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3 phase BLDC Motor Driver IC S3313

Description

The S3313 is a three phase brushless DC motor driver for DVD-P/R/RW. It contains various function for driving BLDC motor in safety. Especially, it contains 3 phase hall input terminal for computing the motor status with hall amps and FG, F-F. it makes a stable movement. Especially, it supports DVD-RW applications with pb free and heat-sink package.

SSOPH-28

With Heat-sink

Application

◈ DVD-Player

◈ DVD-R

◈ DVD-RW

ORDERING INFORMATION

Product Name	Marking	Package Name
S3313	S3313	SSOPH-28

▲ **Marking Information**

① Device Code

② Year & Week Code

Features and Benefits

◈ Three-phase full-wave pseudo linear driving system.

◈ Built in power save, thermal shut down circuit [TSD].

◈ Built in current limit, Hall Bias circuit.

◈ Built in FG-output, FG 3phase synthesize output.

◈ Built in rotation detect.

◈ Built in reverse protection circuit.

◈ Built in Gain switch pin.

◈ Built in Short Brake pin.

◈ Built in Brake Mode pin.

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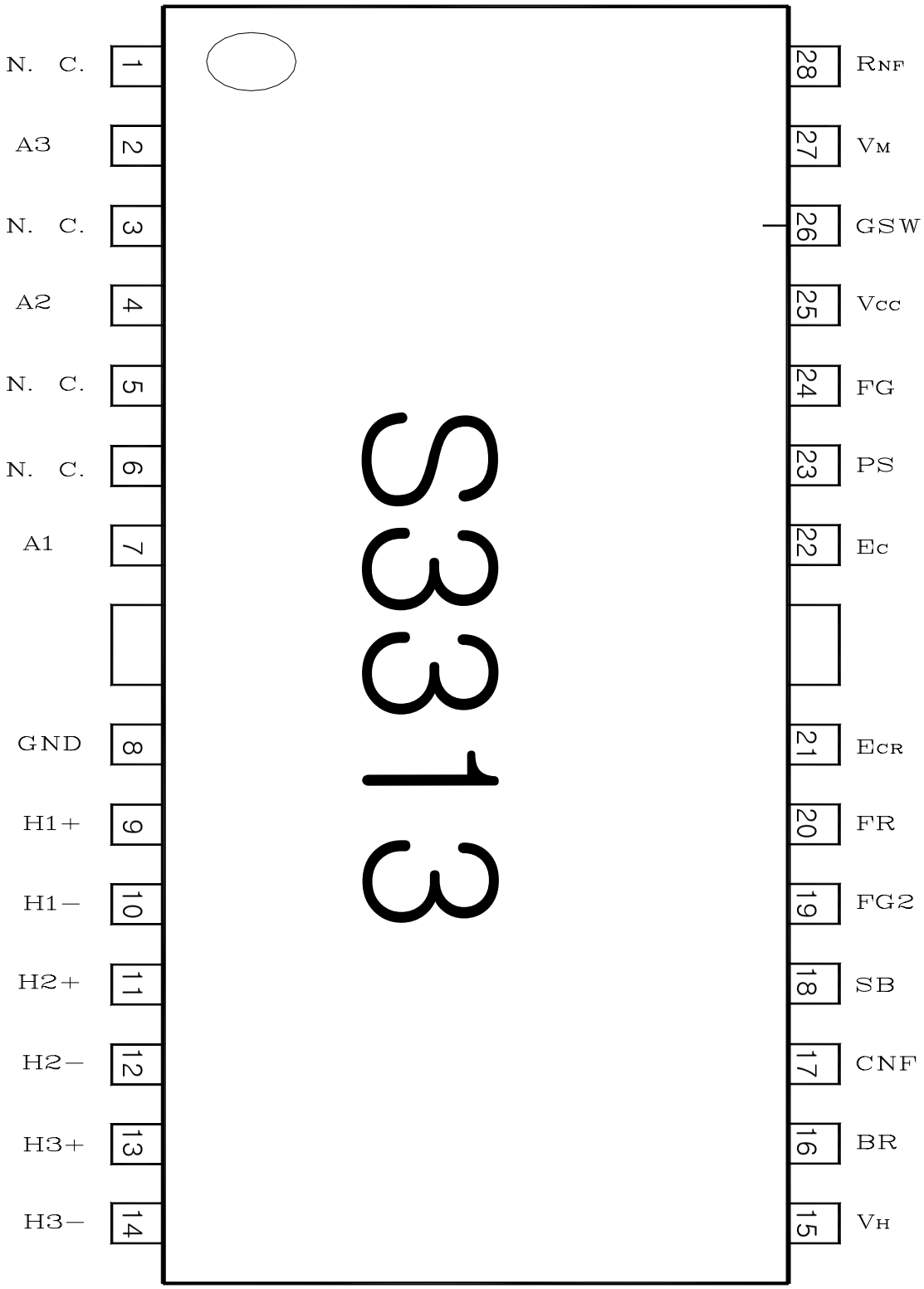
◈ Pin Assignment



◈ Pin Description

NO	SYMBOL	I/O	DESCRIPTION
1	N.C.	-	N.C.
2	A_3	O	Output3 for motor
3	N.C.	-	N.C.
4	A_2	O	Output2 for motor
5	N.C.	-	N.C.
6	N.C.	-	N.C.
7	A_1	O	Output1 for motor
8	GND	-	Ground
9	H_1^+	I	Positive input for hall input AMP1
10	H_1^-	I	Negative input for hall input AMP1
11	H_2^+	I	Positive input for hall input AMP2
12	H_2^-	I	Negative input for hall input AMP2
13	H_3^+	I	Positive input for hall input AMP3
14	H_3^-	I	Negative input for hall input AMP3
15	V_H	O	Hall bias terminal
16	BR	I	Brake Mode terminal
17	C_{NF}	I	Capacitor connection pin for phase compensation
18	SB	I	Short brake terminal
19	FG2	O	3phase synthesized FG signal output terminal
20	FR	O	Rotation detect signal output terminal
21	E_{CR}	I	Torque control standard voltage input terminal
22	E_C	I	Torque control voltage input terminal
23	PS	I	Start & Stop switch
24	FG	O	FG signal output terminal
25	V_{CC}	PWR	Power supply for signal division
26	GSW	I	Gain switch
27	V_M	PWR	Power supply for driver division
28	R_{NF}	I	Resistance connection pin for output current sense

◈ Absolute Maximum Ratings (Ta = 25℃)

