



LB11967V

Monolithic Linear IC
**Variable Speed Single-Phase Full-Wave
Pre-Driver For Fan Motor**

Overview

The LB11967V 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.

Functions and Features

- Pre-driver for single-phase full-wave drive
 - ⇒ PNP-EMOS is used as an external power TR, enabling high-efficiency low-consumption drive by means of the low-saturation output and single-phase full-wave drive. (PMOS-NMOS also applicable)
- External PWM input enabling variable speed control
 - ⇒ Separately-excited upper direct PWM (f = 25kHz) control method, enabling highly silent speed control
- Compatible with 12V, 24V, and 48V power supplies
- Current limiter circuit incorporated
 - ⇒ Chopper type current limit at start
- Reactive current cut circuit incorporated
 - ⇒ Reactive current before phase change is cut to enable silent and low-consumption drive.
- Minimum speed setting pin
 - ⇒ Minimum speed can be set with external resistor. The start assistance circuit enables start at extremely low speed.
- Constant-voltage output pin for Hall bias
- Lock protection and automatic reset functions incorporated
- (Rotation speed detection), RD (Lock detection) output

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
VCC maximum supply voltage	V _{CC} max		18	V
OUT pin maximum output current	I _{OUT} max		50	mA
OUT pin output withstand voltage	V _{OUT} max		18	V
HB maximum output current	HB		10	mA

Continued on next page.

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Parameter	Symbol	Conditions	Ratings	Unit
VTH input pin withstand voltage	VTH max		8	V
RD/FG output pin output withstand voltage	FG max		18	V
RD/FG output current	FG max		10	mA
Allowable power dissipation	Pd max	Mounted on a specified board*	800	mW
Operating temperature range	Topr		-30 to +95	°C
Storage temperature range	Tstg		-55 to +150	°C

*Mounted on a specified board (114.3mm×76.1mm×1.6mm, Glass epoxy)

Recommended Operating Range at Ta = 25°C

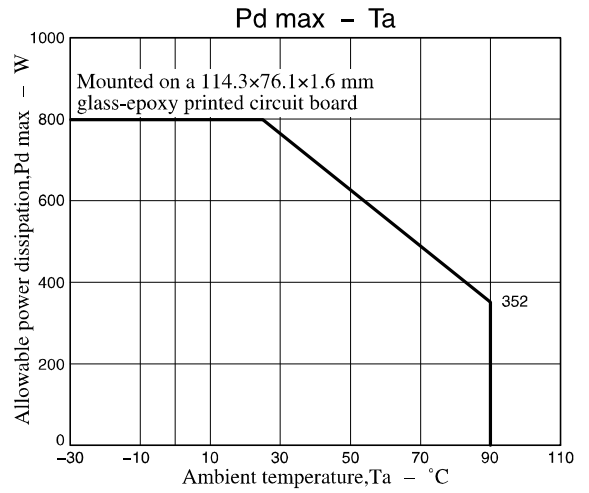
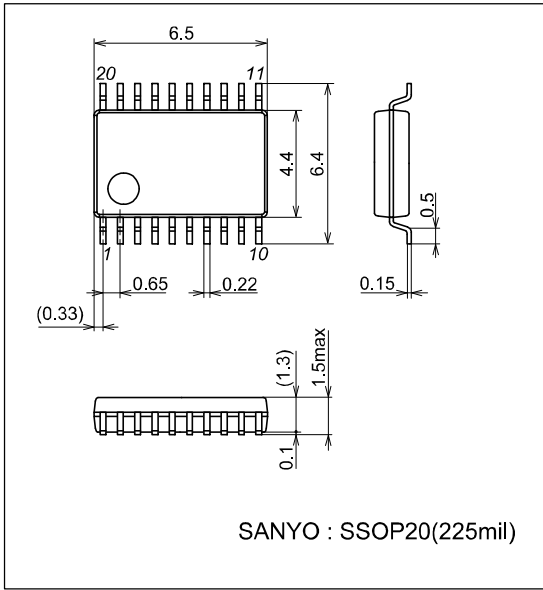
Parameter	Symbol	Conditions	Ratings	Unit
VCC supply voltage	VCC		6 to 16	V
VTH input level voltage range	VTH	Full speed mode	0 to 7	V
Hall input common phase input voltage range	VICM		0.2 to 3	V

Electrical Characteristics at Ta = 25°C, VCC = 12V, unless otherwise specified.

