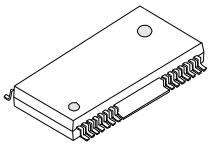
3-PHASE SPINDLE MOTOR DRIVER FOR CD-ROM

DESCRIPTION

The SA5664 is a CD-ROM spindle motor driver supporting reverse-rotation preventing circuit. It incorporates power save circuit, thermal shut down circuit, FG output, hall bias, etc. The 3-phase full-wave pseudo linear driving system achieves high-performance and multi-function.



HSOP-28-375-0.8

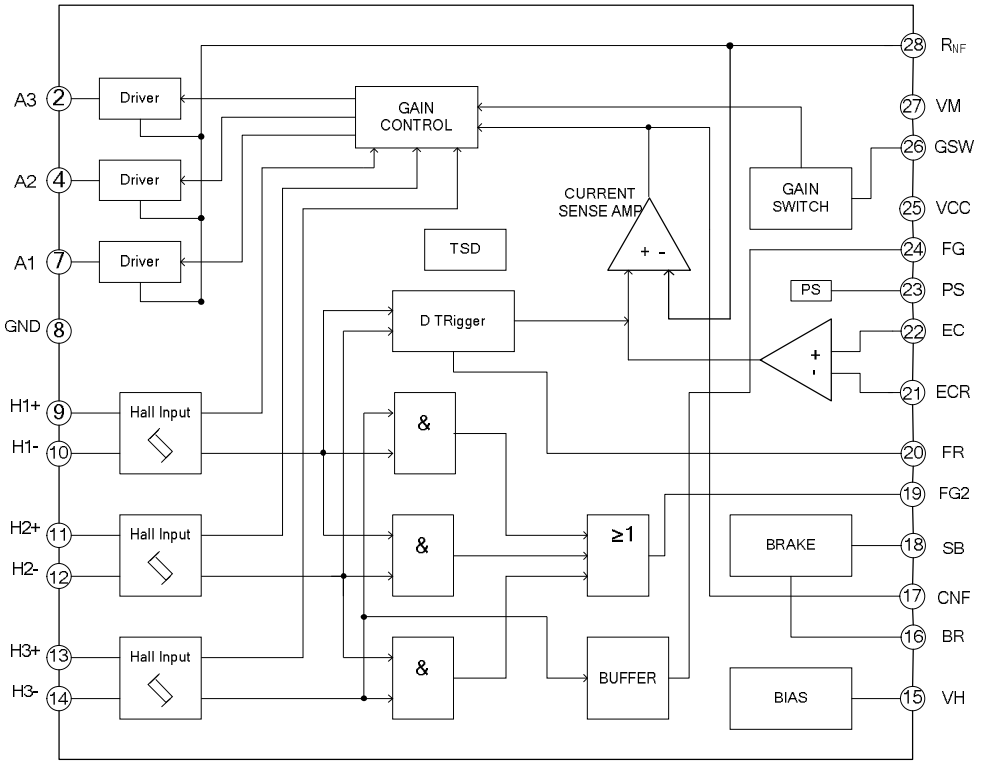
FEATURES

* 3 -phase, full-wave, pseudo linear driving system.
* Built-in power save in stop mode.
* Built-in current limiter.
* Built-in 3X and 1X hall FG output.
* Built-in TSD (thermal shutdown) circuit.
* Built-in gain switch pin.
* Built-in hall bias circuit.
* Built-in rotational direction detector.
* Built-in short-brake.
* Built-in reverse rotation prevented circuit.
* Built-in brake mode pin.
* Corresponds to 3.3V DSP.

