


SSOPH-28

With Heat-sink

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.

Application

- ◆ DVD-Player
- ◆ DVD-R
- ◆ DVD-RW

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.

ORDERING INFORMATION

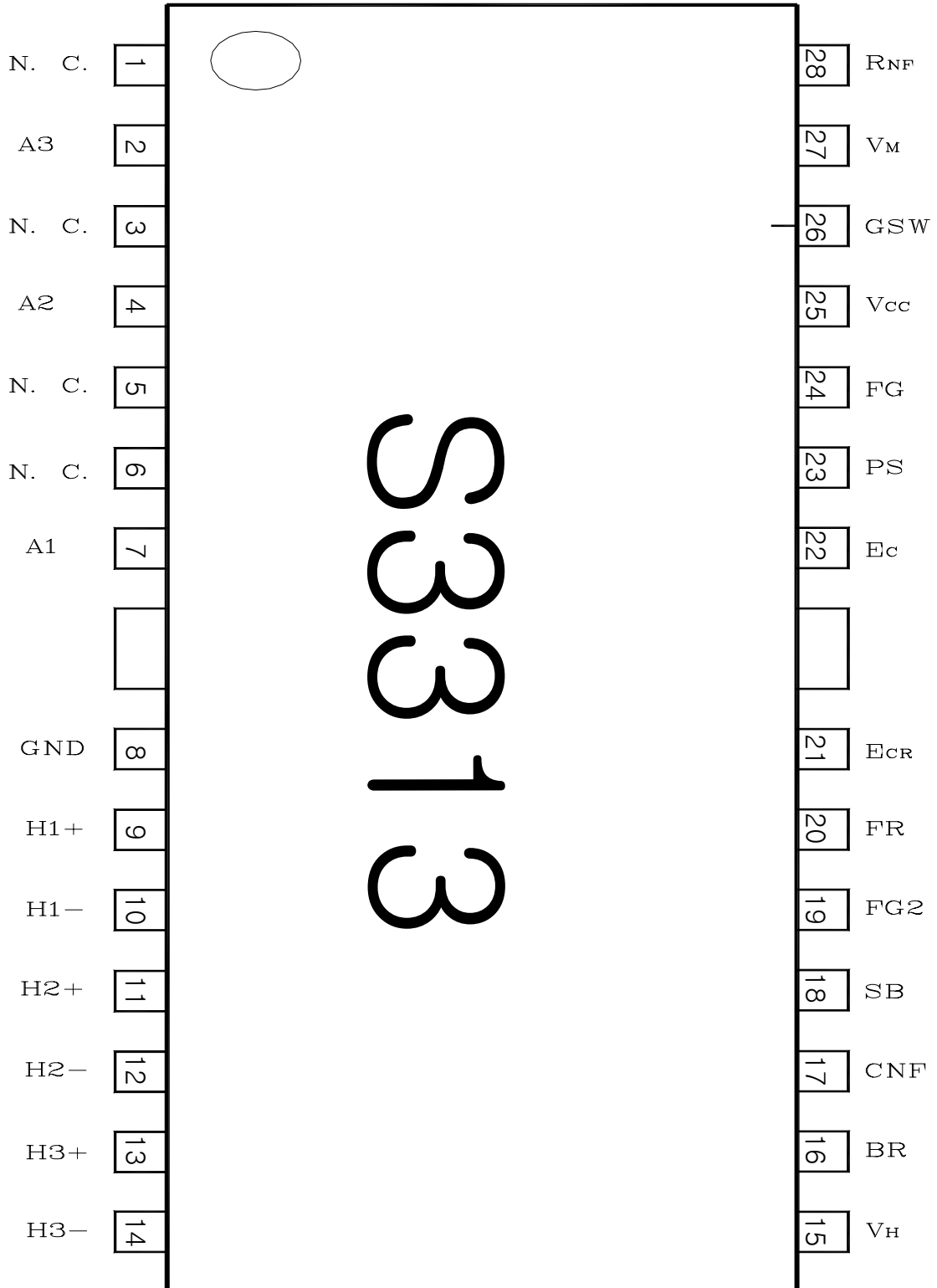
Product Name	Marking	Package Name
S3313	S3313	SSOPH-28

▲ Marking Information



- ① Device Code
- ② Year & Week Code

◆ 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 ($T_a = 25^\circ\text{C}$)

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	$^\circ\text{C}$
Storage Temperature Range	T_{stg}	-55 ~ +150	$^\circ\text{C}$

[P_d] When mounted on a 70mm×70mm×1.6mm glass epoxy board.

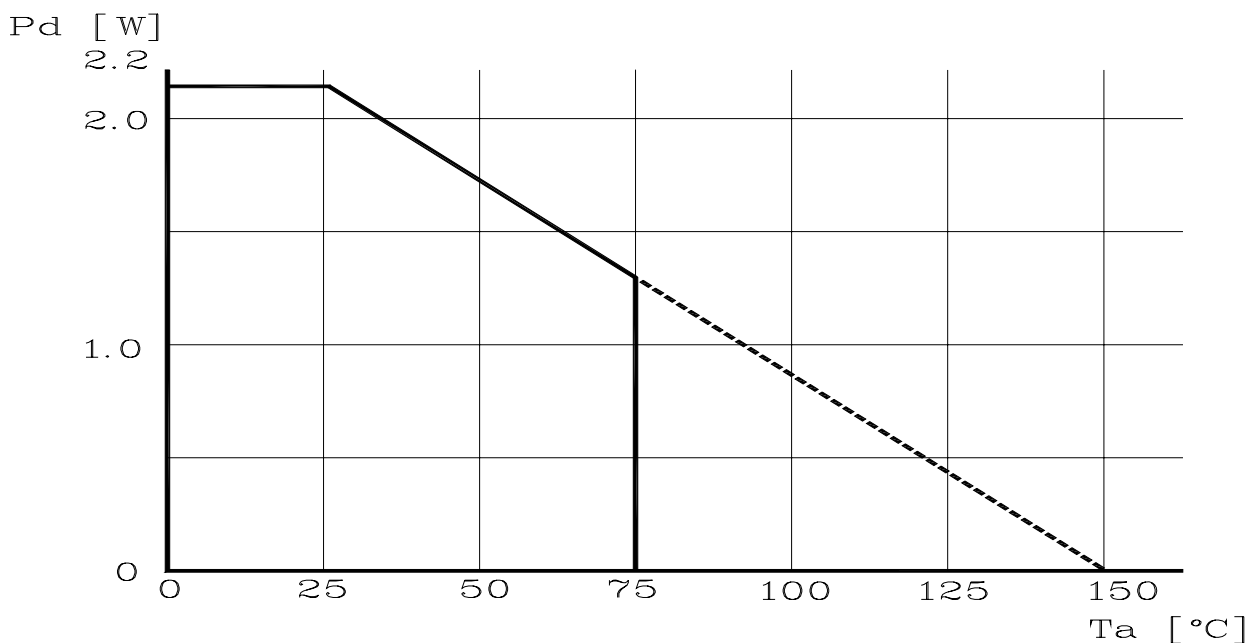
Derating is done 17.6mW/ $^\circ\text{C}$ for operating above $T_a=25^\circ\text{C}$

[T_{stg}] Should not exceed P_d or SOA and $T_j=150^\circ\text{C}$ values

◆ Guaranteed Operating Conditions ($T_a = 25^\circ\text{C}$)

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

◆ Power Dissipation Curve [P_d]



◆ 70mm×70mm×1.6mm glass epoxy board .

