

# KA3084D

## 2-Phase BLDC Motor Driver

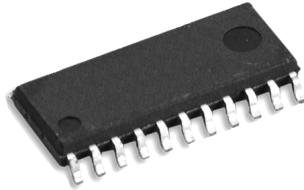
### Features

- Drives the BLDC motor using 2 hall sensors.
- 2-phase, full-wave drive method
- Built-in thermal shutdown (TSD) circuit
- Controls the motor speed through voltage
- Built-in bandgap circuit
- Built-in frequency Generator (FG) & Phase Generator (PG) amplifier & comparator.

### Description

The KA3084D is a monolithic integrated circuit, and it is suitable for drum motor driver of VCR system.

22-SOP-300



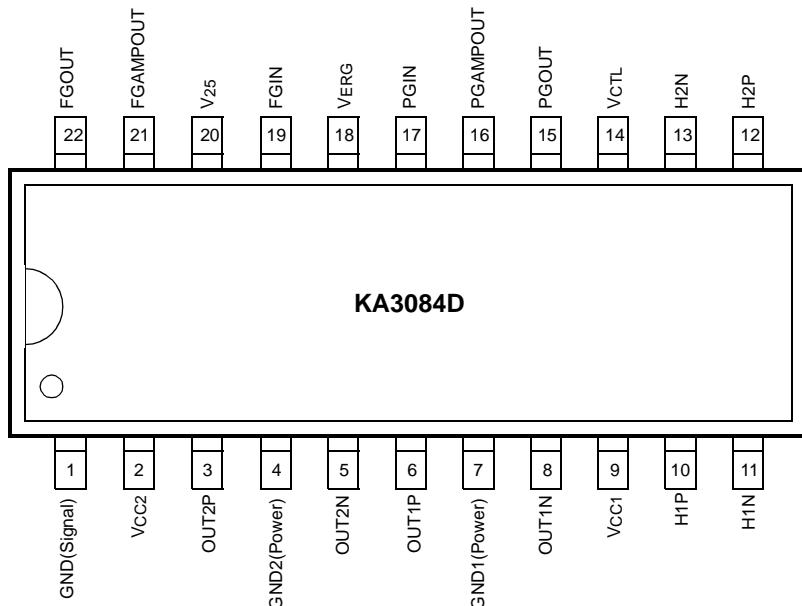
### Target Applications

- Video cassette recorder(VCR) cylinder (drum) motor
- Other 2-phase BLDC motor

### Ordering Information

Device	Package	Operating Temp.
KA3084D	22-SOP-300	-25°C ~ +75°C
KA3084DTF	22-SOP-300	-25°C ~ +75°C