ORDERING INFORMATION

Device	Package
SA5664	HSOP-28-375-0.8

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS (Tamb=25°C)

Characteristics	Symbol	Rating	Unit
Maximum Supply Voltage	V_{CC}	7	V
Maximum Supply Voltage	V_M	15	V
Power Dissipation	Pd	2200	mW
Operate Temp. Range	T_{OPR}	-20~+75	°C
Storage Temp. Range	T_{STG}	-55~+150	°C
Maximum Output Current	I_{OUT}	1300	mA

ELECTRICAL CHARACTERISTICS (Unless otherwise noted, Tamb=25°C, V_{CC}=5V,V_M=12V , R_L=8 Ω, RNF=0.5 Ω)

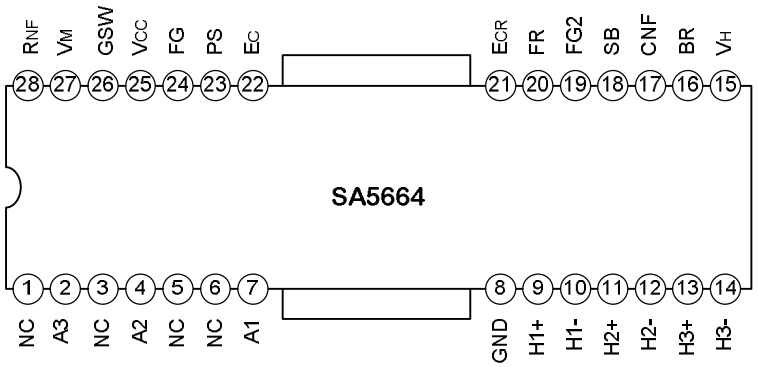
Characteristics	Symbol	Test condition	Min.	Typ.	Max.	Unit
Total						
Operating Supply Voltage	V_{CC}	--	4.5		5.5	V
	V_M	--	3.0		14	V
Quiescent Current	I_{CC1}	PS=L, GSW=OPEN	--	0	0.2	mA
Circuit Current 1	I_{CC2}	PS=H, GSW=OPEN	--	15	20	mA
Circuit Current 2	I_{CC3}	PS=H, GSW=OPEN H1,2,3＋＝1/2V_{CC}+0.1 H1,2,3 －＝1/2V_{CC}	--	0.46	1.0	mA
Power save						
ON Voltage Range	V_{PSON}	Output driver off	--	--	1.0	V
OFF Voltage Range	V_{PSOFF}	Output driver on	2.5	--	--	V
PS Input Current	I_{ps}	PS=5V	--	230	--	μA
HALL BIAS						
Hall Bias Voltage	V_{HB}	V_{PS} = 5 V, I_{HB}=10mA	-	0.5	1.5	V
HALL AMP						
Input Bias Current	I_{HA}	--	--	0.7	3.0	μA
Common-mode Input Range	V_{HAR}	--	1.0	--	4.0	V
Minimum Input Level	V_{INH}	--	50	--	--	mVpp
H1 Hysteresis Level	V_{HYS}	--	5	20	40	mV
TORQUE CONTROL						
Input Voltage Range	E_C, E_{CR}	Linear range 0.5~3.3V	0	--	5.0	V
Offset Voltage -	E_{COFF-}	E_{CR}=1..65V, GSW=0 V	-75	-45	-15	mV
Offset Voltage +	E_{COFF+}	E_{CR}=1.65V, GSW=0 V	15	45	75	mV
Input Current	E_{CIN}	E_C=E_{CR}=1.9 V	-3	--	3	μA
Input-output Gain L	G_{ECL}	GSW=0 V, RNF=0.5Ω	0.52	0.65	0.78	A/V
Input-output Gain M	G_{ECM}	GSW=OPEN, RNF=0.5Ω	1.04	1.30	1.56	A/V
Input-output Gain H	G_{ECH}	GSW=H, RNF=0.5Ω	2.24	2.80	3.36	A/V

(To be continued)

(Continued)

