

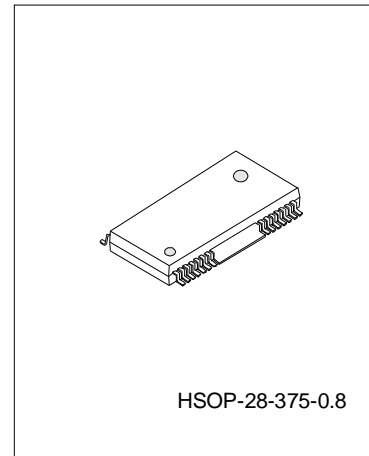
3-PHASE SPINDLE MOTOR DRIVER FOR CD-ROM

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.

FEATURES

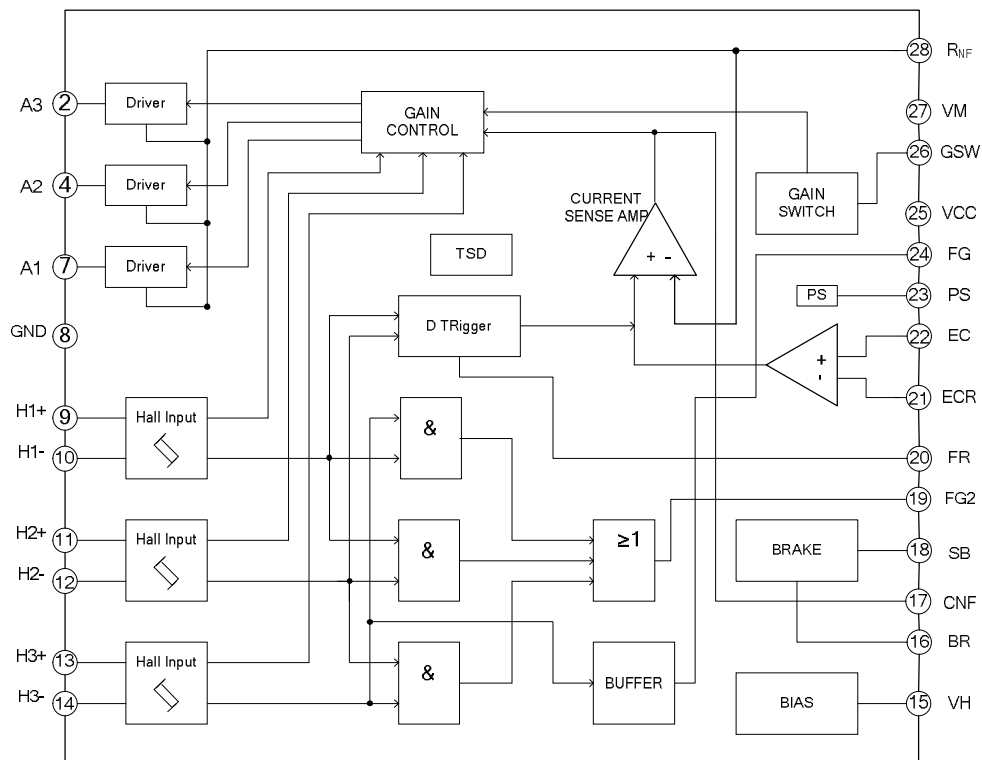
- * 3 -phase, full-wave, pseudo linear driving system.
- * Built-in power save in stop mode.
- * Built-in current limiter.
- * Built-in 3X and 1X hall FG output.
- * Built-in TSD (thermal shutdown) circuit.
- * Built-in gain switch pin.
- * Built-in hall bias circuit.
- * Built-in rotational direction 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 ($T_{amb}=25^{\circ}\text{C}$)

Characteristics	Symbol	Rating	Unit
Maximum Supply Voltage	VCC	7	V
Maximum Supply Voltage	VM	15	V
Power Dissipation	Pd	2200	mW
Operate Temp. Range	TOPR	-20~+75	$^{\circ}\text{C}$
Storage Temp. Range	TSTG	-55~+150	$^{\circ}\text{C}$
Maximum Output Current	IOUT	1300	mA