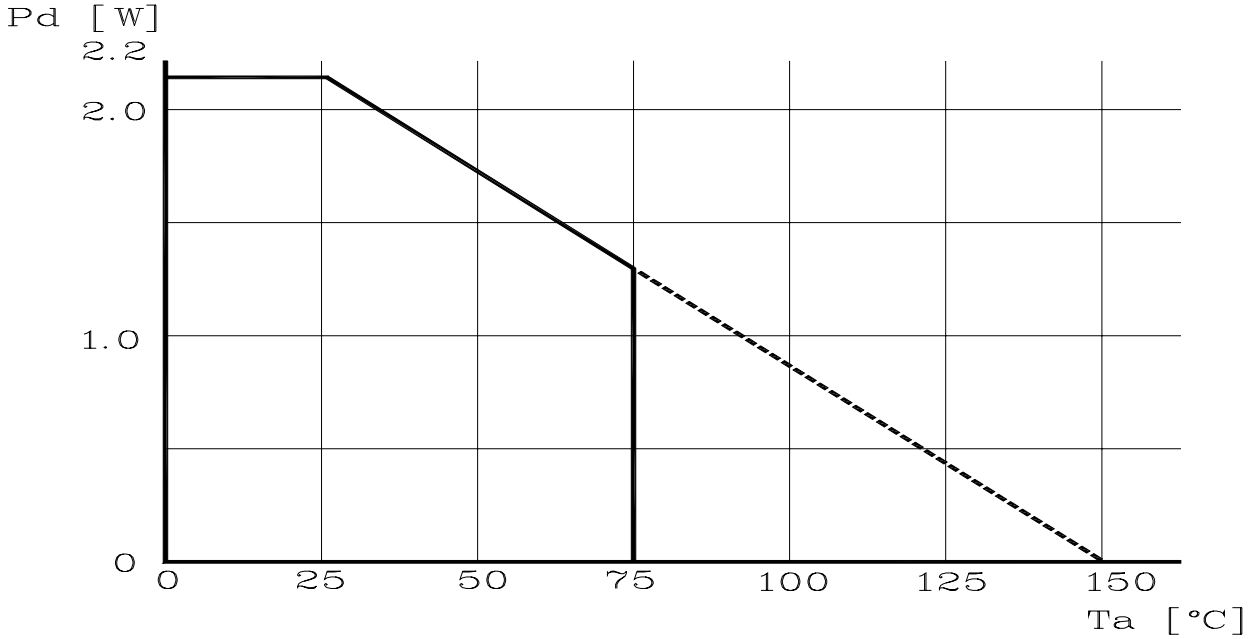
Parameter	Symbol	Limits	Unit
Supply Voltage	V_{CC}	7	V
	V_M	15	V
Power Dissipation	P_d	2.2	W
Operate Temperature Range	T_{opr}	-20 ~ +75	℃
Storage Temperature Range	T_{stg}	-55 ~ +150	℃

[Pd] When mounted on a 70mm×70mm×1.6mm glass epoxy board.
Derating in done 17.6mW/℃ for operating above Ta=25℃
[T_{stg}] Should not exceed Pd or SOA and T_j=150℃ values

◈ Guaranteed Operating Conditions (Ta = 25℃)

Parameter	Symbol	Limits	Unit
Power Supply Voltage	V_{CC}	4.5 ~ 5.5	V
	V_M	3.0 ~ 14	V

◈ Power Dissipation Curve [Pd]



◈ 70mm×70mm×1.6mm glass epoxy board .
◈ De-rating is done at 17.6mW/℃ for operating above T_a=25℃

◈ Electrical Characteristics 1

(Unless otherwise specified Ta=25℃, Vcc=5V, V_M=12V)

NO	Characteristics	Symbol	Condition	Specification			Unit
				MIN.	TYP.	MAX.	
1	Circuit Current 1	I_{CC1}	PS=L, GSW=Open	-	0	0.2	mA
2	Circuit Current 2	I_{CC2}	PS=H, GSW=Open	-	6.2	9.1	mA
< Power Save >							
3	On Voltage Range	V_{PSON}	Circuit OFF	-	-	1.0	V
4	OFF Voltage Range	V_{PSOFF}	Circuit ON	2.5	-	-	V
< Hall Bias >							
5	Hall Bias Voltage	V_{HB}	I_{HB}=10mA	0.5	0.9	1.5	V
< Hall AMP >							
6	Input Bias Current	I_{HA}		-	0.7	3.0	uA
7	In-phase Input Voltage Range	V_{HAR}		1.0	-	4.0	V
8	Minimum Input Level	V_{INH}		50	-	-	mV_{PP}
9	H_3 Hysteresis Level	V_{HYS}		5	20	40	mV
< Torque Control >							
10	Input Voltage Range	E_C, E_{CR}	Linear Range 0.5 ~ 3.3V	0	-	5.0	V
11	Offset Voltage (-)	E_{COFF-}	E_{CR}=1.65V, GSW=L	-75	-45	-15	mV
12	Offset Voltage (+)	E_{COFF+}	E_{CR}=1.65V, GSW=L	15	45	75	mV
13	Input Current	E_{CIN}	E_C=E_{CR}	7.4	9.2	11	uA
14	Input-Output Gain L	G_{ECL}	GSW=L, RNF=0.5Ω	0.52	0.65	0.78	A/V
15	Input-Output Gain M	G_{ECM}	GSW=OPEN, RNF=0.5Ω	1.04	1.30	1.56	A/V
16	Input-Output Gain H	G_{ECH}	GSW=H, RNF=0.5Ω R	2.24	2.80	3.36	A/V
< Gain Switch >							
17	Low Voltage Range	V_{GSWL}		-	-	1.0	V
18	Open Voltage Range	V_{GSWOP}		-	2.0	-	V
19	High Voltage Range	V_{GSWH}		3.0	-	-	V
< FG >							
20	FG Output High Voltage	V_{FGH}	I_{FG}=-20uA	4.5	4.8	-	V
21	FG Output Low Voltage	V_{FGL}	I_{FG}=3mA	-	0.2	0.4	V
< FG2 >							
22	FG2 Output High Voltage	V_{FG2H}	I_{FG2}=-20uA	4.6	4.9	-	V
23	FG2 Output Low Voltage	V_{FG2L}	I_{FG2}=3mA	-	0.2	0.4	V
24	Duty (Reference)	DU		-	50	-	%

◈ Electrical Characteristics 2

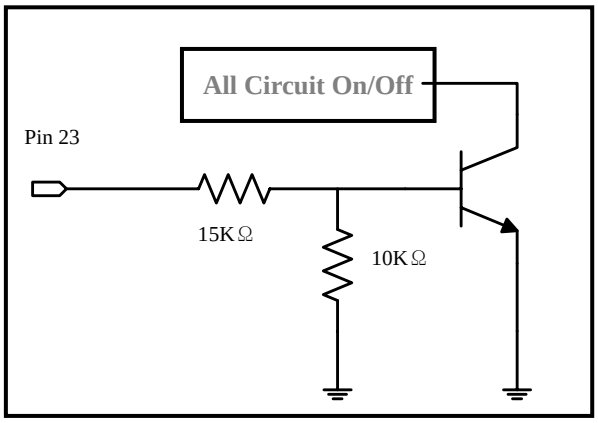
(Unless otherwise specified Ta=25℃, Vcc=5V, V_M=12V)

NO	Characteristics	Symbol	Condition	Specification			Unit
				MIN.	TYP.	MAX.	
< Rotation Detector >							
25	FR Output Voltage H	V_{FRH}	I_{FR} = -20uA	4.1	4.4	-	V
26	FR Output Voltage L	V_{FRL}	I_{FR} = 3mA	-	0.2	0.4	V
< Output >							
27	Saturation Voltage H	V_{OH}	I_O= -600mA	-	1.0	1.35	V
28	Saturation Voltage L	V_{OL}	I_O= 600mA	-	0.4	0.65	V
29	Pre-drive Current	I_{VML}	E_C=5V, Output = Open	-	35	70	mA
30	Torque Limit Current	I_{TL}	R_{NF}= 0.5Ω	560	700	840	mA
< Short Brake >							
31	On Voltage Range	V_{SBON}	BR=0V	2.5	-	-	V
32	OFF Voltage Range	V_{SBOFF}	BR=0V	-	-	1.0	V
< Brake Mode >							
33	On Voltage Range	V_{BRON}	E_C 〉 E_{CR}, SB=OPEN	2.5	-	-	V
34	OFF Voltage Range	V_{BROFF}	E_C 〉 E_{CR}, SB=OPEN	-	-	1.0	V