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Circuit current	ICC1	During drive	6	10	14	mA
	ICC2	During lock protection	6	10	14	mA
6VREG voltage	6VREG	IHB = 5mA	5.80	6.0	6.15	V
VOVER voltage	VOVER		12.0	12.8	13.6	V
CPWM-H level voltage	VCRH		4.35	4.55	4.75	V
CPWM-L level voltage	VCRL		1.45	1.65	1.85	V
CPWM oscillation frequency	FPWM	C = 100pF	18	25	32	kHz
CT pin H level voltage	VCTH		3.4	3.6	3.8	V
CT pin L level voltage	VCTL		1.4	1.6	1.8	V
ICT pin charge current	ICT1		1.6	2.0	2.5	μA
ICT pin discharge current	ICT2		0.16	0.20	0.28	μA
ICT charge/discharge current ratio	RCT		8	10	12	deg
OUT-N output voltage	VON	IO = 20mA	4	10		V
OUT-P sink current	IOP		15	20		mA
Hall input sensitivity	VHN	Zero peak value (including offset and hysteresis)		10	20	mV
RD/FG output pin L voltage	VFG	I _{FG} = 5mA		0.15	0.3	V
RD/FG output pin leak current	I _{FGL}	V _{FG} = 16V			30	μA

Package Dimensions

unit : mm
3179C



Truth Table

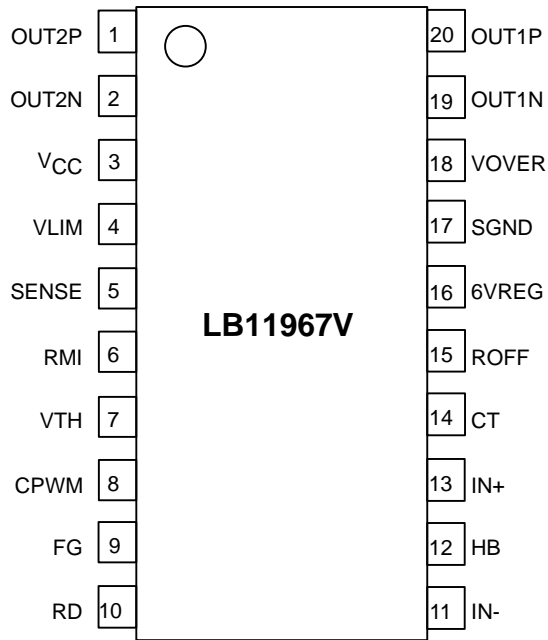
During full-speed rotation

IN-	IN+	CT	OUT1P	OUT1N	OUT2P	OUT2N	FG	RD	Mode
H	L	L	L	-	-	H	L	L	OUT1 → 2 drive
L	H		-	H	L	-	OFF		OUT2 → 1 drive
H	L	H	OFF	-	-	H	L	OFF	Lock protection
L	H		-	H	OFF	-	OFF		

VTH	CPWM	IN-	IN+	OUT1P	OUT1N	OUT2P	OUT2N	Mode
L	H	H	L	L	-	-	H	OUT1 → 2 drive
		L	H	-	H	L	-	OUT2 → 1 drive
H	L	H	L	OFF	-	-	H	During rotation
		L	H	-	H	OFF	-	Regeneration in lower TR

