General Description

The SDC11169 is a single-phase bipolar drive motor driver that easily implements direct PWM drive systems with high excellent efficiency. The SDC11169 is optimal for fan motor driver in personal computer power supply systems and CPU cooling fan systems.

Applications

- CPU cooler fan

Features

- Single-phase bipolar drive (16V/1A)
- Variable speed control with thermistor input or PWM drive with additional components
- Include Hall bias circuit
- Minimum speed settable
- Over-current protection
- Lock protect and auto restart function
- FG output and RD output signal available
- Include thermal shut down circuit

Pin Configuration

SSOP-16

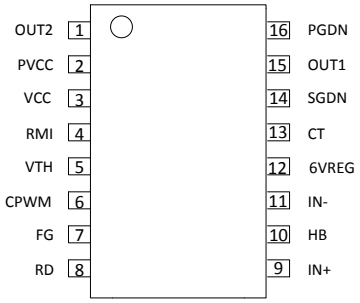


Figure 1. Pin Configuration

Pin Number	Pin Name	Function
1	OUT2	Driver output2
2	PVCC	Power supply voltage
3	VCC	Supply voltage
4	RMI	Minimum speed setting
5	VTH	Speed setting
6	CPWM	Oscillation frequency setting
7	FG	Rotation speed output
8	RD	Rotation detection output
9	IN+	Hall input+
10	HB	Hall bias
11	IN-	Hall input-

Pin Number	Pin Name	Function
12	6VREG	6V Regulator
13	CT	Shutdown time and restart time setting
14	SGND	Control stage GND
15	OUT1	Driver output1
16	PGND	Power ground

Table 1. Pin Description

Functional Block Diagram

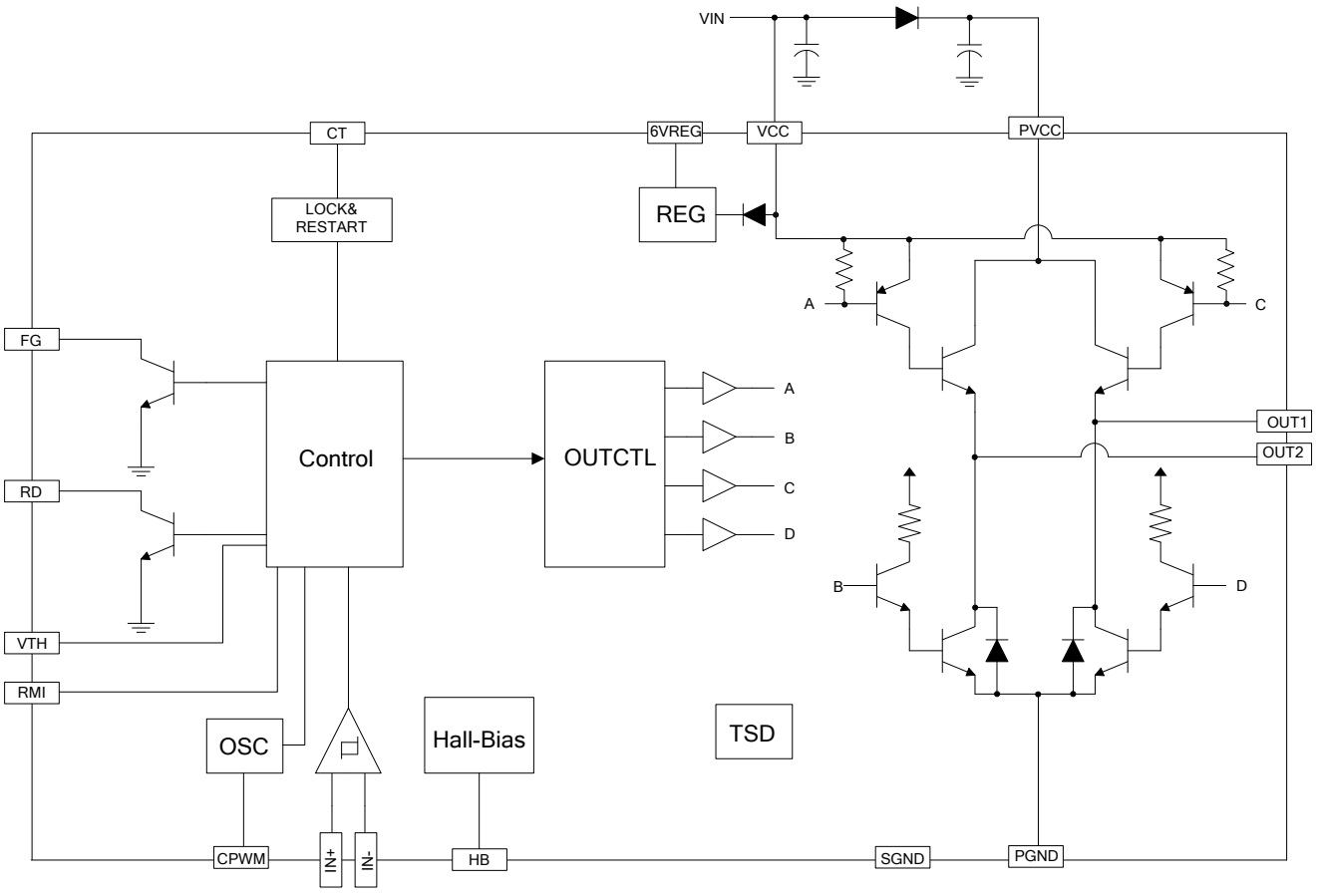
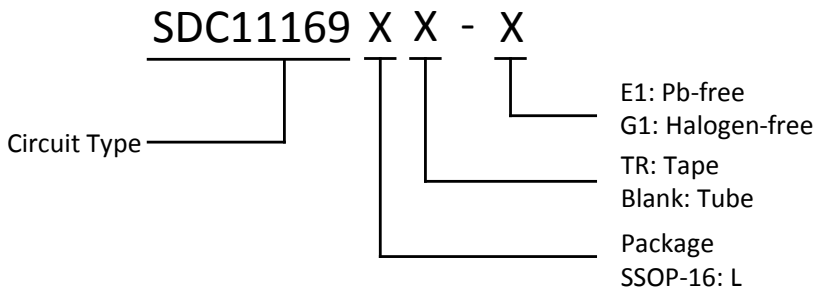