Characteristics	Symbol	Test condition	Min.	Typ.	Max.	Unit
GAIN SWITCH						
Low Voltage Range	V_{GSWL}	GSW=OPEN, E_{CR}=1.9 V	--	--	1.0	V
Hi-voltage Range	V_{GSWH}	E_C=1.7 V	2.5	--	--	V
Open Voltage	V_{GSWOP}	--	--	2.0	--	V
FG						
Current of FG Output HI	I_{FGH}	V_{OL}=0.3V	0.2	0.4	1	mA
Current of FG Output LOW	I_{FGL}	V_{OL}=5.0V	6	12	18	mA
FG2						
Current of FG2 Output HI	I_{FG2H}	V_{OL}=0.3V	0.55	0.75	0.95	mA
Current of FG2 Output LOW	I_{FG2L}	V_{OL}=5.0V	6	12	18	mA
ROTATION DETECT						
Current of FR Output HI	I_{FRH}	V_{OL}=0.3V	0.1	0.13	0.23	mA
Current of FR Output LOW	I_{FRL}	V_{OL}=5.0V	4.0	7.0	10.0	mA
OUTPUT						
Saturation Voltage H	V_{OH}	I_O=-600mA ($V_{M\text{-}RN_F}$ short)	--	1.0	1.35	V
Saturation Voltage L	V_{OL}	I_O=600mA	--	0.4	0.65	V
Pre-drive Current	I_{VML}	E_C=0 V or 5V, E_{CR}=1.9 V P_S= 5V output open	--	35	70	mA
Torque Limit Current	I_{TL}	RNF=0.5Ω	560	700	840	mA
SHORT BRAKE						
ON Voltage Range	V_{SBON}	BR=0V	2.5	--	--	V
OFF Voltage Range	V_{SBOFF}	BR=0V	--	--	1.0	V
SB Input Current	I_{SBin}	SB=5V	--	240	--	μA
BRAKE MODE						
ON Voltage Range	V_{BRON}	E_C>E_{CR}, SB=open	2.5	--	--	V
OFF Voltage Range	V_{BROFF}	E_C>E_{CR}, SB=open	--	--	1.0	V
BR Input Current	I_{BRin}	BR=5V	--	210	--	μA

PIN CONFIGURATION



PIN DESCRIPTION

Pin NO.	Pin name	Descriptions
1	NC	No connection
2	A3	Output (A3)
3	NC	No connection
4	A2	Output (A2)
5	NC	No connection
6	NC	No connection
7	A1	Output (A1)
8	GND	Ground
9	H1+	Hall signal (H1+)
10	H1-	Hall signal (H1-)
11	H2+	Hall signal (H2+)
12	H2-	Hall signal (H2-)
13	H3+	Hall signal (H3+)
14	H3-	Hall signal (H3-)
15	VH	Hall bias
16	BR	Brake mode
17	CNF	Phase compensation capacitor
18	SB	Short brake
19	FG2	FG signal (3X)
20	FR	Rotation terminal direction output
21	ECR	Output current control reference
22	EC	Output current control voltage
23	PS	Start/stop mode
24	FG	FG signal (1X)
25	VCC	Power supply for signal division
26	GSW	Gain switch
27	VM	Power supply for driver division
28	RNF	Output current sense resistance

FUNCTION DESCRIPTIONS

(1) Input-output table

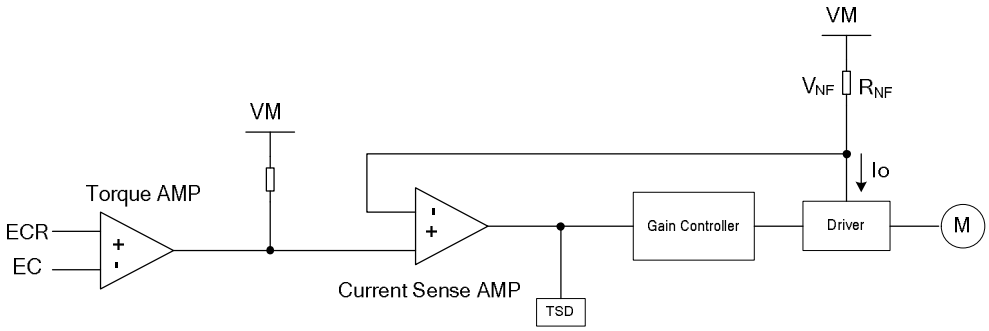
Input condition							Output						Test point
							Regular			Reverse			
Pin no.	9	10	11	12	13	14	7	4	2	7	4	2	
	H1+	H1-	H2+	H2-	H3+	H3-	A1	A2	A3	A1	A2	A3	
Condition1	L	M	H	M	M	M	H	L	L	L	H	H	7 pin HI
Condition2	H	M	L	M	M	M	L	H	H	H	L	L	7pin low
Condition3	M	M	L	M	H	M	L	H	L	H	L	H	4 pin HI
Condition4	M	M	H	M	L	M	H	L	H	L	H	L	4pin low
Condition5	H	M	M	M	L	M	L	L	H	H	H	L	2pin HI
Condition6	L	M	M	M	H	M	L	H	H	L	L	H	2pin low

