
MECHATRONICS



MECHATRONICS INC.

Mechatronics Product /
Process Change Notification

LB11967 IC Change

June 21st, 2021

Mechatronics Product / Process Change Notification

Table 1. Change Identification

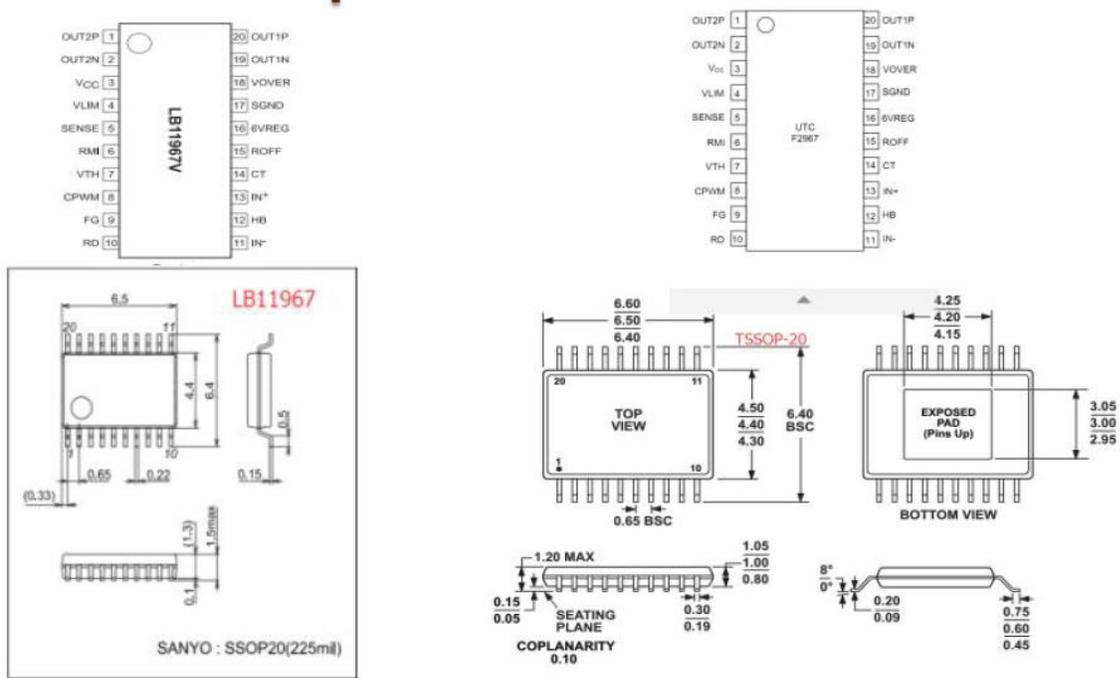
Product Family / Commercial Product	OnSemi LB11967 Discontinuation
Type of change	Integrated circuit change.
Reason for change	OnSemi LB11967 is no longer available for purchase.
Description of change	Driver IC Change from On Semi LB11967 to Unisonic F2967. No change to PCB layout. F2967 has matching footprint and function (see diagram). IC specifications attached for comparison.
Product Line(s) and/or Part Numbers	See Appendix A
Marking to identify changed product	Product manufactured after June 2021
Manufacturing location(s)	China Plant

Table 2. Change Implementation Schedule

Forecasted implementation date for change	June 2021
Forecasted availability date of samples for customer	June 2021
Estimated date of changed product first shipment	October 2021

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IC diagram and layout comparison.



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Appendix A.