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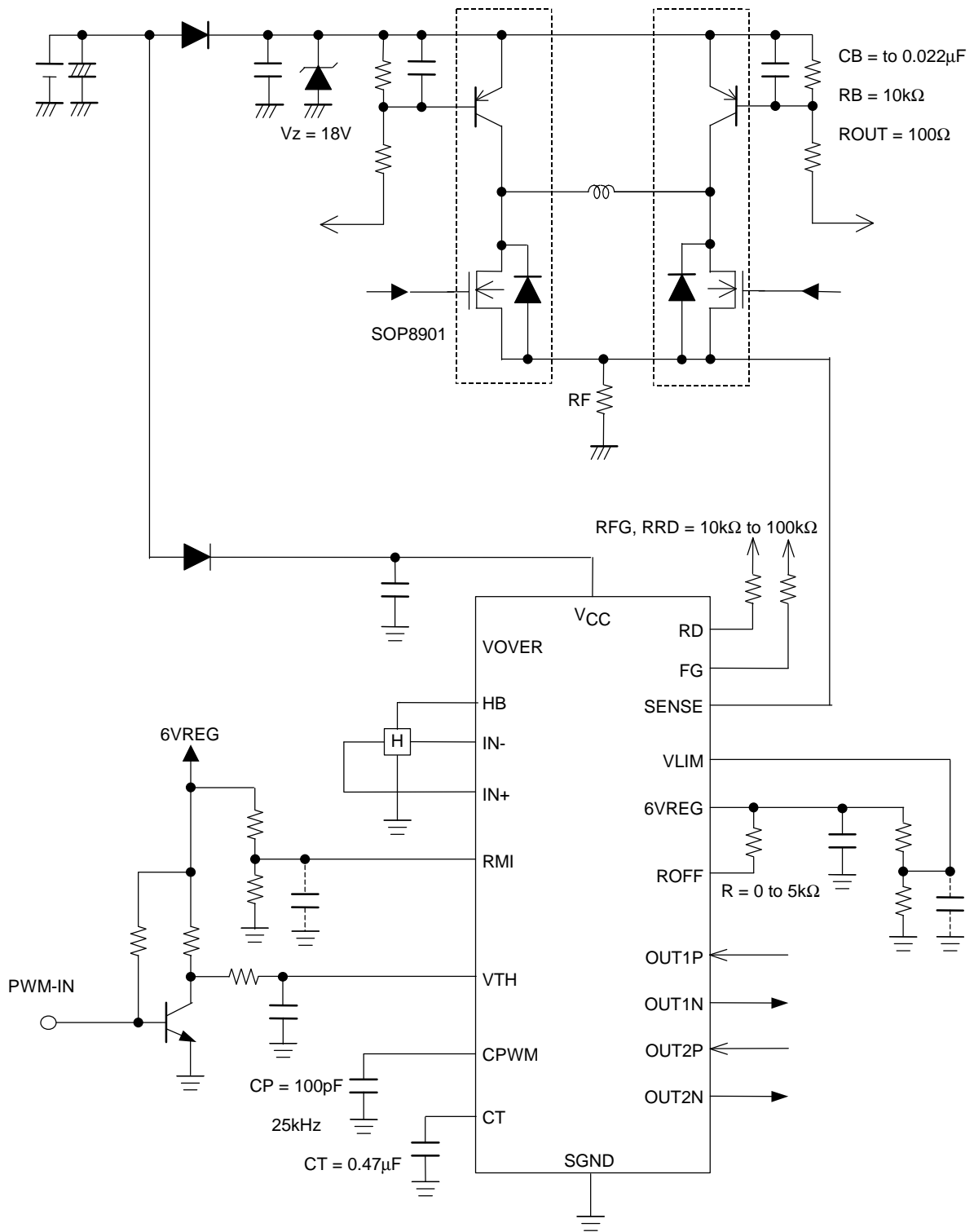
Pin Assignment



(Top view)