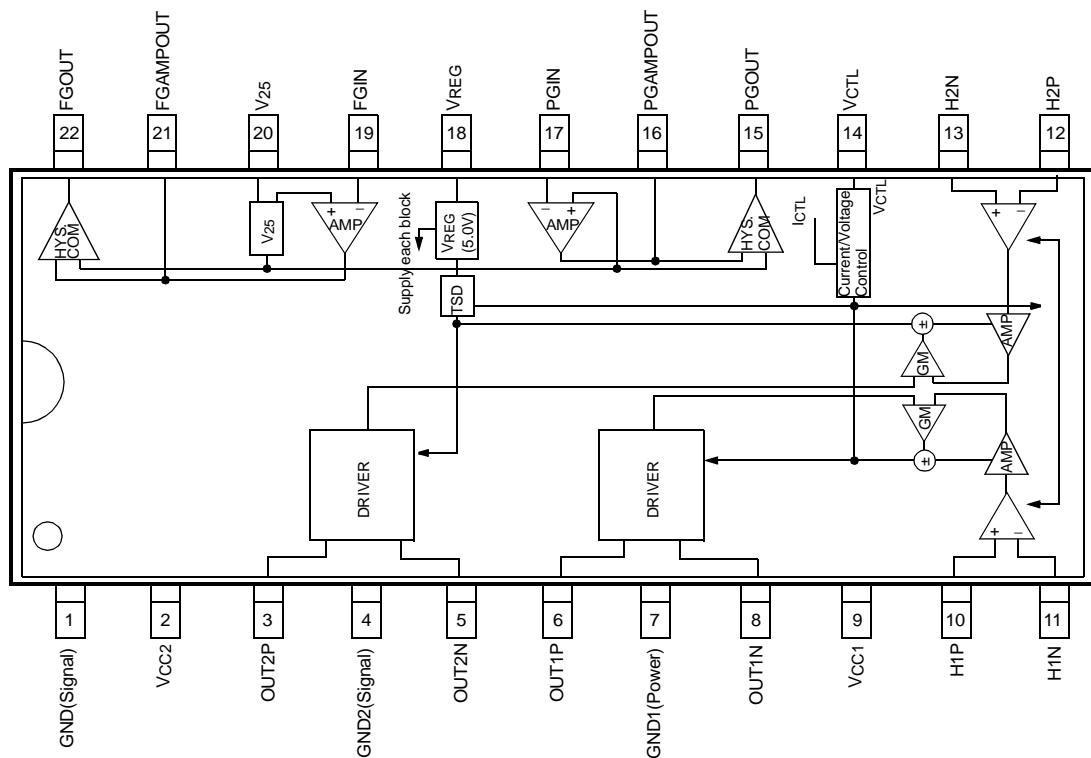
## Pin Assignments



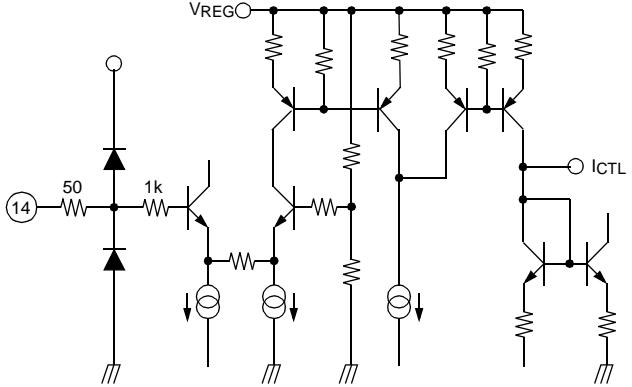
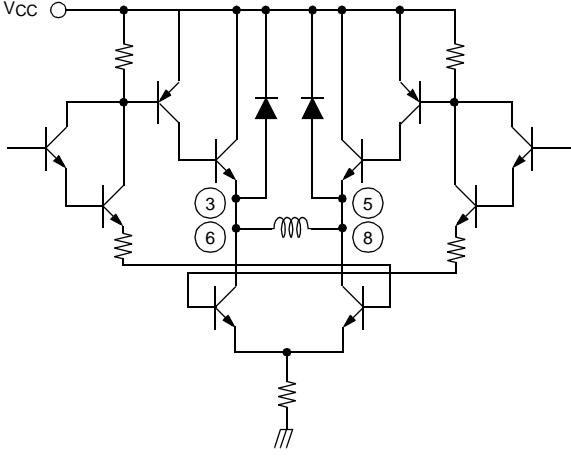
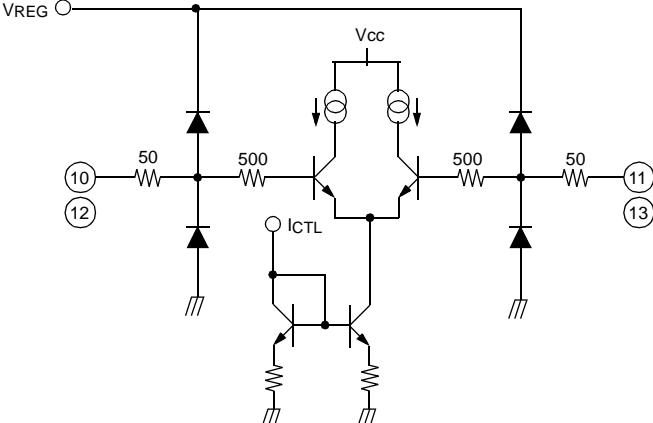
## Pin Definitions

Pine Number	Pin Name	I/O	Pin Function Description
1	GND (Signal)	-	Ground (Signal)
2	VCC2	-	Power supply 2
3	OUT2P	O	Output drive 2(P)
4	GND2 (Power)	-	Power ground 2
5	OUT2N	O	Output drive 2(N)
6	OUT1P	O	Power supply 1(P)
7	GND1 (Power)	-	Power ground 1
8	OUT1N	O	Output drive 1(N)
9	VCC1	-	Power supply 1
10	H1P	I	Hall signal input 1P
11	H1N	I	Hall signal input 1N
12	H2P	I	Hall signal input 2P
13	H2N	I	Hall signal input 2N
14	VCTL	I	Voltage control (Motor speed control)
15	PGOUT	O	Phase generator output
16	PGAMPOUT	O	Phase generator amp. output
17	PGIN	I	Phase generator input
18	VREG	O	Regulated voltage
19	FGIN	I	Frequency generator input
20	V25	I/O	Reference voltage
21	FGAMPOUT	O	Frequency generator amp. output
22	FGOUT	O	Frequency generator output