ME6038U24B-FSR
ME6038U24B-FSR
ME6038L12B1-FSR
ME6038X12B1+6-FSR
ME6038L12B2-FSR
ME6038L12B2-FSR-2005
ME6038X12B2-FSR
ME6038U12B1-FSR
MC8038U12B2-FSR
MD4028V12B-RSR-CC
MA3828V12B-RSR
MA3828V12B-RSR
MA3828X12B1-RSR
MA3828V12B-RSR
MA3828X12B1-RSR
MA3828X12B-RSR
MA3828X12B1-RSR
MD4028V12B-RSR
MD4028V12B-RSR-CC
MD4028V12B1-RSR-1551
MD1238H12B-FSR-EM
MD4028U12B1-RSR
MD1238X12B-FSR-CC
MD1238X12B-FSR-CC
MD1238X12B-FSR
MD1238X12B-FSR-EM
MD1238H12B-FSR-1943
MD1238H12B-FSR
MD4028V12B2-RSR
MD9238X24B-FSR
MD1238L24B-FSR
MD4028V12B1+6-RSR-CC
MC8038U12B-FSR
MD4028V12B1+6-RSR
MD1238X24B2-FSR
MD1238X24B-FSR
MD1238X24B-FSR-CC
MD1238H24B1-FSR
MD4028W12B+6-RSR
MA1751L24B-FSR
MA1751E12B1+6-FSR
MD1238X24B-FSR
MD1238X24B-FSR-CC-L15
MD1238X24B-FSR
MD1238X24B-FSR-CC
MD1238X24B-FSR
MD1238H24B-FSR
MD1238H24B-FSR
MD4028V12B1+6-FSR
MD4028X12B-FSR
MD4028X12B1+6-RSR
MA3828V12B1+6-RSR
MC8038H12B6-FSR-EP
MB8025X24B3-FSR
MA1751E24B-FSR
MA1751H24B-FSR
MA1751H24B-FSR
MA1751L24B-FSR
MA1751L24B1-FSR
MA1751X24B1+6-FSR
MA1751H24B1+6-FSR-2527
MA1751X24B1+6-FSR-2316
MA1751H24B6-FSR-2397
MA1751H24B1+6-FSR
MA1751E12B1+6-FSR-1995
MA1751L24B1+6-FSR
MD1238X12B1+6-FSR-EMC-L25
MD1238X12B1+6-FSR-EM
MD1238E12B1+4-FSR
MD1238X12B1+6-FSR-EM-L25
MD1238X12B1+6-FSR-L24
MD1238X12B1+6-FSR



SANYO Semiconductors

DATA SHEET

An ON Semiconductor Company

LB11967V

Monolithic Digital IC

For Variable Speed Fan Motor

Single-Phase Full-Wave Pre-Driver

Overview

The LB11967V is a single-phase bipolar variable speed fan motor pre-driver 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

- Pre-driver for single-phase full-wave drive
 - ⇒ PNP-EMOS is used as an external power Transistor, 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 ($f = 25\text{kHz}$) 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

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LB11967V

Specifications

Maximum Ratings at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
V_{CC} maximum supply voltage	$V_{CC\text{ max}}$		18	V
OUT pin maximum output current	$I_{OUT\text{ max}}$		50	mA
OUT pin output withstand voltage	$V_{OUT\text{ max}}$		18	V
HB maximum output current	$I_{HB\text{ max}}$		10	mA
VTH input pin withstand voltage	$V_{VTH\text{ max}}$		8	V
RD/FG output pin output withstand voltage	$V_{RD}/V_{FG\text{ max}}$		18	V
RD/FG output current	$I_{RD}/I_{FG\text{ max}}$		10	mA
Allowable power dissipation	$P_d\text{ max}$	Mounted on a specified board*	800	mW
Operating temperature range	T_{opr}		-30 to +95	$^\circ\text{C}$
Storage temperature range	T_{stg}		-55 to +150	$^\circ\text{C}$

*Specified board: 114.3mm × 76.1mm × 1.6mm, glass epoxy board.

Recommended Operating Conditions at $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
V_{CC} supply voltage	V_{CC}		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

