Single-Phase Full-Wave Pre-Driver For Fan Motor SDC11967

General Description

The SDC11967 is a single-phase bipolar variable speed fan motor predriver that works with an external PWM signal. A highly efficient, quiet and low power consumption motor driver circuit, with a large variable speed, can be implemented by adding a small number of external components.

This device is optimal for driving large scale fan motors (with large air volume and large current) such as those used in servers and consumer products.

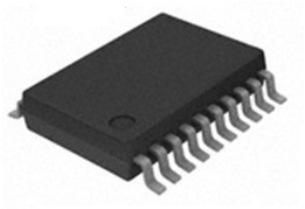
Features

- Pre-driver for single-phase full-wave drive
- External PWM input enabling variable speed control
- Compatible with 12V, 24V, and 48V power supplies
- Reactive current cut circuit incorporated
- Minimum speed setting pin
- Constant-voltage output pin for Hall bias
- RD output

Applications

- PWM control variable speed fan motor

Pin Configuration



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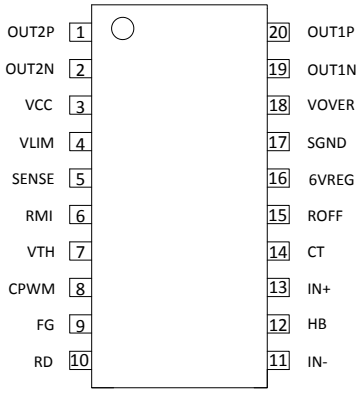


Figure1. Pin Configuration

Pin Number	Pin Name	Function
1	OUT2P	Driver output2P
2	OUT2N	Driver output2N
3	VCC	Supply voltage
4	VLIM	VLIM voltage setting
5	SENSE	Current sensing
6	RMI	Minimum speed setting
7	VTH	Speed setting
8	CPWM	Oscillation frequency setting
9	FG	Rotation speed output
10	RD	Rotation detection output
11	IN-	Hall input-
12	HB	Hall bias
13	IN+	Hall input+
14	CT	Shutdown time and restart time setting
15	ROFF	Soft switching time setting
16	6VREG	6V regulator
17	SGND	Control stage GND
18	VOVER	Over voltage protect
19	OUT1N	Driver output1N
20	OUT1P	Driver output1P