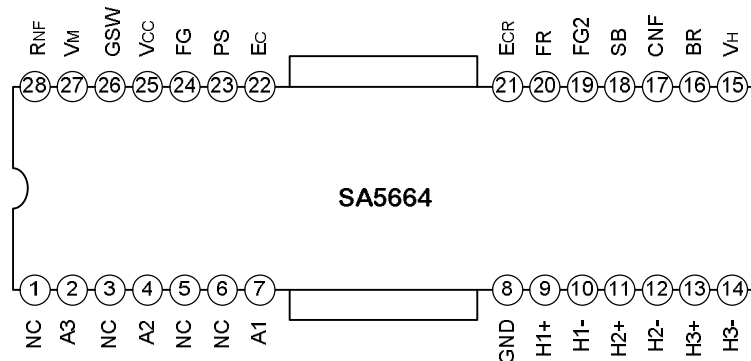
ELECTRICAL CHARACTERISTICS (Unless otherwise noted, $T_{amb}=25^{\circ}\text{C}$, $V_{CC}=5\text{V}$, $V_M=12\text{V}$, $R_L=8\ \Omega$, $R_{NF}=0.5\ \Omega$)

Characteristics	Symbol	Test condition	Min.	Typ.	Max.	Unit
Total						
Operating Supply Voltage	VCC	--	4.5		5.5	V
	VM	--	3.0		14	V
Quiescent Current	ICC1	PS=L, GSW=OPEN	--	0	0.2	mA
Circuit Current 1	ICC2	PS=H, GSW=OPEN	--	15	20	mA
Circuit Current 2	ICC3	PS=H, GSW=OPEN H1,2,3+ = 1/2VCC+0.1 H1,2,3 - = 1/2VCC	--	0.46	1.0	mA
Power save						
ON Voltage Range	VPSON	Output driver off	--	--	1.0	V
OFF Voltage Range	VPSOFF	Output driver on	2.5	--	--	V
PS Input Current	Ips	PS=5V	--	230	--	μA
HALL BIAS						
Hall Bias Voltage	VHB	$V_{PS} = 5\text{V}$, $I_{HB}=10\text{mA}$	-	0.5	1.5	V
HALL AMP						
Input Bias Current	IHA	--	--	0.7	3.0	μA
Common-mode Input Range	VHAR	--	1.0	--	4.0	V
Minimum Input Level	VINH	--	50	--	--	mVpp
H1 Hysteresis Level	VHYS	--	5	20	40	mV
TORQUE CONTROL						
Input Voltage Range	EC, ECR	Linear range 0.5~3.3V	0	--	5.0	V
Offset Voltage -	ECOFF-	ECR=1.65V, GSW=0 V	-75	-45	-15	mV
Offset Voltage +	ECOFF+	ECR=1.65V, GSW=0 V	15	45	75	mV
Input Current	ECIN	EC=ECR=1.9 V	-3	--	3	μA
Input-output Gain L	GECL	GSW=0 V, $R_{NF}=0.5\ \Omega$	0.52	0.65	0.78	A/V
Input-output Gain M	GECM	GSW=OPEN, $R_{NF}=0.5\ \Omega$	1.04	1.30	1.56	A/V
Input-output Gain H	GECH	GSW=H, $R_{NF}=0.5\ \Omega$	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	VGSWL	GSW=OPEN, ECR=1.9 V	--	--	1.0	V
Hi-voltage Range	VGSWH	EC=1.7 V	2.5	--	--	V
Open Voltage	VGSWOP	--	--	2.0	--	V
FG						
Current of FG Output HI	IFGH	VOL=0.3V	0.2	0.4	1	mA
Current of FG Output LOW	IFGL	VOL=5.0V	6	12	18	mA
FG2						
Current of FG2 Output HI	IFG2H	VOL=0.3V	0.55	0.75	0.95	mA
Current of FG2 Output LOW	IFG2L	VOL=5.0V	6	12	18	mA
ROTATION DETECT						
Current of FR Output HI	IFRH	VOL=0.3V	0.1	0.13	0.23	mA
Current of FR Output LOW	IFRL	VOL=5.0V	4.0	7.0	10.0	mA
OUTPUT						
Saturation Voltage H	VOH	IO=-600mA (VM-RNF short)	--	1.0	1.35	V
Saturation Voltage L	VOL	IO=600mA	--	0.4	0.65	V
Pre-drive Current	IVML	EC=0 V or 5V, ECR=1.9 V PS= 5V output open	--	35	70	mA
Torque Limit Current	ITL	RNF=0.5Ω	560	700	840	mA
SHORT BRAKE						
ON Voltage Range	VSBON	BR=0V	2.5	--	--	V
OFF Voltage Range	VSOFF	BR=0V	--	--	1.0	V
SB Input Current	ISBin	SB=5V	--	240	--	μA
BRAKE MODE						
ON Voltage Range	VBRON	EC>ECR, SB=open	2.5	--	--	V
OFF Voltage Range	VBROFF	EC>ECR, SB=open	--	--	1.0	V
BR Input Current	IBRin	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

