

### 3-Phase Spindle Motor Driver for CD-ROM/DVD

The KIA6833HF is a one-chip IC developed for use as the driver of CD system. It achieves high functionality and performance by making use of a 3-phase full-wave pseudo-linear drive method.

#### FEATURES

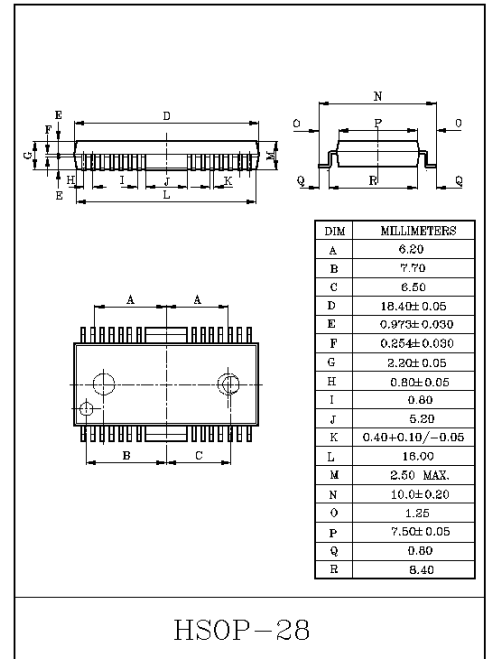
- 3-Phase, Full-Wave, Linear BLDC Motor Driver
- Power Save at Stop Mode.
- Built in Current Limiter.
- Built-in Thermal Shutdown Circuit
- Built-in FG Amplifier.
- Built-in Hall bias Circuit.
- Built-in Rotational Direction Detector.
- Built-in Reverse Rotation Preventer.
- Built-in Short Braker.
- Operation Supply Voltage Range  
:  $V_{CC}=4.25\sim 5.5V$ ,  $V_{M1,2}=3.0\sim 15V$

#### MAXIMUM RATINGS (Ta=25°C)

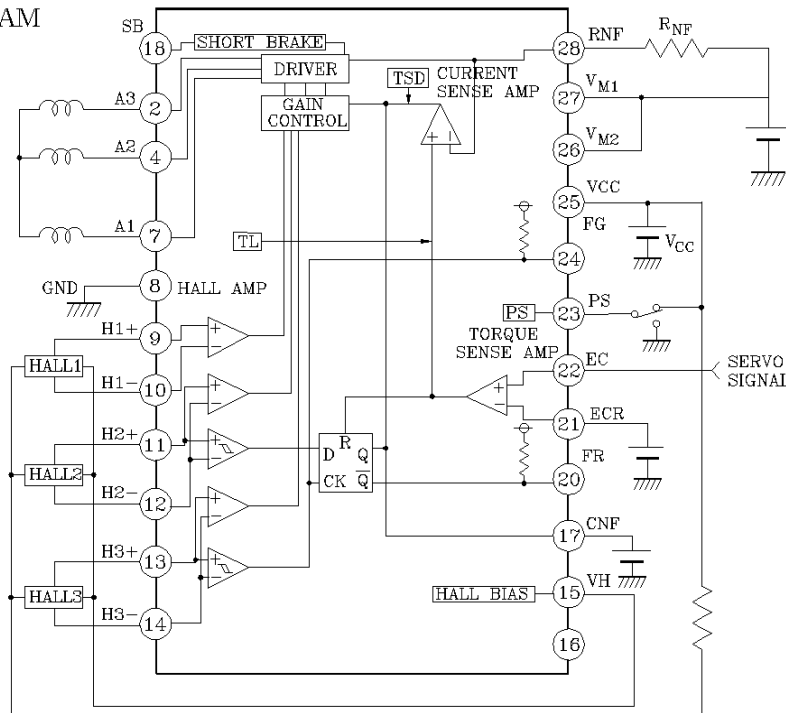
CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage (Signal)	$V_{CC}$	7	V
Supply Voltage (Motor)	$V_M$	16	V
Power Dissipation	$P_D$	1.7 (*1)	W
Output Current	$I_O$	1.3	A
Operating Temperature Range	$T_{opr}$	-20~75	°C
Storage Temperature Range	$T_{stg}$	-55~150	°C

Note) (\*1) : • When mounted on 70mm×70mm×1.6mm PCB  
(Phenolics resin material).