Table 1. Pin Description

Functional Block Diagram

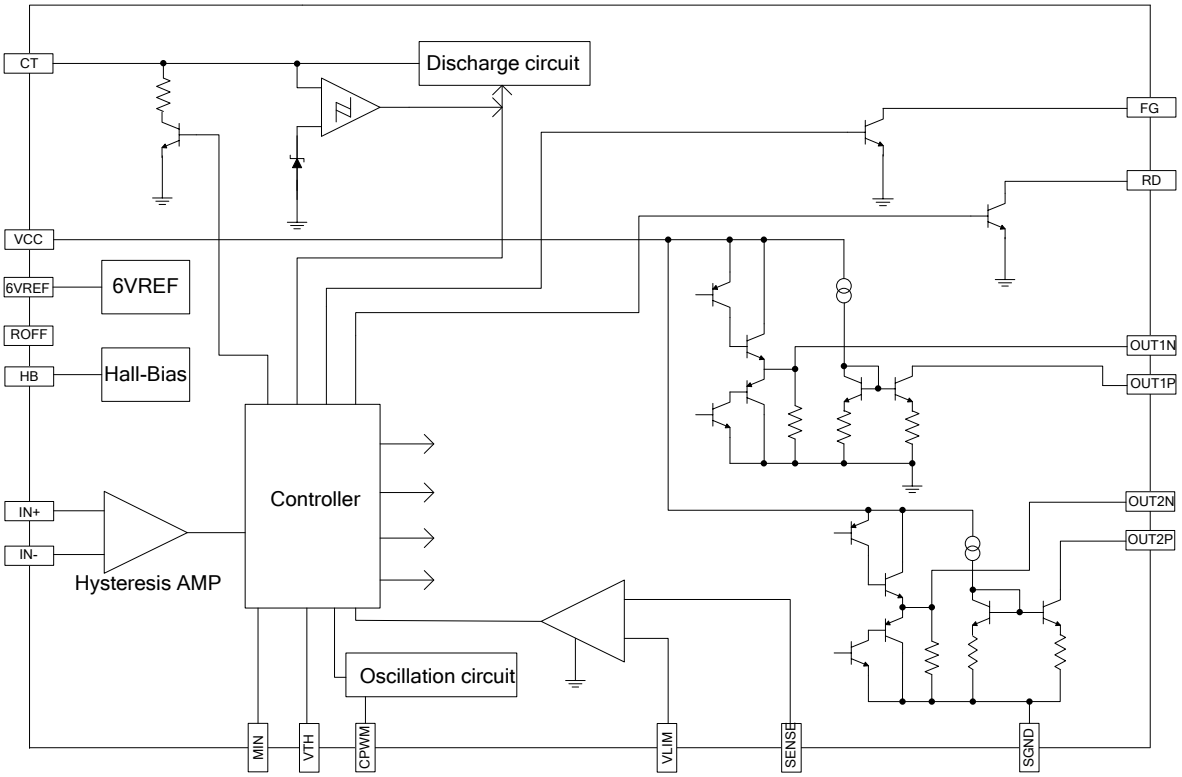
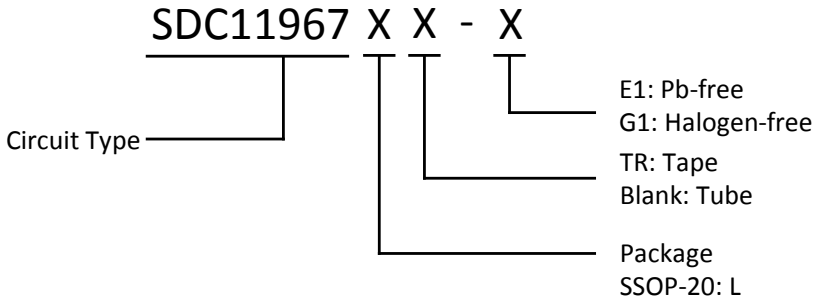


Figure 2. Functional Block Diagram

Ordering Information



Package	Temperature Range	Part Number		Marking ID		Packing Type
		Pb-free	Halogen-free	Pb-free	Halogen-free	
SSOP-20	-30°C~95°C	SDC11967LTR-E1	SDC11967LTR-G1	SDC11967	SDC11967-G	Tape
		SDC11967L-E1	SDC11967L-G1	SDC11967	SDC11967-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	Min	Max	Unit
VCC maximum supply voltage	V_{CCMAX}	-	-	18	V
OUT pin maximum output current	I_{OUTMAX}	-	-	50	mA
OUT pin output withstand voltage	V_{OUTMAX}	-	-	18	V
HB maximum output current	I_{HBMAX}	-	-	10	mA
VTH input pin withstand voltage	V_{THMAX}	-	-	8	V
RD/FG output pin output withstand voltage	$V_{RD/FGMAX}$	-	-	18	V
RD/FG output current	$I_{RD/FGMAX}$	-	-	10	mA
Allowable power dissipation	Pd_{MAX}	-	-	800	mW
Operating temperature range	T_{OPR}	-	-30	90	°C
Storage temperature range	T_{STG}	-	-55	150	°C