Caution1: regular EC<ECR, reverse EC>ECR

Input voltage: H=2.6 V, M=2.5 V , L=2.4 V

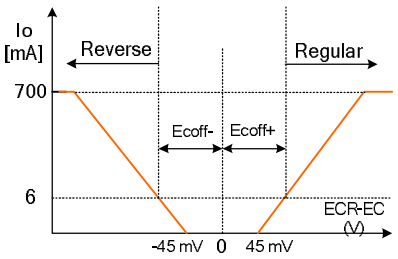
(2) Torque voltage range, gain switch

Fig.1



- By amplifying the voltage difference between Ec and ECR from servo IC, the torque sense amp produces the input (VAMP) for the current sense amp.
- The output current (Io) is converted into the voltage (VNF) through the sense resistor (RNF) and compared with the VAMP. By the negative feedback loop，the sensed output voltage, V_{NF} is equal to the input VAMP. Therefore, the output current (Io) is linearly controlled by the input VAMP.
- As a result, the signals Ec and ECR can control the velocity of Motor by controlling the output current (Io) of the driver.
- The range of the torque voltage is shown Fig.2

Fig.2



	Rotation
EC<ECR	Regular
EC>ECR	Stop

We can determine the value of input-output gain GEC by RNF resistance, and calculate it with the following formula. GEC=0.325/RNF [A/V] (GSW=L)

GECM=0.65/RNF [A/V] (GSW=OPEN)

GECH=1.40/RNF [A/V] (GSW=H)

Torque limit current ITL can be calculated by ITL=0.35/RNF [A]

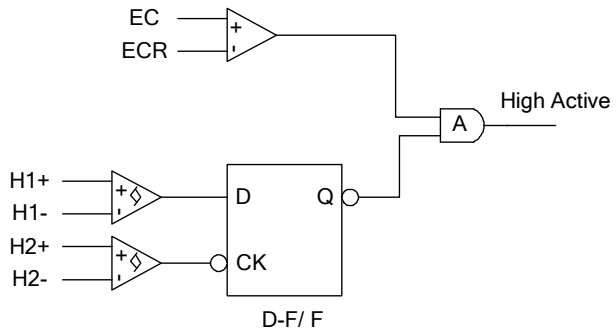
The input range of ECR and Ec is 0.5 V ~ 3.3 V (R_{NF} = 0.5 Ω).

(3) Power save

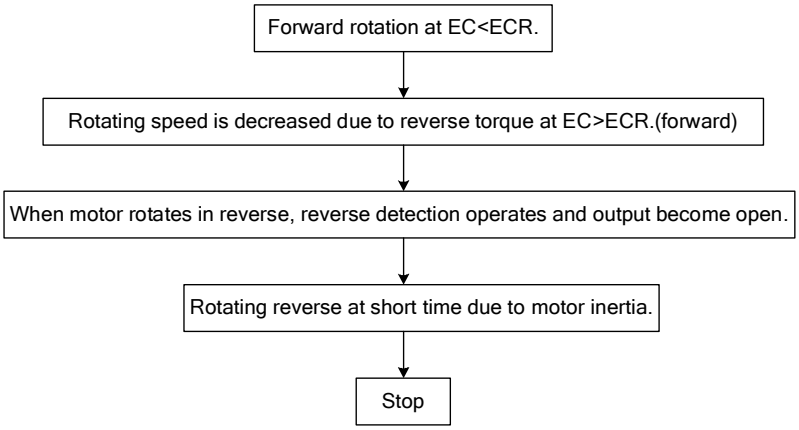
When power save function is active，all power TRs turn off.

