2-phase half-wave motor driver
BA6809F / BA6819AF

The BA6809F and BA6819AF are motor drivers designed for 3V and 5V fan motors. Built-in output transistors reduce the number of external components required. The ICs have an alarm output pin (BA6809F) and Hall output pin (BA6819AF).

●Applications
Fan motors

●Features
1) Lock detection and rotational speed sensing mechanisms are built in.
2) Alarm output pin (BA6809F) and Hall output pin (BA6819AF).
3) Built-in thermal shutdown circuit.
4) Operation assured with a supply voltage as low as 2.7V.
5) Compact 8-pin SOP package.

●Absolute maximum ratings (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	V_{CC}	15	V
Power dissipation	Pd	550[*1]	mW
Operating temperature	Topr	−25~+85	°C
Storage temperature	Tstg	−55~+150	°C
Output current	I_{OUT}	0.5[*2]	A
Alarm output pin current	I_{AL}	10[*3]	mA
Alarm output pin withstading voltage	V_{AL}	15[*3]	V
Hall signal output pin current	I_{HO}	10[*4]	mA
Hall signal output pin withstading voltage	V_{HO}	15[*4]	V

*1 Reduced by 4.4 mW for each increase in Ta of 1°C over 25°C.
    When mounted on a glass epoxy board (50.0✕50.0✕1.6 mm).
*2 Should not exceed Pd or ASO values.
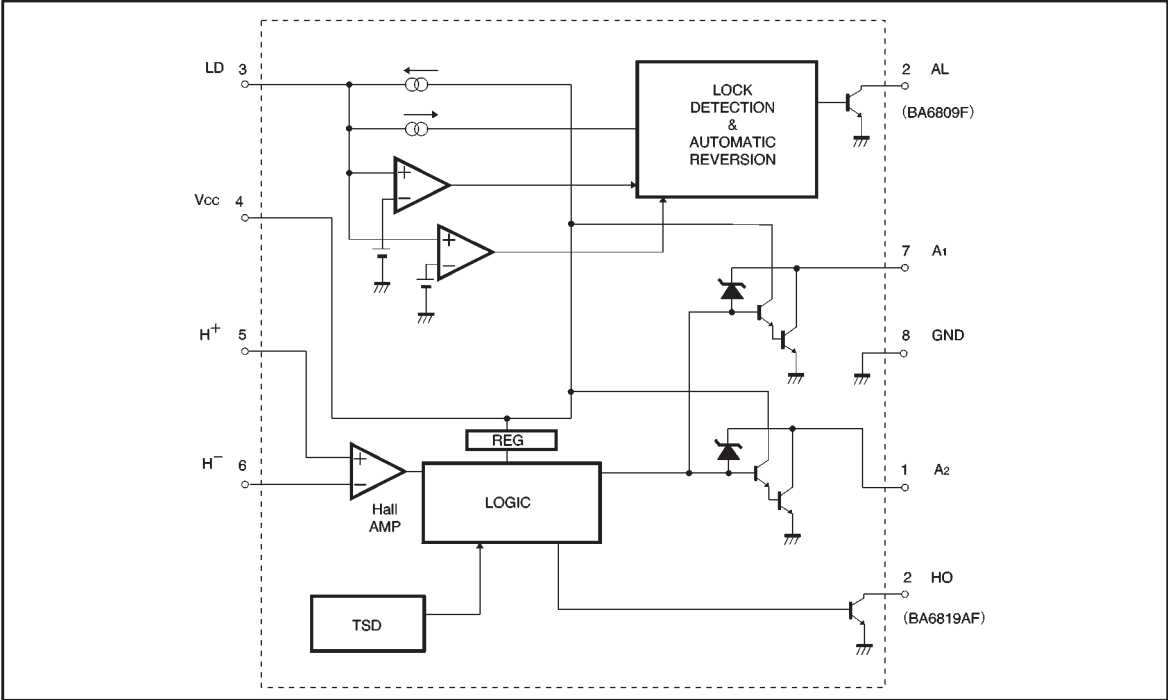*3 BA6809F only
*4 BA6819AF only