◆ De-rating is done at 17.6mW/ $^\circ\text{C}$ for operating above $T_a=25^\circ\text{C}$

◆ Electrical Characteristics 1

(Unless otherwise specified $T_a=25^{\circ}\text{C}$, $V_{CC}=5\text{V}$, $V_M=12\text{V}$)

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}	$I_{HB}=10\text{mA}$	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-}	$E_{CR}=1.65\text{V}$, GSW=L	-75	-45	-15	mV
12	Offset Voltage (+)	E_{COFF+}	$E_{CR}=1.65\text{V}$, 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=0.5 Ω	0.52	0.65	0.78	A/V
15	Input-Output Gain M	G_{ECM}	GSW=OPEN, RNF=0.5 Ω	1.04	1.30	1.56	A/V
16	Input-Output Gain H	G_{ECH}	GSW=H, RNF=0.5 Ω_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}	$I_{FG}=-20\text{uA}$	4.5	4.8	-	V
21	FG Output Low Voltage	V_{FGL}	$I_{FG}=3\text{mA}$	-	0.2	0.4	V
< FG2 >							
22	FG2 Output High Voltage	V_{FG2H}	$I_{FG2}=-20\text{uA}$	4.6	4.9	-	V
23	FG2 Output Low Voltage	V_{FG2L}	$I_{FG2}=3\text{mA}$	-	0.2	0.4	V
24	Duty (Reference)	DU		-	50	-	%

◆ Electrical Characteristics 2

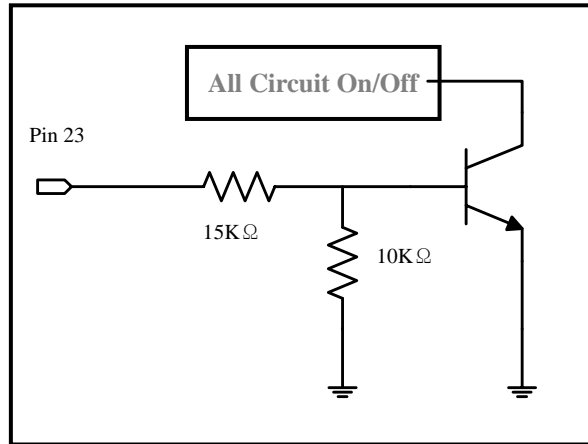
(Unless otherwise specified $T_a=25^\circ\text{C}$, $V_{CC}=5\text{V}$, $V_M=12\text{V}$)

NO	Characteristics	Symbol	Condition	Specification			Unit
				MIN.	TYP.	MAX.	
< Rotation Detector >							
25	FR Output Voltage H	V_{FRH}	$I_{FR} = -20\mu\text{A}$	4.1	4.4	-	V
26	FR Output Voltage L	V_{FRL}	$I_{FR} = 3\text{mA}$	-	0.2	0.4	V
< Output >							
27	Saturation Voltage H	V_{OH}	$I_O = -600\text{mA}$	-	1.0	1.35	V
28	Saturation Voltage L	V_{OL}	$I_O = 600\text{mA}$	-	0.4	0.65	V
29	Pre-drive Current	I_{VML}	$E_C=5\text{V}$, Output = Open	-	35	70	mA
30	Torque Limit Current	I_{TL}	$R_{NF} = 0.5\ \Omega$	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

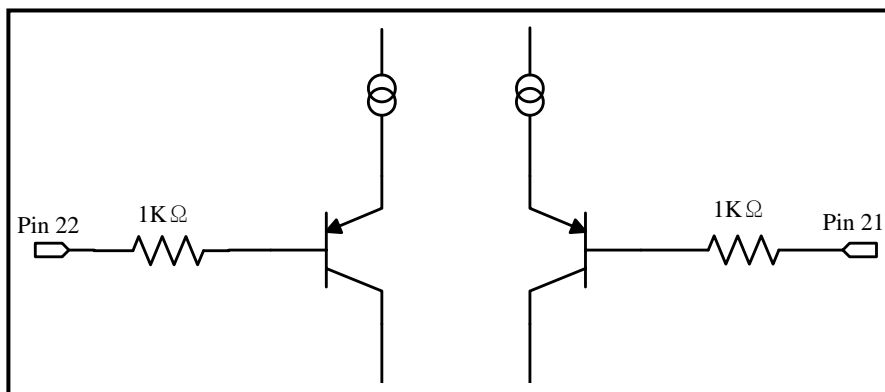
Application Information

1. Input-Output circuits

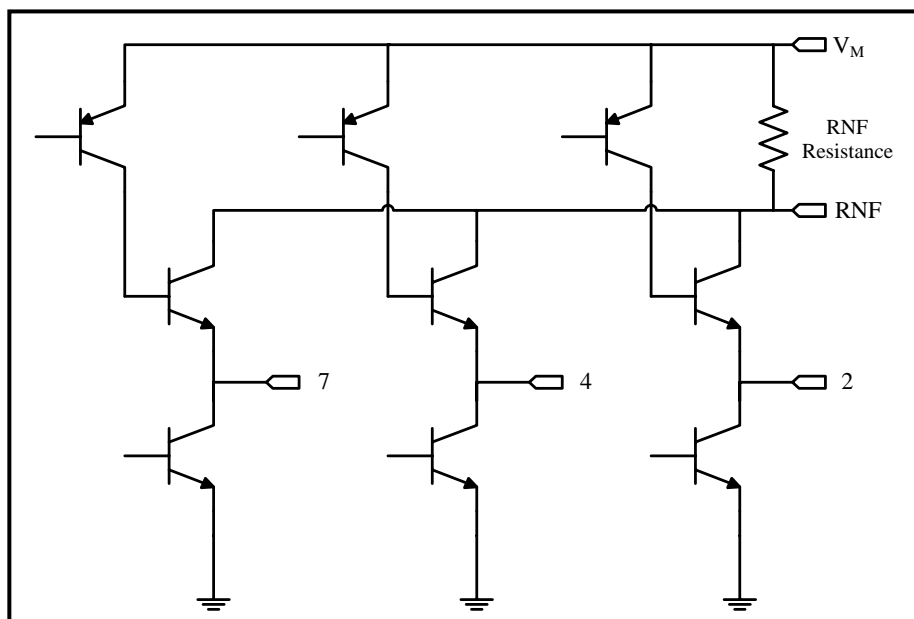
1) Power Save (Pin 23)



