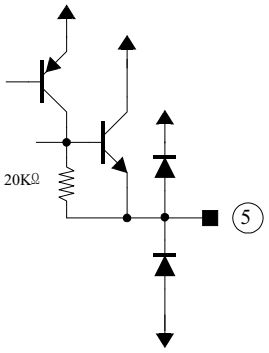
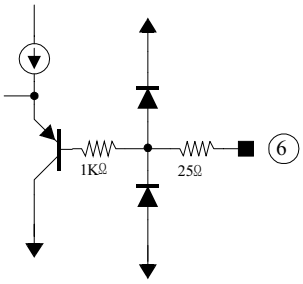
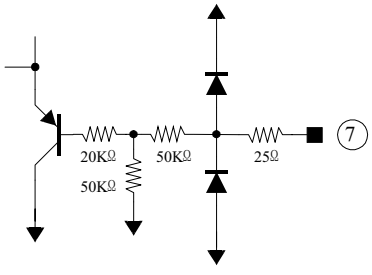
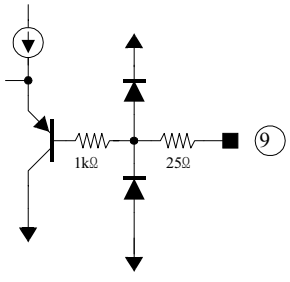
Pin Definitions

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(CH2,CH3,CH5)
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(CH1,CH4)
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)

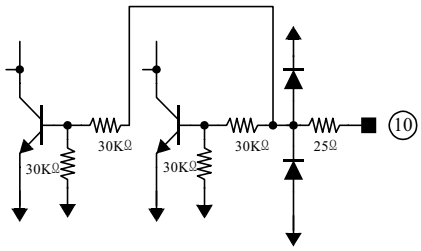
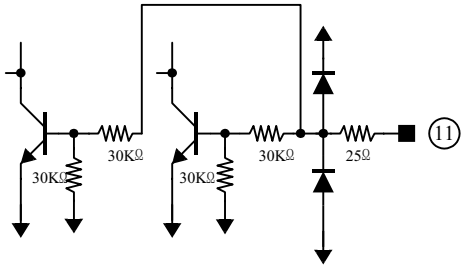
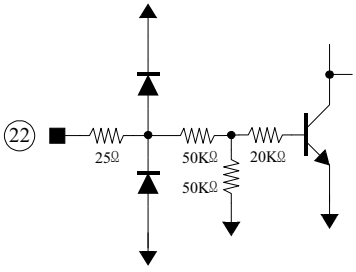
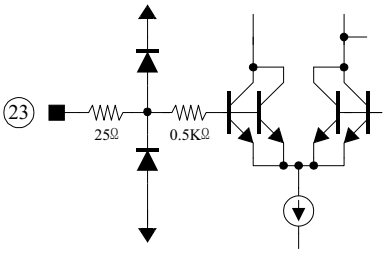
Internal Block Diagram



Equivalent Circuits

BTL DRVER OUTPUT	BTL DRIVE INPUT
	
REGULATOR OUTPUT	**REGULATOR FEEDBACK INPUT**
	
REGULATOR RESET	**MOTOR SPEED CONTROL**
	

Equivalent Circuits (Continued)

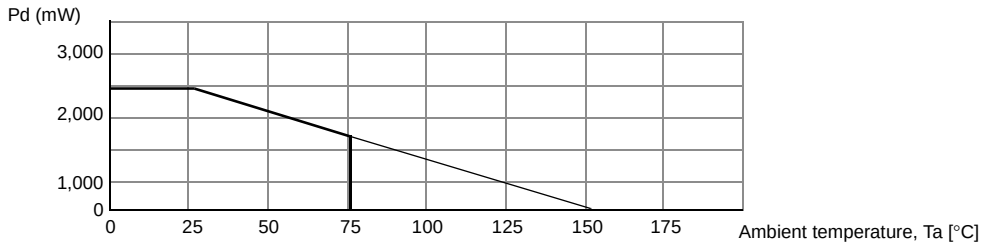
FOWARD INPUT	REVERSE INPUT
	
POWER SAVE	**BIAS VOLTAGE**
	

Absolute Maximum Ratings (Ta = 25°C)