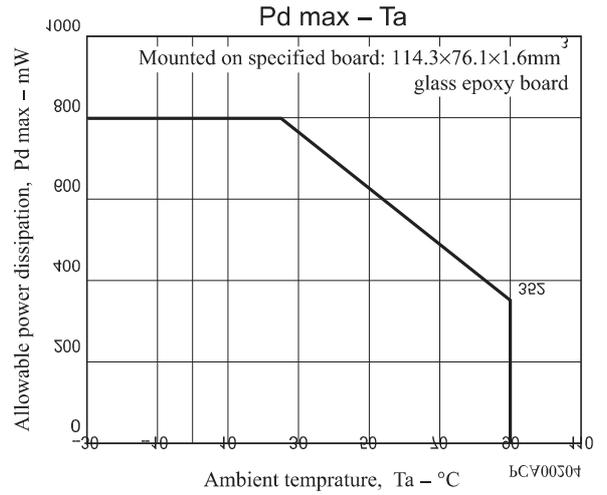
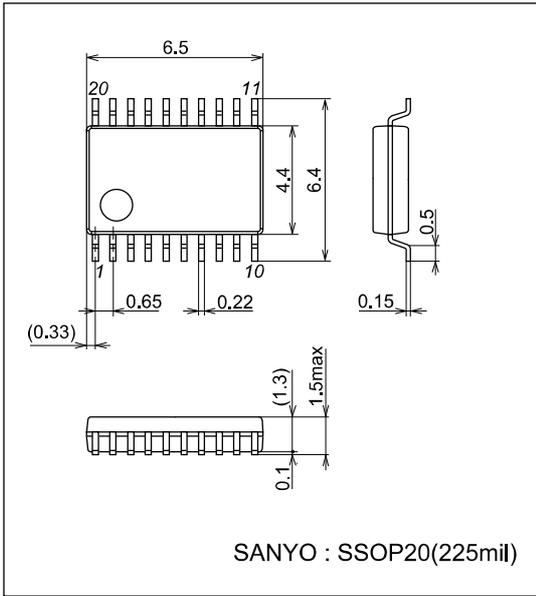
Electrical Characteristics at $T_a = 25^\circ\text{C}$, $V_{CC} = 12\text{V}$, unless otherwise specified.

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Circuit current	I_{CC1}	During drive	6	10	14	mA
	I_{CC2}	During lock protection	6	10	14	mA
6VREG voltage	6VREG	$I_{6VREG} = 5\text{mA}$	5.80	6.0	6.15	V
HB voltage	V_{HB}	$I_{HB} = 5\text{mA}$	1.05	1.22	1.35	V
VOVER voltage	V_{VOVER}	$I_{VOVER} = 1\text{mA}$	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	FPWM	$C = 100\text{pF}$	18	25	32	kHz
CT pin H level voltage	V_{CTH}		3.4	3.6	3.8	V
CT pin L level voltage	V_{CTL}		1.4	1.6	1.8	V
ICT pin charge current	I_{CT1}	$V_{CT} = 1.2\text{V}$	1.6	2.0	2.5	μA
ICT pin discharge current	I_{CT2}	$V_{CT} = 4.0\text{V}$	0.16	0.20	0.28	μA
ICT charge/discharge current ratio	RCT	I_{CT1}/I_{CT2}	8	10	12	deg
OUT-N output voltage	V_{ON}	$I_O = 20\text{mA}$	4	10		V
OUT-P sink current	I_{OP}		15	20		mA
Hall input sensitivity	VHN	Zero peak value (including offset and hysteresis)		10	20	mV
RD/FG output pin L voltage	V_{RD}/V_{FG}	$I_{RD}/I_{FG} = 5\text{mA}$		0.15	0.3	V
RD/FG output pin leak current	I_{RDL}/I_{FGL}	$V_{RD}/V_{FG} = 16\text{V}$			30	μA