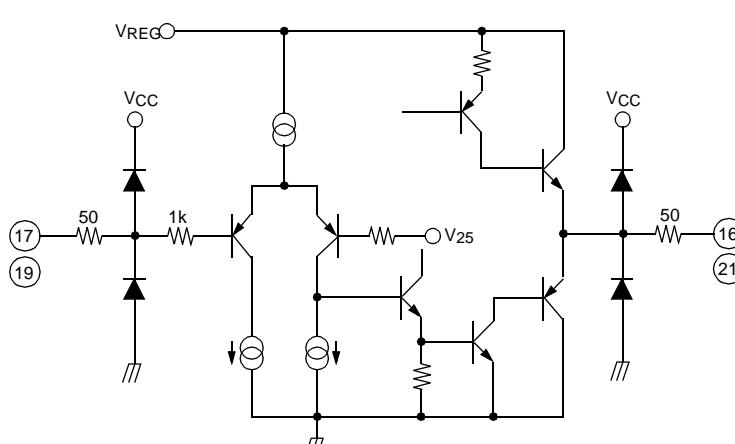
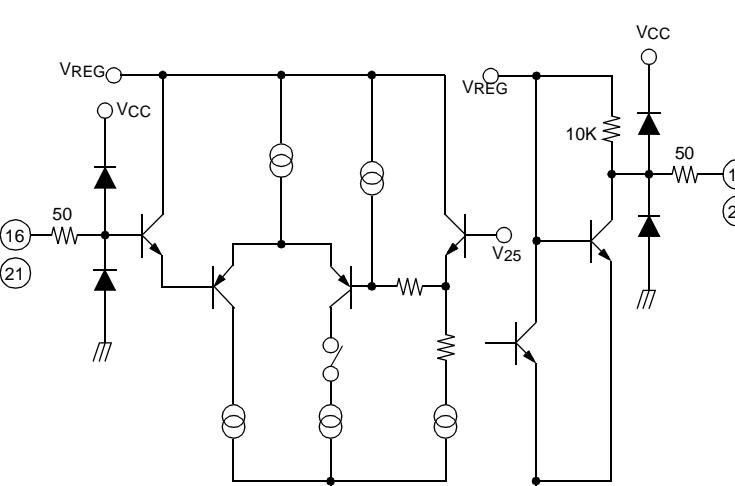
## Internal Block Diagram



## Equivalent Circuits

Description	Pin No.	Internal circuit
VCTL	14	 <p>Internal circuit diagram for VCTL pin:</p> <p>The circuit shows a voltage-controlled voltage source (V<sub>CTL</sub>) connected to the internal V<sub>REGO</sub> node. A 50Ω resistor connects Pin 14 to ground, and a 1kΩ resistor connects Pin 14 to the V<sub>REGO</sub> node. The V<sub>REGO</sub> node is connected to the base of a transistor stage, which provides feedback to the V<sub>CTL</sub> pin through a 50Ω resistor. The output current I<sub>CTL</sub> is controlled by this stage.</p>
Motor output	3, 5, 6, 8	 <p>Internal circuit diagram for Motor output pins 3, 5, 6, 8:</p> <p>The circuit is a four-phase H-bridge driver. It consists of four half-bridge stages, each with two transistors (NPN and PNP) driving a common-emitter connection. The phases are connected in a full-bridge configuration. The power supply V<sub>CC</sub> is connected to the common-emitter node of the first stage. The outputs of the stages are connected to the motor terminals.</p>
Hall input	10, 11, 12, 13	 <p>Internal circuit diagram for Hall input pins 10, 11, 12, 13:</p> <p>The circuit is a Hall effect sensor interface. It includes a reference voltage V<sub>REG</sub>, a 50Ω resistor from Pin 10 to ground, a 500Ω resistor from Pin 10 to the Hall sensor, and a 50Ω resistor from Pin 11 to ground. The Hall sensor signal is processed through a differential amplifier stage. The output current I<sub>CTL</sub> is controlled by this stage, with a 50Ω resistor from Pin 12 to ground.</p>

**Equivalent Circuits (Continued)**

Description	Pin No.	Internal circuit
PG, FG amplifier	16, 17 19, 21	 <p>This diagram shows the internal circuit for the PG, FG amplifier. It features a differential input stage with resistors of 50Ω and 1kΩ. The output of this stage is fed into a current mirror. A feedback loop is formed by a resistor of 50Ω connected between the output and the non-inverting input. The circuit also includes a reference voltage source V<sub>REG</sub>, a power supply V<sub>CC</sub>, and various biasing and compensation components.</p>
PG, FG hysteresis amplifier	3, 5, 6, 8	 <p>This diagram shows the internal circuit for the PG, FG hysteresis amplifier. It features a differential input stage with resistors of 50Ω and 10kΩ. The output of this stage is fed into a current mirror. A feedback loop is formed by a resistor of 50Ω connected between the output and the non-inverting input. The circuit also includes a reference voltage source V<sub>REG</sub>, a power supply V<sub>CC</sub>, and various biasing and compensation components.</p>

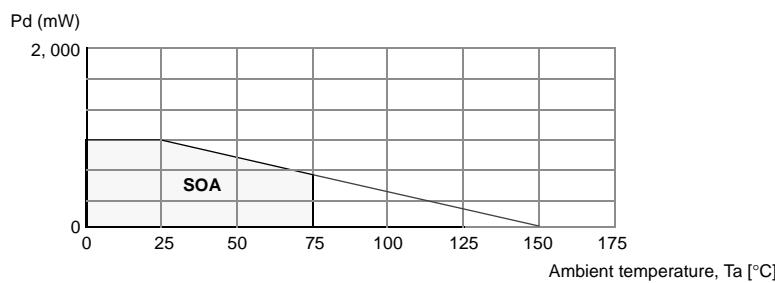
## Absolute Maximum Ratings (Ta=25°C)