Parameter	Symbol	Value	Unit
Maximum Supply Voltage	VCC	18	V
Power Dissipation	P_D	2.5[note]	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

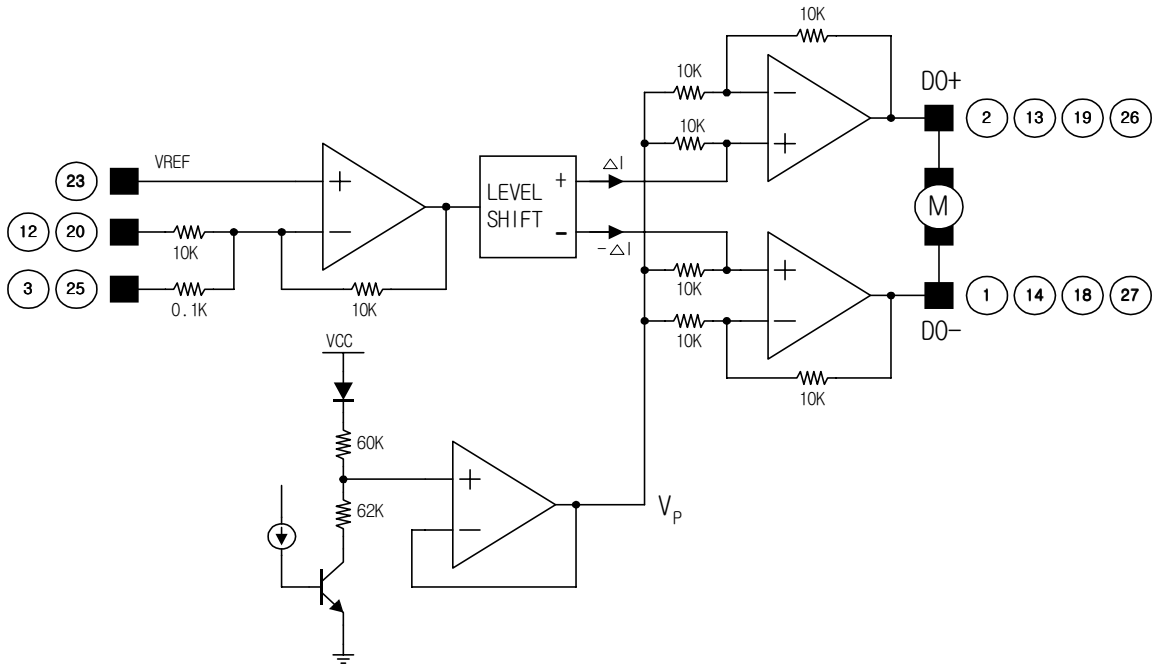
(V_{CC} = V_{CC1} = 8V, T_A = 25°C, unless otherwise specified)

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	ΔV_{RL}	I_L = 0mA → 200mA	-40	0	10	mV
Line Regulation	ΔV_{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}=4V_{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_{CC}1=8V, V_{CTL}=OPEN, RL=12Ω	5.5	6.5	-	V
Output Voltage2	V_{O2}	V_{CC}=V_{CC}1=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)



A voltage, VREF is the reference voltage driven by the external bias voltage on pin#23. The input signal(Vin) on pin#12 and #20 is aplified by 10K/10K times and then fed to the level shift. The level shift provides a current as +ΔI and -ΔI due to the differnce between the input signal and the arbitrary reference signal. The current can be fed into the driver Amp, so it drives the power TR on the output stage. The output can be shown 2 times as much as the input signal. (gain = 1 + 10K/10K) .