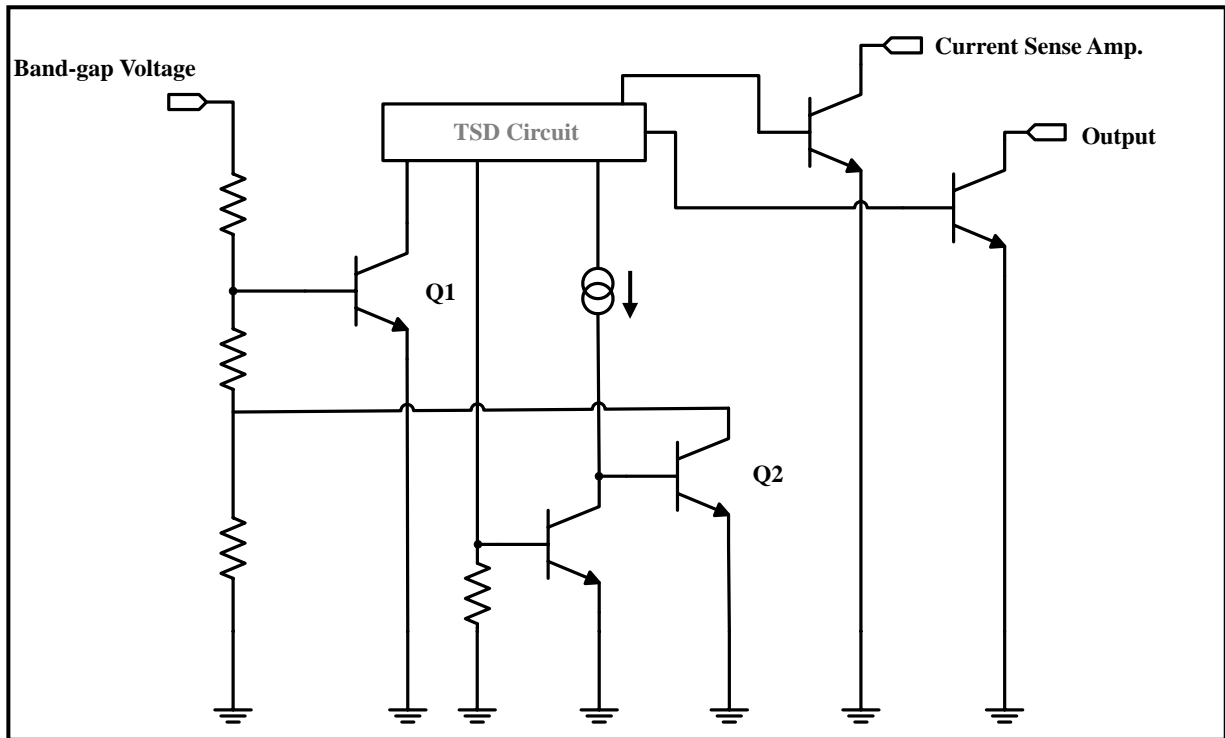
2) Torque control input (Pin 21, Pin 22)



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

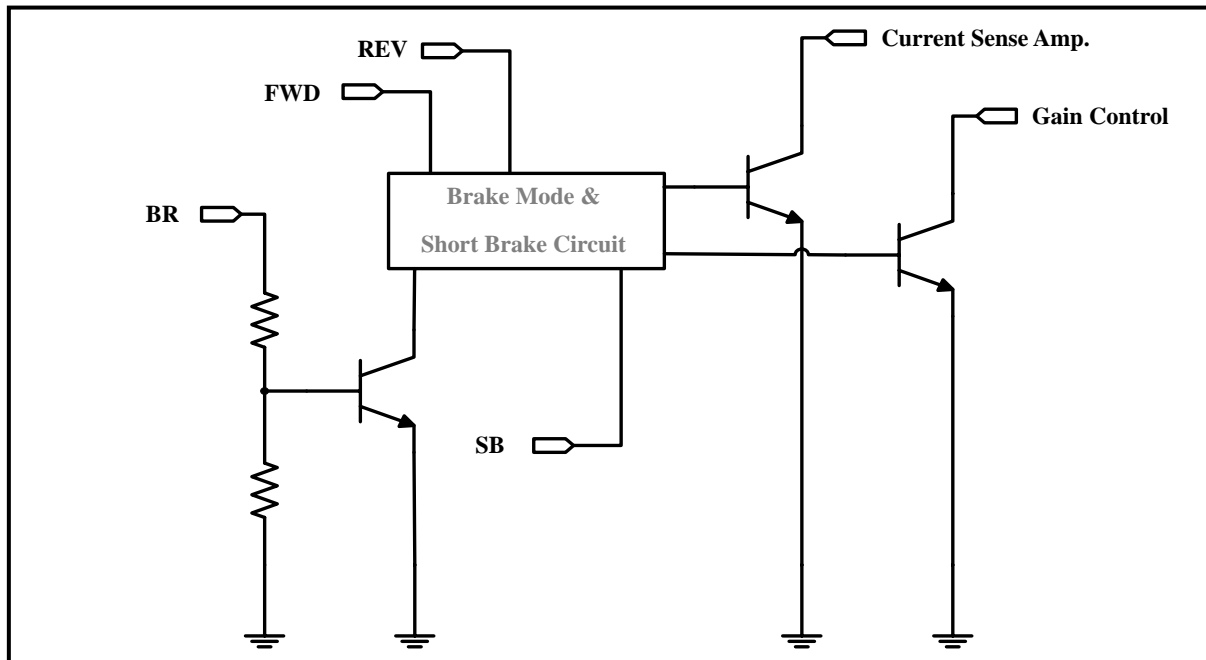


2. Thermal Shut Down (TSD)



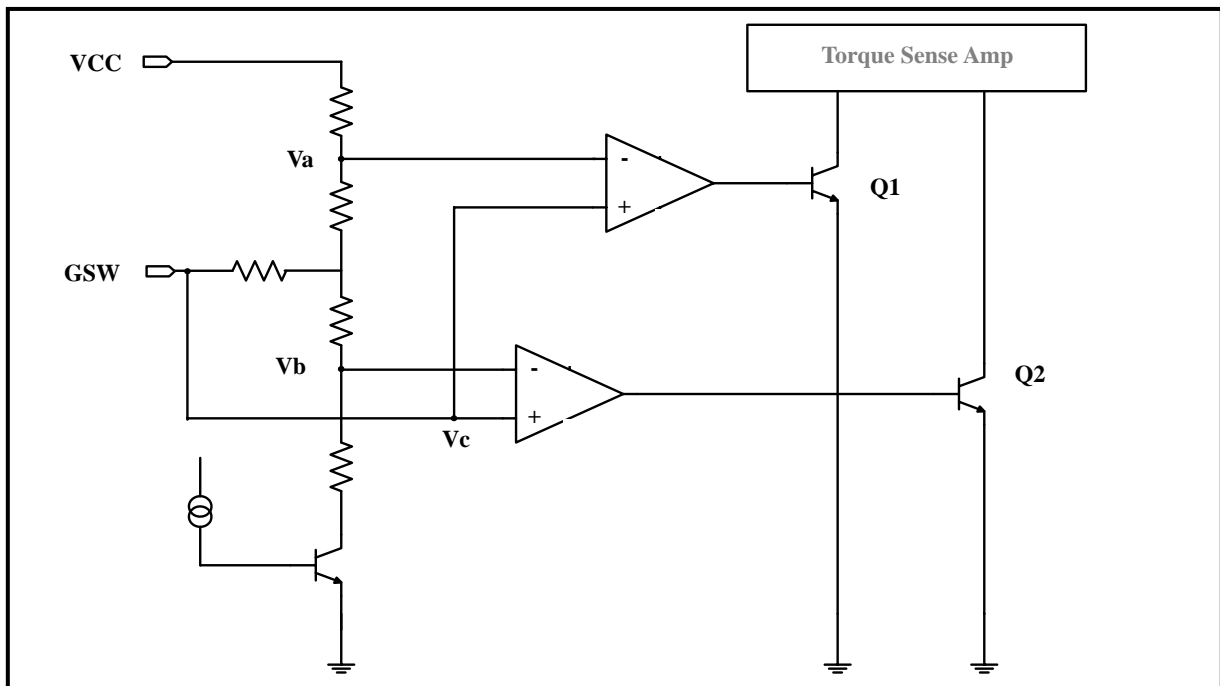
The built-in thermal shutdown circuit mutes the output current when the chip temperature reaches 175 °C (typ.). The hysteresis is set to 25 °C (typ.) by IHys, so the circuit will start up again when the chip temperature falling to 150 °C (typ.)