Figure 2. Functional Block Diagram

Ordering Information



Package	Temperature Range	Part Number		Marking ID		Packing Type
		Pb-free	Halogen-free	Pb-free	Halogen-free	
SSOP-16	-40°C~85°C	SDC11169LTR-E1	SDC11169LTR-G1	11169	11169-G	Tape
		SDC11169L-E1	SDC11169L-G1	11169	11169-G	Tube

Absolute Maximum Ratings (Note: Stresses greater than those listed under Absolute Maximum Ratings may cause permanent damage to the device.)

Parameter	Symbol	Conditions	Value	Unit
Supply voltage	V_{CCMAX}	-	18	V
Output current	I_{OUTMAX}	-	1	A
Output supply voltage	V_{OUTMAX}	-	18	V
HB output current	I_{HBMAX}	-	10	mA
VTH input voltage	V_{THMAX}	-	7	V
RD/FG output supply voltage	$V_{RD/FGMAX}$	-	18	V
RD/FG output current	I_{CCMAX}	-	10	mA
6VREG output current	$I_{6VREGMAX}$		10	mA
Allowable maximum power dissipation	Pd_{MAX}	SSOP-16	0.8	W
Operating temperature	T_{OPR}	-	-40~90	°C
Storage temperature	T_{STG}	-	-55~150	°C

Table 2. Absolute Maximum Ratings

Recommended Operating Conditions

Parameter	Symbol	Conditions	Min	Max	Unit
Supply voltage	V_{CC}	-	3.5	16	V
Threshold input voltage range	V_{TH}	-	0	6.0	V
Common-mode input voltage range	V_{ICM}	-	0.2	3.0	V