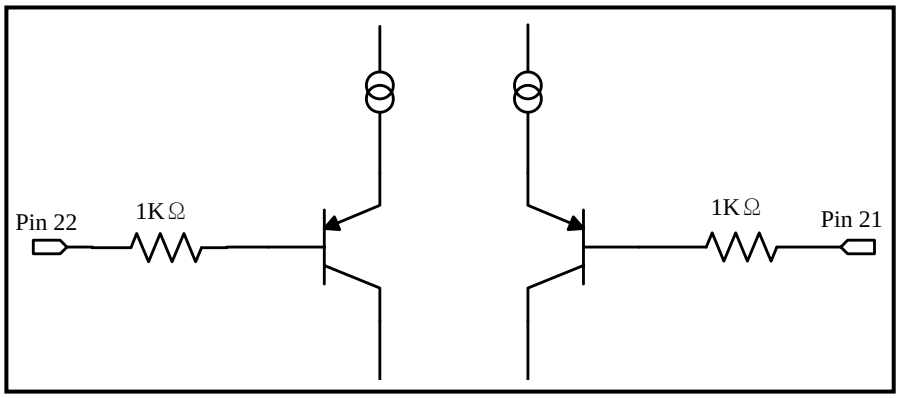
Application Information

1. Input-Output circuits

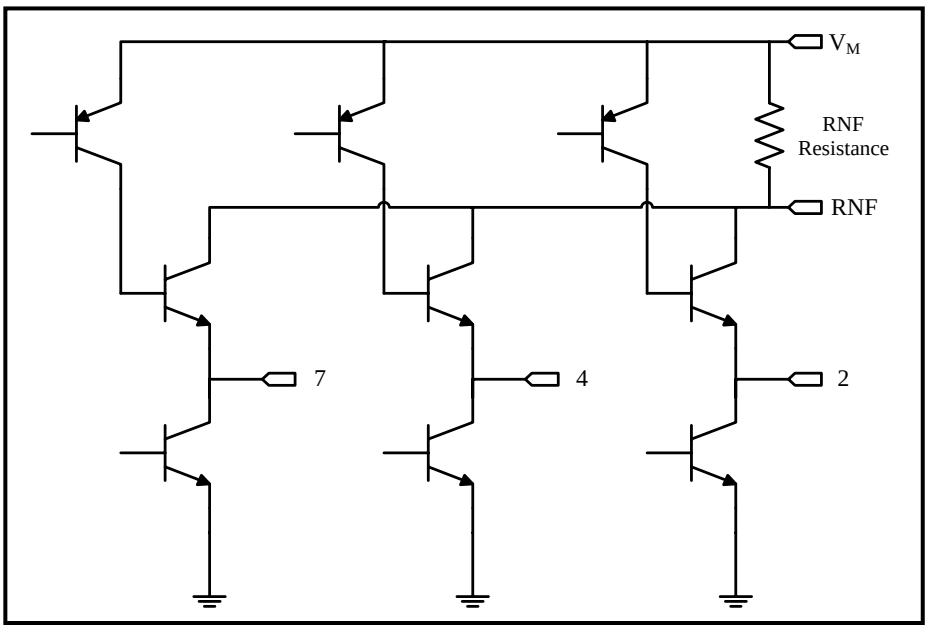
1) Power Save (Pin 23)



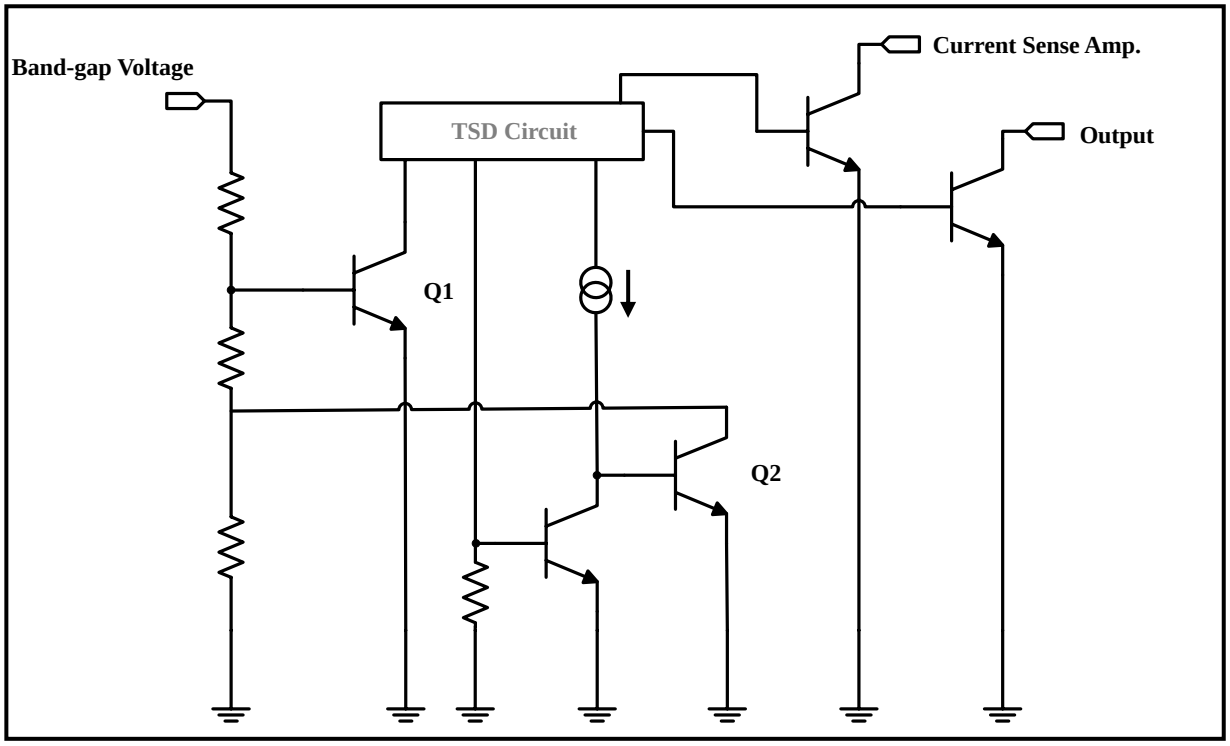
2) Torque control input (Pin 21, Pin 22)



3) 3phase output Power TR Structure (A1:Pin 7, A2:Pin 4, A3:Pin 2)