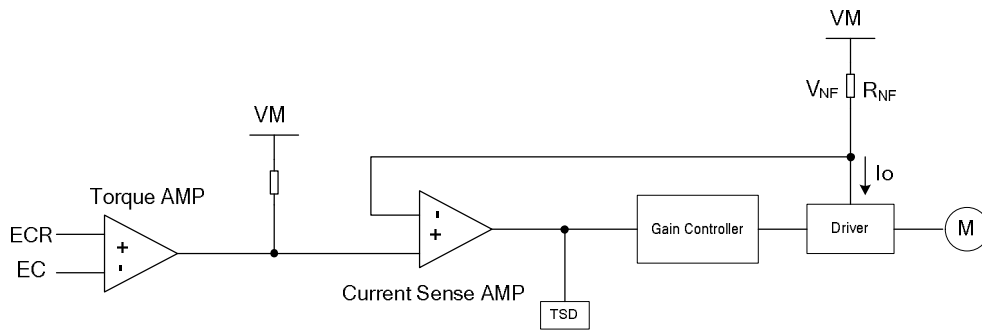
Pin no.	Input condition						Output						Test point
	9	10	11	12	13	14	Regular			Reverse			
	H1+	H1-	H2+	H2-	H3+	H3-	7	4	2	7	4	2	
							A1	A2	A3	A1	A2	A3	
Condition1	L	M	H	M	M	M	H	L	L	L	H	H	7 pin HI
Condition2	H	M	L	M	M	M	L	H	H	H	L	L	7pin low
Condition3	M	M	L	M	H	M	L	H	L	H	L	H	4 pin HI
Condition4	M	M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

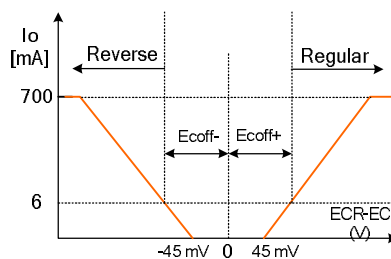
(2) Torque voltage range, gain switch

Fig.1



- By amplifying the voltage difference between E_c and E_{CR} from servo IC, the torque sense amp produces the input (VAMP) for the current sense amp.
- The output current (I_o) is converted into the voltage (V_{NF}) through the sense resistor (R_{NF}) 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 (I_o) is linearly controlled by the input VAMP.
- As a result, the signals E_c and E_{CR} can control the velocity of Motor by controlling the output current (I_o) 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 G_{EC} by RNF resistance, and calculate it with the following formula. $G_{EC}=0.325/RNF [A/V]$ (GSW=L)

$G_{ECM}=0.65/RNF [A/V]$ (GSW=OPEN)

$G_{ECH}=1.40/RNF [A/V]$ (GSW=H)

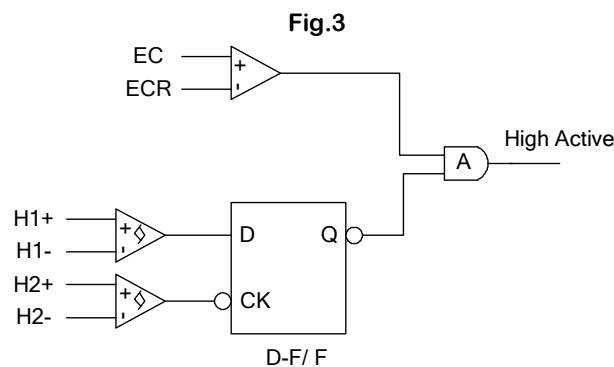
Torque limit current ITL can be calculated by $ITL=0.35/RNF [A]$

The input range of ECR and E_c is 0.5 V ~ 3.3 V ($R_{NF} = 0.5 \Omega$).