Parameter	Symbol	Value	Unit	Remark
Supply voltage	V <sub>CCmax</sub>	18	V	-
Maximum output current	I <sub>Omax</sub>	1.0 <sup>note1</sup>	A	-
V <sub>REG</sub> output current	I <sub>REGmax</sub>	30	mA	-
Power dissipation	P <sub>d</sub>	1 <sup>note2</sup>	W	No heat sink
Operating temperature	T <sub>OPR</sub>	-25 ~ +75	°C	-
Storage temperature	T <sub>STG</sub>	-45 ~ +125	°C	-

**Notes:**

1. Duty 1 / 100, pulse width 500μs
2. 1) When mounted on glass epoxy PCB (76.2 × 114 × 1.57mm)  
2) Power dissipation reduces 8.0mW / °C for using above Ta=25°C. (Without heat-sink)  
3) Do not exceed P<sub>d</sub> and SOA(Safe Operating Area).

## Power Dissipation Curve



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

Parameter	Symbol	Min.	Typ.	Max	Units
Operating supply voltage	V <sub>CC</sub>	8	12	16	V

## Electrical Characteristics

(Ta=25°C, VCC=12V, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Units
<b>FULL CIRCUIT</b>						
Quiescent current	I <sub>Q</sub>	V <sub>CC</sub> =12V	-	8.5	13	mA
<b>VOLTAGE REGULATOR</b>						
Regulated voltage	V <sub>REG</sub>	V <sub>CC</sub> =12V	4.6	5.0	5.4	V
Regulated voltage	V <sub>REG</sub>	V <sub>CC</sub> =12V, I <sub>REG</sub> =-20mA	4.6	5.0	5.4	V
<b>HALL INPUT</b>						
Hall minimum input level <sup>note</sup>	V <sub>INH</sub>	-	50	-	-	mVp-p
Hall bias current	I <sub>BH</sub>	V <sub>CTL</sub> =2.0V, Hall=2.5V	-	0.25	2.0	μA
<b>OUTPUT DIRVE</b>						
Output saturation voltage (Upper)	V <sub>SU</sub>	V <sub>CTL</sub> =4.5V	-	1.3	2.0	V
Output saturation voltage (Lower)	V <sub>SL</sub>	V <sub>CTL</sub> =4.5V	-	2.0	2.0	V
Output current A	I <sub>OUTA</sub>	V <sub>H1P</sub> =2.6V V <sub>H1N</sub> =2.4V, V <sub>CTL</sub> =3.5V	500	700	900	mA
Output current B	I <sub>OUTB</sub>	V <sub>H2P</sub> =2.6V V <sub>H2N</sub> =2.4V, V <sub>CTL</sub> =2.5V	500	700	900	mA
<b>VOLTAGE CONTROL</b>						
V <sub>CTL</sub> reference voltage <sup>note</sup>	V <sub>25</sub>	0.48 × V <sub>REG</sub>	2.0	2.3	2.5	V
V <sub>CTL</sub> input range <sup>note</sup>	V <sub>CTL</sub>	-	0	-	V <sub>REG</sub>	V
V <sub>CTL</sub> offset range	V <sub>OFF</sub>	V <sub>CTL</sub> =0 ~ V <sub>CTL</sub>	-150	0	+150	mV
V <sub>CTL</sub> input bias current	I <sub>VCTL</sub>	V <sub>CTL</sub> =2.5V	-	1.0	6.0	μA
Voltage control gain	G <sub>M</sub>	V <sub>CTL</sub> =2.8V, 3.3V ΔI <sub>O</sub> / ΔV <sub>CTL</sub> V <sub>H1P</sub> =2.6V, V <sub>H1N</sub> =2.4V	0.38	0.55	0.64	A / V
		<p>The graph plots Output Current (Io) on the vertical axis against Voltage Control (VCTL) on the horizontal axis. A straight line starts at the point (0.48 × V<sub>REG</sub> (TYP), 0) and extends linearly to the point (3.3V, Io). The slope of the line is labeled as 0.55A/V(TYP).</p>				

**Notes:**

The note in the chart means items calculated and approved in design not the items proven by actual test result.