- Power Dissipation reduces 13.6mW/°C for using above Ta=25°C



#### BLOCK DIAGRAM



# KIA6833HF

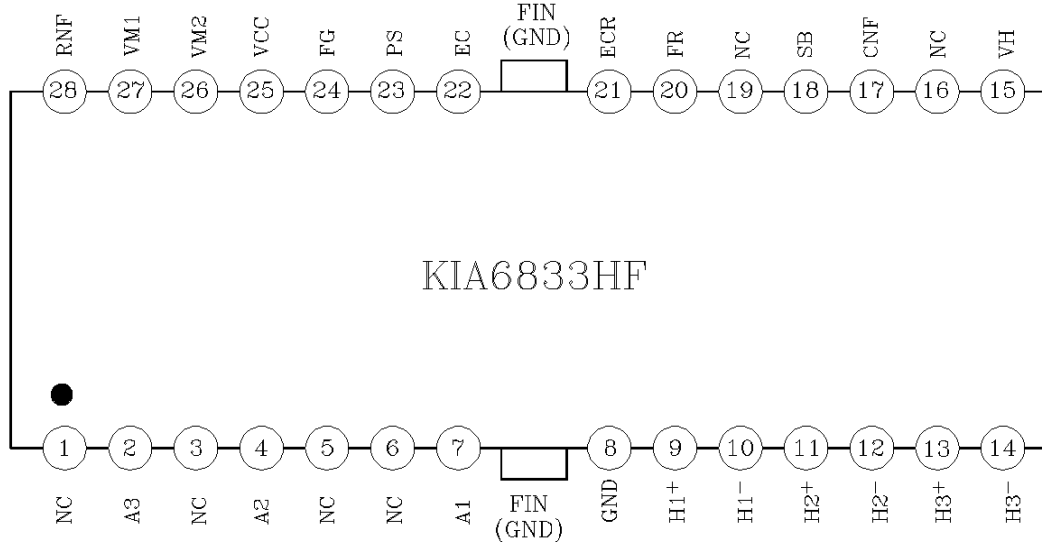
## ELECTRICAL CHARACTERISTICS

(Unless otherwise noted, Ta=25°C, V<sub>CC</sub>=5V, V<sub>M1</sub>=12V, V<sub>M2</sub>=12V)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Quiescent Circuit Current	I <sub>CC1</sub>	Power save=0V	-	0	0.2	mA
	I <sub>CC2</sub>	Power save=5V	-	5.4	7.2	
<b>POWER SAVE</b>						
On Voltage Range	V <sub>PSON</sub>		3.5	-	-	V
Off Voltage Range	V <sub>PSOFF</sub>		-	-	1.5	V
<b>SHORT BRAKE</b>						
On Voltage Range	V <sub>SBON</sub>		3.5	-	-	V
Off Voltage Range	V <sub>SBOFF</sub>		-	-	1.5	V
<b>HALL BIAS</b>						
Hall Bias Voltage	V <sub>HB</sub>	I <sub>HB</sub> =10mA	0.5	0.9	1.5	V
<b>HALL AMP</b>						
Hall Bias Current	I <sub>HA</sub>		-	0.7	3.0	μA
In-Phase Input Voltage Range	V <sub>HAR</sub>		1.5	-	4.0	V
Minimum Input Level	V <sub>INH</sub>		50	-	-	mV <sub>P-P</sub>
Hysteresis Voltage Level	V <sub>HYS</sub>		10	20	40	mV
<b>TORQUE CONTROL</b>						
Input Voltage Range	E <sub>C</sub>		1.0	-	4.0	V
Offset Voltage (-)	E <sub>COFF-</sub>	E <sub>cr</sub> =2.5V	-80	-50	-20	mV
Offset Voltage (+)	E <sub>COFF+</sub>	E <sub>cr</sub> =2.5V	20	50	80	mV
Input Current	E <sub>CIN</sub>	E <sub>c</sub> =E <sub>cr</sub> =2.5V	-	0.5	2.0	μA
Input/Output Gain	G <sub>EC</sub>	E <sub>cr</sub> =2.5V	0.41	0.51	0.61	A/V
<b>FG</b>						
FG Output Voltage (H)	V <sub>FGH</sub>	I <sub>FG</sub> =-20μA	4.5	4.8	-	V
FG Output Voltage (L)	V <sub>FGL</sub>	I <sub>FG</sub> =3mA	0	0.25	0.4	V
Duty Ratio (*reference value)	D <sub>U</sub>		-	50	-	%
<b>ROTATION DETECTION</b>						
FR Output Voltage (H)	V <sub>FRH</sub>	I <sub>FG</sub> =-20μA	4.1	4.4	-	V
FR Output Voltage (L)	V <sub>FRL</sub>	I <sub>FG</sub> =3mA	0	0.25	0.4	V
<b>OUTPUT BLOCK</b>						
Saturation Voltage (upper TR)	V <sub>OH</sub>	I <sub>O</sub> =-600mA	-	1.0	1.5	V
Saturation Voltage (lower TR)	V <sub>OL</sub>	I <sub>O</sub> =600mA	-	0.4	0.8	V
VM Leakage Current	V <sub>VML</sub>	E <sub>C</sub> =0V, output open	-	35	70	mA
Torque Limit Current	I <sub>TL</sub>	R <sub>nf</sub> =0.5Ω, E <sub>cr</sub> =2.5V, E <sub>c</sub> =0V	560	700	840	mA

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## PIN CONFIGURATIONS

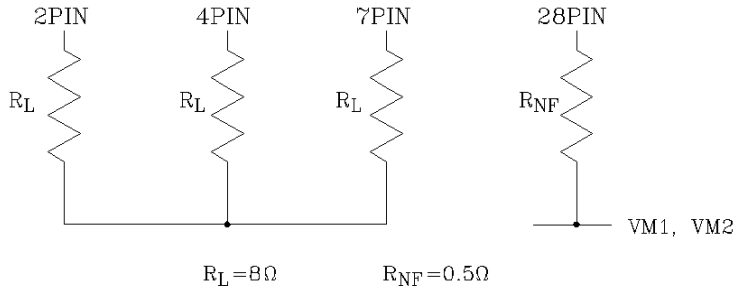


## PIN DESCRIPTIONS

Pin No.	SYMBOL	I/O	DESCRIPTION	Pin No.	SYMBOL	I/O	DESCRIPTION
1	NC	-	No connection	15	VH	I	Hall bias
2	A3	O	Output (A3)	16	NC	-	No connection
3	NC	-	No connection	17	CNF	-	Phase compensation capacitor
4	A2	O	Output (A2)	18	SB	I	Short brake
5	NC	-	No connection	19	NC	-	No connection
6	NC	-	No connection	20	FR	O	Rotational direction detection
7	A1	O	Output (A1)	21	ECR	I	Output current control reference
8	GND	-	Ground	22	EC	I	Output current control voltage
9	H1+	I	Hall signal (H1+)	23	PS	I	Power save (Start/Stop switch)
10	H1-	I	Hall signal (H1-)	24	FG	O	FG waveform
11	H2+	I	Hall signal (H2+)	25	VCC	-	Supply voltage (Signal)
12	H2-	I	Hall signal (H2-)	26	VM2	-	Supply voltage (Motor)
13	H3+	I	Hall signal (H3+)	27	VM1	-	Supply voltage (Motor)
14	H3-	I	Hall signal (H3-)	28	RNF	-	Output current detection