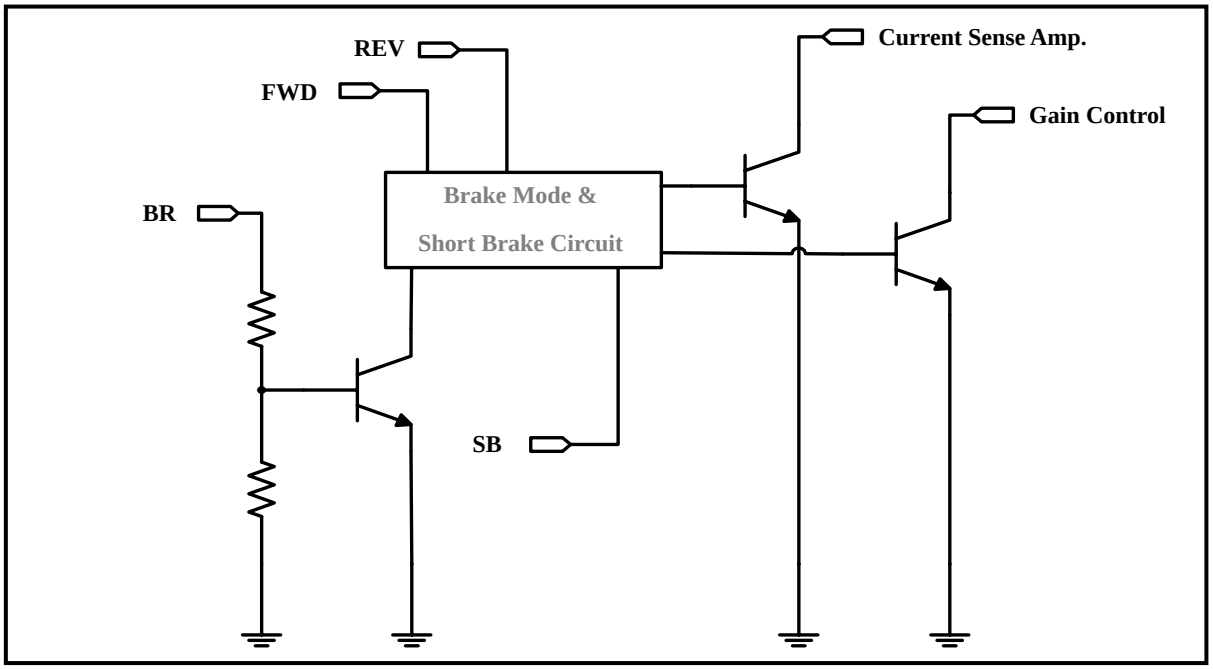


2. Thermal Shut Down (TSD)



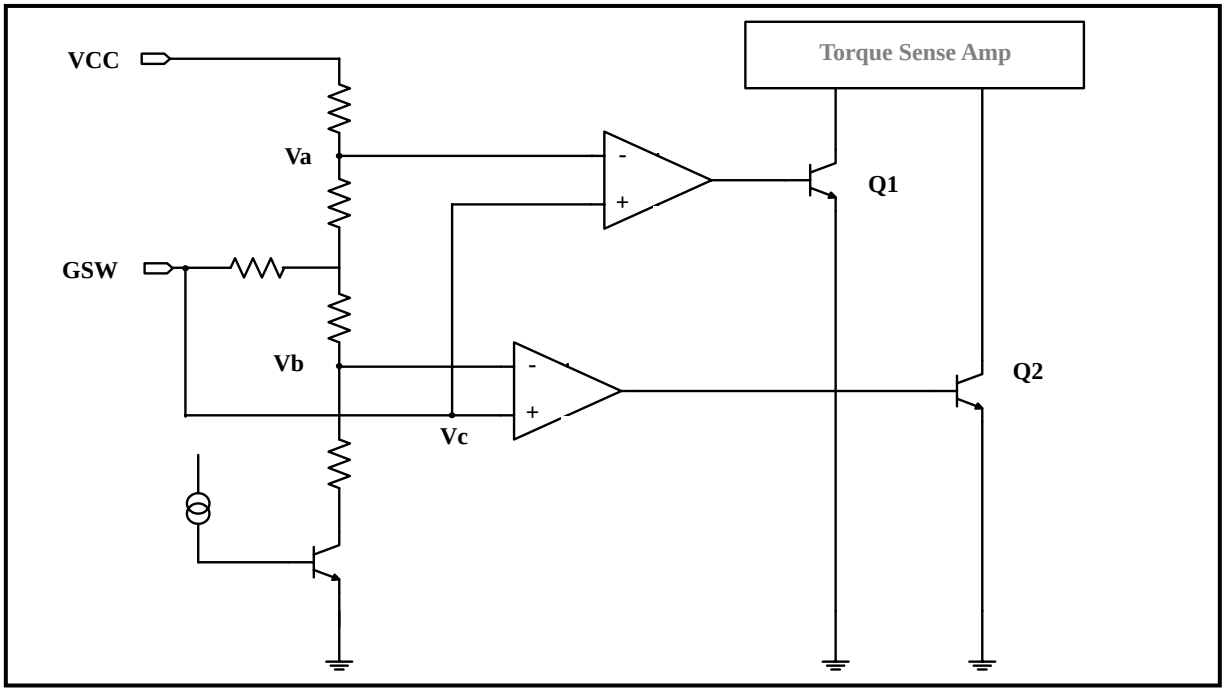
The built-in thermal shutdown circuit mutes the output current when the chip temperature reaches 175℃ (typ.). The hysteresis is set to 25℃ (typ.) by IHys,
so the circuit will start up again when the chip temperature falling to 150℃ (typ.)

3. Brake Mode & Short Brake Mode



Input “H” voltage to BR pin, change brake type at $E_C > E_{CR}$.
Input “H” to Short Brake pin. Short Brake operates to output-upper-Power Tr off and Output-lower-Power Tr on.

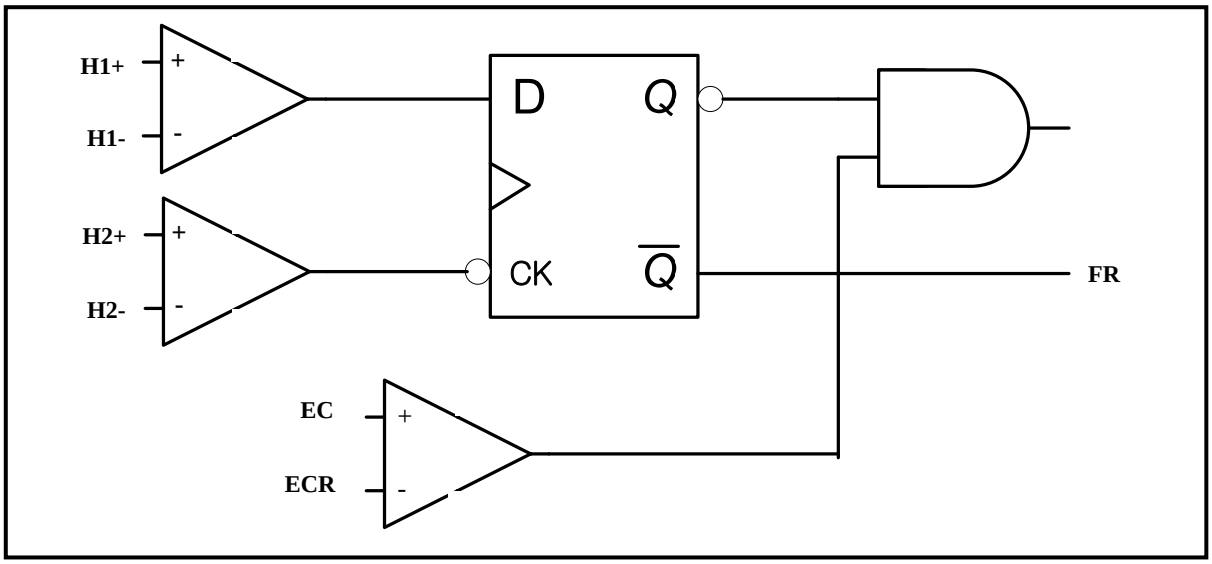
4. Gain Switch



We can determine the value of input-output gain G_{EC} by R_{NF}-resistance, and calculate it with the following formula.

$G_{EC}=0.325/R_{NF}$ [A/V] (GSW = Low : 0V)
$G_{ECM}=0.65/R_{NF}$ [A/V] (GSW = OPEN)
$G_{ECH}=1.40/R_{NF}$ [A/V] (GSW = High : 3V ↑)

5. Reverse Rotation Detector



Case 1] Forward Rotation (EC＜ECR)

Hall input H1+ and H2+ have phase relation as shown Reverse Rotation Detector circuit.

In this case, reverse detection don't operate.