## Electrical Characteristics (Continued)

(Ta=25°C, VCC=12V, unless otherwise specified)

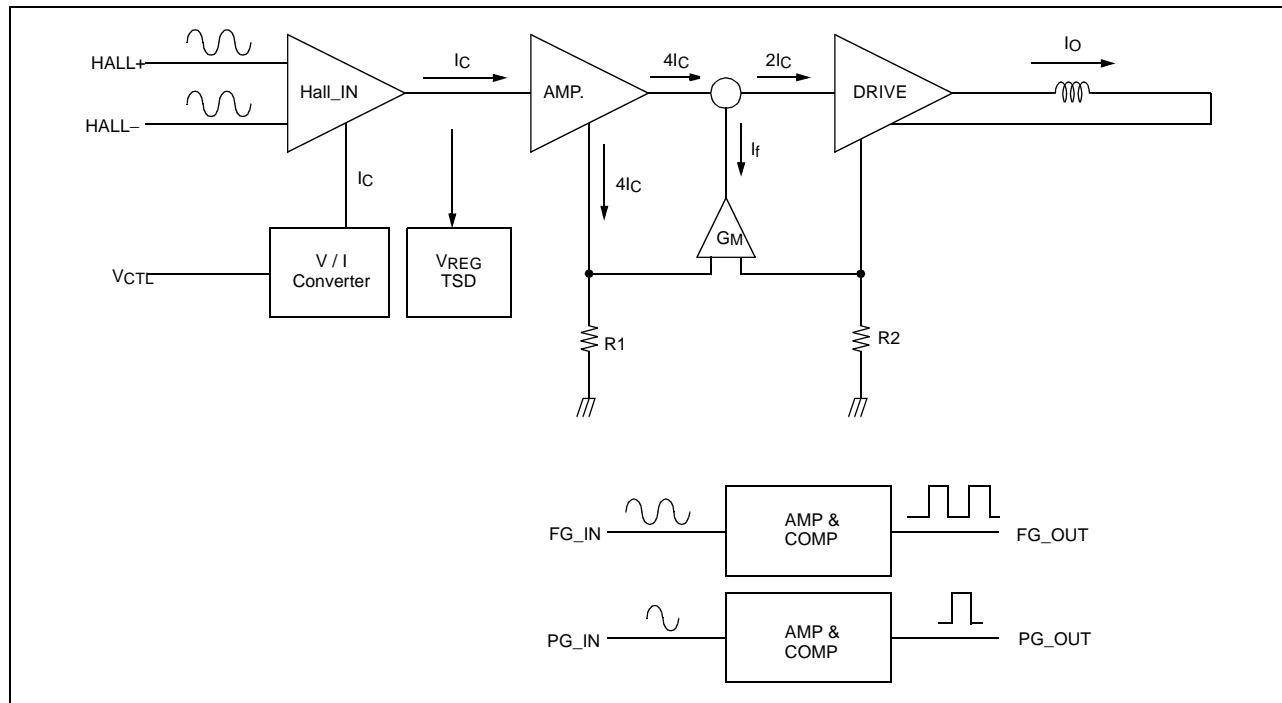
Parameter	Symbol	Condition	Min.	Typ.	Max.	Units
<b>FULL CIRCUIT</b>						
Shutdown temperature <sup>note</sup>	TSD	-	130	160	-	°C
Temperature hysteresis <sup>note</sup>	THYS	-	-	30	-	°C
<b>FG / PG AMP</b>						
Input offset voltage	V <sub>OFS</sub>	-	-	0	± 8	mV
Input current	I <sub>AMPIN</sub>	V <sub>IN</sub> =2.5V	-	0.2	2.0	µA
Open loop gain <sup>note</sup>	G <sub>A</sub>	V <sub>CC</sub> =12V, Signal=500Hz	65	70	-	dB
Output high voltage	V <sub>OHA</sub>	V <sub>IN</sub> =2.0V	V <sub>REG</sub> -1.48	V <sub>REG</sub> -0.74	-	V
Output low voltage	V <sub>OLO</sub>	V <sub>IN</sub> =2.7	-	0.85	1.45	V
<b>COMPARATOR (HYSTERESIS)</b>						
Hysteresis level	V <sub>HYS</sub>	-	±130	±165	±200	mV
Output low voltage	V <sub>OLOHYS</sub>	V <sub>IN</sub> =2.0V	-	0.12	0.32	V
Output pull-up resistance	V <sub>BHYS</sub>	-	7.0	10	13	kΩ

**Notes:**

The note in the chart means items calculated and approved in design not the items proven by actual test result.

## Application Informations

### 1. A DIAGRAM SUMMARIZING THE ENTIRE SYSTEM



**Figure 1.**

Figure 1 is a conceptual diagram of the KA3084D. It shows that it turns on or off depending on the signal of the hall sensor used for sensing the rotor position of motor.

The AMP, GM (Feedback) and output blocks are circuits used to determine current gain of KA3084D.

Furthermore, HallIN represents the hall signal switch.

It supplies stable bias to each VREG block. The TSD block is a thermal shutdown circuit that protects the IC during an high temperature inside the IC.

Moreover, FG. and PG. blocks output individual signals generated in the motor using the amplifier and comparator.

These signals transmit motor speed and position data to controller of external servo etc. for their control.

### 2. CURRENT CONTROL

Figure 2 simplifies figure 1.