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.

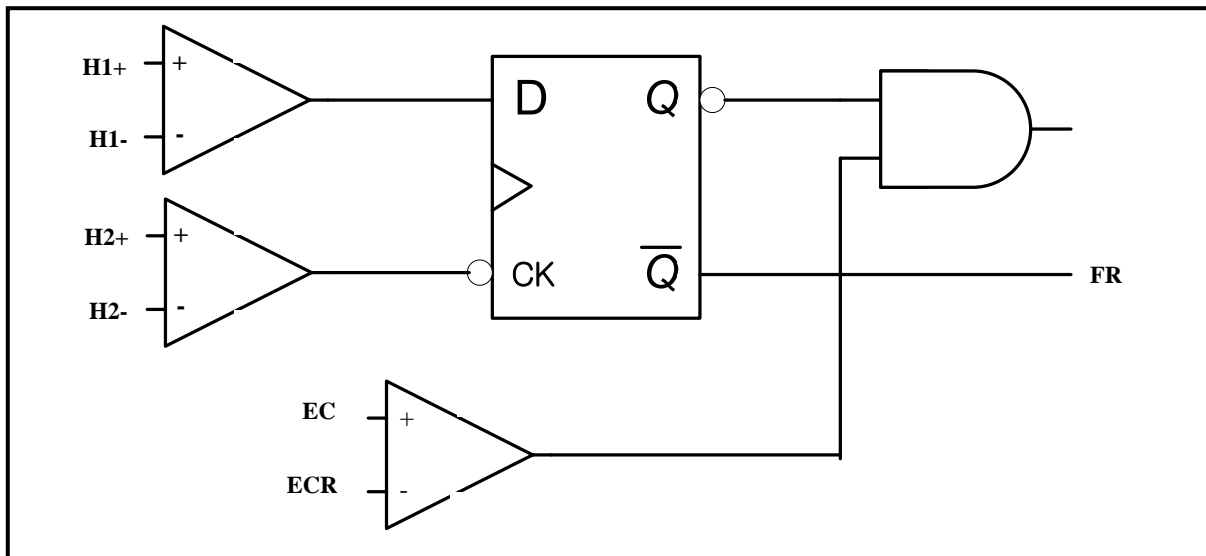
4. Gain Switch



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

$$\begin{aligned}
 G_{EC} &= 0.325/R_{NF} & [A/V] & \quad (GSW = \text{Low} : 0V) \\
 G_{ECM} &= 0.65/R_{NF} & [A/V] & \quad (GSW = \text{OPEN}) \\
 G_{ECH} &= 1.40/R_{NF} & [A/V] & \quad (GSW = \text{High} : 3V \uparrow)
 \end{aligned}$$

5. Reverse Rotation Detector



Case 1] Forward Rotation ($EC < ECR$)

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

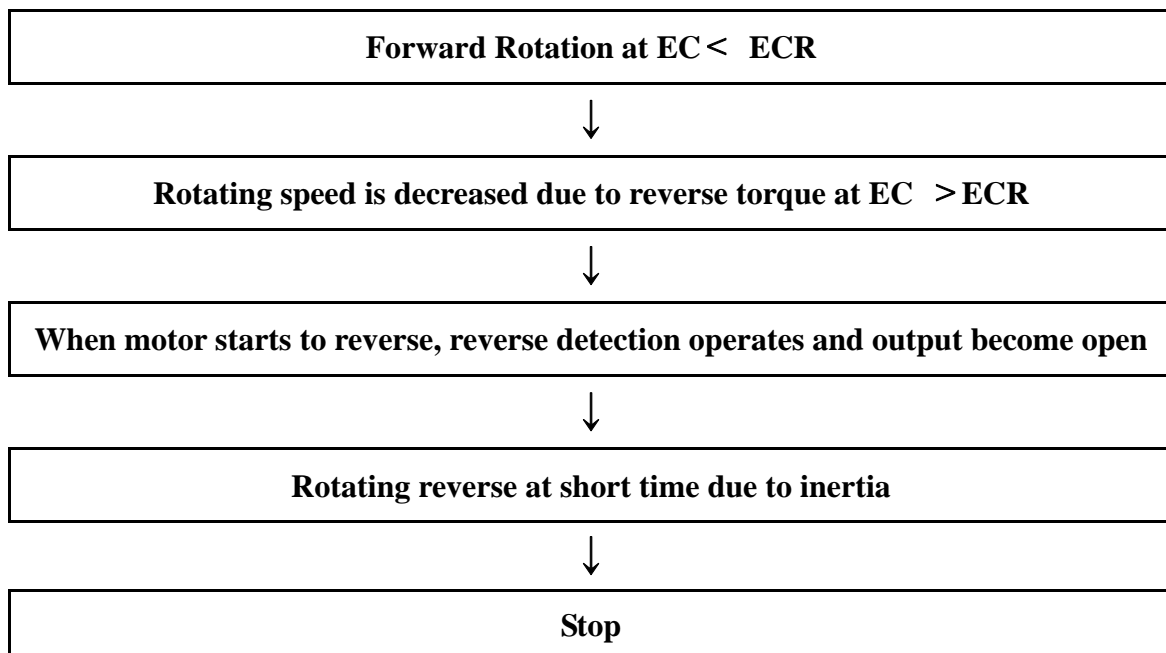
In this case, reverse detection don't operate.