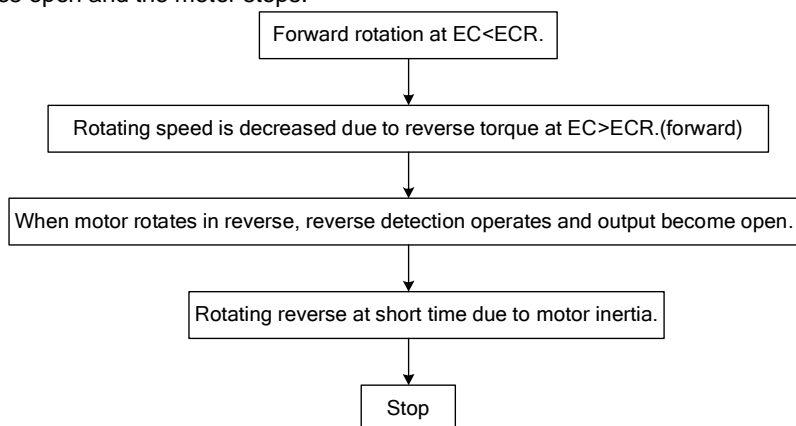
(3) Power save

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

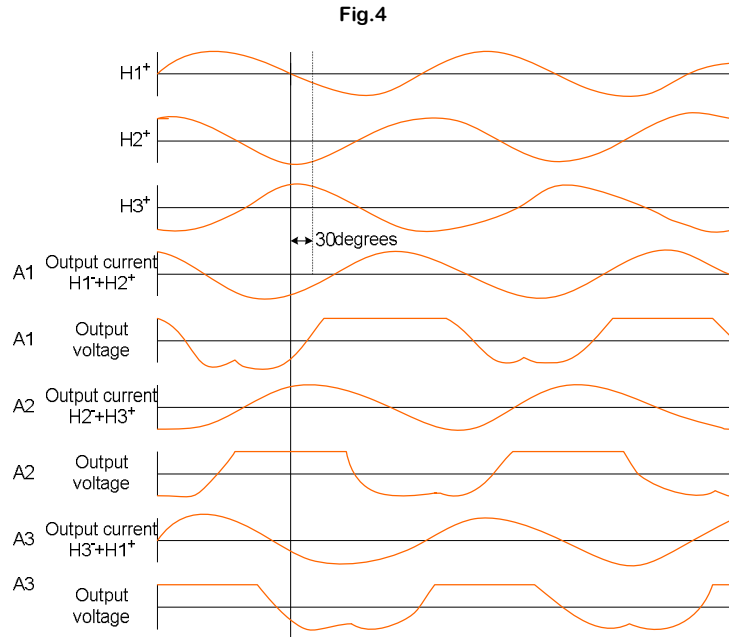
(4) Reverse detection



- 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.



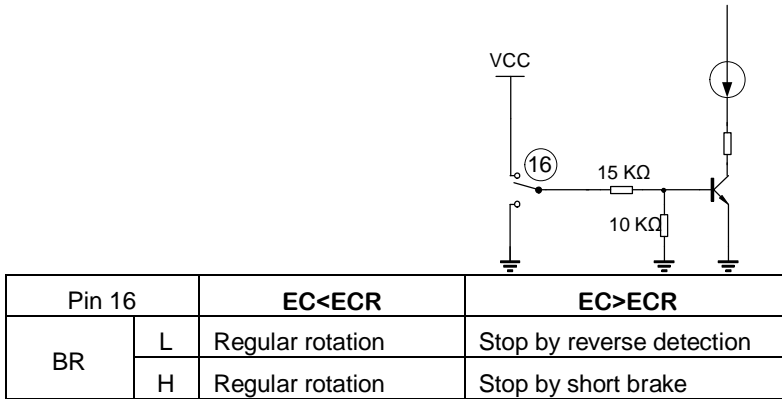
(5) Input-output timing chart



(6) Brake mode terminal

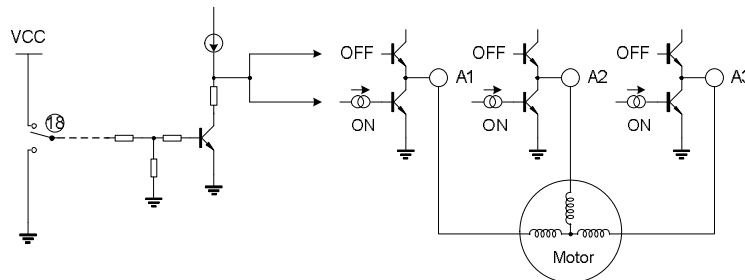
Input 'H' voltage to BR pin. Change brake type at EC>ECR

Fig. 5



(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.