The supplied I<sub>O</sub> current drives the motor and the I<sub>C</sub> current controls the motor speed.

Figure 3 is a graph of I<sub>CTL</sub> vs. I<sub>O</sub>.

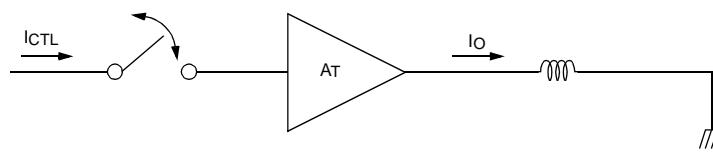


Figure 2.

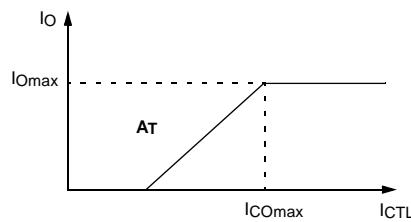


Figure 3.

### 3. VOLTAGE CONTROL

Even though KA3084D command uses  $I_c$  to control the magnitude of  $I_o$ , it can also use voltage. KA3084D mainly uses voltage control and has option to use current control.

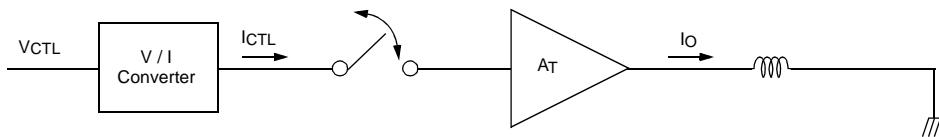


Figure 4.

Figure 4 shows the principle of the voltage control.

The  $V_{CTL}$  is the motor speed control voltage, and the  $I_{CTL}$  is converted to current through the V / I converter.

Figure 5 shows the graph of  $V_{CTL}$  vs.  $I_o$ .