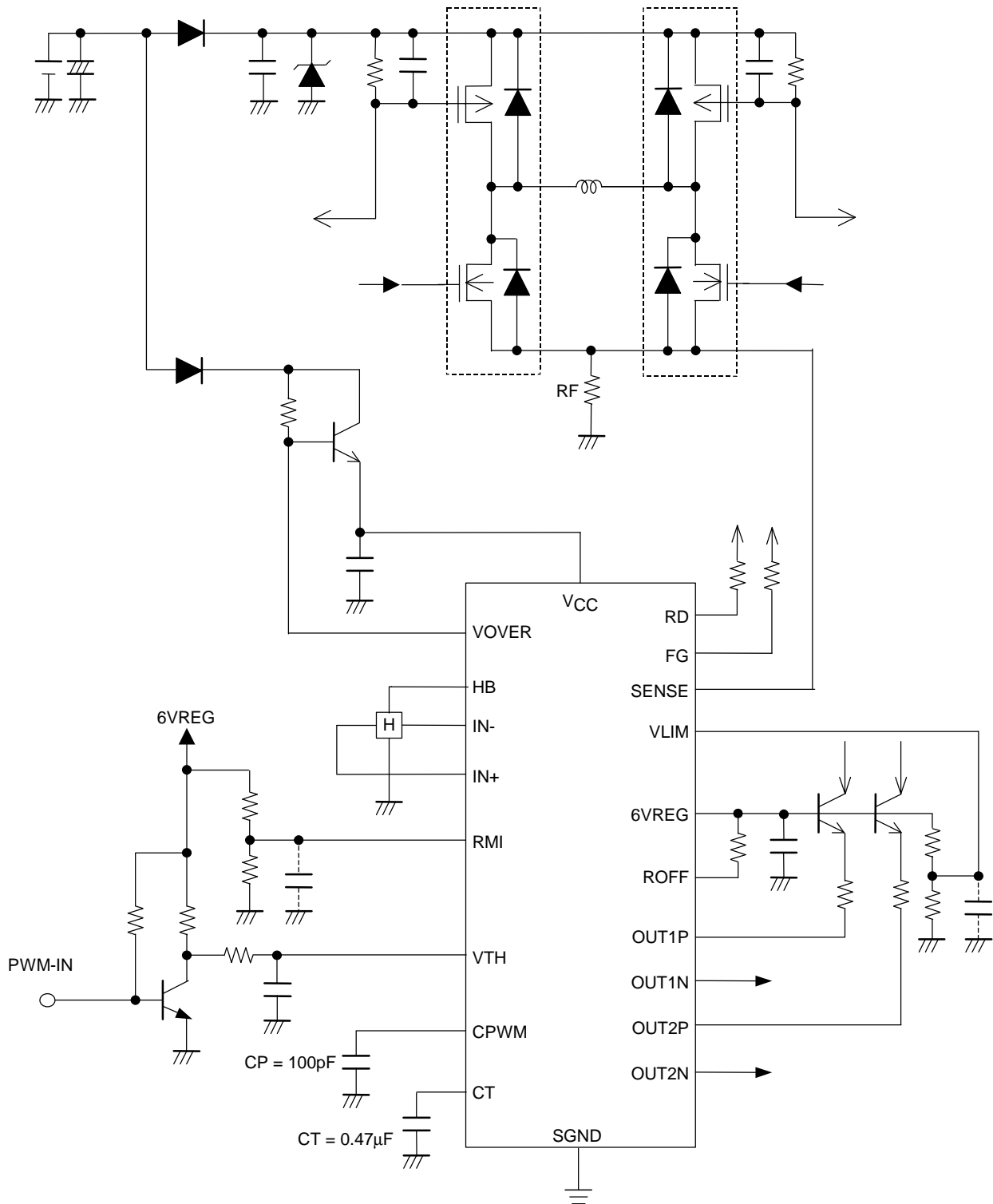
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12V Sample Application Circuit