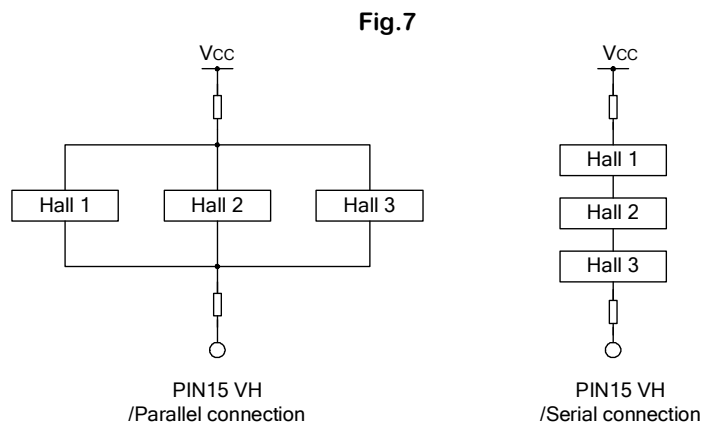
(8) Hall Sensor Connection

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

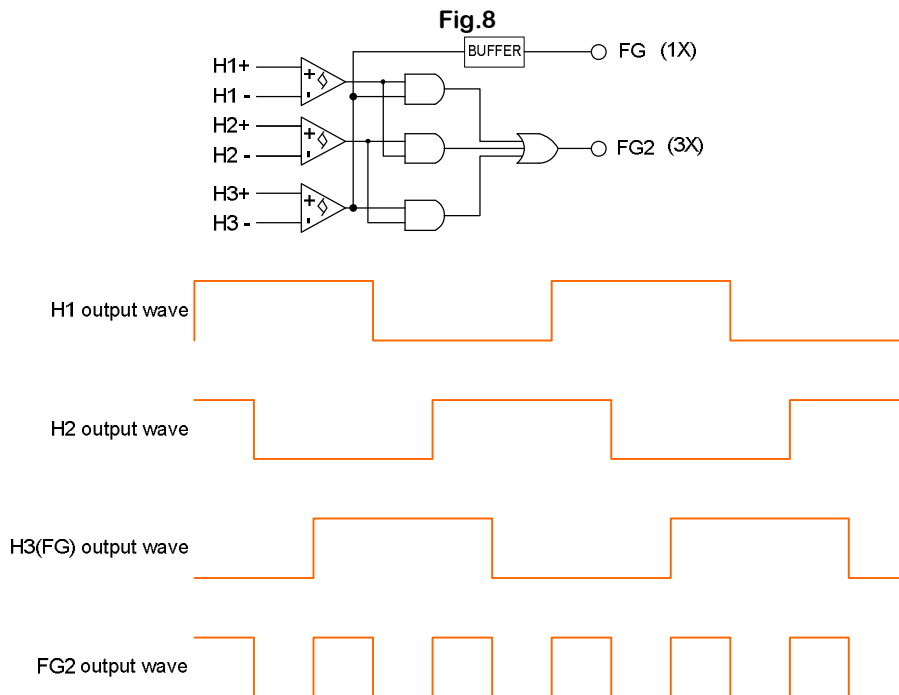
Please set hall input voltage at 1.0~4.0V and Hall minimum input level over 50mVpp.

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.