(4) Reverse detection

Fig.3

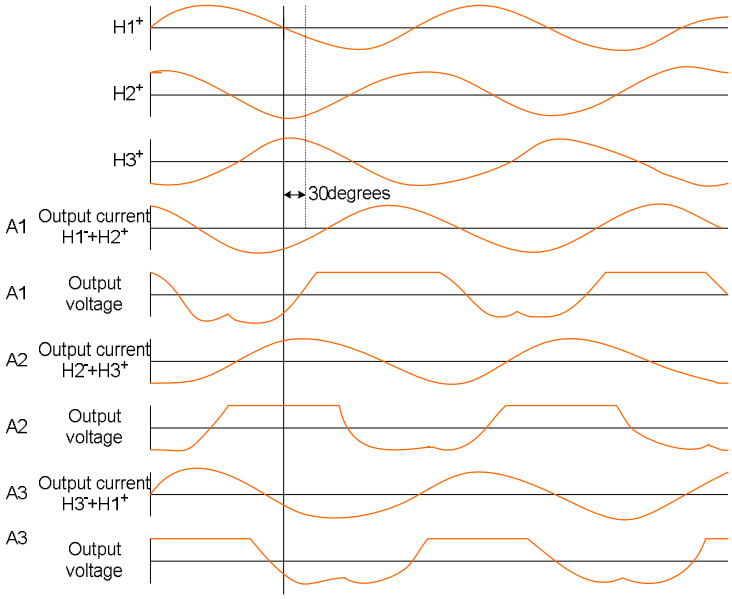


- When the output of the AND Gate, A is High, the output of the Driver becomes open and the motor stops.
- When in the state of the forward rotation, the D-F/F output Q is LOW and the control input is EC < ECR, so the motor rotates normally.
- At Forward rotation, if the control input is changed such that EC > ECR, then the motor rotates slowly by the reverse commutation in the Driver. When the motor rotates in reverse direction, the D-F/F output becomes High and the AND Gate output, becomes High. Thus detective circuit operates, make the output of the Driver becomes open and the motor stops.



(5) Input-output timing chart

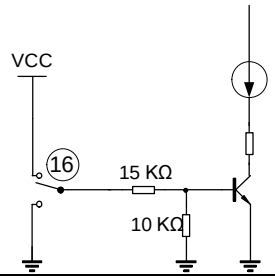
Fig.4



(6) Brake mode terminal

Input 'H' voltage to BR pin. Change brake type at EC>ECR

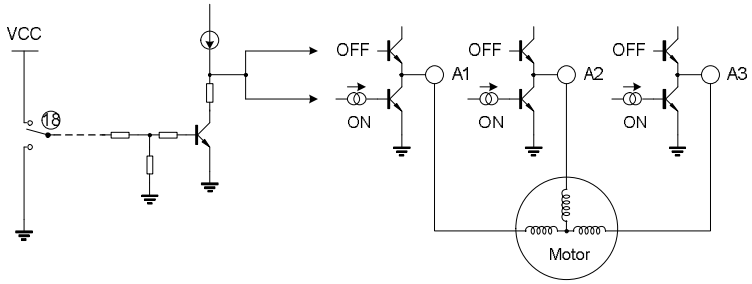
Fig. 5



Pin 16		EC<ECR	EC>ECR
BR	L	Regular rotation	Stop by reverse detection
	H	Regular rotation	Stop by short brake

(7) Short brake

Fig. 6



Pin 18	**Short brake**
High	ON
Low	OFF

When the short brake function is active, all upper power TRs turn off and all lower power TRs turn on, and the motor slows down.