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## 1. The Value of Test Circuit Resistor



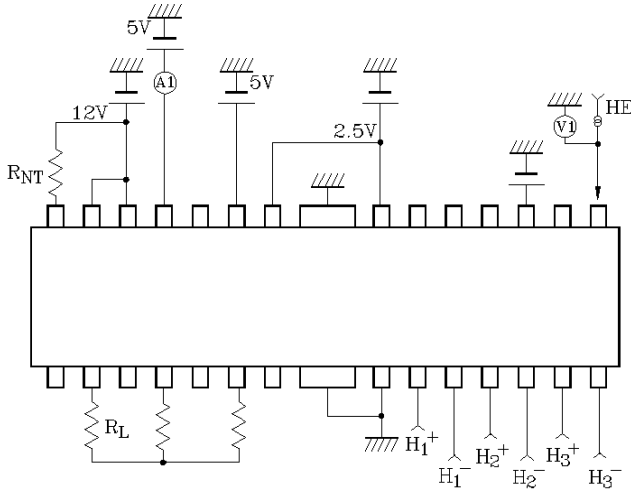
## 2. Input-Output Truth Table

Pin No.	INPUT						OUTPUT						TEST POINT
							FORWARD			REVERSE			
	9	10	11	12	13	14	7	4	2	7	4	2	
	H1 +	H1 -	H2 +	H2 -	H3 +	H3 -	A1	A2	A3	A1	A2	A3	
Condition 1	L	M	H	M	M	M	H	L	L	L	H	H	7 Pin Hi
Condition 2	H	M	L	M	M	M	L	H	H	H	L	L	7 Pin Low
Condition 3	M	M	L	M	H	M	L	H	L	H	L	H	4 Pin Hi
Condition 4	M	M	H	M	L	M	H	L	H	L	H	L	4 Pin Low
Condition 5	H	M	M	M	L	M	L	L	H	H	H	L	2 Pin Hi
Condition 6	L	M	M	M	H	M	H	H	L	-	L	H	2 Pin Low

Note 1) 1. Forward :  $E_c < E_{CR}$   
Reverse :  $E_c > E_{CR}$   
2. Input Voltage  
H:2.6V, M:2.5V, L:2.4V

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## 3. Test Circuit

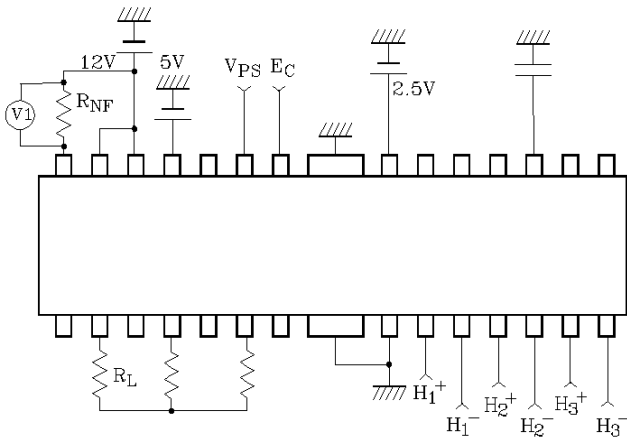


**Fig-1.**

$I_{CC1} : A1$   
 $V_{PS}=0[V]$   
 $H_{1,2,3+}=1/2V_{CC}+0.1[V]$   
 $H_{1,2,3-}=1/2V_{CC} [V]$

$I_{CC2} : A1$   
 $V_{PS}=5[V]$   
 $H_{1,2,3+}=1/2V_{CC}+0.1[V]$   
 $H_{1,2,3-}=1/2V_{CC} [V]$

$V_{HB} : V1$   
 $V_{PS}=5[V]$   
 $I_{HB}=10[mA]$



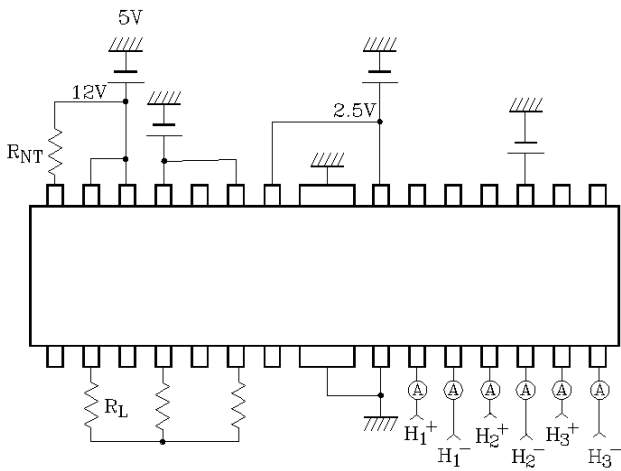
**Fig-2.**

$V_{PSON} : \text{Input Condition } 1 \sim 6$

$V_{PSOFF} : \text{Input Condition } 1 \sim 6$

$I_{TL} : V1/0.5$   
 $V_{PS}=5[V]$   
 $E_C=0[V]$   
 $\text{Input Condition } 1 \sim 6$