●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Operating power supply voltage	V_{CC}	2.7	—	6.0	V

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●Block diagram

●Pin descriptions

BA6809F   BA6819AF

Pin No.	Pin name	Function	Pin No.	Pin name	Function
1	A_2	Output 2	1	A_2	Output 2
2	AL	Alarm	2	HO	Hall signal output
3	LD	Capacitor connection pin for lock detection and automatic restart	3	LD	Capacitor connection for lock detection and automatic restart
4	V_{CC}	Power supply	4	V_{CC}	Power supply
5	H^+	Hall input (+)	5	H^+	Hall input (+)
6	H^-	Hall input (-)	6	H^-	Hall input (-)
7	A_1	Output 1	7	A_1	Output 1
8	GND	GROUND	8	GND	GROUND

●Hall input / output truth table

H^+	H^-	A_1	A_2	HO
H	L	HIGH (output transistor OFF)	LOW (output transistor ON)	LOW (output transistor ON)
L	H	LOW (output transistor ON)	HIGH (output transistor OFF)	HIGH (output transistor OFF)

Note: LD = 0V

●Input / output circuits
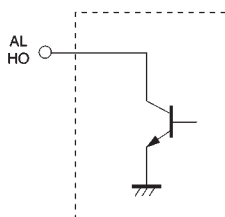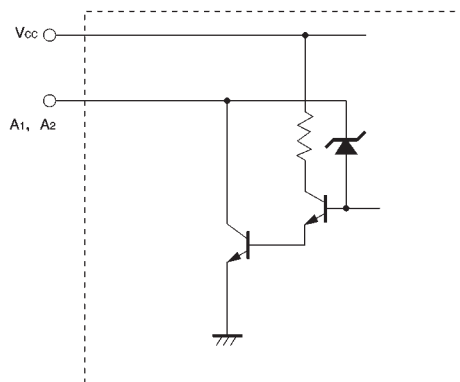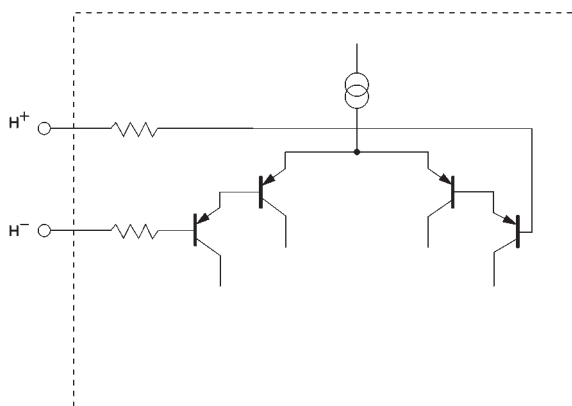
●Electrical characteristics (unless otherwise noted, Ta = 25°C and V_{CC} = 3V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Supply current	I_{CC}	1.5	4.3	8.6	mA	When output is OFF
Lock detection capacitor charge current	I_{LDC}	1.21	2.20	3.52	μA	V_{LD}=1.2V
Lock detection capacitor discharge current	I_{LDD}	0.21	0.42	0.70	μA	V_{LD}=1.2V
Lock detection capacitor charge/discharge ratio	r_{CD}	2.6	5.2	9.0	—	r_{CD}=I_{LDC} / I_{LDD}
Lock detection capacitor clamp voltage	V_{LDCL}	1.24	1.90	2.57	V	
Lock detection capacitor comparator voltage	V_{LDCP}	0.44	0.73	1.03	V	
Output low level voltage	V_{OL}	—	0.25	0.6	V	I_O=200mA
Output leakage current	I_{OL}	—	—	100	μA	V_O=10V
Output zener voltage	V_{OZ}	13	15	17	V	Clamp current = 10 mA
Alarm output pin low level voltage [1]	V_{ALL}	—	0.14	0.5	V	I_O=5mA
Alarm output pin leakage current [1]	I_{ALL}	—	—	50	μA	V_{AL}=10V
Hall signal output pin low level voltage [2]	V_{HOL}	—	0.14	0.5	V	I_O=5mA
Hall signal output pin leakage current [2]	I_{HOL}	—	—	50	μA	V_{HO}=10V
Hall input pin offset voltage	V_{OFF}	—	—	10	mV	V_{COM}=0.5V

*1 BA6809F only
*2 BA6819AF only
◎Not designed for radiation resistance.