Table 3. Commended Operating Conditions

Electrical Characteristics (Ta=25°C, V_{CC}=12V, unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Operating current	I_{CC1}	Rotation mode	12	18	24	mA
	I_{CC2}	Lock protect mode	5	8	11	mA
6V regulator	$6V_{REG}$	I_O=-5mA	5.8	6	6.2	V
CPWM high level voltage	V_{CRH}	-	3.45	3.6	3.75	V
CPWM low level voltage	V_{CRL}	-	1.95	2.05	2.15	V
CPWM oscillation frequency	f_{PWM}	C=100pF	18	25	32	kHz
CT pin high level voltage	V_{CTH}	-	3.45	3.6	3.75	V
CT pin low level voltage	V_{CTL}	-	1.55	1.7	1.85	V
CT charge current	I_{CT1}	V_{CT}=0V	1.5	2.0	2.5	uA
CT discharge current	I_{CT2}	V_{CT}=4.2V	0.15	0.2	0.25	uA
CT charge/discharge current ratio	R_{CT}	$R_{CD}= I_{CT1}/ I_{CT2}$	9.5	11	12.5	-
Output lower side saturation	V_{OL}	I_O=200mA	-	0.2	0.3	V
Output upper side saturation	V_{OH}	I_O=-200mA	-	0.9	1.1	V
Hall input sensitivity	V_{HN}	-	-	±10	±20	mV
RD/FG pin low voltage	V_{FG}	I_{FG}=5mA	-	0.2	0.3	V
RD/FG pin leak current	I_{FGL}	V_{FG}=7V	-	-	30	uA
Over temperature shutdown	T_{SD}	-	-	175		°C
Temperature hysteresis	T_{SDH}	-	-	30		°C

Table 4. Electrical Characteristics

Truth Table

VTH	IN-	IN+	CPWM	CT	Output1	Output2	FG	RD	Mode
L (OPEN)	H	L	H	L	H	L	L	L	Rotation(Drive)
	L	H			L	H	OFF	-	PWM OFF
H	H	L	L		OFF	L	L	-	Rotation(regeneration)
	L	H			L	OFF	OFF	-	PWM ON
-	H	L	-	H	H	OFF	L	OFF	Lock protection
-	L	H			OFF	H	OFF	-	
-	L	H			OFF	H	OFF	-	

CPWM-H: VCPWM>VTH, CPWM-L: VCPWM<VTH

Table 5. Truth Table

Power Dissipation Curve

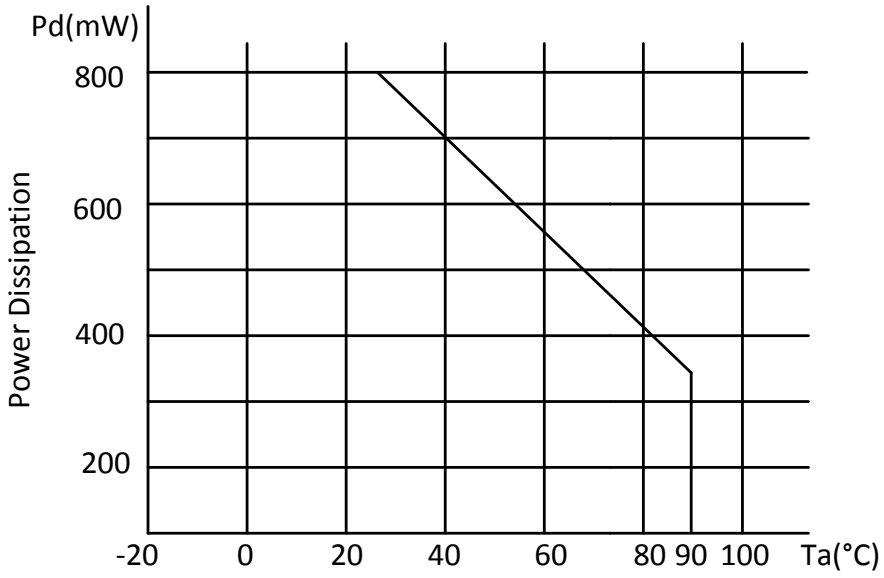


Figure 3. Power Dissipation Curve (SSOP-16)