Case 2] Reverse Rotation (EC＞ECR)

Hall input H1+ and H2+ have opposite relation to forward rotation.

So detective circuit operate, make output open.

Actual motor rotation at reverse detection

Forward Rotation at EC＜ ECR

↓

Rotating speed is decreased due to reverse torque at EC ＞ECR

↓

When motor starts to reverse, reverse detection operates and output become open

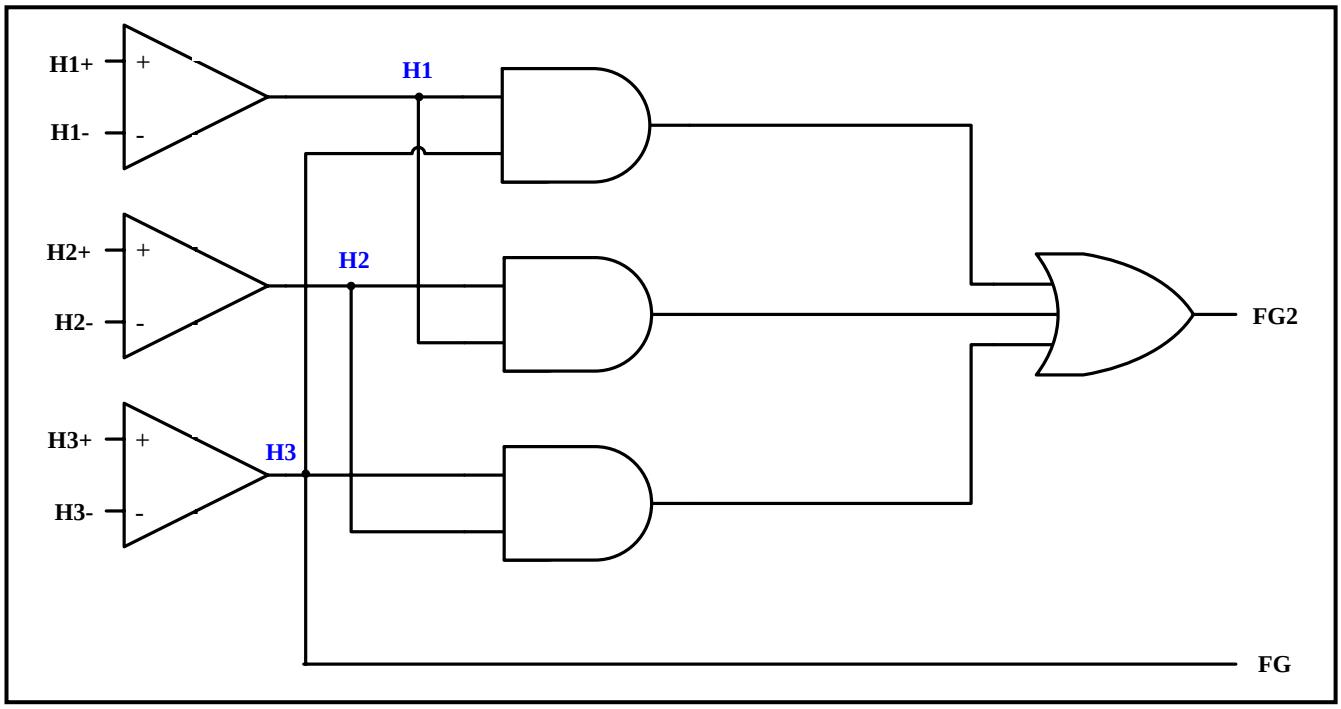
↓

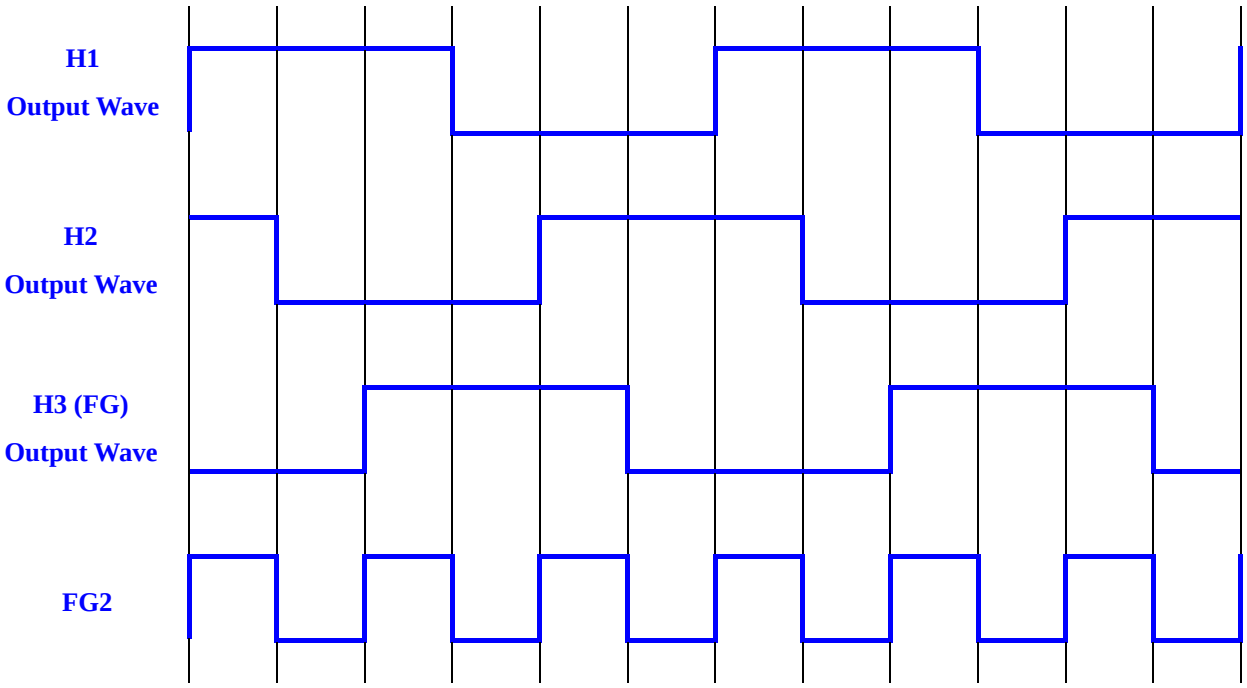
Rotating reverse at short time due to inertia