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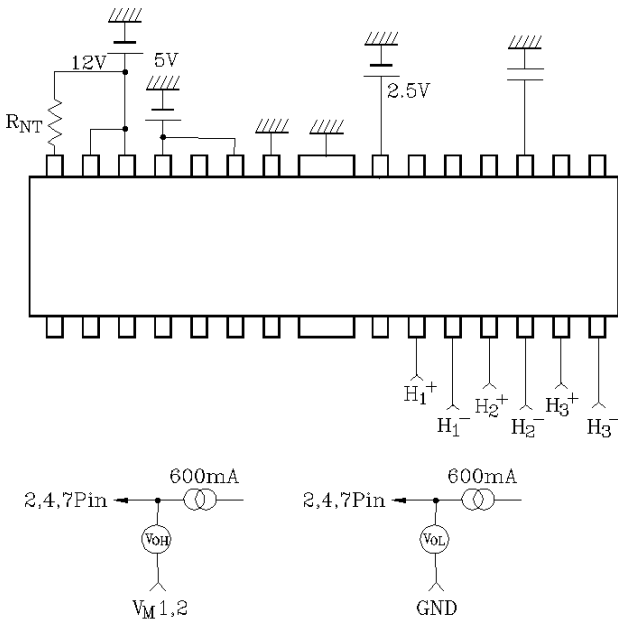


$I_{HA}$  :  $H_n^+ = 4.0V$ ,  $H_n^- = 2.5V$   
 $H_n^+$   
 $H_n^+ = 2.5V$ ,  $H_n^- = 4.0V$   
 $H_n^-$  (n=1, 2, 3)

$V_{HAR}$  : Hall Input Voltage Range

$V_{INH}$  : Hall Input Level  
 $|H_n^+ - H_n^-|$   $H_n^- = 2.5V$

**Fig-3.**

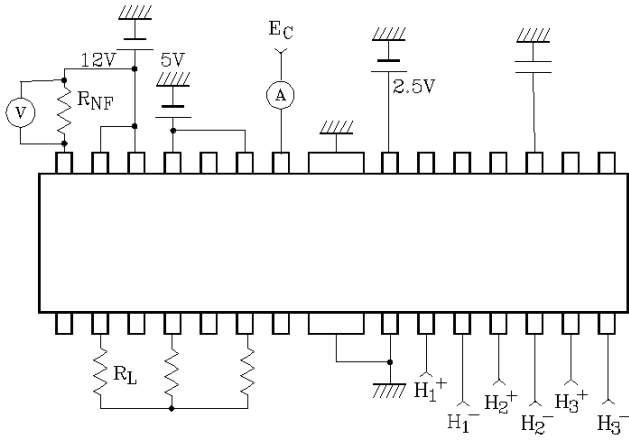


$V_{OH}$  :  $I_O = -600mA$  ( $V_M - R_{NF}$  short)

$V_{OL}$  :  $I_O = 600mA$

**Fig-4.**

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**Fig-5.**

$E_C$  : Torque Operating Voltage Range

$E_{COFS}$ ,  $E_{COFSA}$ ,  $E_{CR}=2.5V$

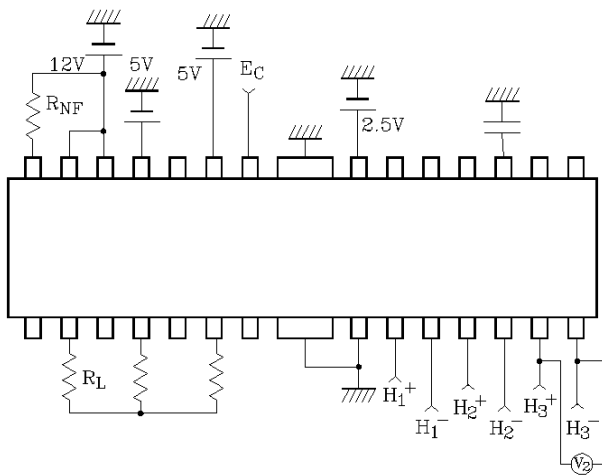
$V_{RNF}=3mV$  :  $E_C$  of Voltage Range.

$E_{CIN}$  :  $E_C=E_{CR}=2.5V$  : A

$G_{EC}$  :  $E_C=1.5V$  : V1

$E_C=2.0V$  : V2

$G_{EC}=\{(V1-V2)/(2.0-1.5)\}/RNF$   
 $RND=0.5\Omega$ .



**Fig-6.**

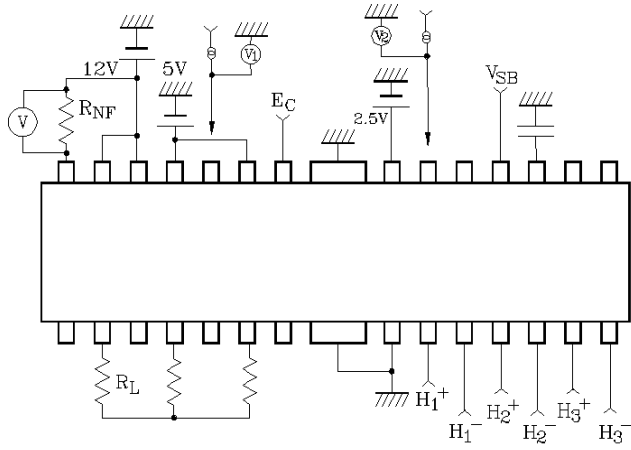
$V_{HYS}$  :  $E_C=E_{CR}=2.5V$

$|H3^+-H3^-|=V_2$  : FG Voltage

$I_{VML}$  : Output open (Input Condition 1~6)

$E_C=0V$ ,  $E_{CR}=2.5V$

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**Fig-7.**

$V_{SBON}$  : Voltage range of VSB for output "L"

$V_{SBOFF}$  : Voltage range of VSB at input-output truth able.