Typical Application

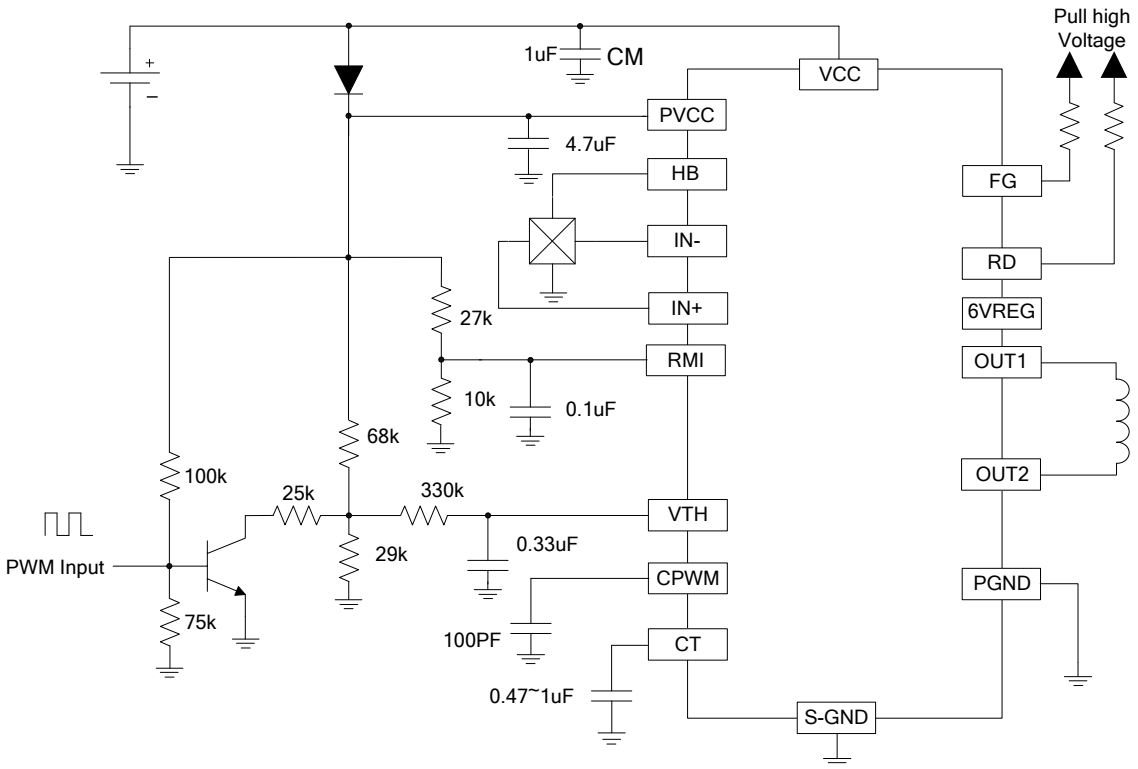


Figure 4. Typical Application

Function Description

Power Supply and Ground Lines

P-GND is connected to the motor power supply system and S-GND is connected to the control circuit power supply system.

These two systems should be formed from separate lines and the control system external components should be connected to S-GND.

Regeneration Power Supply Stabilization Capacitor

The capacitor CM provides power supply stabilization for both PWM drive and kickback absorption. A capacitor with a value of over 0.1μF is used for CM. A large capacitor must be used when the coil inductance is large or when the coil resistance is low. Since this IC adopts a technique in which switching is performed by the high side transistor and regeneration is handled by the low side transistor, the pattern connecting CM to VCC and P-GND must be as wide and as short as possible.

Hall Input

Lines that are as short as possible must be used to prevent noise from entering the system. The Hall sensor input circuit consists of a comparator with hysteresis (20mV). We recommend that the Hall sensor input level be at least three times this hysteresis, i.e. at least $60mV_{P-P}$.

PWM Oscillation Frequency Setting Capacitor

If a value of 100pF is used for CP, the oscillator frequency will be f = 25 kHz, and this will be the basic frequency of the PWM signal.

RD Output

This is an open collector output. It outputs a low level when the motor is turning and a high level when it is stopped. This pin must be left open if unused.

FG Output

This is an open collector output, and a rotation count detection function can be implemented using this FG output, which corresponds to the phase switching. This pin must be left open if unused.