Case 2] Reverse Rotation ($EC > ECR$)

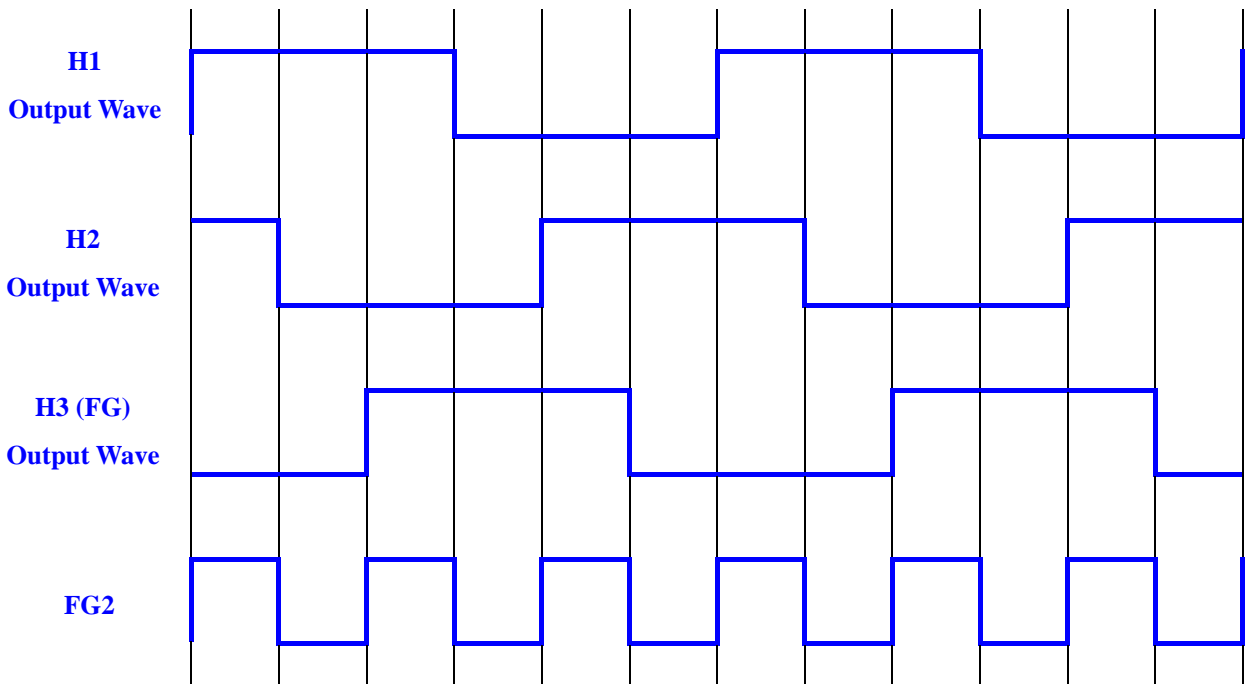
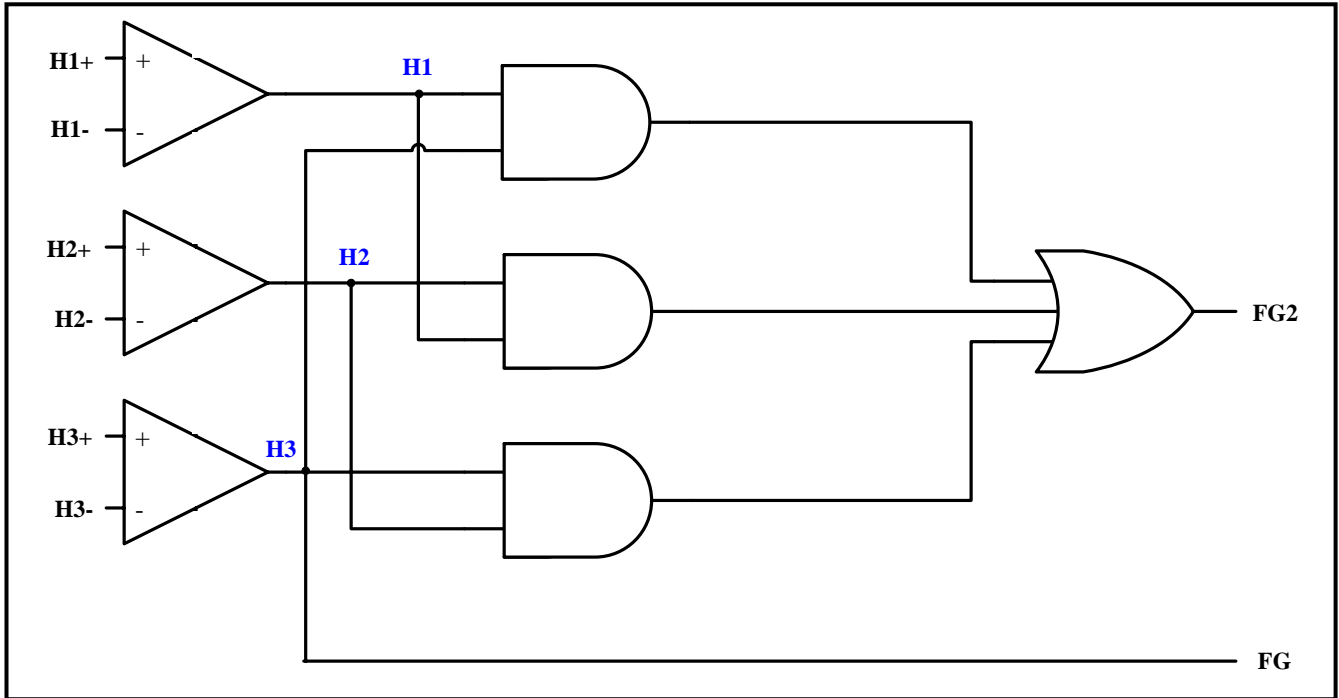
Hall input H1+ and H2+ have opposite relation to forward rotation.

So detective circuit operate, make output open.