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

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

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

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

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

Pin#3 or #25 can be used to modify the gain. The output stage is the balanced transformerless(BTL) driver.
The bias voltage VP is described as follows.

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

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

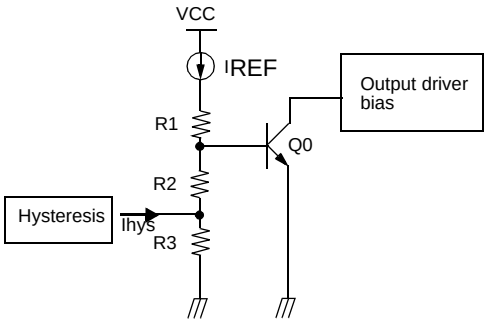
2. Thermal Shutdown

The TSD circuit turns activated when the junction temperature becomes over 175°C.

It cuts off the bias current on the output driver and keeps all the output drivers off. Meanwhile, the junction temperature begins to decrease.

The TSD circuit can be deactivated when the unction temperature falls under 150°C, so the output driver begins operating in normal condition

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

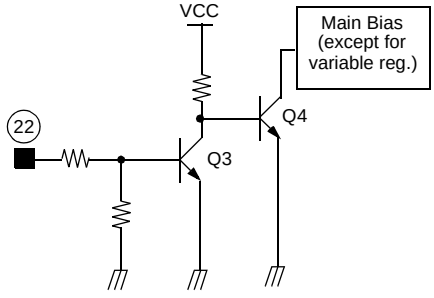


3. Power Save Function

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, it will make all the circuit blocks except for variable regulator off, so low power quiescent state can be extablished.
Truth table is as follows.

Pin#22	FAN8039BD3
High	Power Save Off
Low	Power Save On



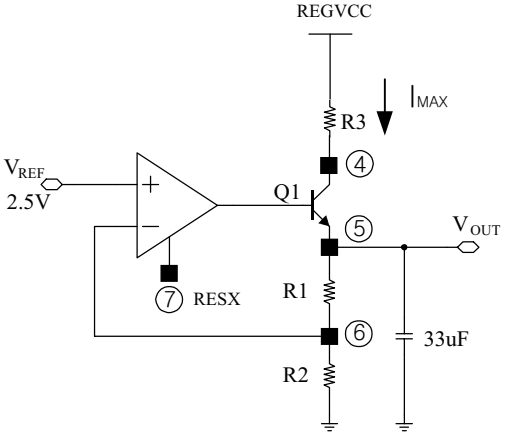
4. Variable Regulator

A 33uF capacitor is used as a ripple eliminator in the external circuit. Therefore, output voltage, Vout can be calcuated as follows.