HB Pin

This pin provides a Hall effect sensor bias constant-voltage output of 1.25V.

RMI Pin

Connect this pin to VTH if unused. Even if unused, the IC is set internally to operate at a 10% drive duty at the voltage corresponding to the lowest speed. (The capacitor is used to set up full-speed mode at startup.)

Control Timing Chart

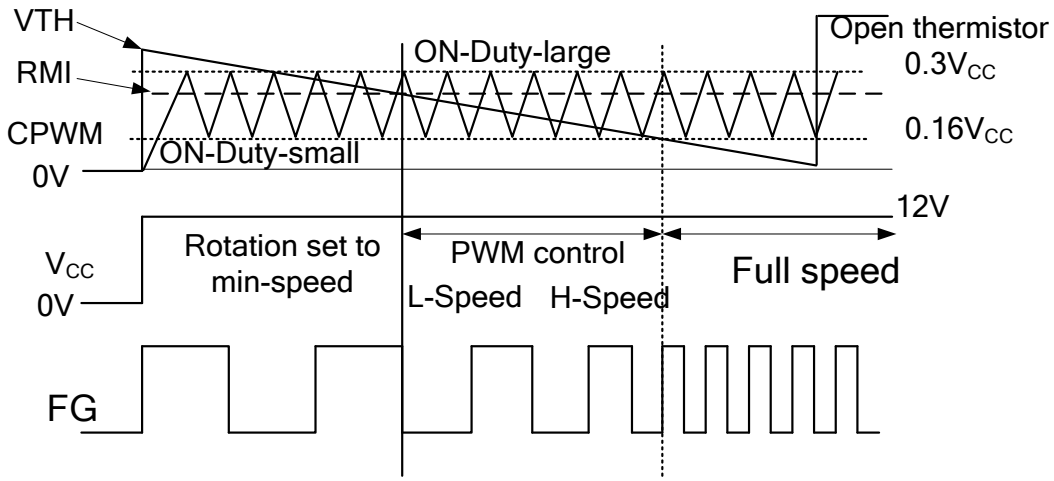


Figure 5. Control Timing Chart

Minimum Speed Setting Mode

A VTH voltage level is generated when the thermistor detects the set temperature. At low temperature, the fan motor turns at the lowest speed, which is set with the RMI pin. The SDC11169 compares the CPWM oscillator voltage with the RMI pin voltage and sets the duty for the lowest drive state.

Low Speed to High-speed Mode

The PWM signal is controlled by comparing the CPWM oscillation voltage that cycles is between 1.2V and 3.8V and the VTH voltage.

When the VTH voltage is lower, the high and low side transistors are turned on, and when the VTH voltage is higher, the high side transistor is turned off and the coil current is regenerated through the low side transistor. Thus the output on duty increases as the VTH voltage becomes lower, the coil current increases, and the motor speed increases. Rotation speed feedback is provided by the FG output.

Full Drive Mode

The SDC11169 switches to full-speed mode above a certain temperature.

Thermistor Removed Mode

If the thermistor is removed, the VTH input voltage will rise. However, the output will go to full drive at 100% and the motor will run at full speed.