↓

Stop

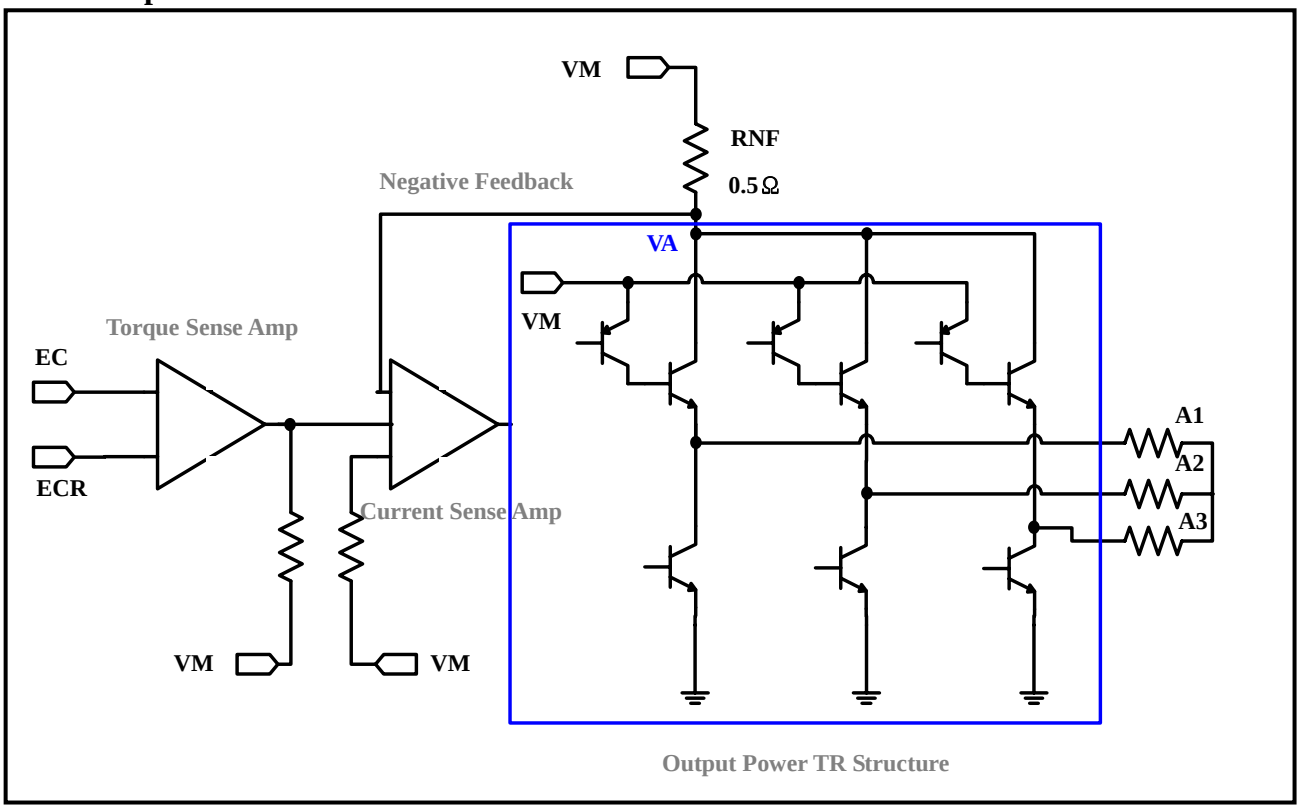
6. Rotation Speed Detection





DSP chip can detect rotation speed by this circuit, show us FG and FG2's output pulse.

7. Power Output



Forward rotation and Reverse rotation are decided by Torque Sense Amp.

Forward rotation [EC < ECR] **Reverse rotation [EC > ECR]**

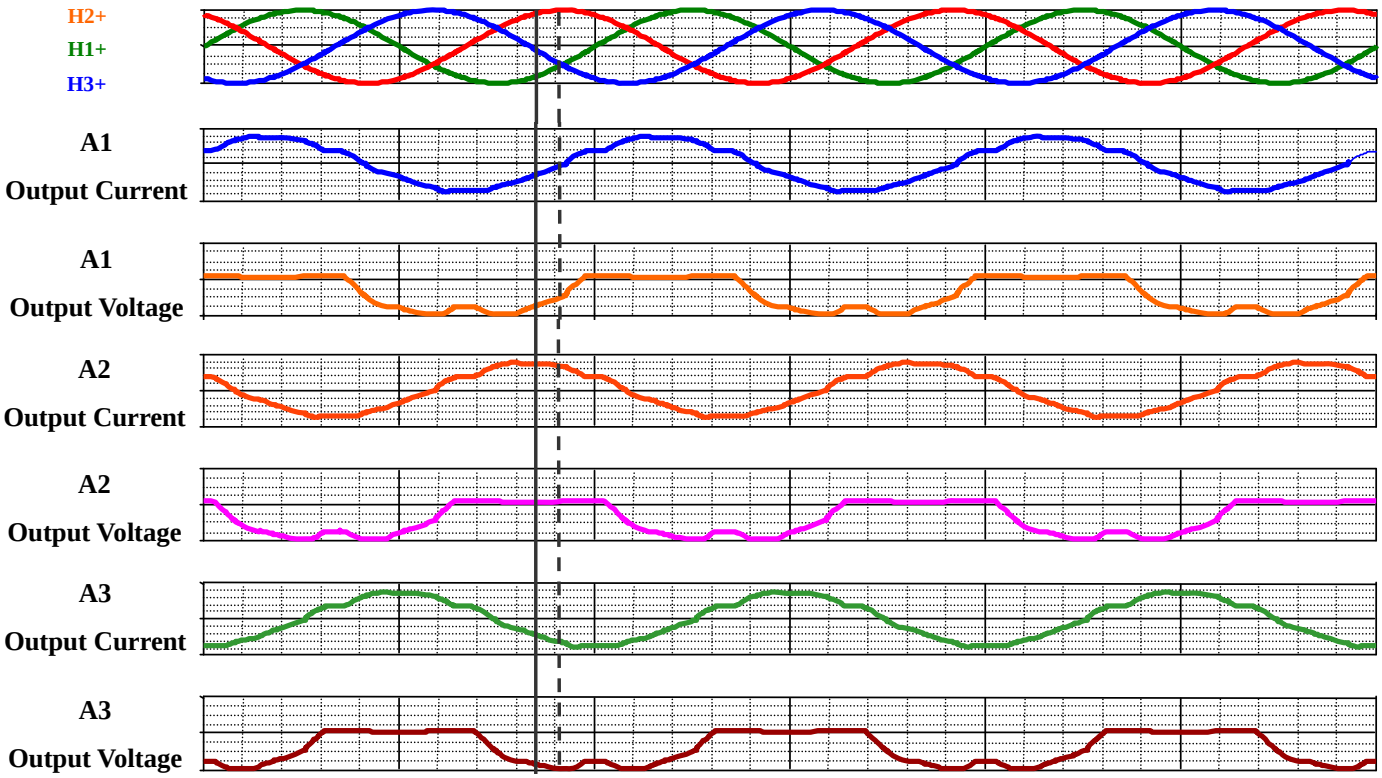
The Power Output's Current is controlled limitary, according to Torque Sense Amp's sink current and Current Sense Amp's source current, when EC and ECR have potential difference.

Maximum Current : Ilimit = VRNF / 0.5Ω (VRNF = VM-VA)

[Input-Output Table]

Input Condition							Output						Notice
							Forward Rotation			Reverse Rotation			
Pin no.	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	Pin 7 [H]
Condition 2	H	M	L	M	M	M	L	H	H	H	L	L	Pin 7 [L]
Condition 3	M	M	L	M	H	M	L	H	L	H	L	H	Pin 4 [H]
Condition 4	M	M	H	M	L	M	H	L	H	L	H	L	Pin 4 [L]
Condition 5	H	M	M	M	L	M	L	L	H	H	H	L	Pin 2 [H]
Condition 6	L	M	M	M	H	M	H	H	L	L	L	H	Pin 2 [L]