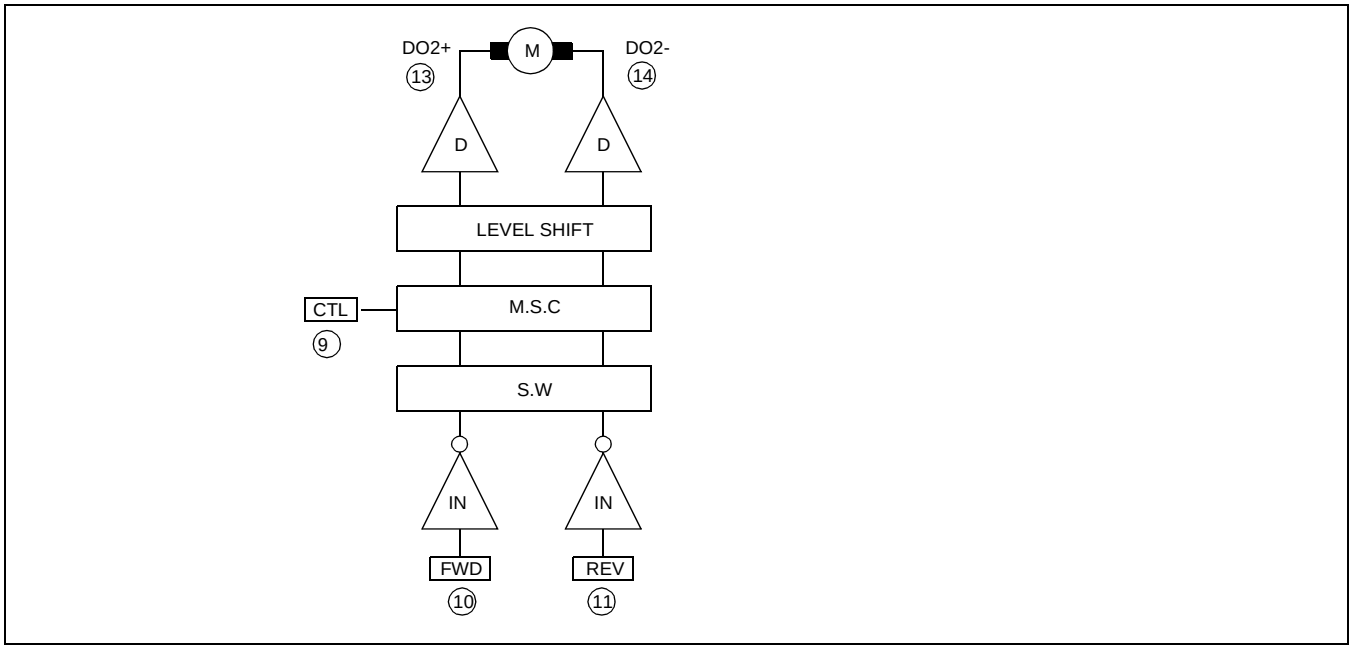
$$V_{OUT} = V_{REF} \bullet \left(1 + \frac{R_1}{R_2}\right) = 2.5 \times 2 = 5V(R1 = R2)$$

In order to reduce the heating problem on regulator output TR,Q1, a resistor R3 can be used and calculated as follows.

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



5. Loading Motor Driver

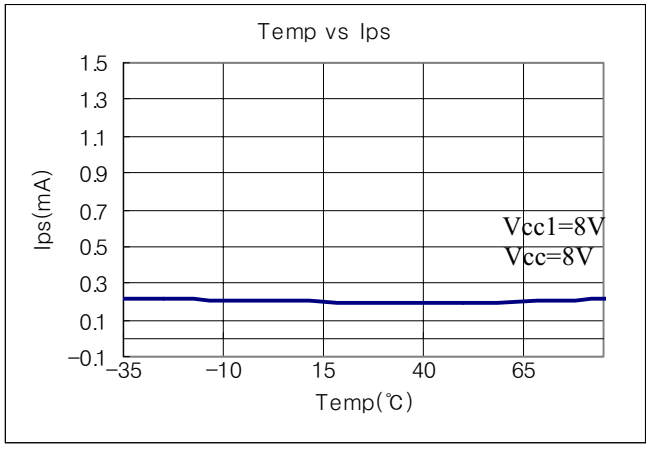


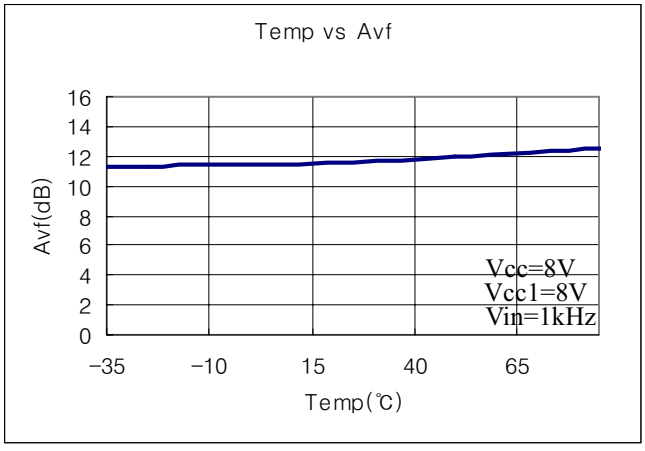
- Rotational direction control
  The forward and reverse rotational direction is controlled by FWD (pin10) and REV (pin11) , so the conditions are as follows.