Actual motor rotation at reverse detection

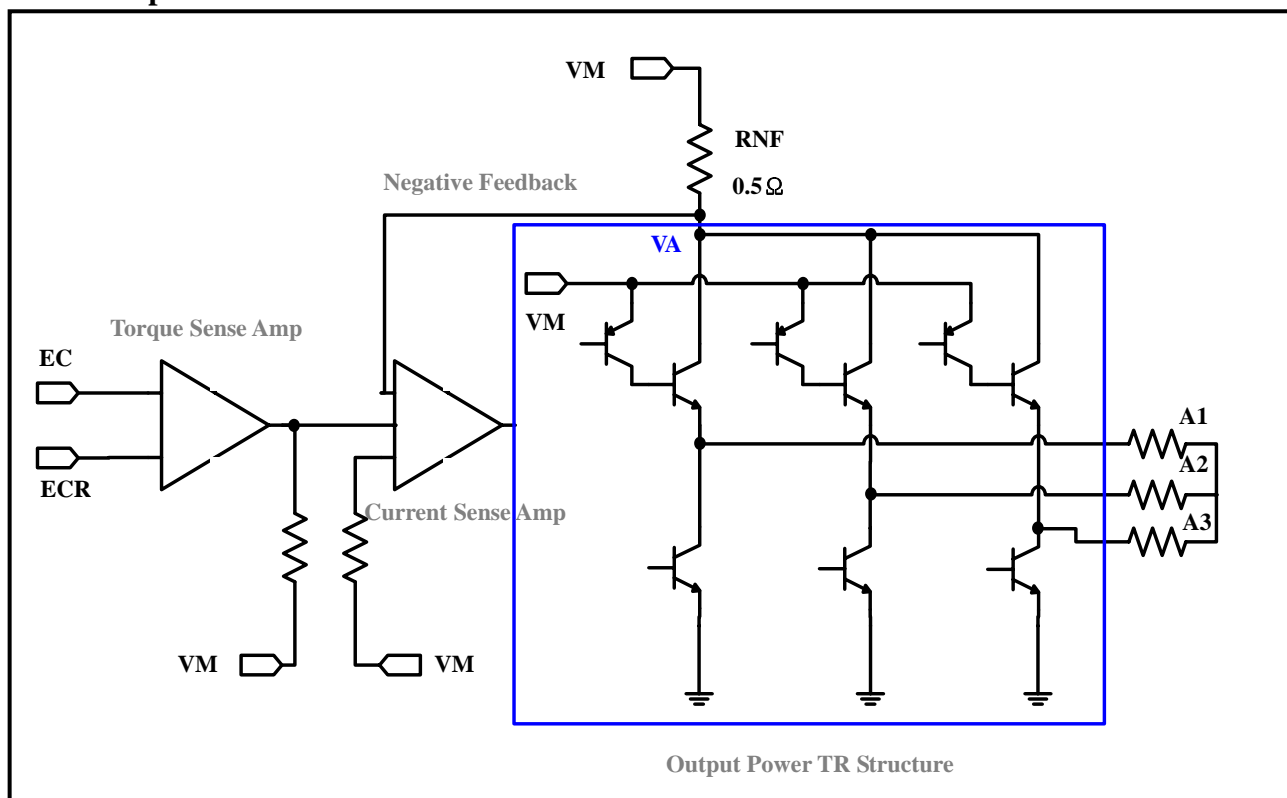


6. Rotation Speed Detection



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]

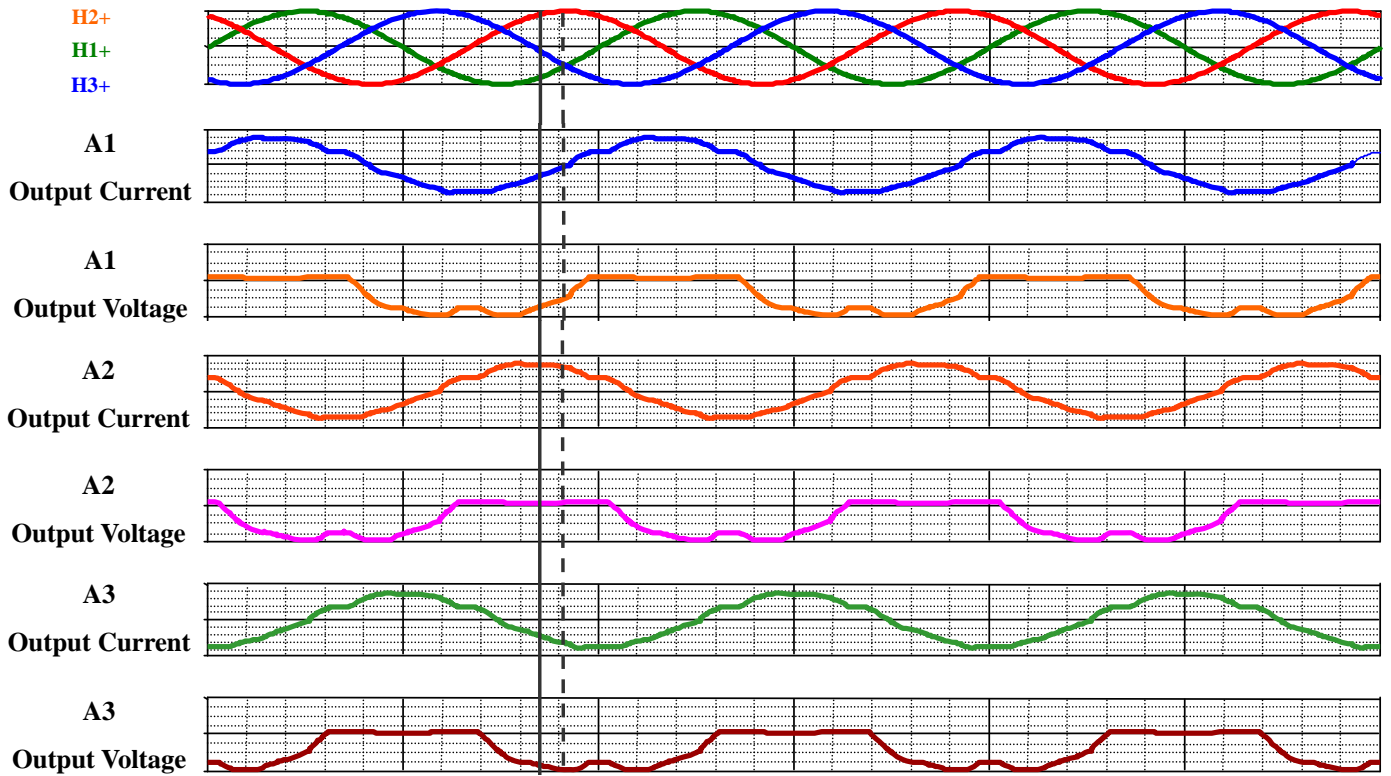
The Power Output's Current is controlled limitary, according to Torque Sense Amp's sink current and Current Sense Amp's source current, when EC and ECR have potential difference.

Maximum Current : $I_{limit} = VRNF / 0.5\Omega$ ($VRNF = VM-VA$)