8. Input-Output Timing Chart



Characteristic Diagrams

Fig. 1 V_{CC} - I_{QC}

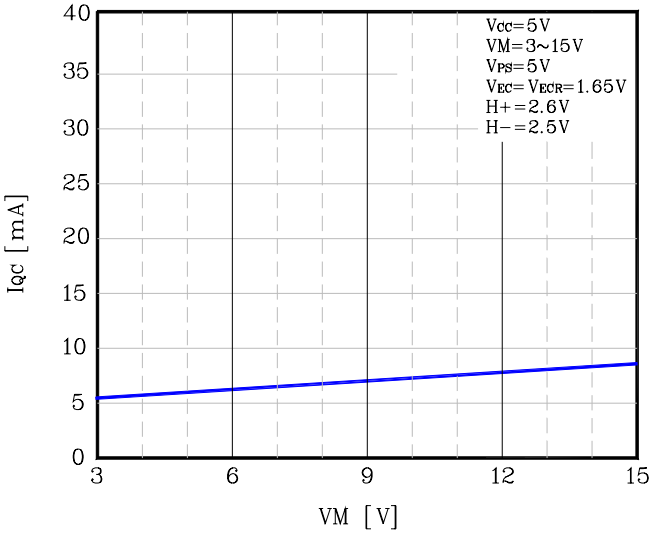


Fig. 2 Temperature - I_{QC}

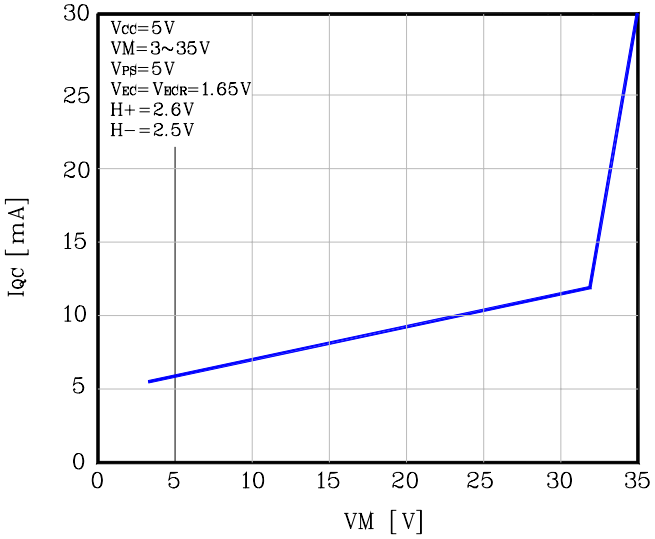


Fig. 3 V_{EC} - V_{ECOFF}

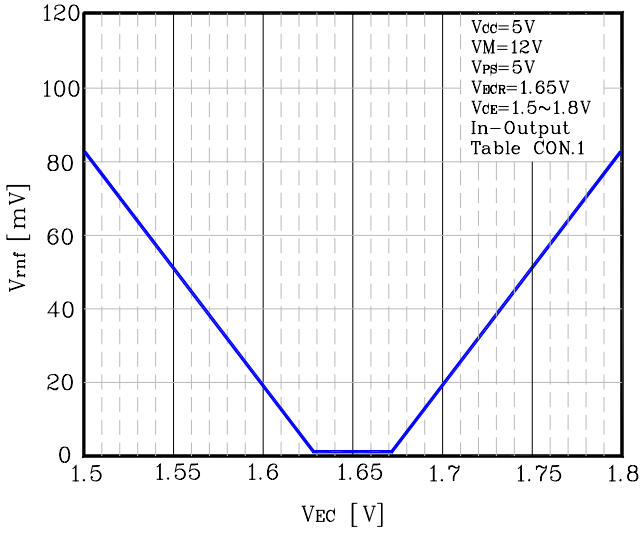


Fig.4 V_{GSW} - V_{rnf} [In-Output Gain]

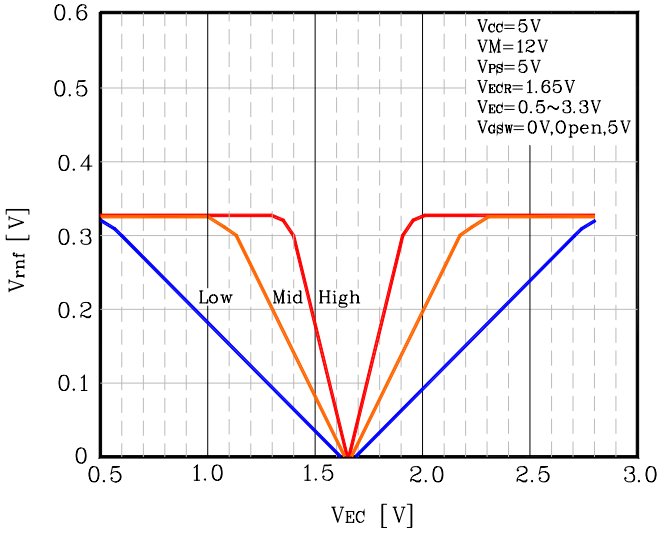


Fig. 5 V_{PS} - I_{qc}

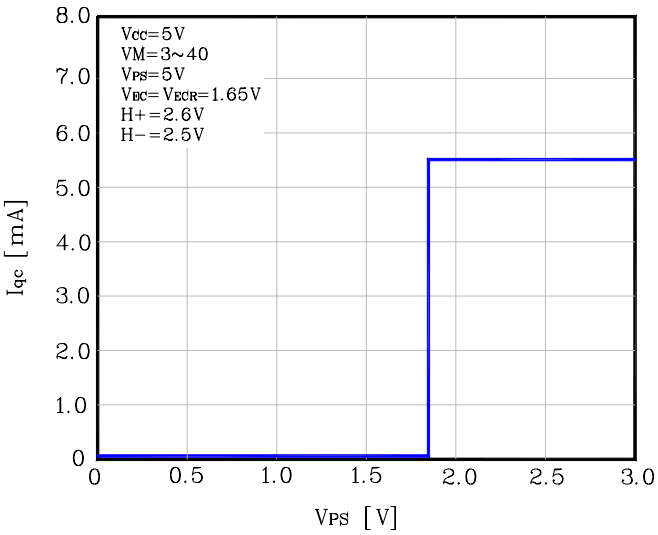
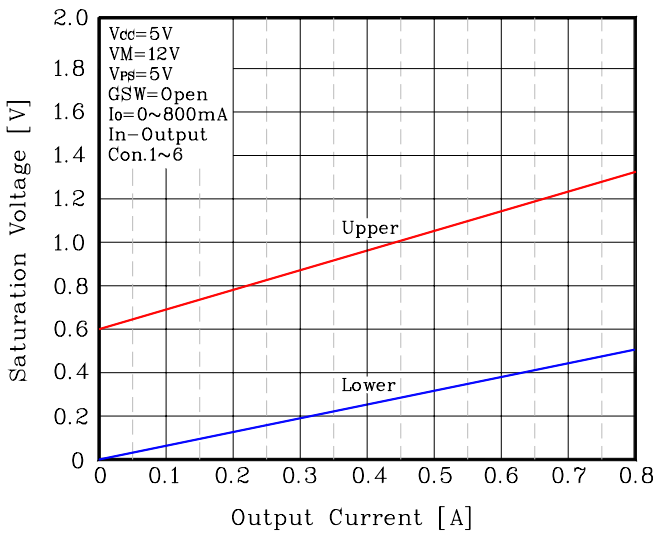
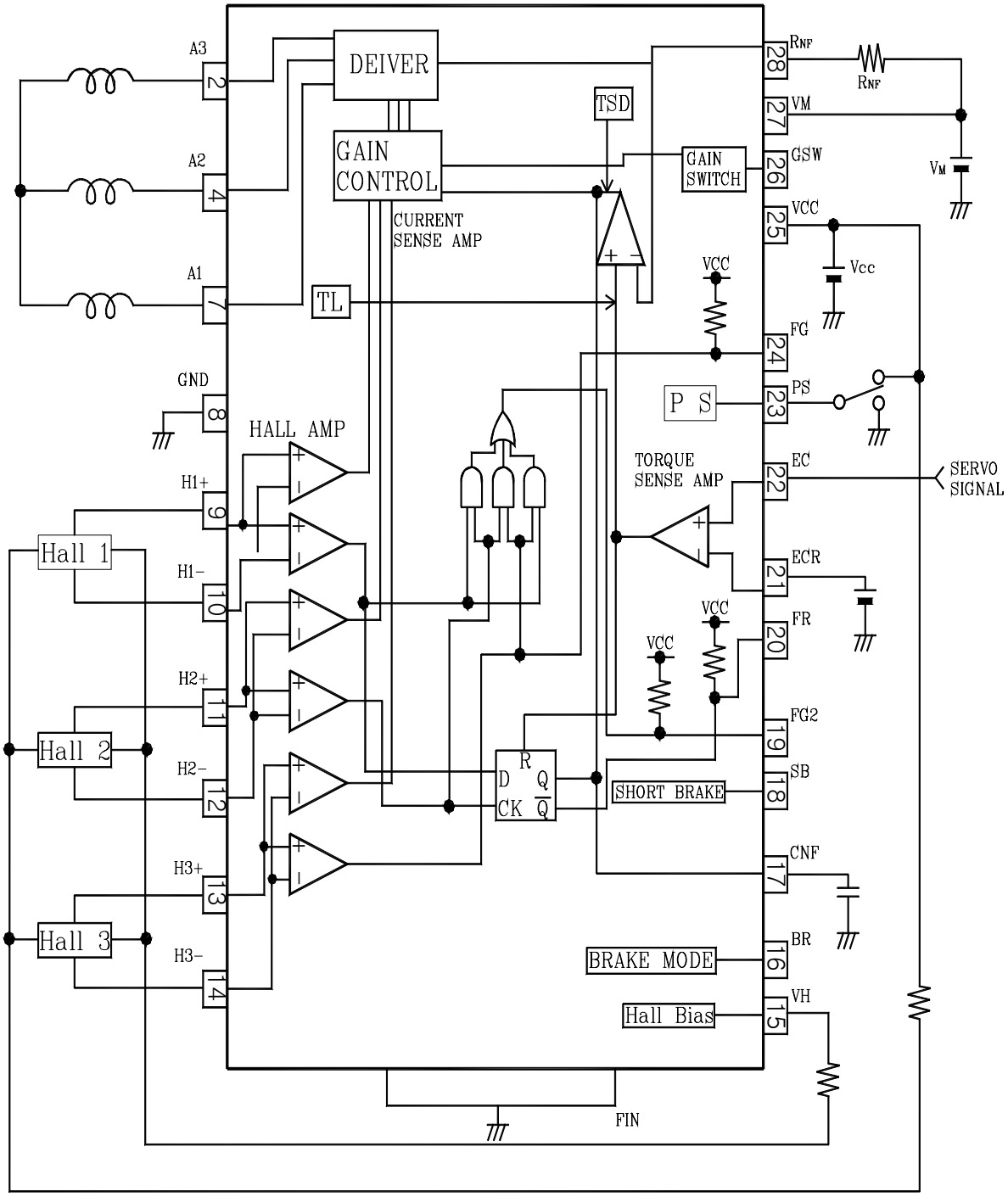