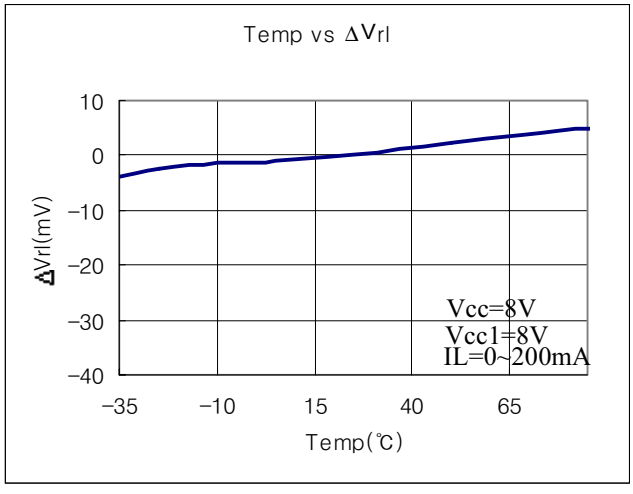
INPUT		OUTPUT		
FWD	**REV**	**OUT 1**	**OUT 2**	**State**
H	H	Vp	Vp	High Impedence
H	L	H	L	Forward
L	H	L	H	Reverse
L	L	-	-	Short Brake

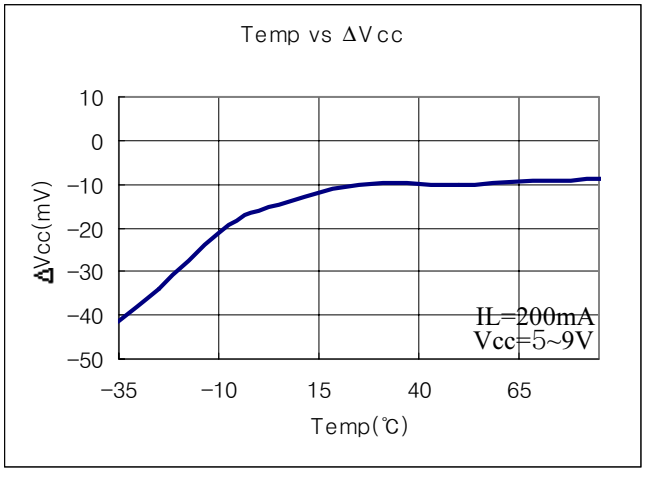
- Vp(Power Bias voltage) can be approximately 3.75V where Vcc1and Vcc are 8V.
- Motor speed control (Where VCC=VCC1=8V)
  - The maximum torque can be obtained when the pin 9(CTL) is open.
  - If the voltage on pin 9(CTL) is 0V, the motor will not be operating.