Table 2. Absolute Maximum Ratings

Recommended Operating Conditions

Parameter	Symbol	Conditions	Min	Max	Unit
VCC supply voltage	V_{CC}	-	6	16	V
VTH input level voltage range	V_{TH}	-	0	7.0	V
Hall input common phase 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
Circuit current	I_{CC1}	Rotation mode	6	10	14	mA
	I_{CC2}	Lock protect mode	6	10	14	mA
6VREG voltage	$6V_{REG}$	I_{HB}=5mA	5.8	6	6.15	V
VOVER voltage	V_{OVER}	-	12.0	12.8	13.6	V
CPWM-H level voltage	V_{CRH}	-	4.35	4.55	4.75	V
CPWM-L level voltage	V_{CRL}	-	1.45	1.65	1.85	V
CPWM oscillation frequency	f_{PWM}	C=100pF	18	25	32	kHz
CT pin high level voltage	V_{CTH}	-	3.4	3.6	3.8	V
CT pin Low level voltage	V_{CTL}	-	1.4	1.6	1.8	V
CT charge current	I_{CT1}	V_{CT}=0V	1.6	2.0	2.5	uA
CT discharge current	I_{CT2}	V_{CT}=4.2V	0.16	0.2	0.28	uA

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

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
CT charge/Discharge current ratio	R_{CT}	$R_{CD}= I_{CT1}/ I_{CT2}$	8	10	12	deg
Output- N saturation	V_{ON}	I_O=20mA	4	10		V
OUT-P sink current	I_{OP}	-	15	20		mA
Hall input sensitivity	V_{HN}	-		±10	±20	mV
RD/FG output pin L voltage	V_{FG}	I_{FG}=5mA	-	0.15	0.3	V
RD/FG output pin leak current	I_{FGL}	V_{FG}=16V	-	-	30	uA

Table 4. Electrical Characteristics

Truth Table

VTH	CPWM	IN-	IN+	Output1P	Output 1N	Output 2P	Output 2N	Mode
L	H	H	L	L	-	-	H	OUT1 to 2 drive
		L	H	-	H	L	-	OUT2 to 1 drive
H	L	H	L	OFF	-	-	H	During rotation
		L	H	-	H	OFF	-	

IN-	IN+	CT	Output1P	Output 1N	Output 2P	Output 2N	FG	RD	Mode
H	L	L	L	-	-	H	L	L	OUT1 to 2 drive
L	H		-	H	L	-	OFF		OUT2 to 1 drive
H	L	H	OFF	-	-	H	L	OFF	Lock protection
L	H		-	H	OFF	-	OFF		

Table 5. Truth Table

Power dissipation curve

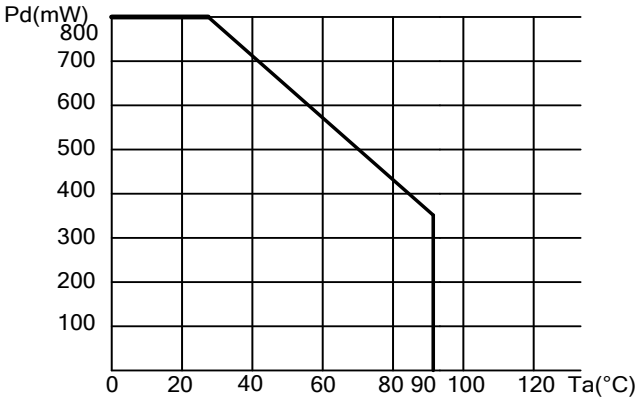


Figure 4. Power Dissipation Curve (SSOP-20)