Fig.6 I_O – V_{Osat} [Upper/Lower]



◈ Application Circuit



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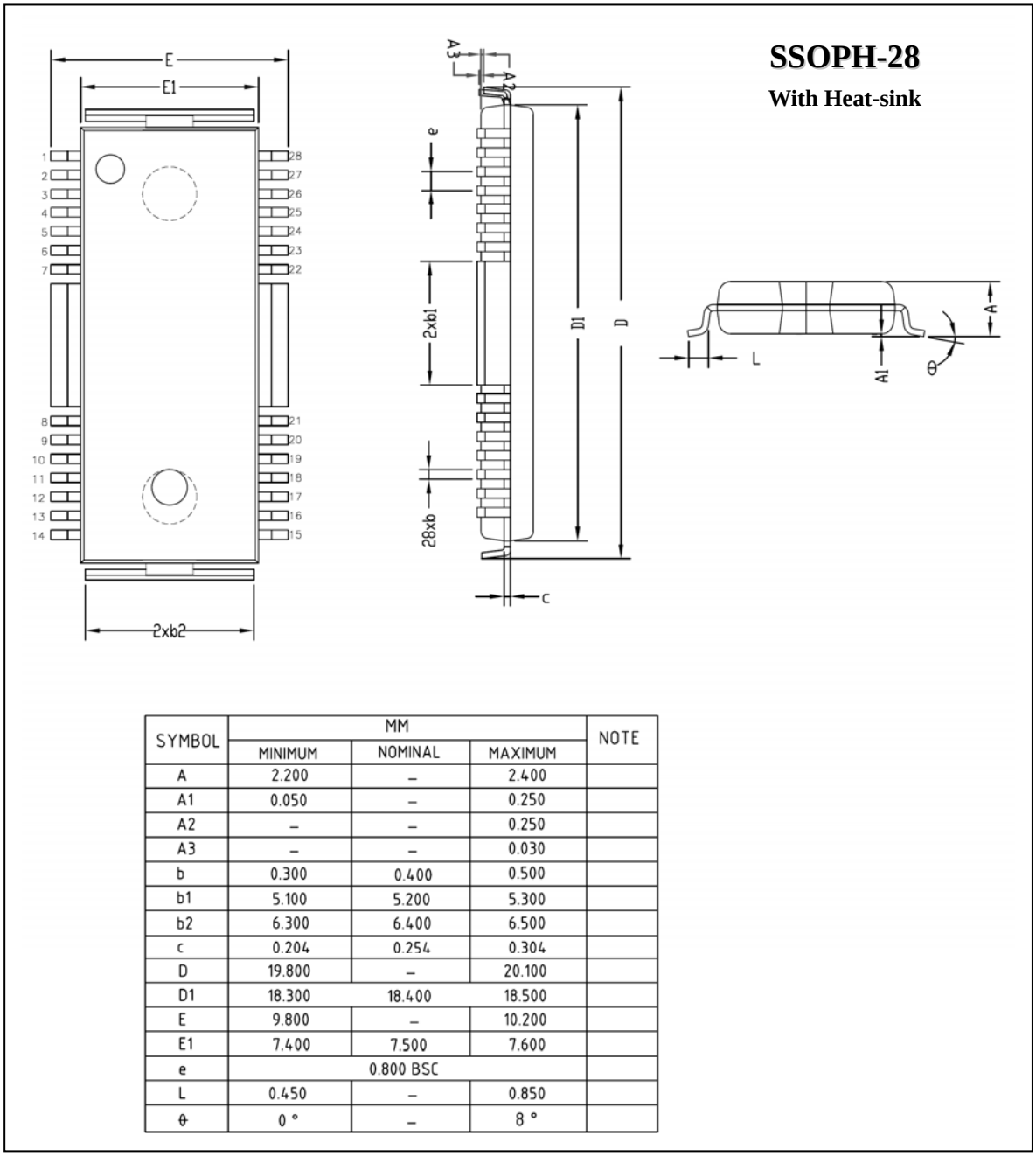
◈ Package Dimension



SYMBOL	MM			NOTE
	MINIMUM	NOMINAL	MAXIMUM	
A	2.200	–	2.400	
A1	0.050	–	0.250	
A2	–	–	0.250	
A3	–	–	0.030	
b	0.300	0.400	0.500	
b1	5.100	5.200	5.300	
b2	6.300	6.400	6.500	
c	0.204	0.254	0.304	
D	19.800	–	20.100	
D1	18.300	18.400	18.500	
E	9.800	–	10.200	
E1	7.400	7.500	7.600	
e		0.800 BSC		
L	0.450	–	0.850	
θ	0 °	–	8 °	

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