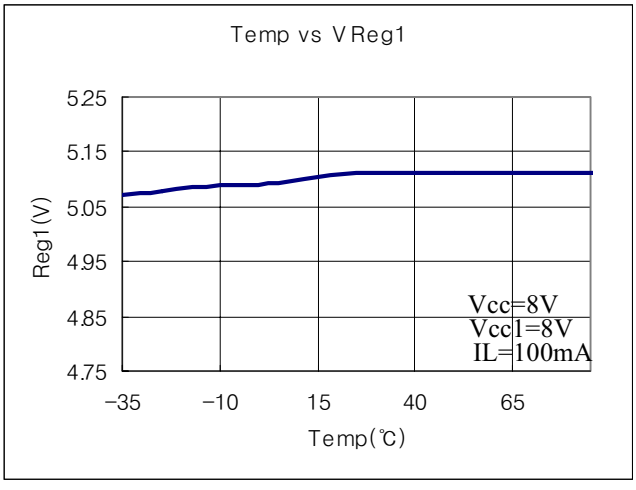
Typical Performance Characteristics

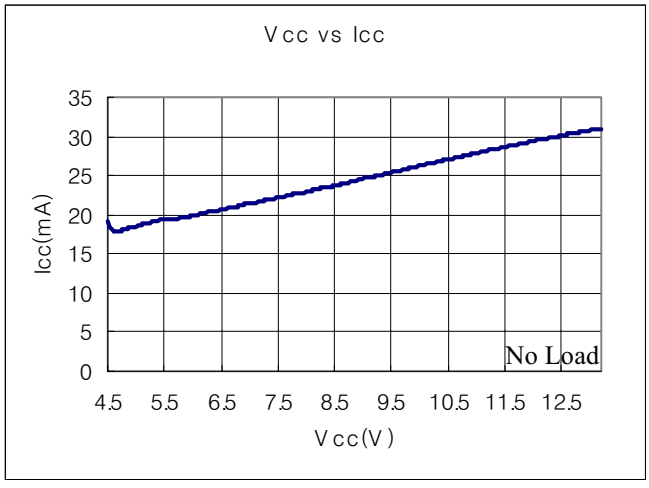


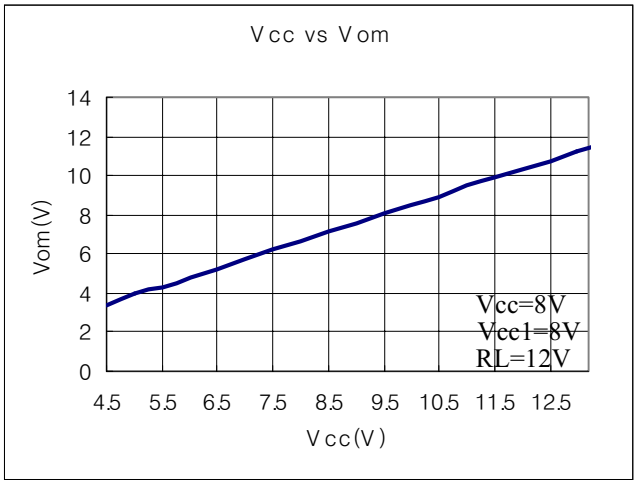


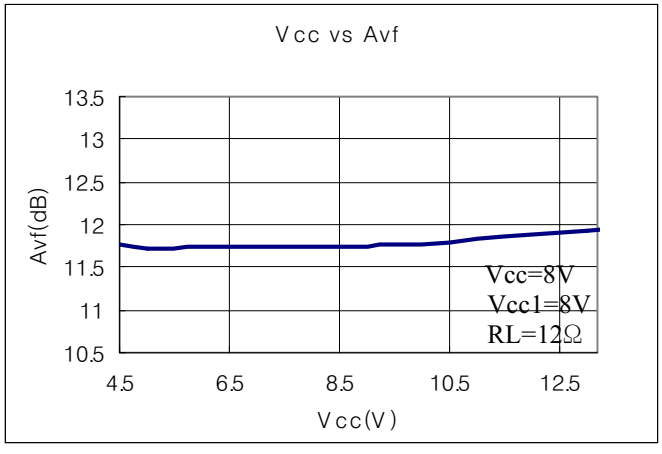


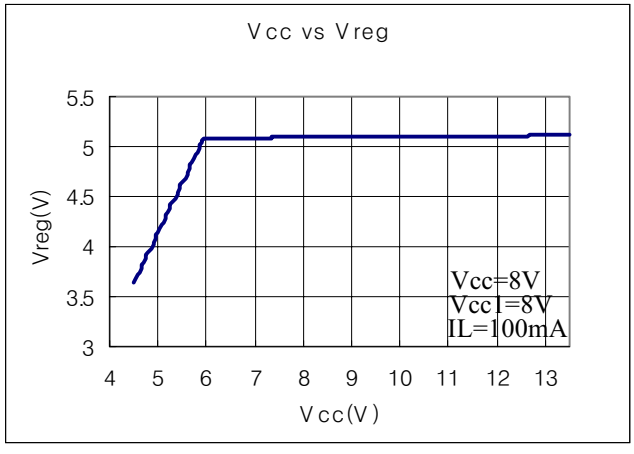