$V_{FGH}$  :  $I_{FG} = -20\mu A$  (Condition3)

$V_{FGL}$  :  $I_{FG} = 3mA$   $V_1$  (Condition4)

$V_{FRH}$  :  $I_{FR} = -20\mu A$   $V_2$  ( $H2^+ : H, H3^+ : H \rightarrow L$ )

$V_{FRL}$  :  $V_2$   
 $I_{FR} = 3mA$  ( $H2^+ : L, H3^+ : H \rightarrow L$ )

$V_{HYS}$  :  $E_C = E_{CR} = 2.5V$   
 $|H3^+ - H3^-| = V_2$  : FG Voltage

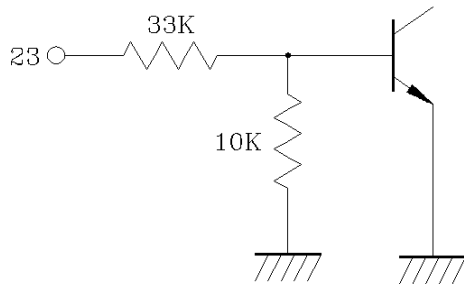
$I_{VML}$  : Output open (Input Condition 1~6)  
 $E_C = 0V, E_{CR} = 2.5V$



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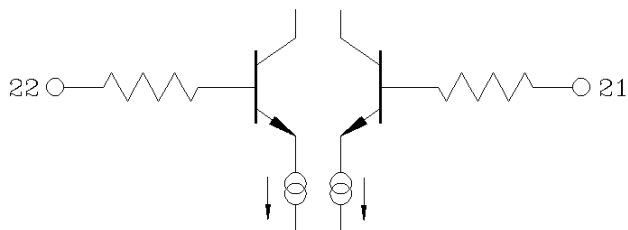
## 1. Input-Output Circuit

### (1) Power Save (23 pin)



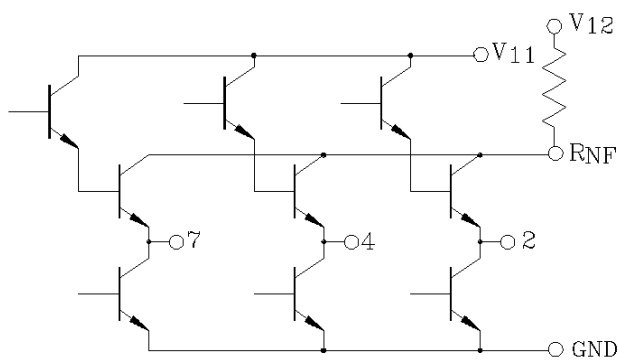
**Fig-8.**

### (3) Torque Input (22 pin)



**Fig-9.**

### (4) Coil Output

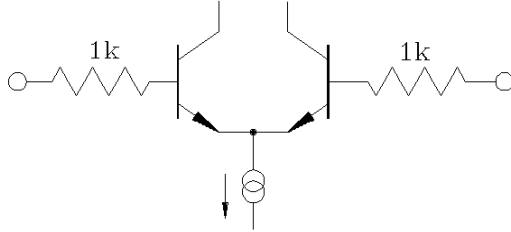


**Fig-10.**

# KIA6833HF

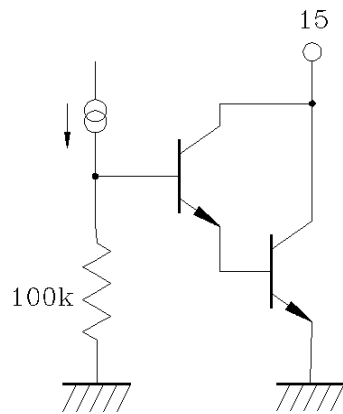
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(5) Hall Input ( $H_1^+$ :9pin,  $H_1^-$ :10pin,  $H_2^+$ :11pin,  $H_2^-$ :12pin,  $H_3^+$ :13PIN,  $H_3^-$ :14pin)



**Fig-11.**

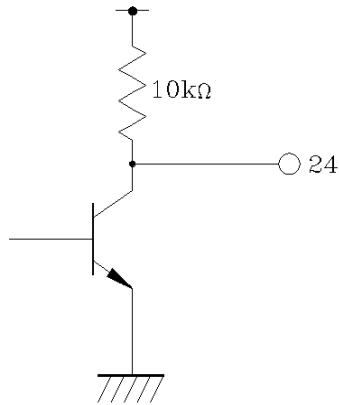
(6) Hall Bias (15pin)



**Fig-12.**

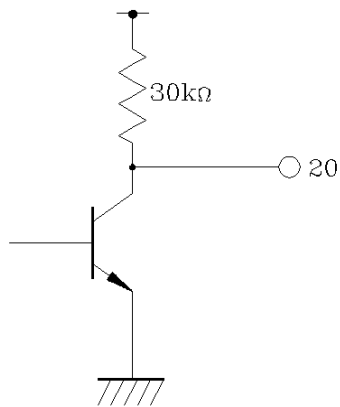
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(7) FG Output (24 pin)



**Fig-13.**

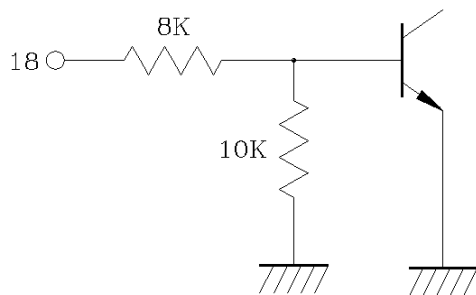
(8) FR Output (20 pin)



	FR Signal Output
Forward	L
Reverse	H

**Fig-14.**

(9) Short Brake (18 pin)

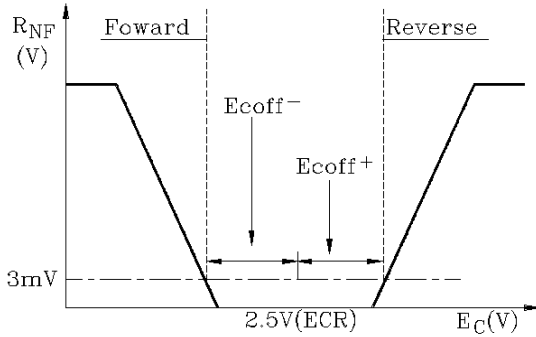


**Fig-15.**

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## 2. Torque

The range of the torque voltage is as shown below.