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●Circuit operation

The BA6809F and BA6819AF have motor lock detection and automatic restart circuits. The timing of lock detection and automatic restart is determined by the external capacitor connected to the LD pin. The charge time of the external capacitor is given by :

$$t_{on} \text{ (Charge time)} = \frac{C \cdot (V_{LDCL} - V_{LDCP})}{I_{LDC}}$$

$$t_{off} \text{ (Discharge time)} = \frac{C \cdot (V_{LDCL} - V_{LDCP})}{I_{LDD}}$$

(Typical value)

where

V_{LDCL} is the LD-pin clamp voltage (1.90V),
V_{LDCP} is the LD-pin comparator voltage (0.73V),
I_{LDC} is the LD-pin charge current (2.2μA),
I_{LDD} is the LD-pin discharge current (0.42μA),
C is the capacitance of the LD-pin external capacitor.
For C=0.47μF, for example, the charge and discharge times are 0.25s (output ON) and 1.31s (output OFF), respectively.
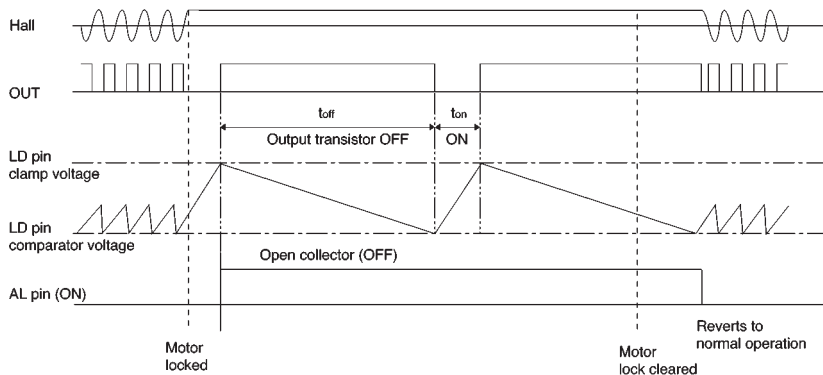