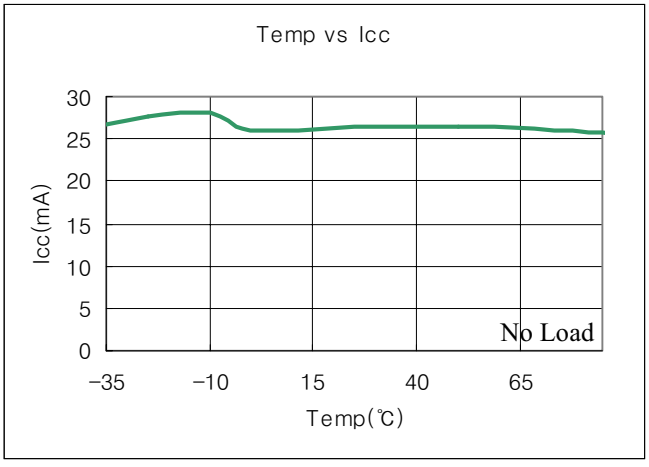


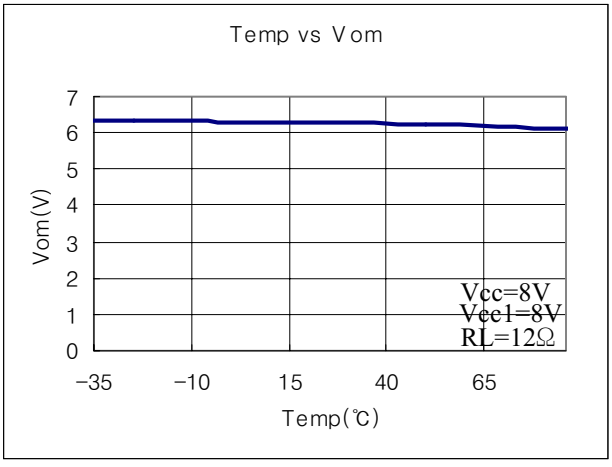

Vcc vs Icc
Icc(mA)
35
30
25
20
15
10
5
0
4.5 5.5 6.5 7.5 8.5 9.5 10.5 11.5 12.5
Vcc(V)
No Load


Vcc vs Vom
Vom(V)
14
12
10
8
6
4
2
0
4.5 5.5 6.5 7.5 8.5 9.5 10.5 11.5 12.5
Vcc(V)
Vcc=8V
Vcc1=8V
RL=12V