[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 $V_{CC} - I_{QC}$

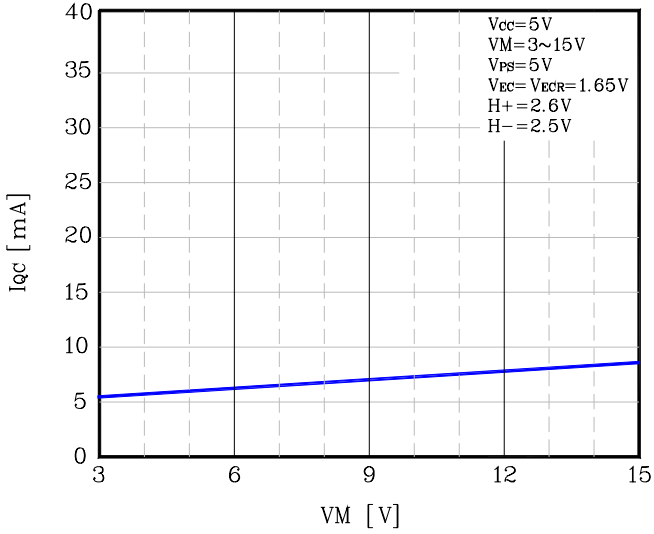


Fig. 2 Temperature - I_{QC}

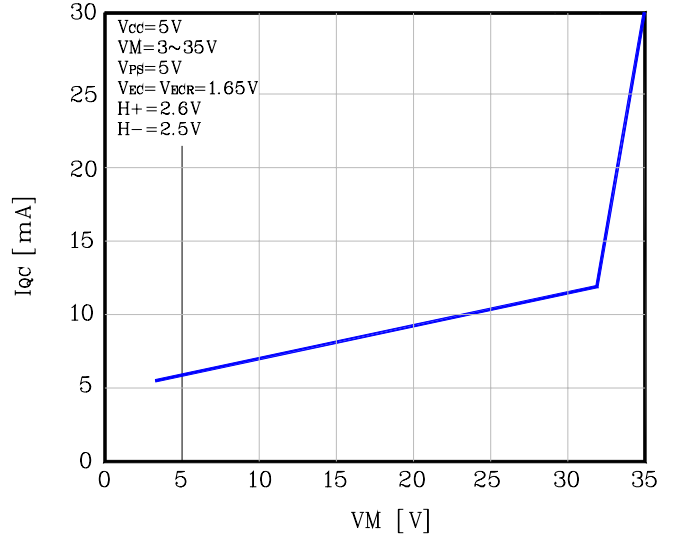


Fig. 3 $V_{EC} - V_{ECCOFF}$

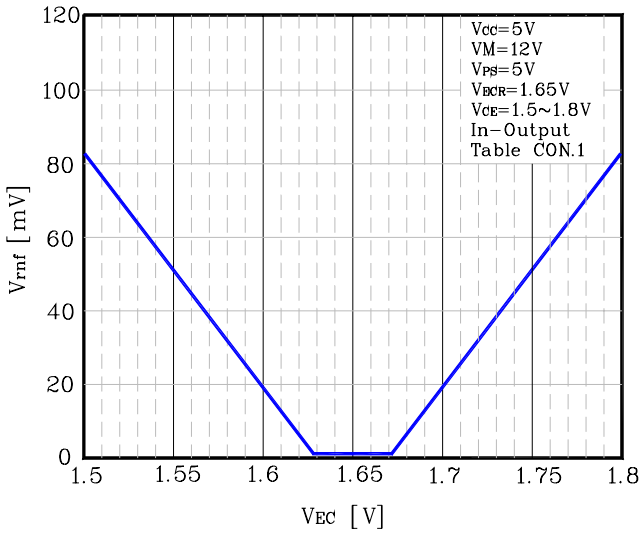


Fig.4 $V_{GSW} - V_{rnf}$ [In-Output Gain]

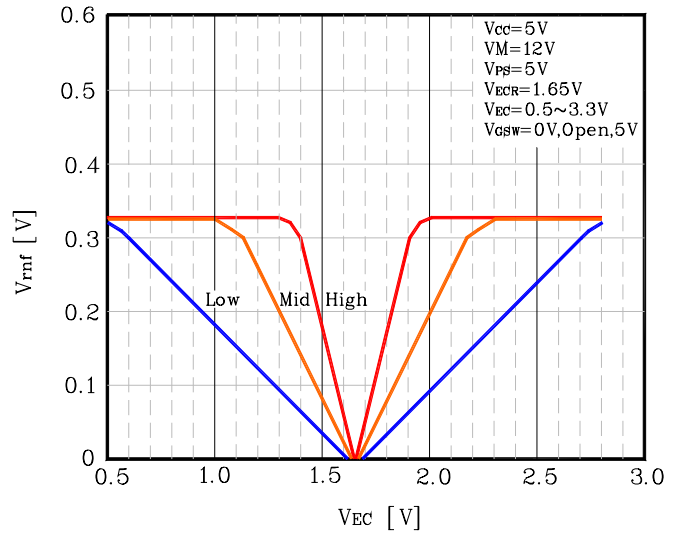


Fig. 5 $V_{PS} - I_{QC}$

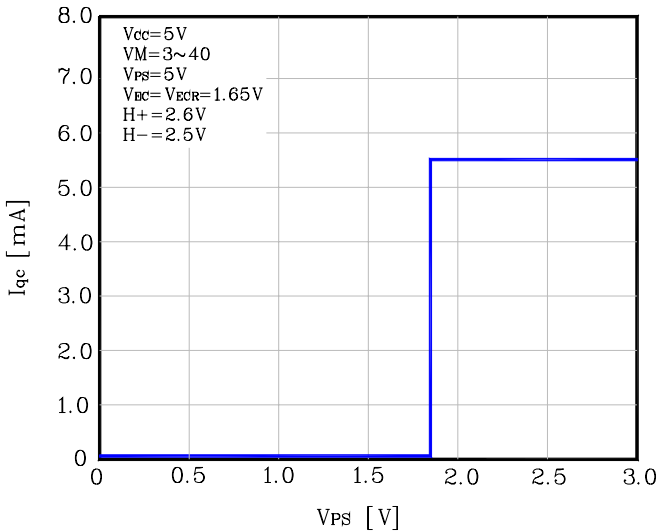
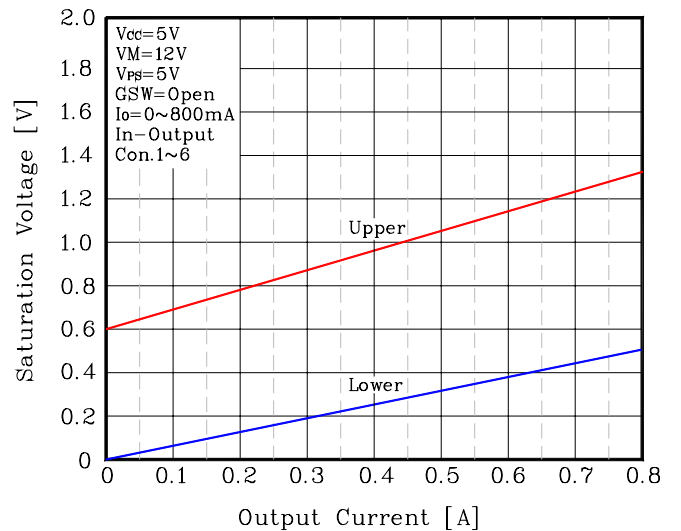
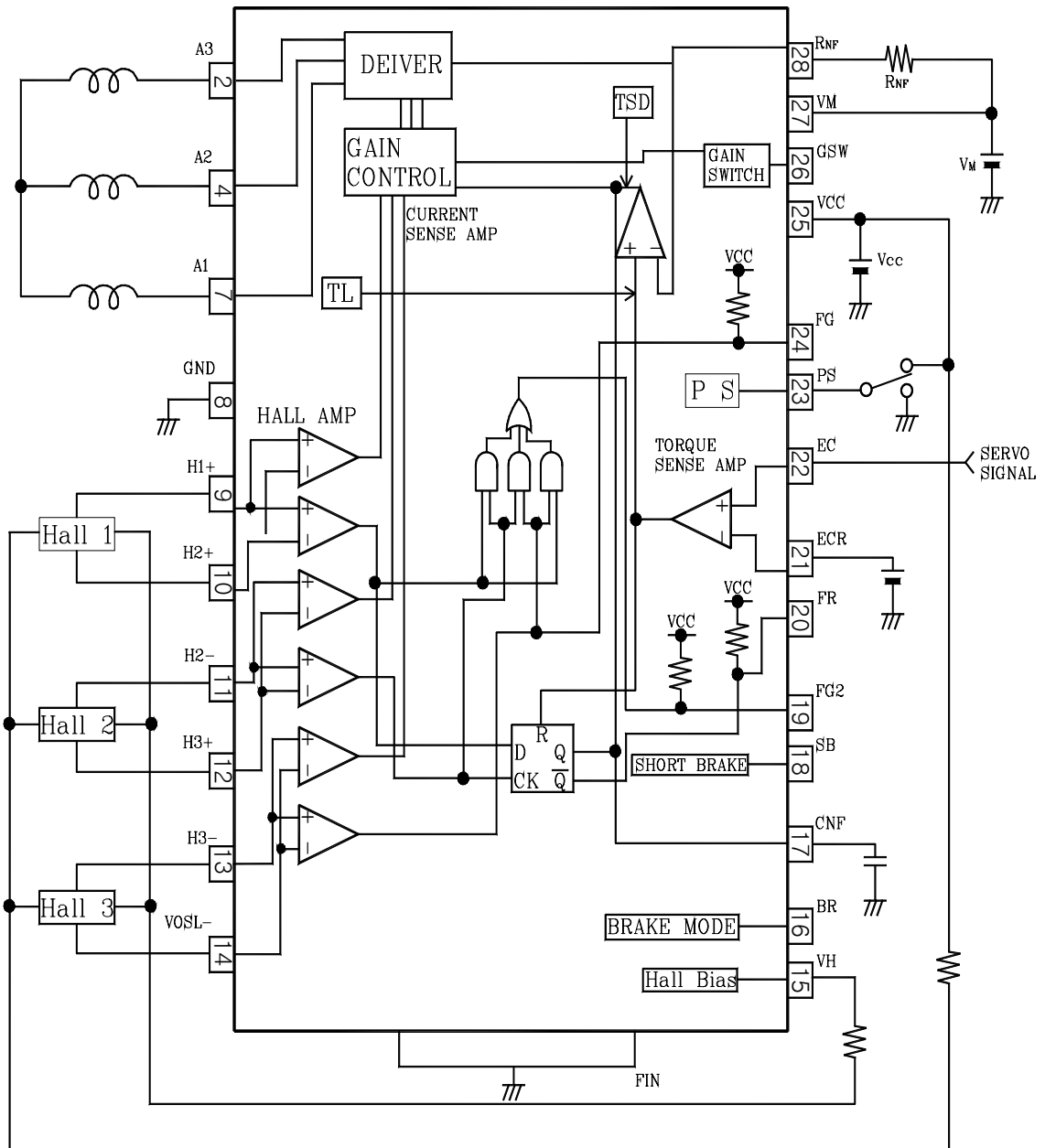