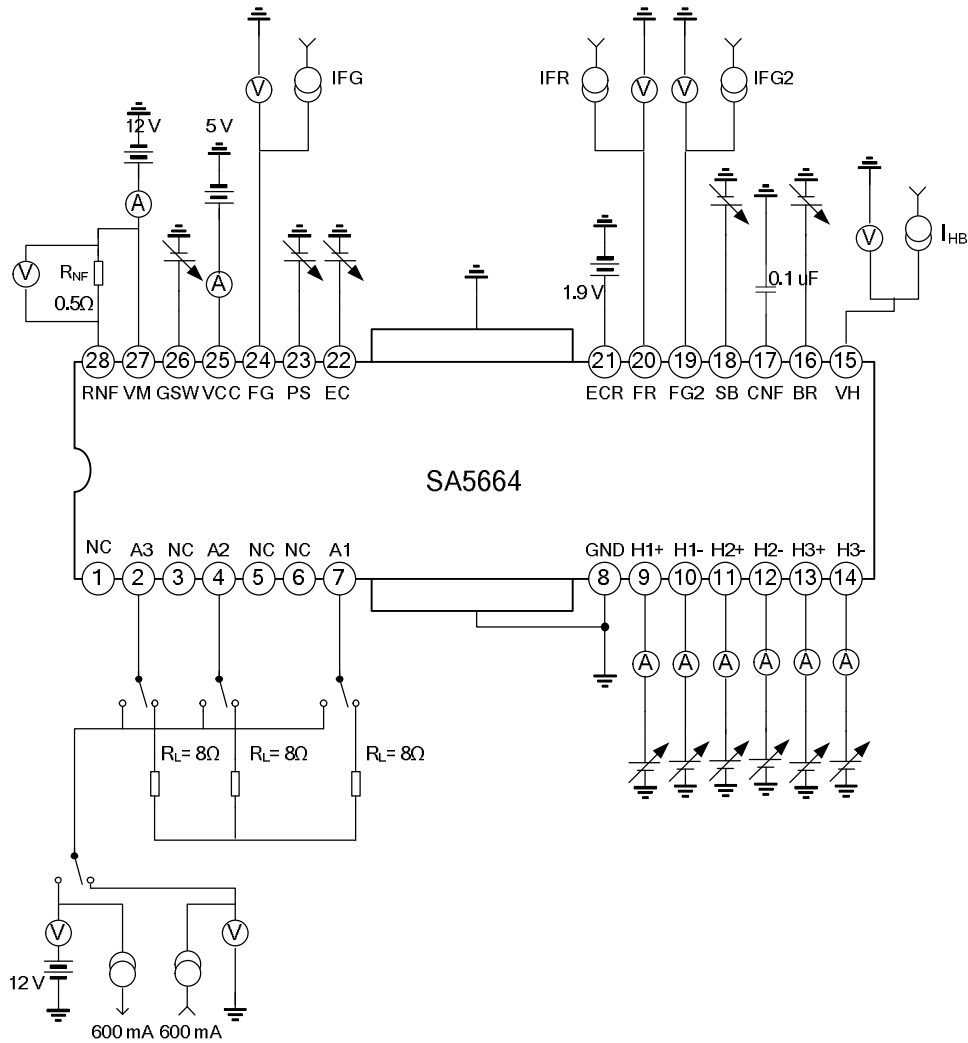
(9) FG (1X) output, FG2 (2X) output



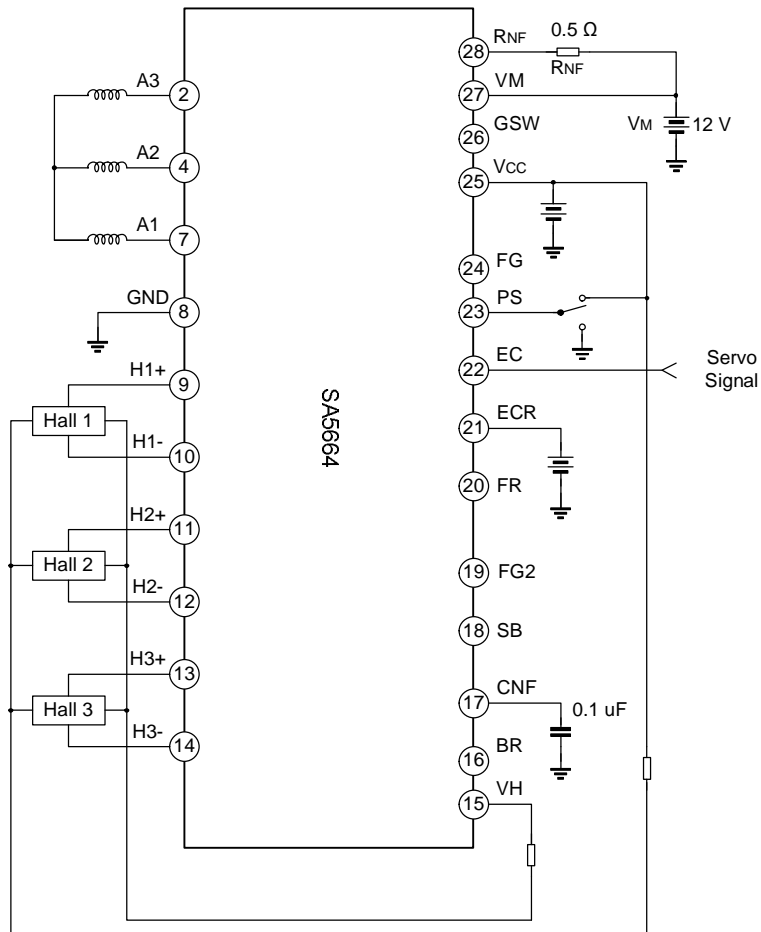
(10) Thermal shut down (TSD)