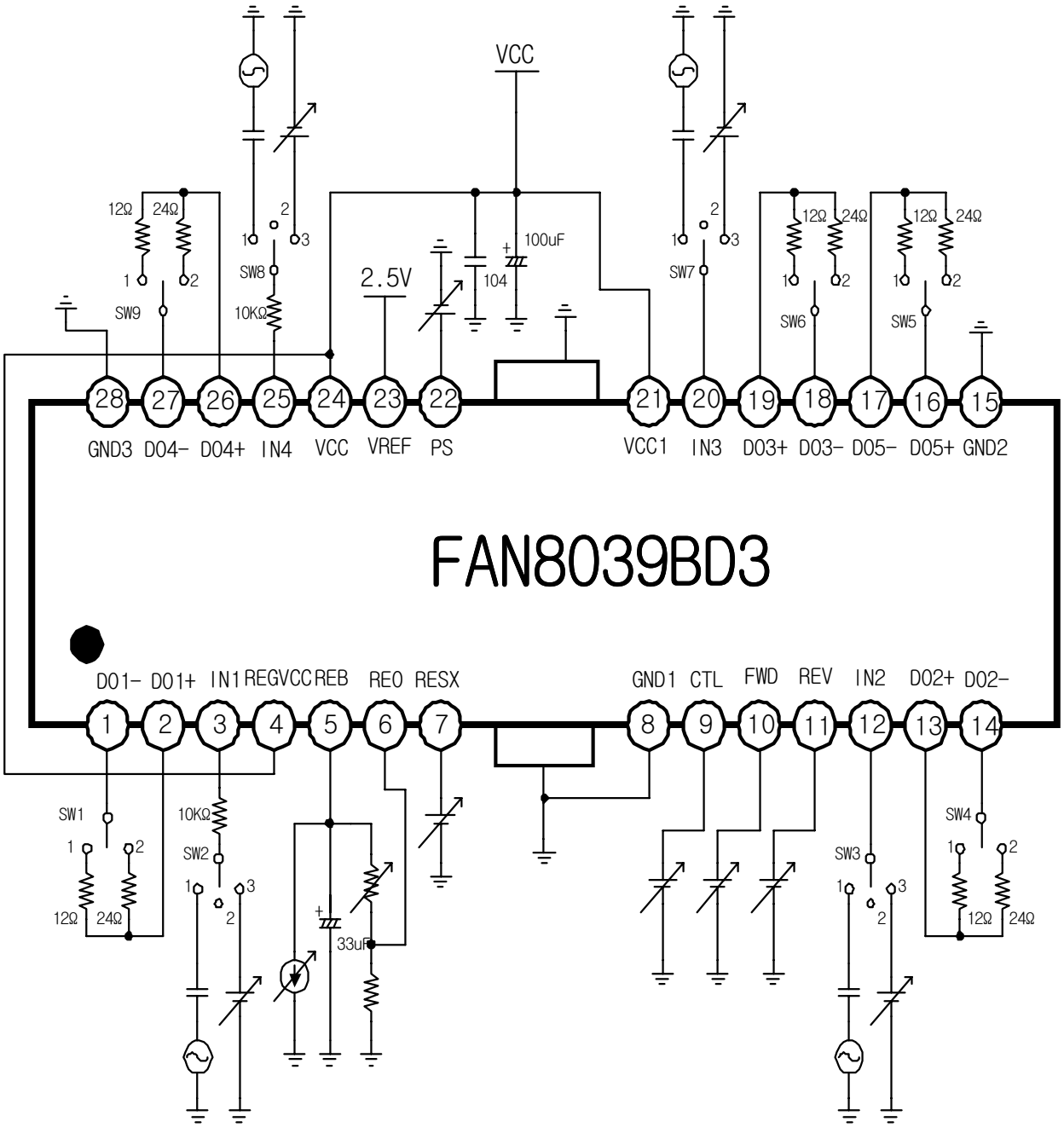

Vcc vs Avf
Avf(dB)
13.5
13
12.5
12
11.5
11
10.5
4.5 6.5 8.5 10.5 12.5
Vcc(V)
Vcc=8V
Vcc1=8V
RL=12Ω


Vcc vs Vreg
Vreg(V)
5.5
5
4.5
4
3.5
3
4 5 6 7 8 9 10 11 12 13
Vcc(V)
Vcc=8V
Vcc1=8V
IL=100mA


Temp vs Icc
Icc(mA)
30
25
20
15
10
5
0
−35 −10 15 40 65
Temp(℃)
No Load


Temp vs Vom
Vom(V)
7
6
5
4
3
2
1
0
−35 −10 15 40 65
Temp(℃)
Vcc=8V
Vcc1=8V
RL=12Ω

Test Circuit



Application Circuit