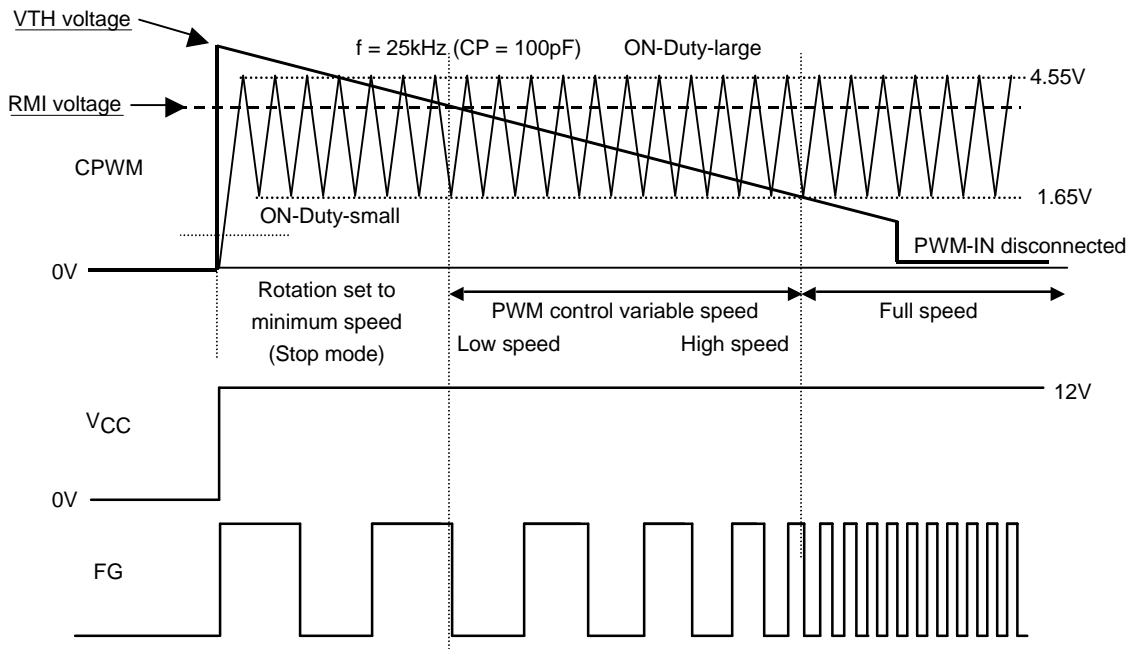
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24V, 48V Sample Application Circuit