**Fig-16.**

	Rotation
$E_C < E_{CR}$	Forward Rotation
$E_C > E_{CR}$	Stop after Detecting Reverse Rotation

The GEC is determined by  $R_{NF}$   
(Where  $G_{EC} : E_C - R_{NF}$  gain)

$$G_{EC} = 0.255 / R_{NF} \text{ [A/V]}$$

Torque limit current  $I_{TL}$

$$I_{TL} = 0.35 / R_{NF} \text{ [A]}$$

## 3. (Start/Stop)

Pin 23	KIA6833HF
High	Start
Low	Stop

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## 4. REVERSE ROTATION PREVENTION

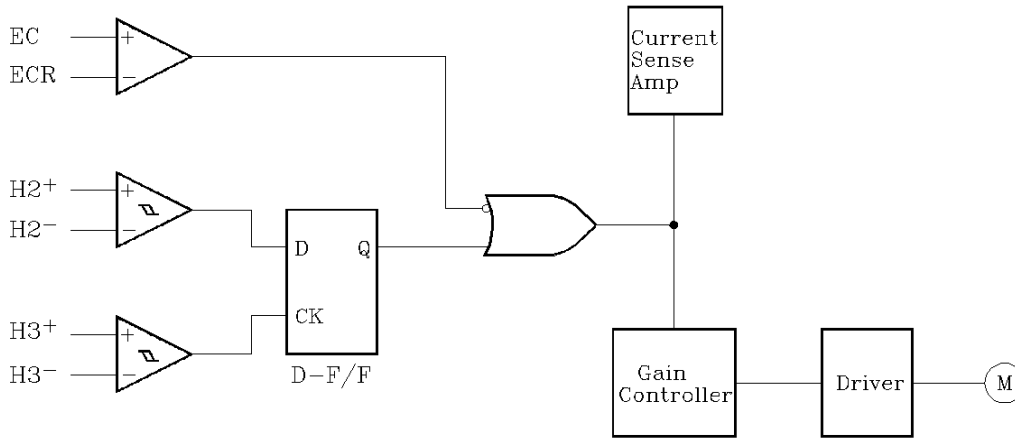


Fig-17.

- 1) The forward and the reverse rotation of the motor are detected, as shown in the below Table, by the circuit as shown in the above. Consequently at reverse rotation, the output Q becomes LOW and cuts off the output of the Current Sense Amp, resulting in the stoppage of the Gain Controller function.
- 2) When the CD is rotating in the forward direction,  $E_C > E_{CR}$  is sometimes controlled to retard and/or to stop the CD. As the controlling time of  $E_C > E_{CR}$  gets longer, CD slows down, stops, and then rotates in the reverse direction. To prevent the CD from rotating in the reverse direction, a reverse rotation resistant function is required. Its operational principles are discussed in  5ROTATIONAL DIRECTION DETECTION , and are summarized in the below.

Rotation	H2	H3	D-E/F (Q)	Reverse Rotation Preventer	
				$E_C < E_{CR}$	$E_C > E_{CR}$
Forward	H	H→L	H	Forward	Brake and Stop
Reverse	L	L→H	L	Breaks and Stop	

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## 5. (Forward Rotation)