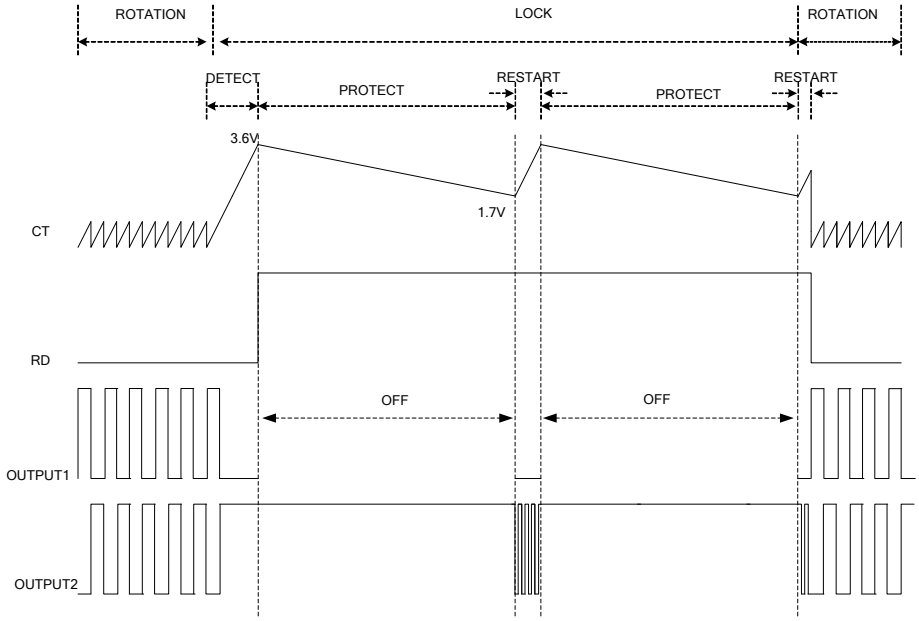


Figure 6. Lock Control Timing Chart

Rotation Mode

In normal operation, the capacitor will be discharged frequently and the voltage of CT will not reach 1.6V. RD output at low.

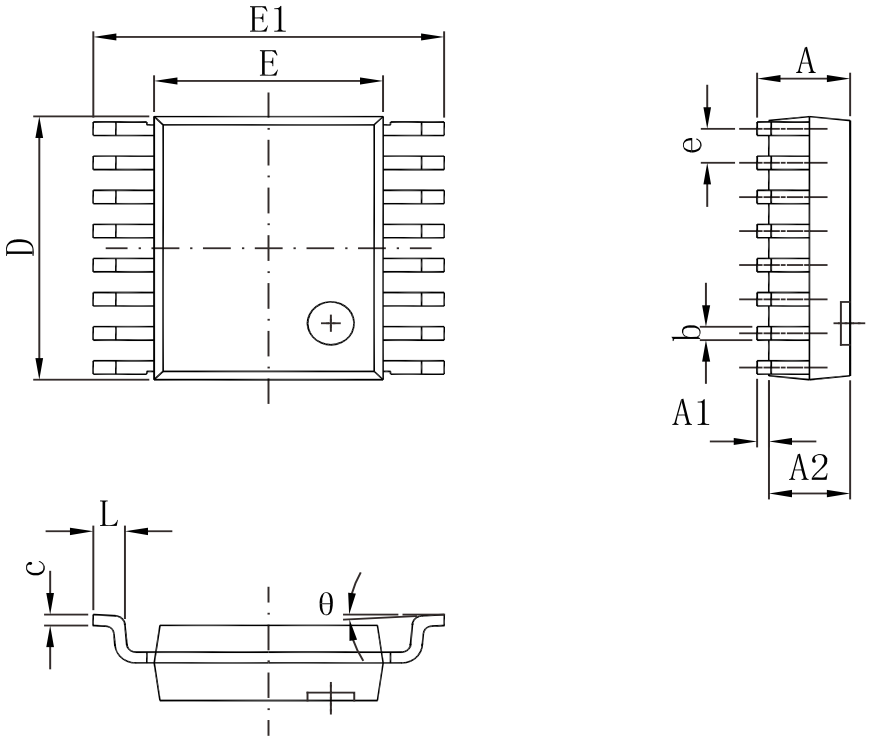
Lock-shutdown and Auto-restart

If the fan is stopped by force, lock-shutdown will be triggered when the voltage of CT reaches 3.6V, shut the output transistors down to prevent overheating. Then the capacitor will be discharged by a 0.22uA current, until the voltage of CT reaches 1.7V and enter restart mode.

During restart, the output pin pulse width will be 0.5 times of the original pulse width in order to achieve a low temperature rise in lock condition (shown in the illustration below); if not, the pulse width will be normal.

Package Dimension

SSOP-16



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.200	0.300	0.008	0.012
c	0.170	0.250	0.007	0.010
D	4.700	5.100	0.185	0.200
e	0.635(BSC)		0.025(BSC)	
E1	5.800	6.200	0.228	0.244
E	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°TYP.	8°TYP.	0°TYP.	8°TYP.

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