Typical Application

12V Typical Application

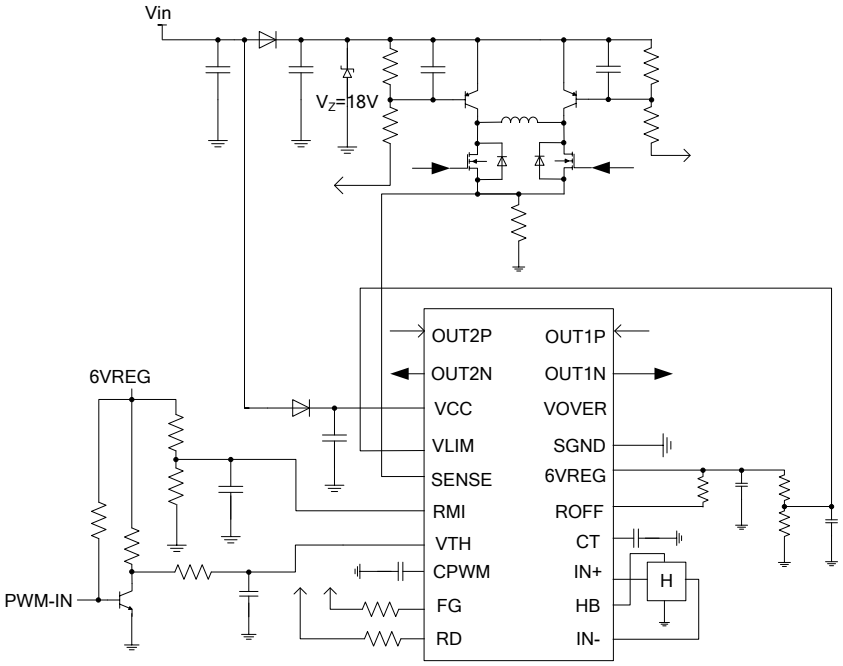


Figure 4. 12V Typical Application

24V/48V Typical Application

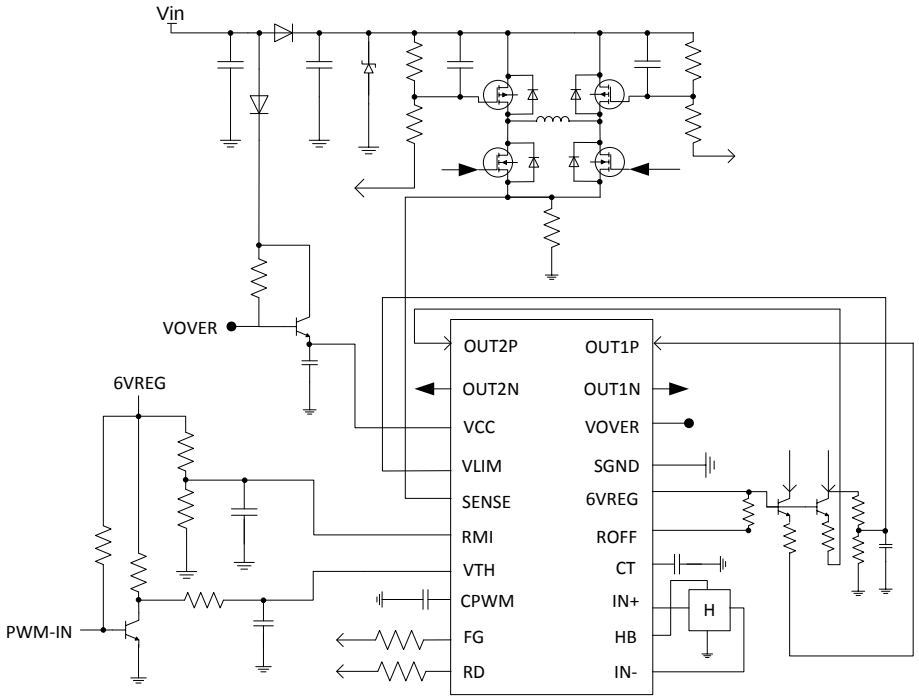


Figure 5. 24V/48V Typical Application

Function Description

Power supply-GND wiring

SGND is connected to the control circuit power supply system.

Power stabilization capacitor for regeneration

For the CM capacitor that is a power stabilization capacitor for PWM drive and for absorption of kick-back, the capacitance of 0.1 to 1F is used. In this IC, the lower TR performs current regeneration by means of switching of upper TR. Connect CM between VCC and GND with the thick pattern and along the shortest route.

Zener diode to stabilize power supply for regeneration

Be sure to use the zener diode if kick-back causes excessive increase of the supply voltage because such increase damages IC.