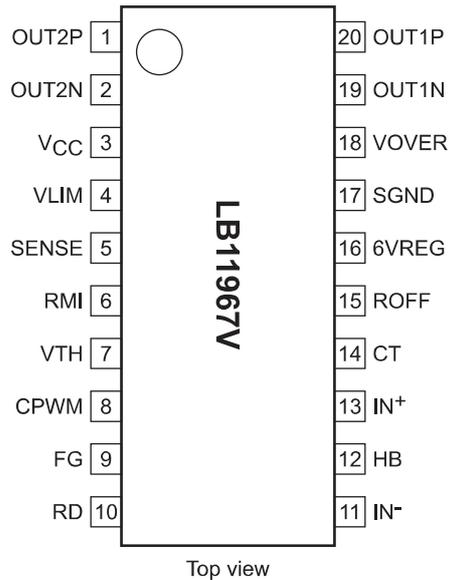
LB11967V

Package Dimensions

unit : mm (typ)
3179C



Pin Assignment



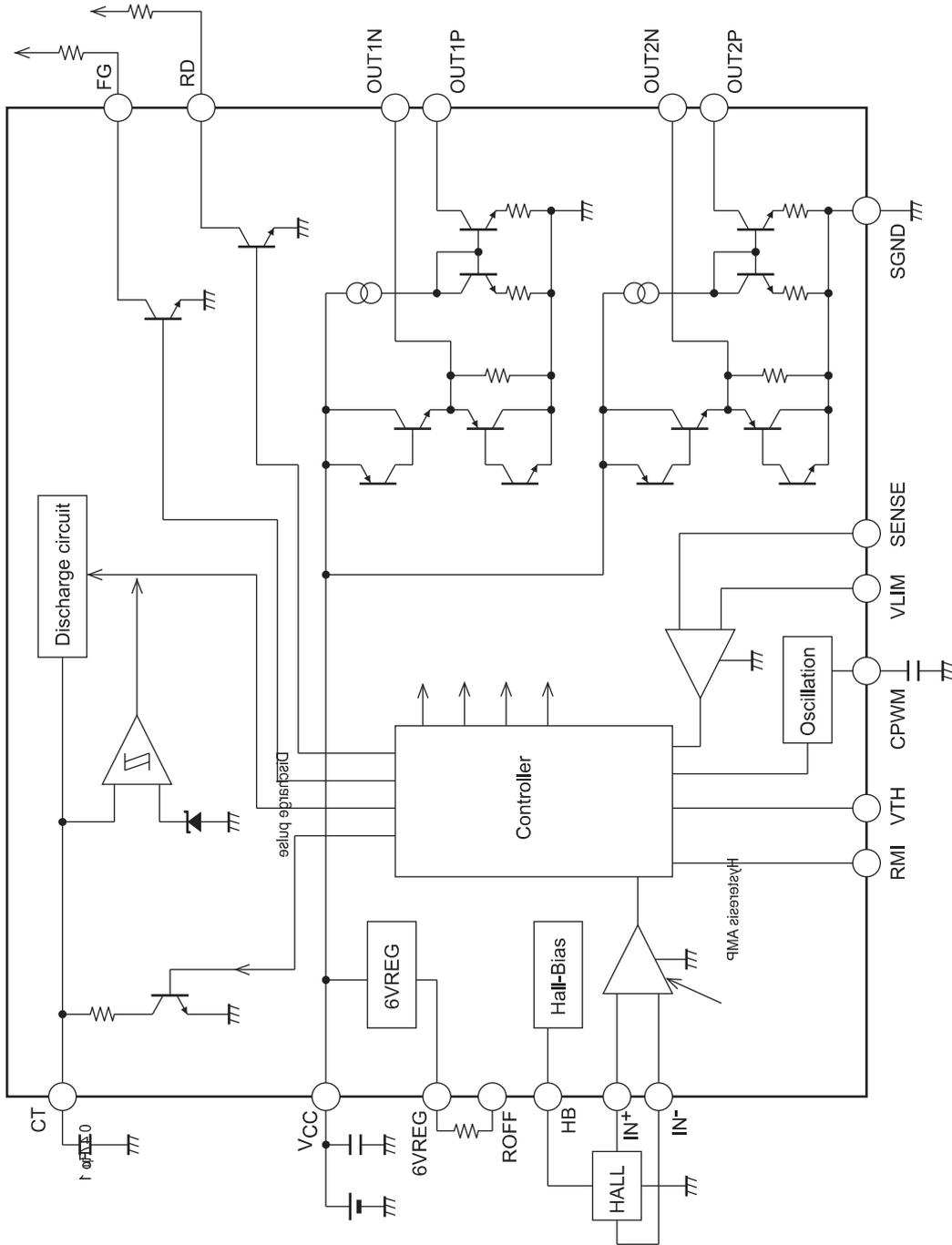
Truth Table

During full-speed rotation

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