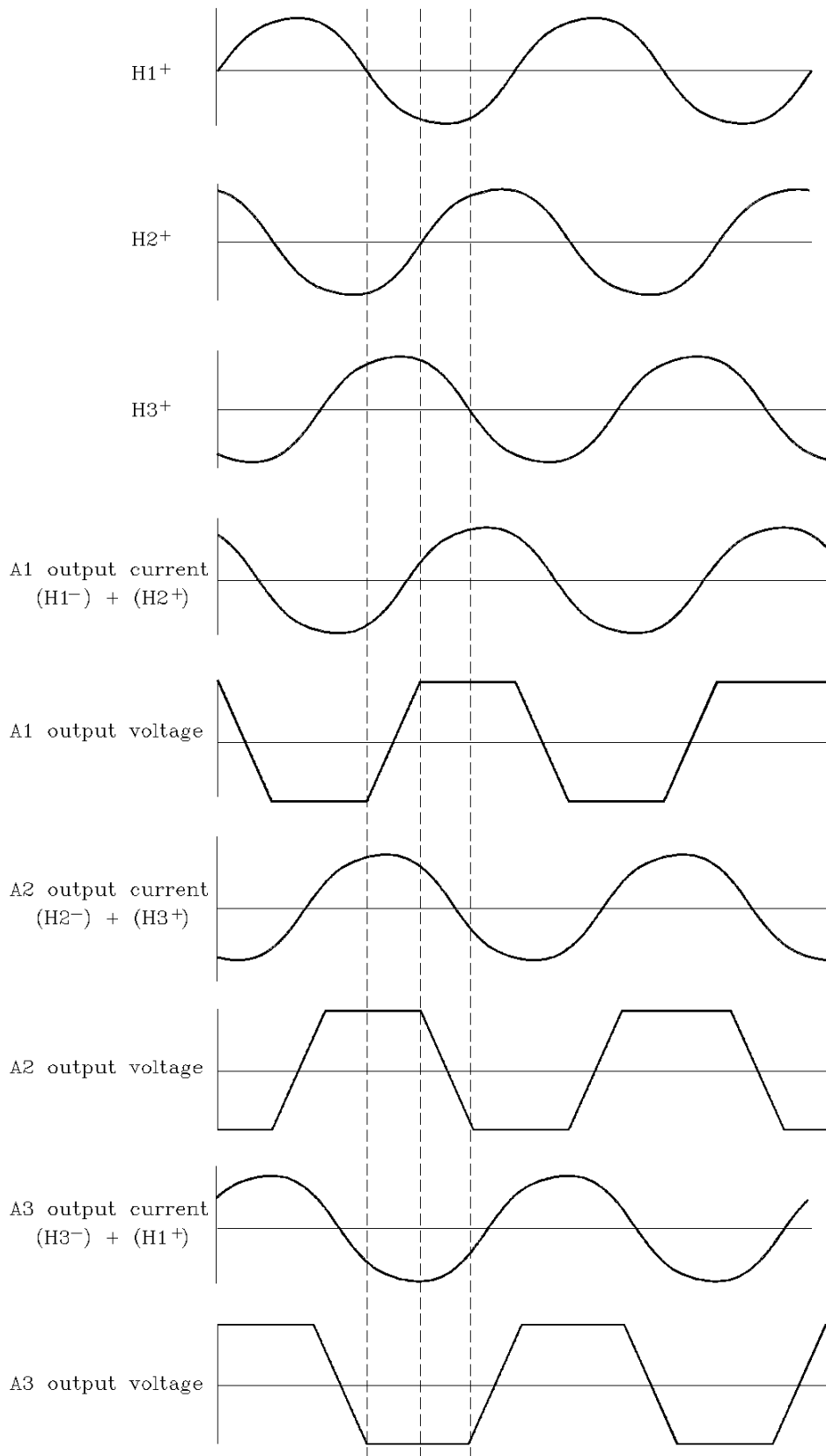
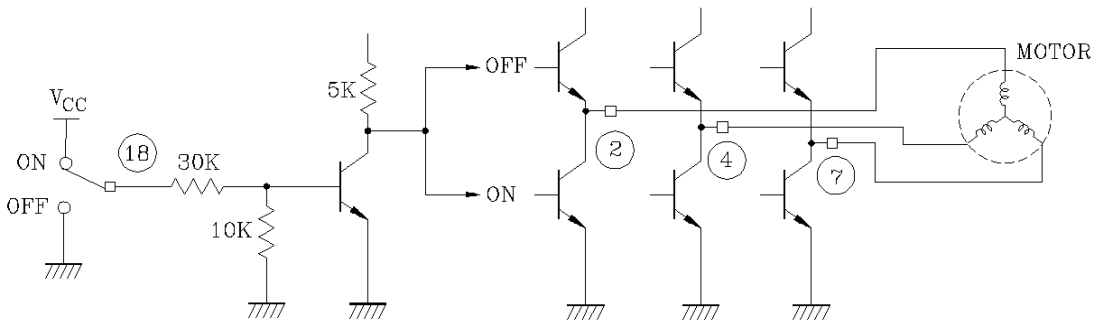


Fig-18.

# KIA6833HF

## 6. SHORT BRAKE

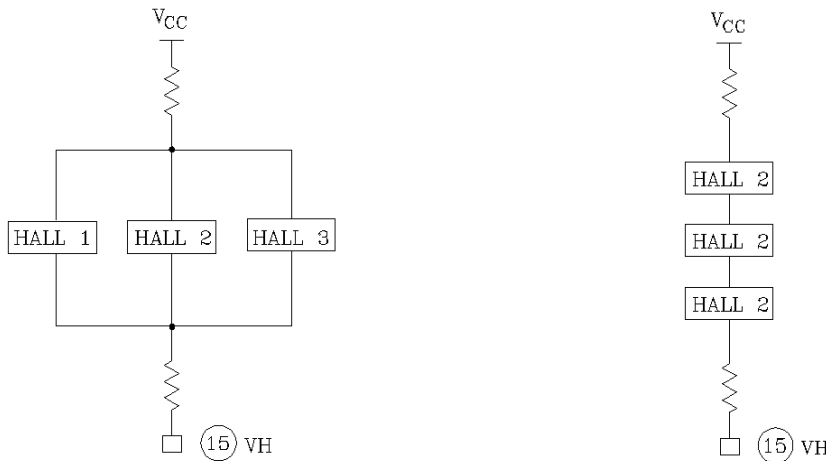


**Fig-19.**

Pin #18	Short Brake
HIGH	ON
LOW	OFF

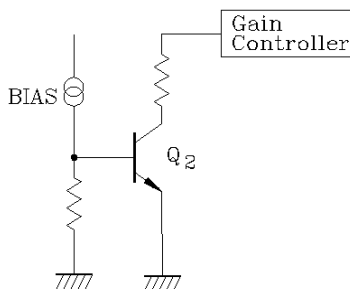
When the pick-up part moves from the inner to the outer spindle of the CD, the Brake function of the reverse voltage is commonly employed to retard the rotative velocity of the reverse voltage may produce much heat at Drive IC. To remove these shortcomings and to enhance the efficiency, the short breaks function is added to when short brake function is active, all upper Power TRs turn off and all Lower Power TRs turn on, so as to make the rotative velocity of the Motor slow down.