Hall Input

Wiring need to be short to prevent carrying of the noise. If the noise is carried, insert a capacitor between IN+ and IN-. The Hall input circuit is a comparator having a hysteresis of 20mV. It is recommended that the Hall input level is more than three times (60mVp-p) this hysteresis.

Capacitor to set the PWM oscillation frequency

With CP=100pF, oscillation occurs at f=25 kHz and provides the basic frequency of PWM.

RD Output

This is the open collector output, which outputs “L” during rotation and “H” at stop. This output is left open when not used.

FG output

This is the open collector output, which can detect the rotation speed using the FG output according to the phase shift. This output is left open when not used.

HB Pin

This is a Hall element bias pin, that is, the 1.5V constant-voltage output pin.

RMI Pin

This is the minimum speed setting pin, which is pulled up with 6 VREG when not used. When IC power may possibly be turned OFF first when the pin is used, be sure to insert a current limiting resistor to prevent inflow of the large current. (The same applies to the VTH pin.)

ROFF Pin

This pin sets the soft switching time to cut the reactive current before phase change and is connected to 6 VREG when not used.

VLIM Pin

This pin activates the current limiter when the SENSE pin voltage is higher than the VLIM pin voltage and is connected to 6 VREG when not used.

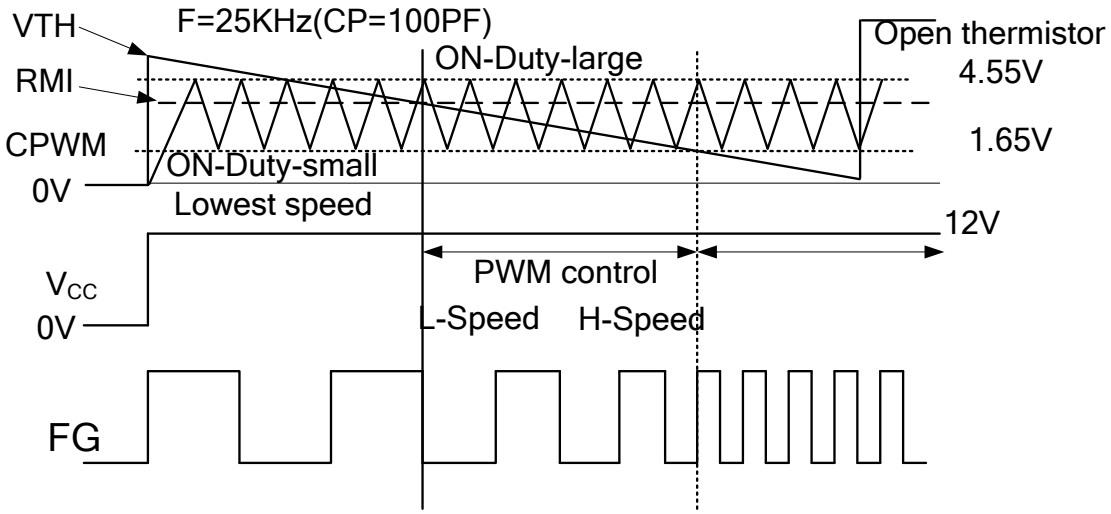
SENSE Pin

This is connected to GND when not used.

VOVER Pin

This is a pin for constant-voltage bias and should be used for application of 24V and 48V. (Refer to the sample application circuit.) Be sure to use the current limiting resistor. This is left open when not used.

Control Timing Chart



Minimum speed setting (stop) mode

PWM-IN input is filtered to generate the VTH voltage. At low speed, the fan rotates with the minimum speed set with RMI pin during low speed. If the minimum speed is not set (RMI = 6VREG), the fan stops.

Low speed to High-speed mode

PWM control is made through comparison of oscillation and VTH voltages with CPWM changing between 1.6V to 4.6V. Upper and lower TRs are turned ON when the VTH voltage is higher. The upper output TR is turned OFF when the VTH voltage is lower, and the coil current is regenerated in the lower TR. Therefore, as the VTH voltage lowers, the output ON-DUTY increases, increasing the coil current and raising the motor speed. The rotation speed is fed back by the FG output.