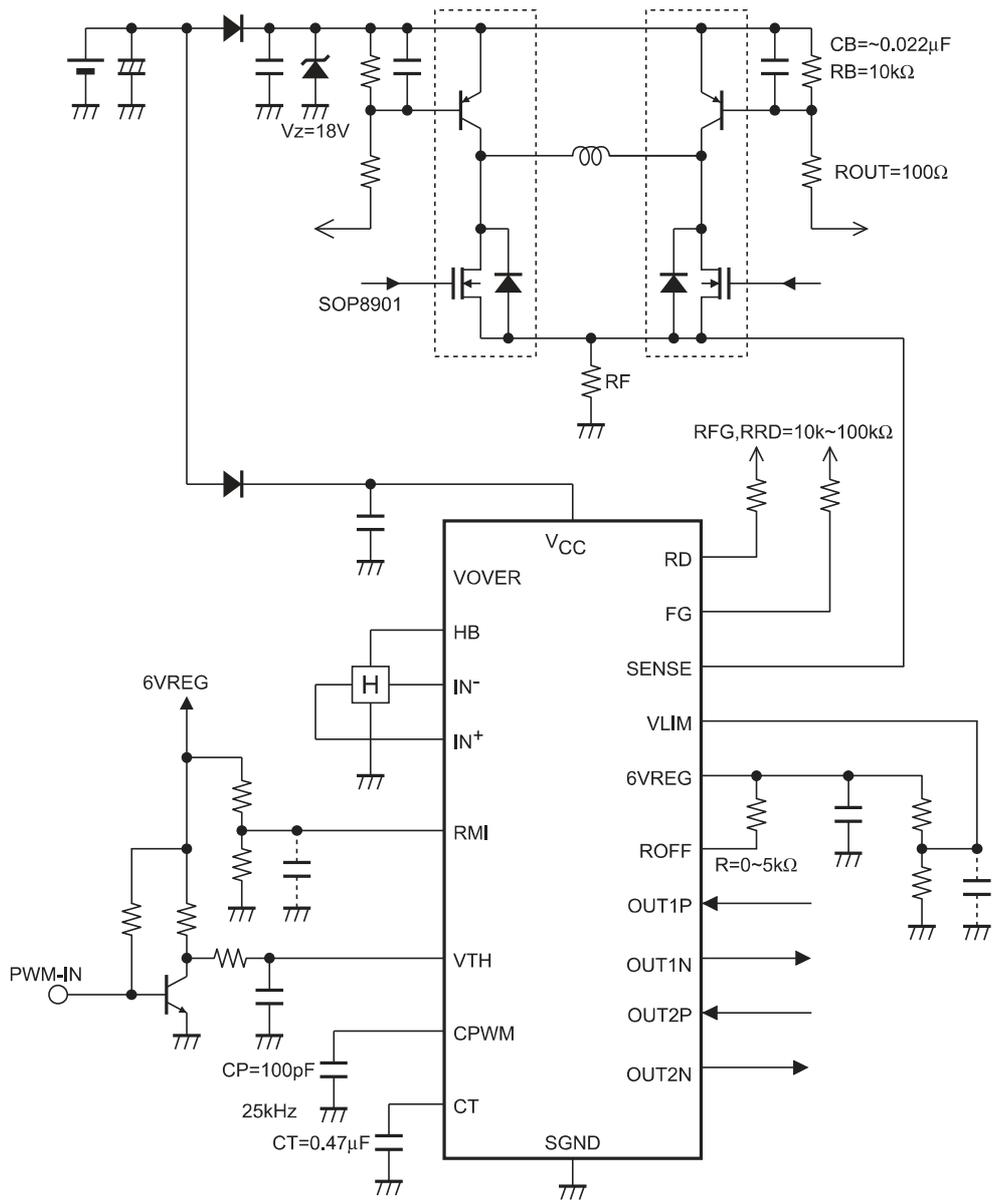
VTH	CPWM	IN ⁻	IN ⁺	OUT1P	OUT1N	OUT2P	OUT2N	Mode
L	H	H	L	L	L	OFF	H	OUT1 → 2 drive
		L	H	OFF	H	L	L	OUT2 → 1 drive
H	L	H	L	OFF	L	OFF	H	During rotation Regeneration in lower Tr
		L	H	OFF	H	OFF	L	