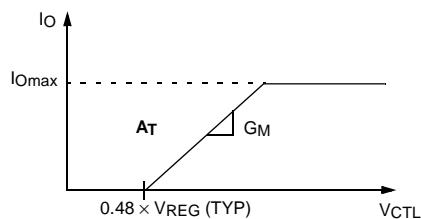
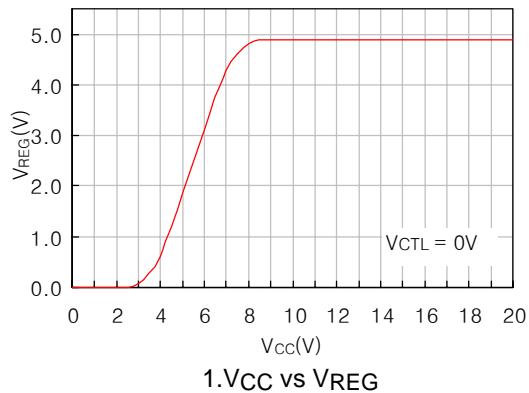
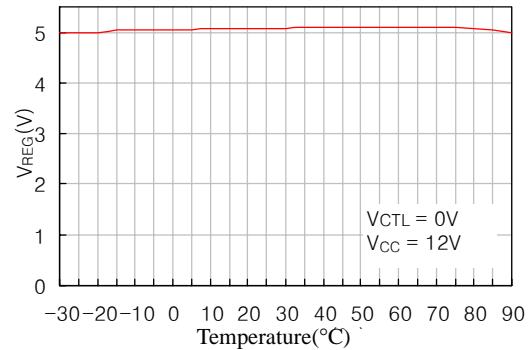
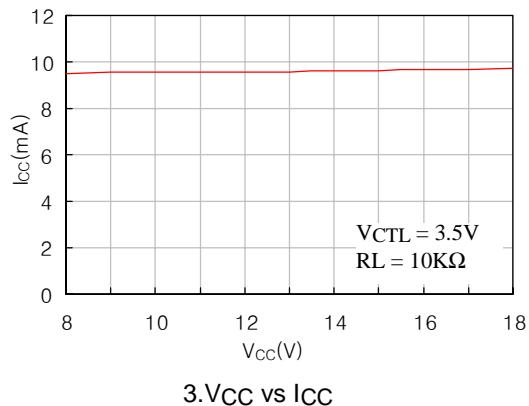
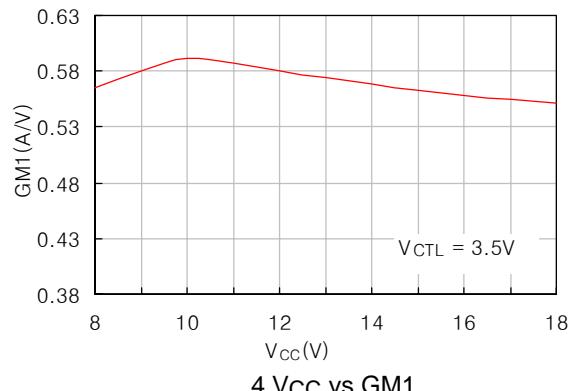
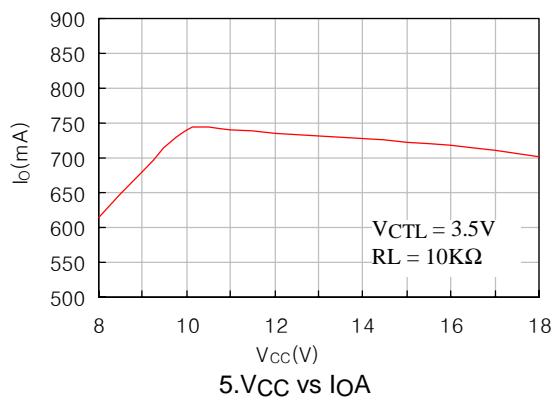
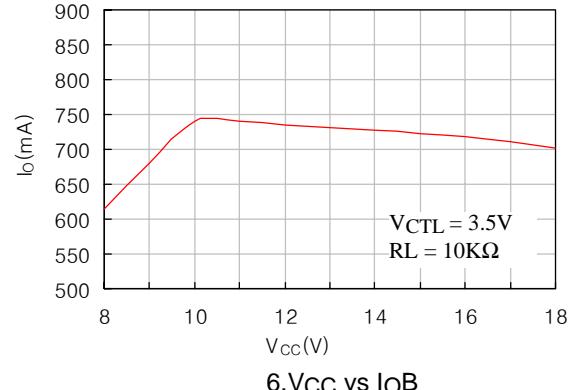
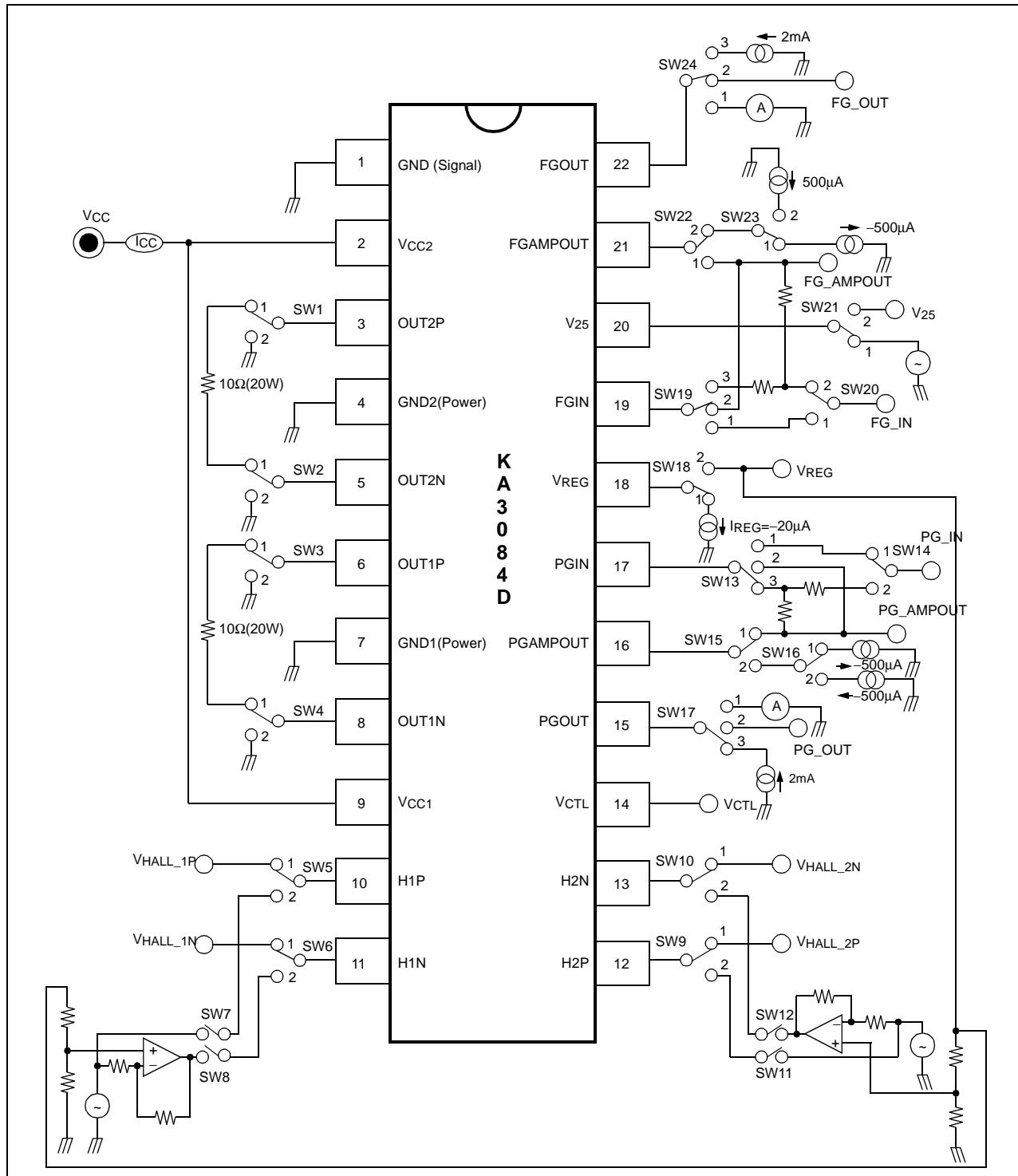


Figure 5.