Full speed mode

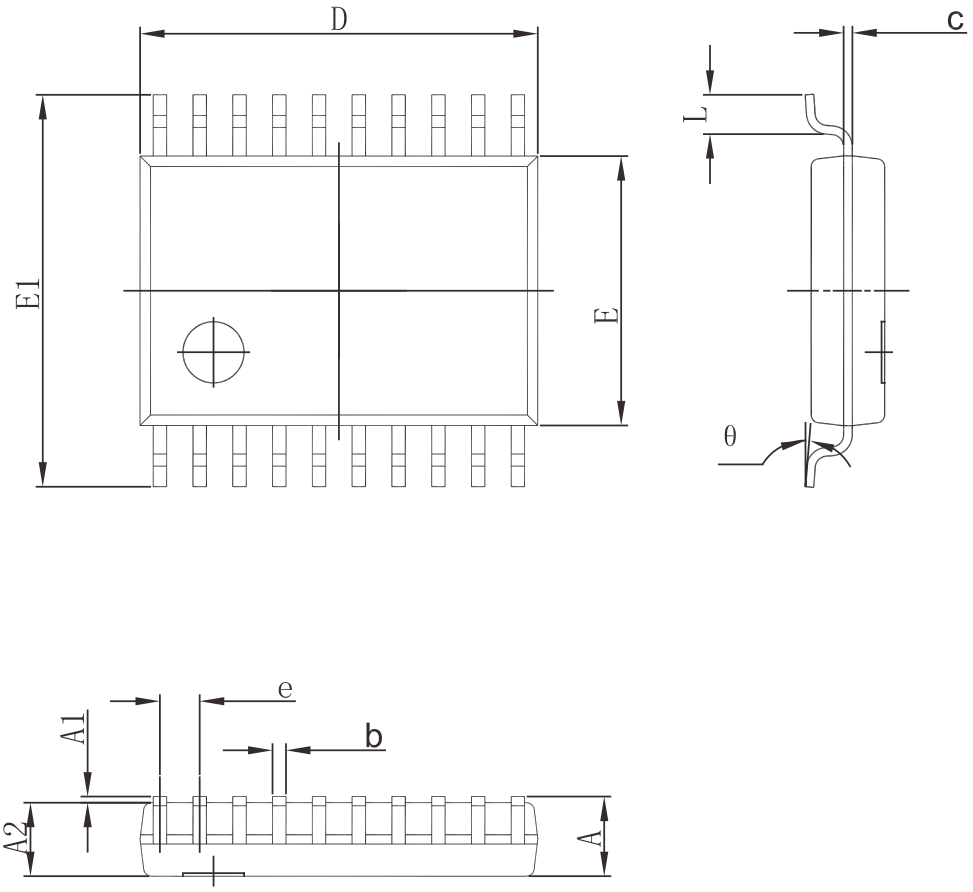
The full-speed mode becomes effective with the VTH voltage of 1.65V or less. (VTH must be equal to GND when the speed control is not to be made.)

PWM-IN input disconnection mode

When the PWM-IN input pin is disconnected, VTH becomes 1.65V or les and the output enables full drive at 100%. The fan runs at full speed. (Refer to the sample application circuit.)

Package Dimension

SSOP-20



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	--	1.450	--	0.057
A1	0.050	0.200	0.002	0.008
A2	1.150	1.250	0.045	0.049
b	0.200	0.310	0.008	0.013
c	0.090	0.200	0.004	0.008
D	6.300	6.700	0.248	0.264
e	0.65(BSC)		0.026(BSC)	
E1	6.200	6.600	0.244	0.260
E	4.200	4.500	0.169	0.177
L	0.450	0.750	0.018	0.030
θ	0°	8°	0°	8°

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