Block Diagram



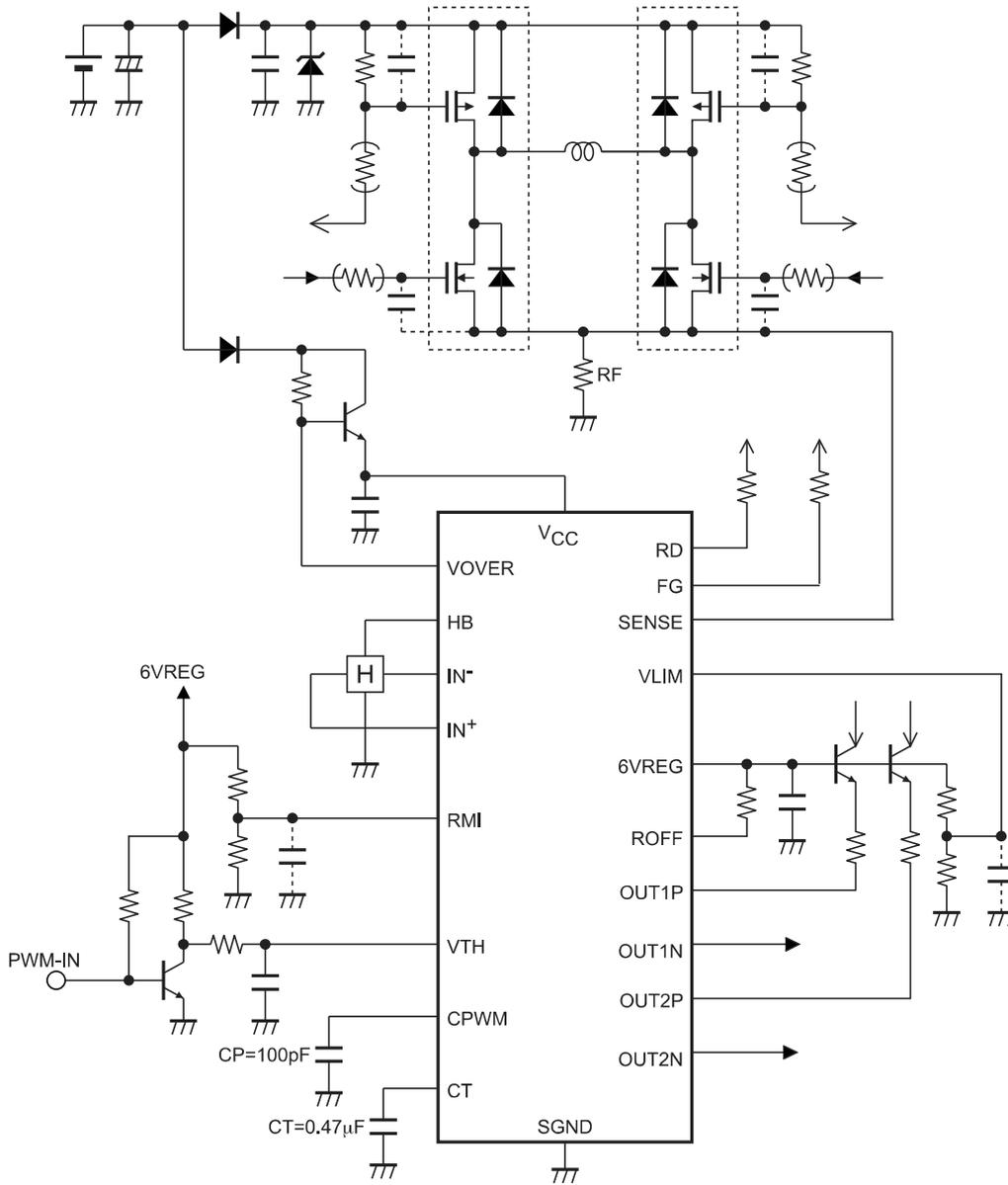
LB11967V

Sample Application Circuit 1 (12V)