(8) Hall Sensor Connection

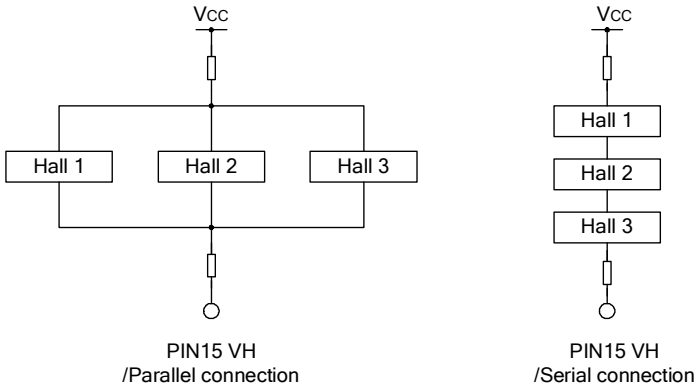
Hall element can be used with both series connection and parallel connection.

Please set hall input voltage at 1.0~4.0V and Hall minimum input level over 50mVpp.

And estimate the value of resistance to VH pin and Vcc pin. There considering the current into the hall element.

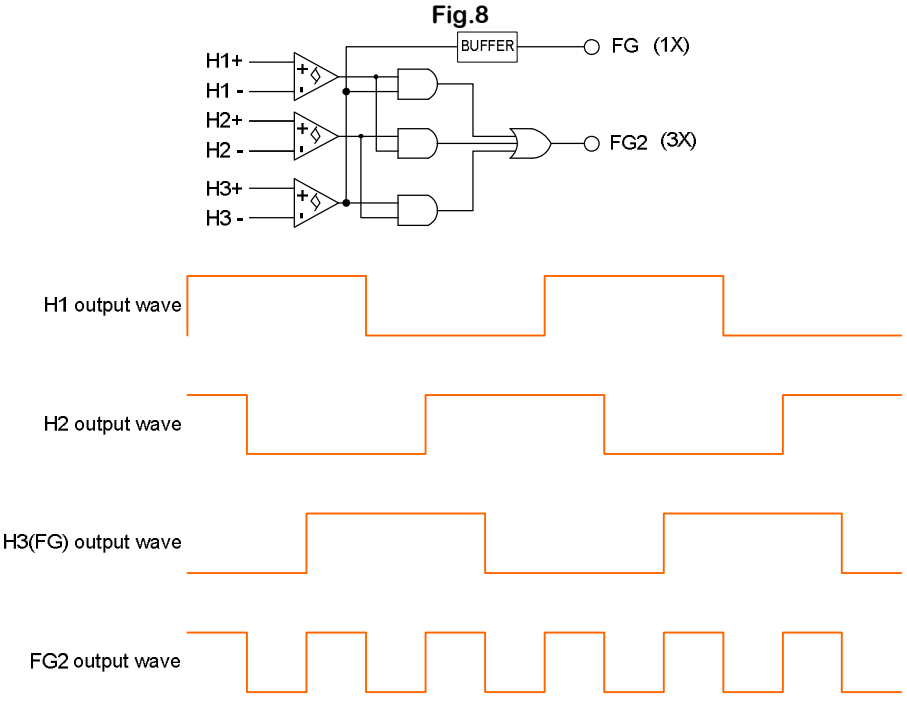
When use without the resistance to VH pin. $I_{VH} \geq 5mA$ is recommended.