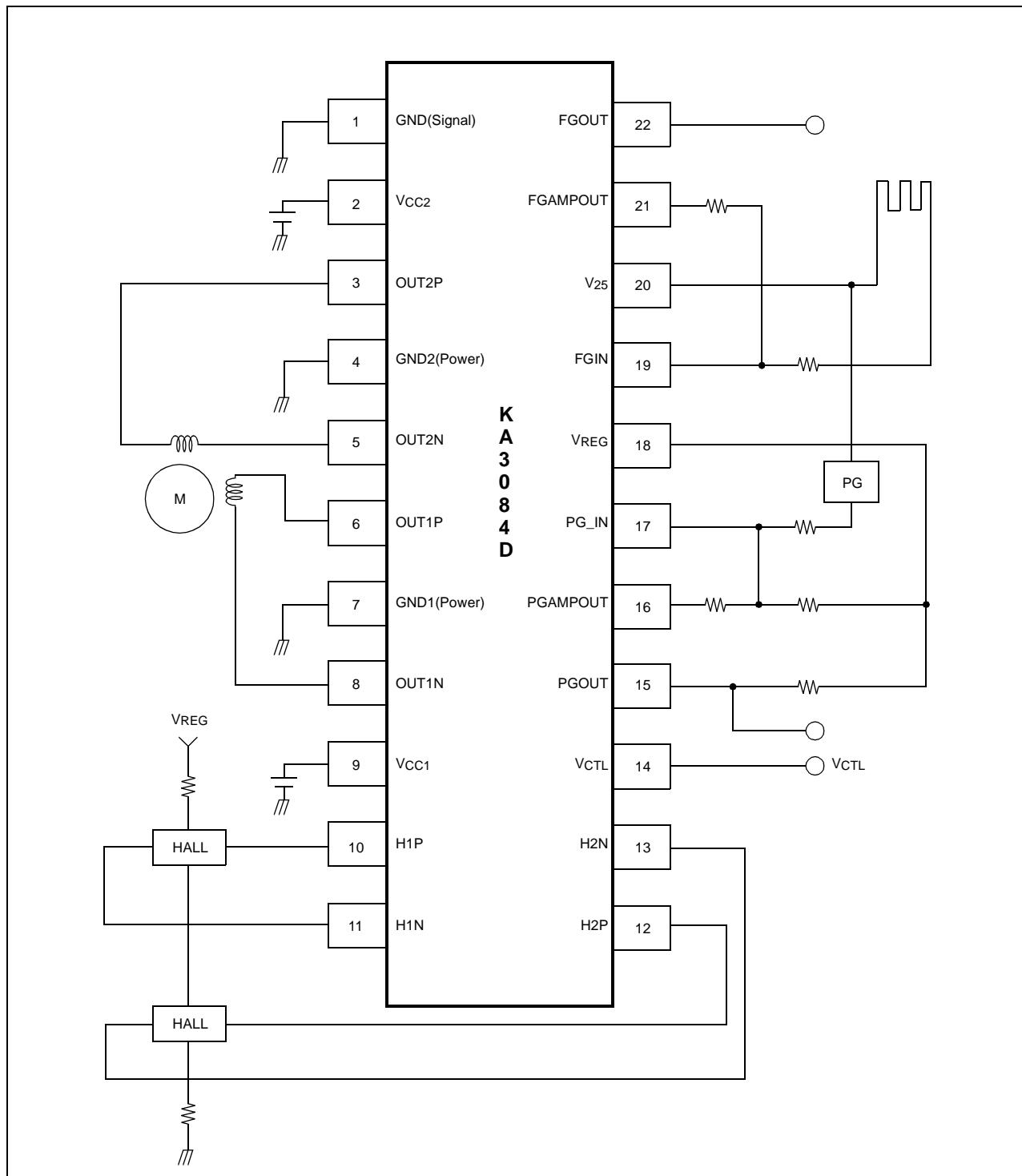
## Typical Performance Characteristics

1.V<sub>CC</sub> vs V<sub>REG</sub>2.Temp. vs V<sub>REG</sub>3.V<sub>CC</sub> vs I<sub>CC</sub>4.V<sub>CC</sub> vs GM<sub>1</sub>5.V<sub>CC</sub> vs I<sub>OA</sub>6.V<sub>CC</sub> vs I<sub>OB</sub>

## Test Circuits



## Typical Application Circuits



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