## 7. HALL SENSOR CONNECTION



**Fig-20.**

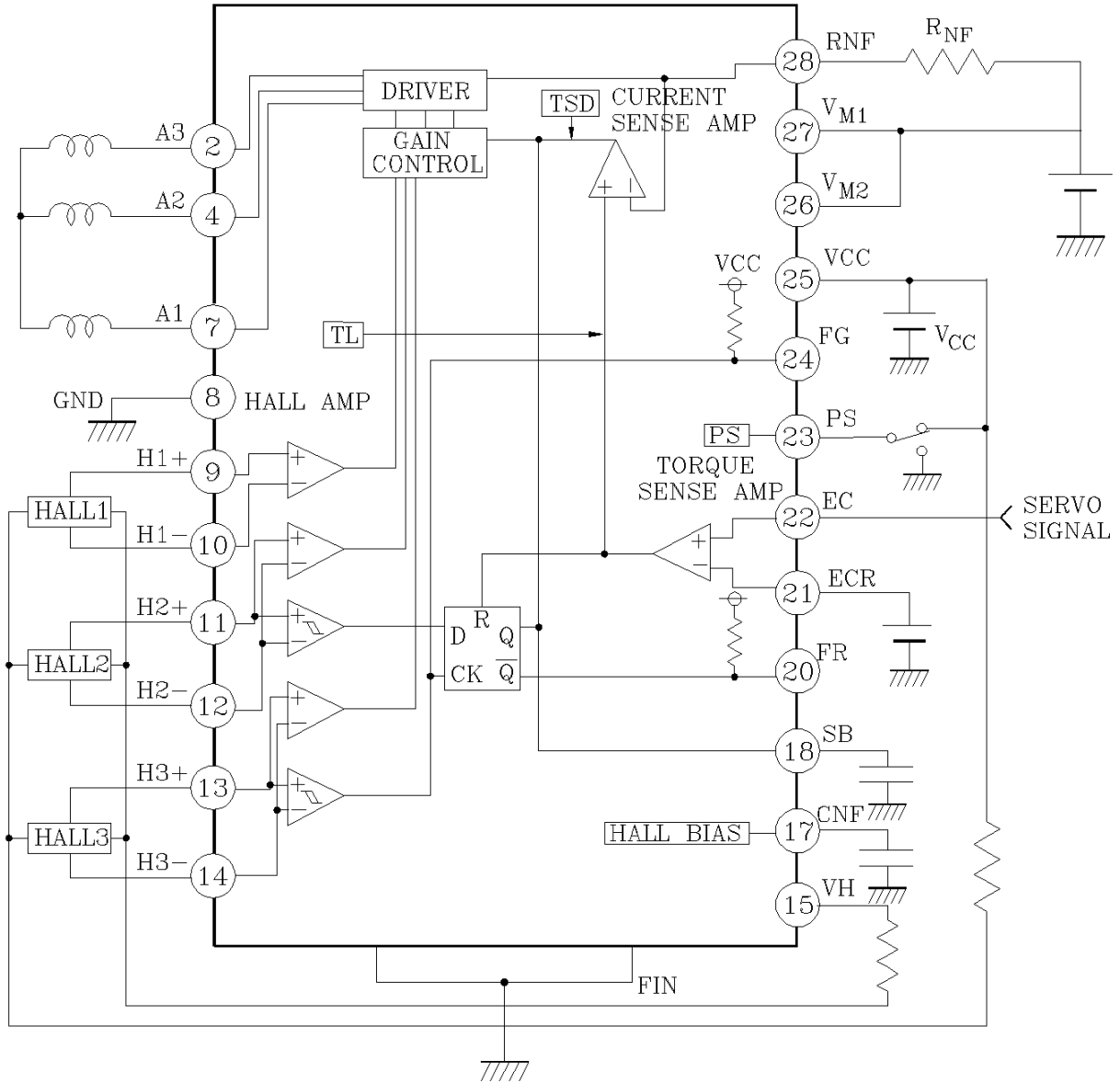
## 8. TSD (Thermal Shutdown)



When the chip temperature rises up to about 175°C then the Q2 would turn on so the output driver will be shutdown, and then when the chip temperature falls off to about 160°C then the Q2 would turn off so the driver will be normally operated. It has the temperature Hysteresis of about 15°C

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## TYPICAL APPLICATIONS

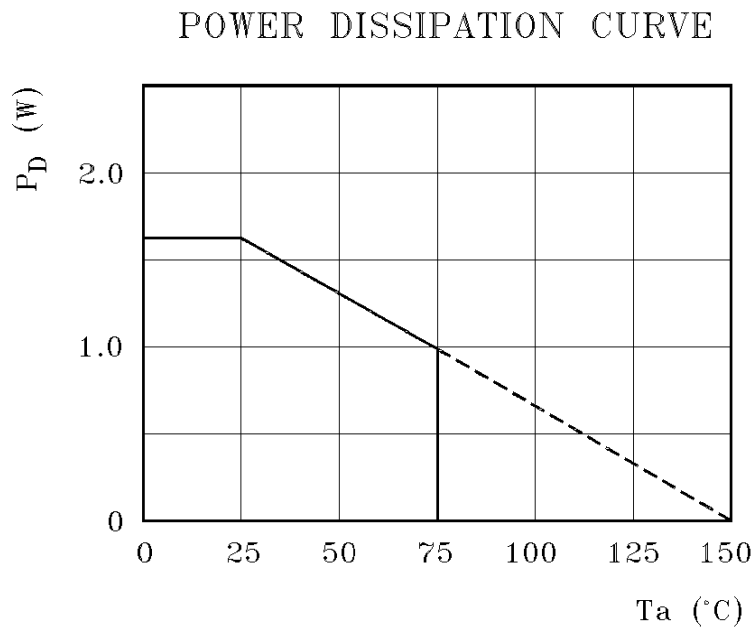




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## POWER DISSIPATION CURVE



- Note) 1. When mounted on 70mm×70mm×1.6mm PCB (Phenolics resin material)  
2. Power dissipation reduces 13.6mW/ $^{\circ}C$  for using above  $T_a=25^{\circ}C$