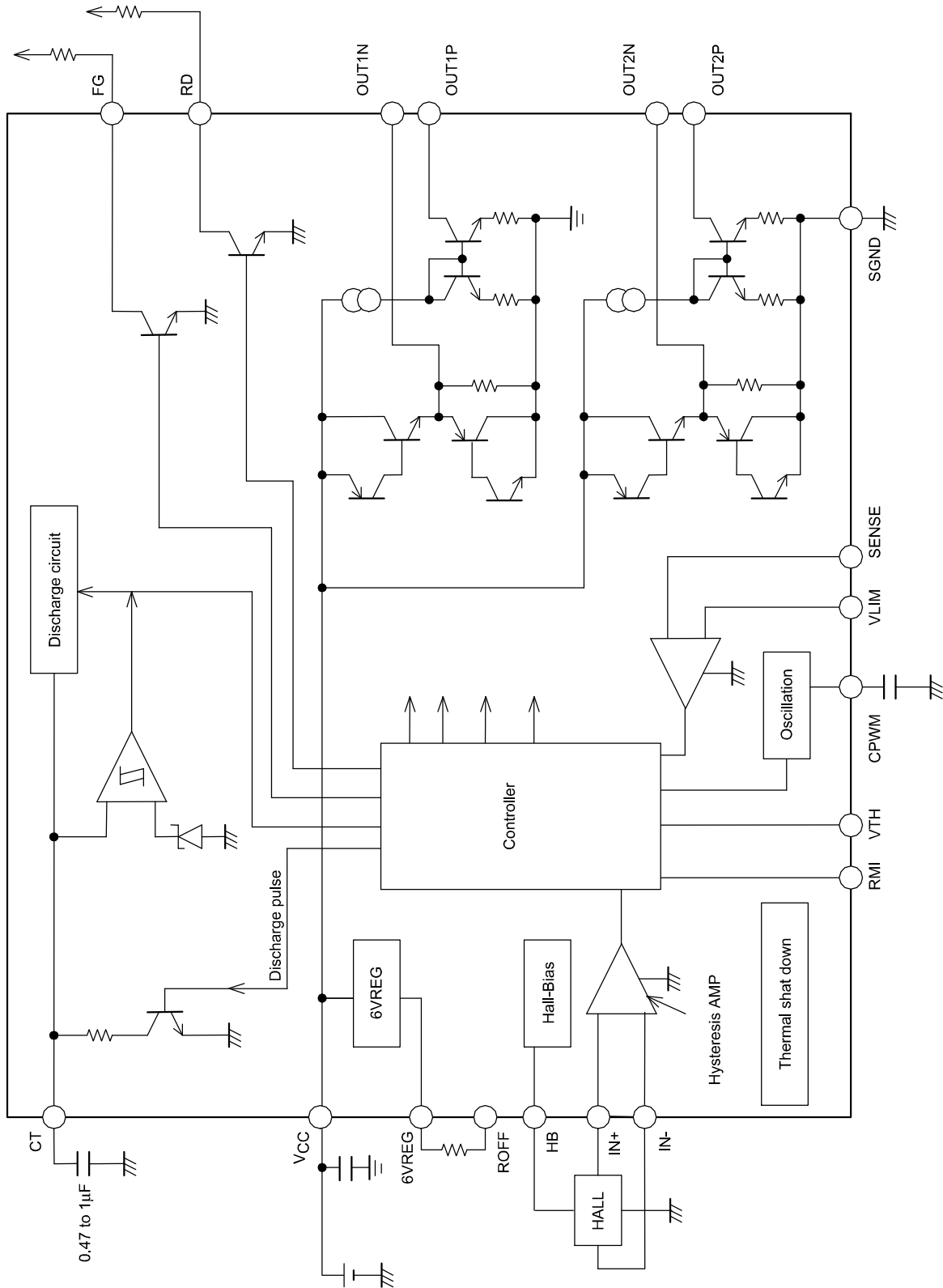
- *1. <Power supply-GND wiring>
SGND is connected to the control circuit power supply system.
- *2. <Power stabilization capacitor for regeneration>
For the CM capacitor that is a power stabilization capacitor for PWM drive and for absorption of kick-back, the capacitance of 0.1 to 1 μ F is used. In this IC, the lower TR performs current regeneration by means of switching of upper TR. Connect CM between V_{CC} and GND with the thick pattern and along the shortest route.
- *3. <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.
- *4. <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 (60mV_{p-p}) this hysteresis.
- *5. <Capacitor to set the PWM oscillation frequency>
With CP = 100pF, oscillation occurs at f = 25kHz and provides the basic frequency of PWM.
- *6. <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.
- *7. <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.
- *8. <HB pin>
This is a Hall element bias pin, that is, the 1.5V constant-voltage output pin.
- *9. <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.)
- *10. <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.
- *11. <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.
- *12. <SENSE pin>
This is connected to GND when not used.
- *13. <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



- ① 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.
- ② Low⇔High speed mode
 PWM control is made through comparison of oscillation and VTH voltages with CPWM changing between 1.6V⇔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.
- ③ 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.)
- ④ PWM-IN input disconnection mode
 When the PWM-IN input pin is disconnected, VTH becomes 1.65V or less and the output enables full drive at 100%. The fan runs at full speed. (Refer to the sample application circuit.)

Block Diagram



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