Fig.7



(9) FG (1X) output, FG2 (2X) output

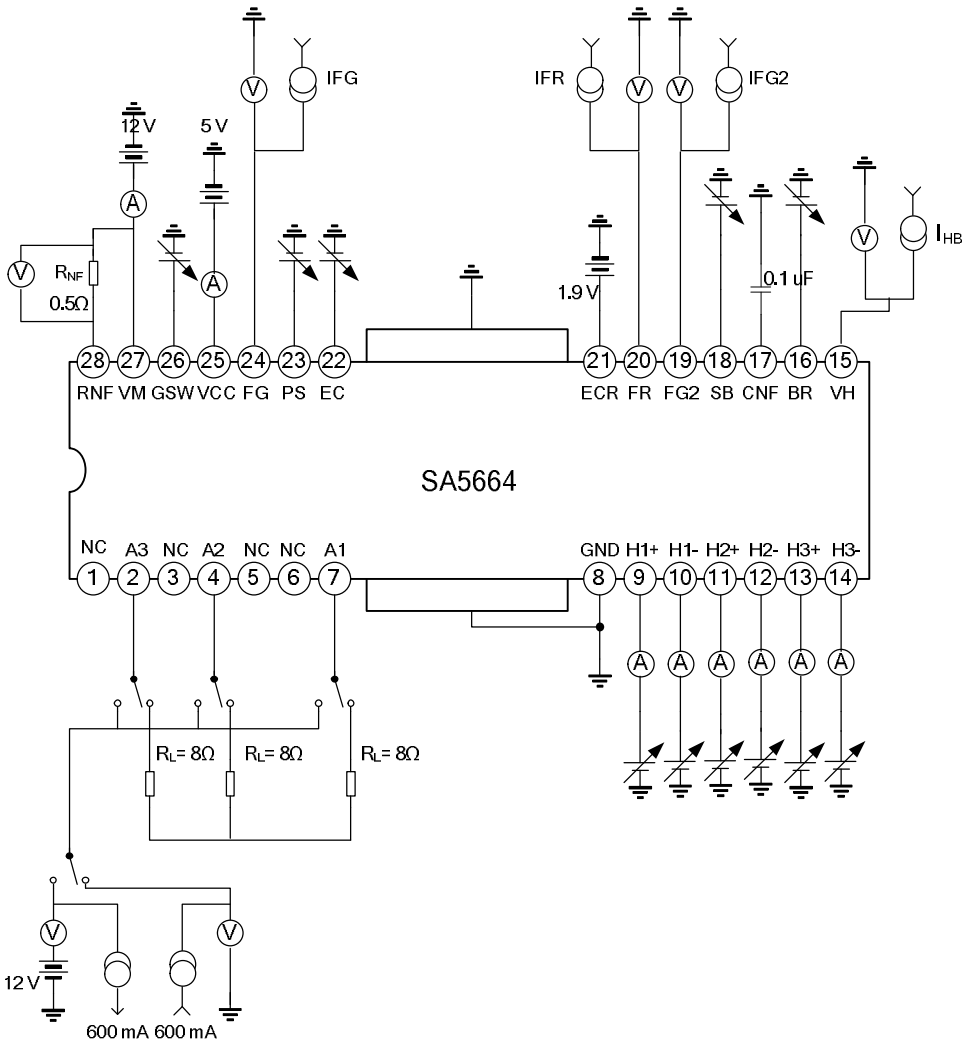
Fig.8



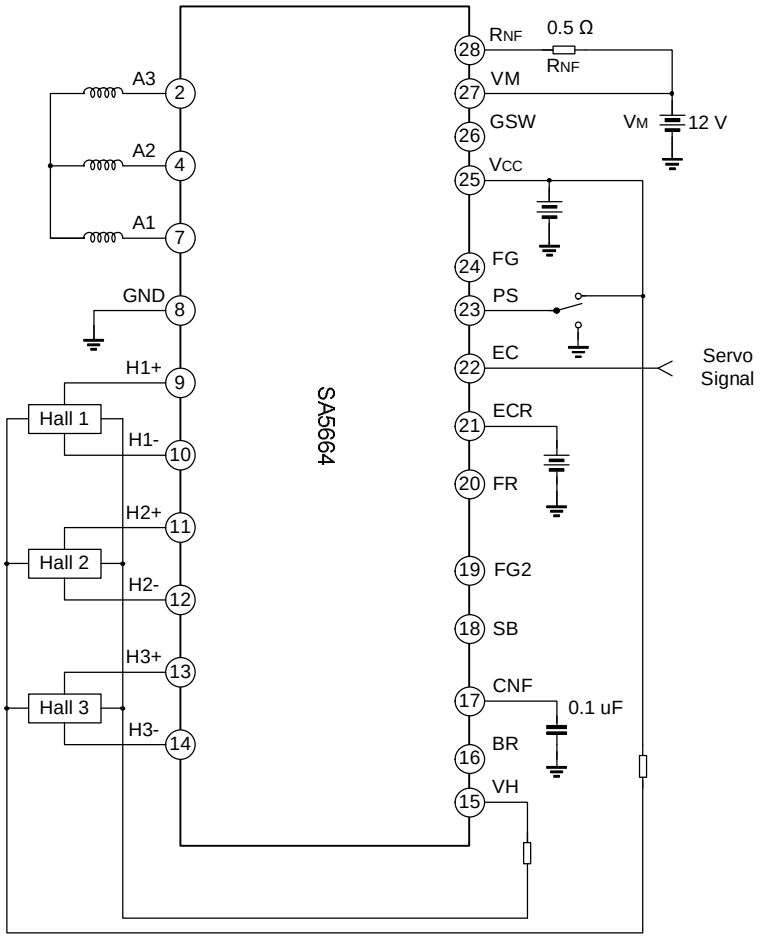
(10) Thermal shut down (TSD)

If the temperature of chip rises above 175°C (TYP), it makes and the output driver shuts down. TSD has temperature hysteresis of about 15°C (TYP).