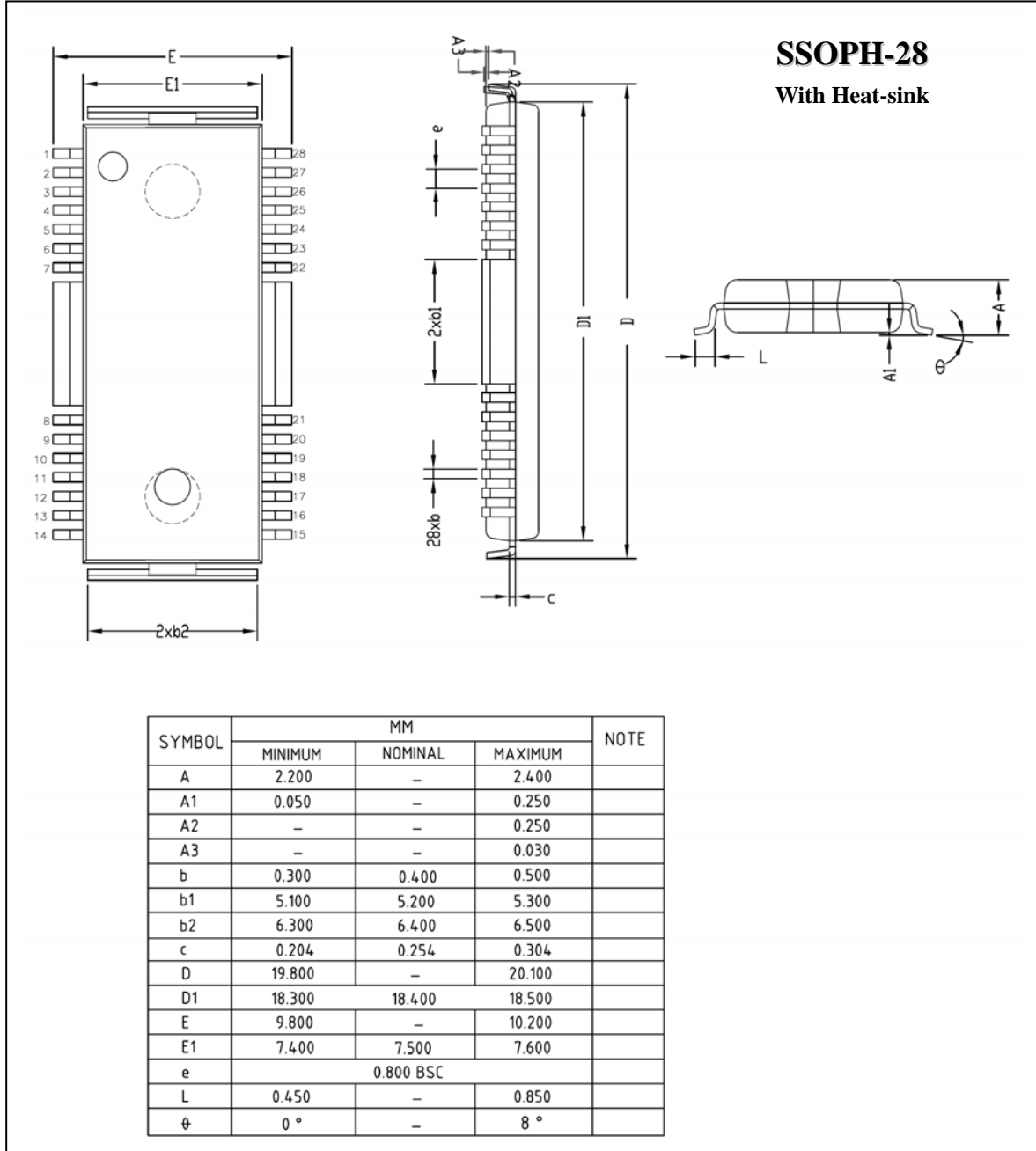
Fig.6 $I_O - V_{Osat}$ [Upper/Lower]



◆ Application Circuit



◆ Package Dimension



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