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



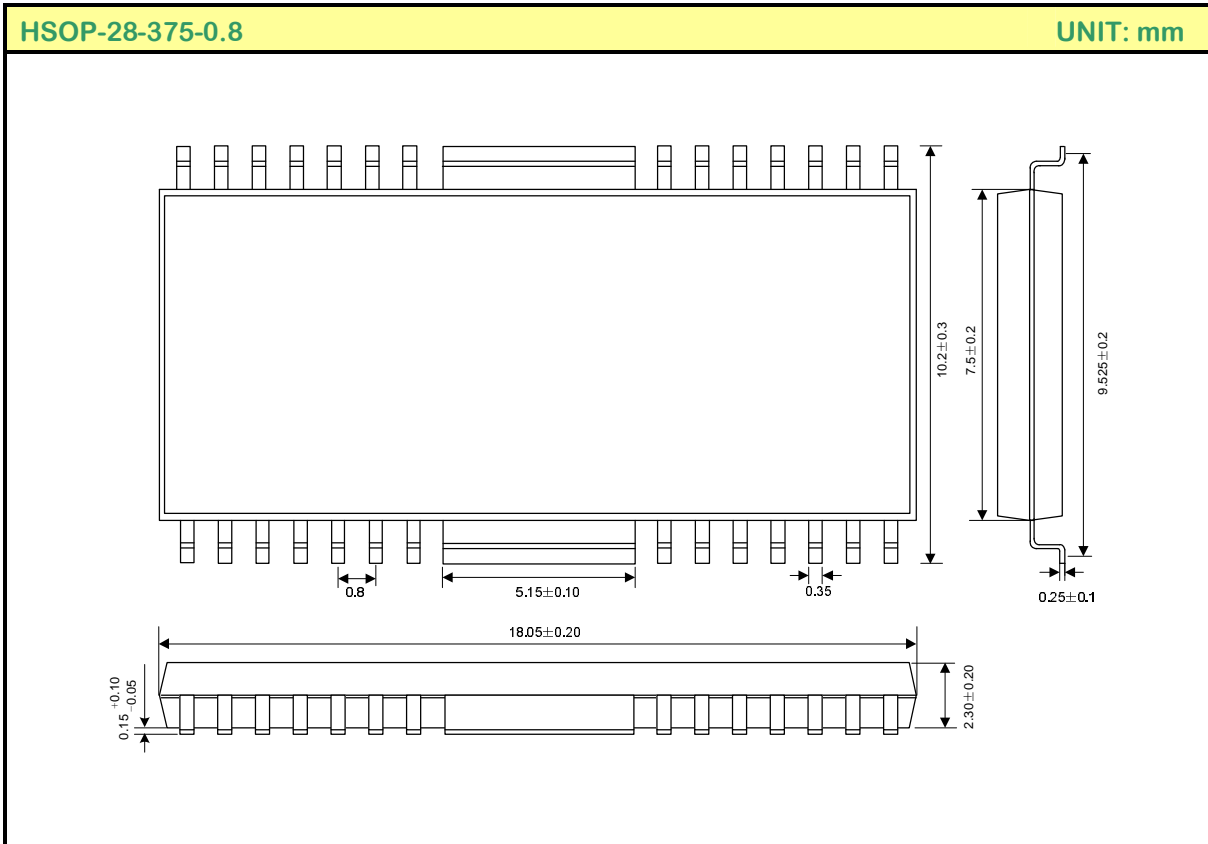
TYPICAL APPLICATION CIRCUIT



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