TEST CIRCUIT

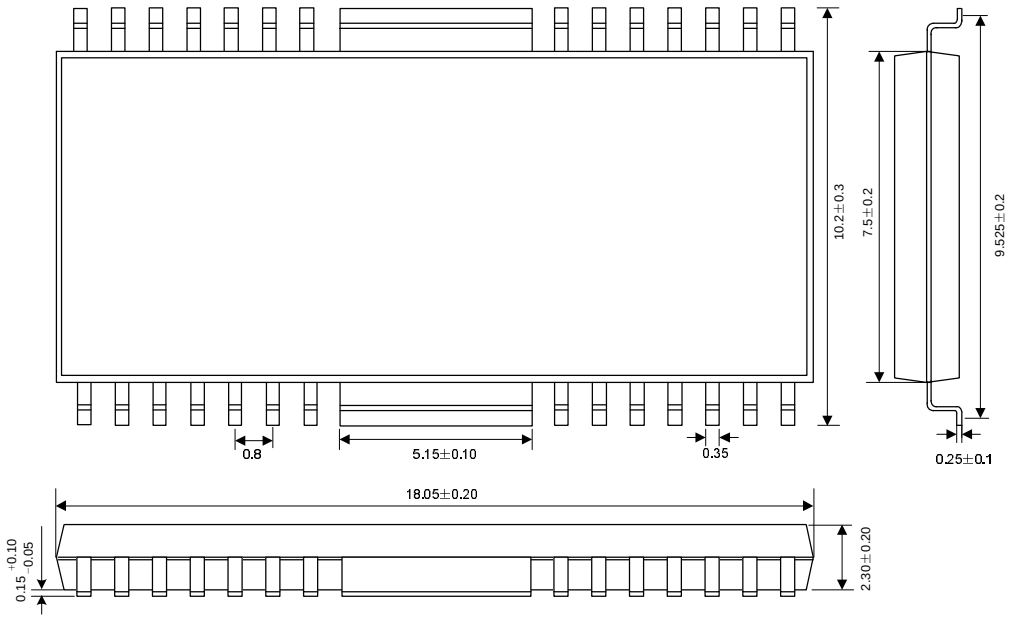


TYPICAL APPLICATION CIRCUIT



PACKAGE OUTLINE

HSOP-28-375-0.8 **UNIT: mm**



ATTACHMENT

Revision History

Data	REV	Description	Page
2003.04.08	1.0	Original	
2005.08.09	1.1	Change the electronic characteristics.	5