Fig.1   Timing chart

●Application example

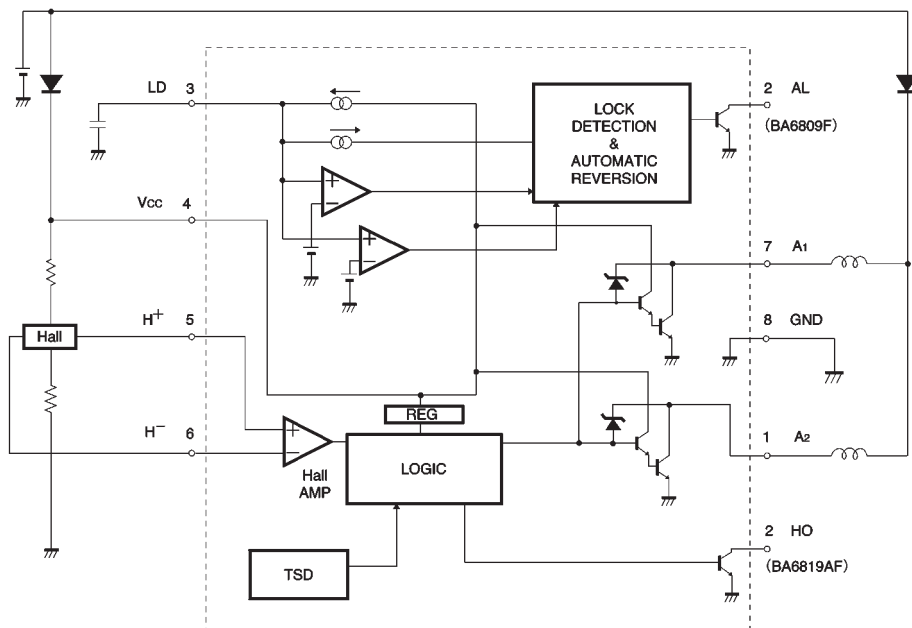
Fig.2

●Operation notes

(1) Thermal shutdown circuit

The IC has a built-in thermal shutdown circuit. The is a temperature difference of 20°C (typical) between the temperatures at which the circuit is activated and deactivated.
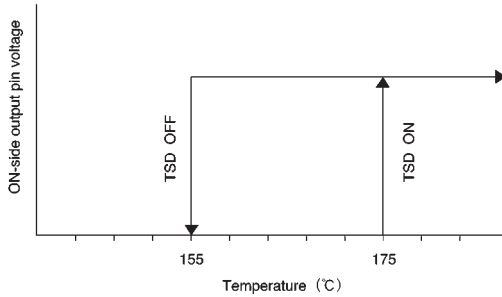

Fig.3   Temperature setting of the thermal shutdown circuit

The circuit is activated at the temperature of about 175°C (typical), so that all outputs are turned OFF. Normal operation resumes when the circuit is deactivated.

(2) Power dissipation

Power consumed in the IC can be calculated from the following equation :

$P_C = P_{C1} + P_{C2} + P_{C3}$

P_{C1} is power consumed by the circuit current.

$P_{C1} = V_{CC} \times I_{CC}$

P_{C2} is the output current consumption.

$P_{C2} = V_{OL} \times I_O$

V_{OL} is the LOW level output voltage of output pins 1 and 2, and I_O is the sink current of pins 1 and 2.

P_{C3} is power consumed by the AL and HO pins.

$P_{C3} = V_{ALL} \times I_{AL}$ (BA6809F)

$P_{C3} = V_{HOL} \times I_{HO} / 2$ (BA6819AF)

where

V_{ALL} is the AL-pin LOW level voltage,

I_{AL} is the AL-pin sink current,

V_{HOL} is the HO-pin LOW level voltage,

I_{HO} is the HO-pin sink current.

Make sure that your application does not exceed the allowable power dissipation of the IC.
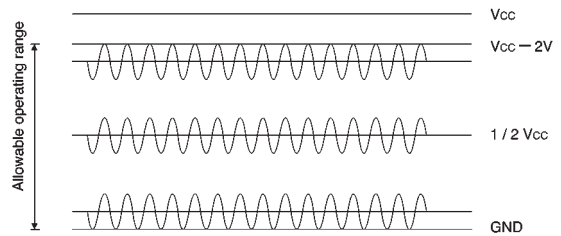
(3) Hall amplifier input voltage

Fig.4   Hall amplifier input bias voltage

The R1 and R2 resistances must be set so as to maintain the Hall amplifier input bias voltage within the range of 0V to ($V_{CC} - 2V$) including the signal amplitude.

The Hall device may be affected by power supply noise due to the PCB conductor pattern. If you have this problem, insert a capacitor C1 as shown in Fig. 5.

If the conductor lines from the Hall device output terminals to the Hall inputs of the IC are particularly long, noise can be picked up and fed into the inputs. If you have this problem, insert a capacitor C2 as shown in Fig. 5. Note that the Hall inputs have no hysteresis in this IC.

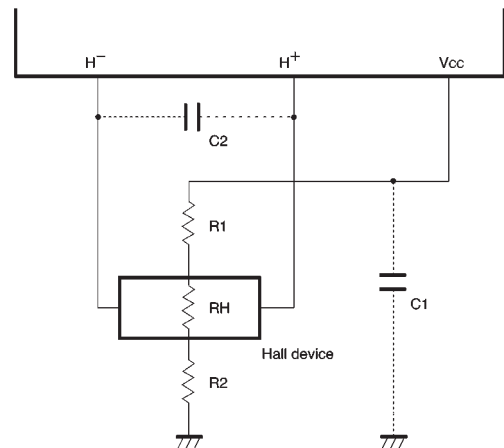Hall current is given by $= \dfrac{V_{CC}}{R1 + R2 + RH}$

where RH is the Hall device impedance.

Fig.5

●External dimensions (Units: mm)

SOP8