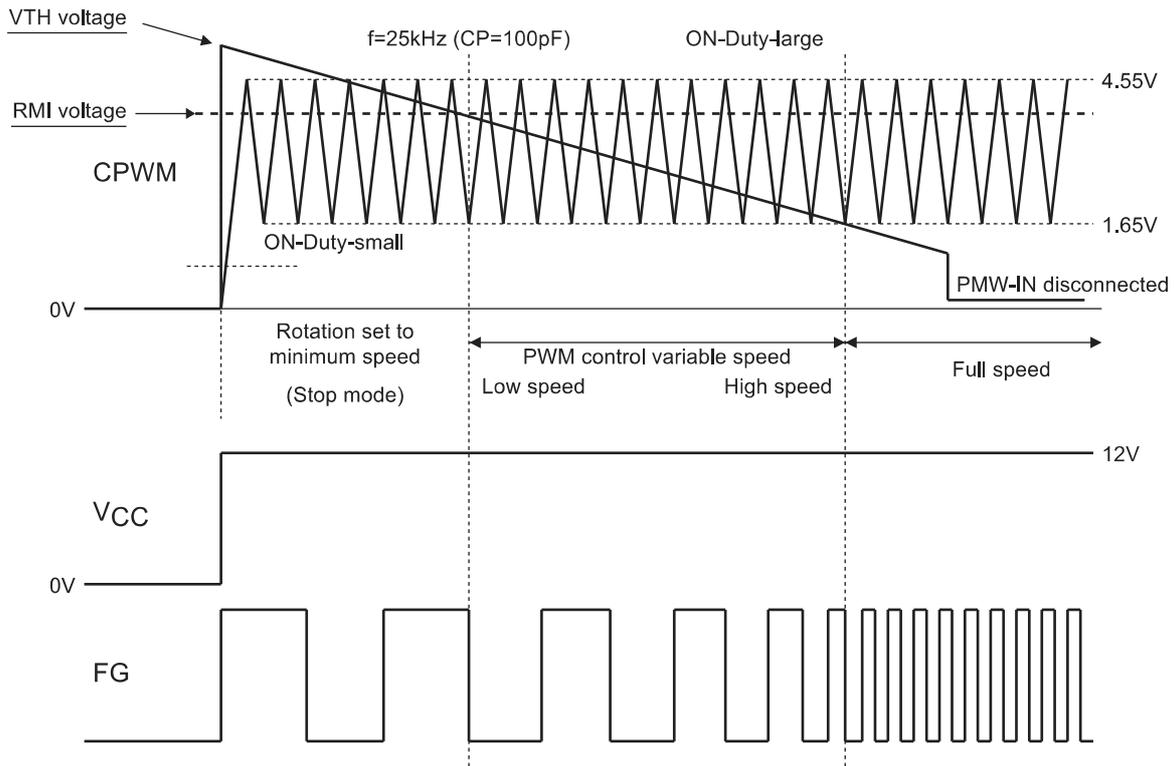
LB11967V

Sample Application Circuit 2 (24V, 48V)



- *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 uses 0.1 μ F or more. In this IC, the lower Transistor performs current regeneration by means of switching of upper Transistor. 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 (60mVp-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 constant-voltage output pin.
- *9. <RMI pin>
This is the minimum speed setting pin, which is pulled up with 6VREG 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 6VREG 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 6VREG 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.

When the VTH voltage is lower, the IC switches to drive mode. When the VTH voltage is higher, the p-channel FET is turned off and coil current is regenerated through the low-side FET. 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.)

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This catalog provides information as of June, 2010. Specifications and information herein are subject to change without notice.



F2967

Preliminary

LINEAR INTEGRATED CIRCUIT

FOR VARIABLE SPEED FAN MOTOR SINGLE-PHASE FULL-WAVE PRE-DRIVER

DESCRIPTION

The UTC **F2967** is a single-phase fan motor pre-driver IC. This IC has variable speed function that works with an external Pulse-Width Modulation signal. A quiet and low power consumption motor driver circuit can be implemented by adding a small number of external components.

This IC 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

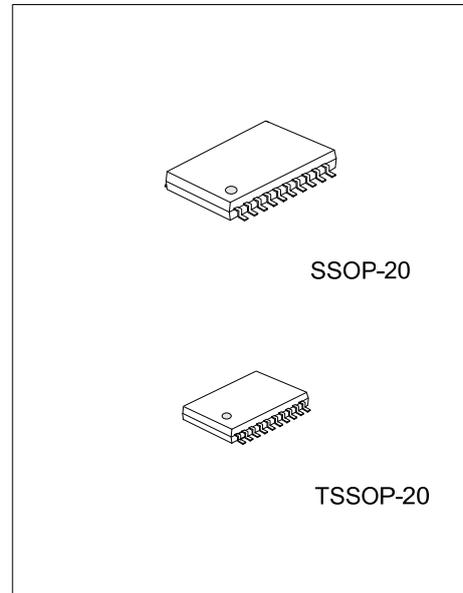
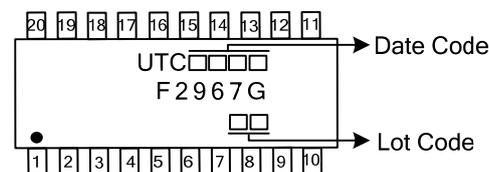
- * Single-phase full-wave drive
- * Variable speed control with External PWM input
- * Current limiter circuit
- * Reactive current cut circuit
- * Compatible with 12V, 24V, and 48V power supplies
- * Minimum speed setting pin
- * Reference voltage output pin for Hall bias
- * automatic reset and Lock protection functions incorporated
- * (Rotation speed detection), RD (Lock detection) output

ORDERING INFORMATION

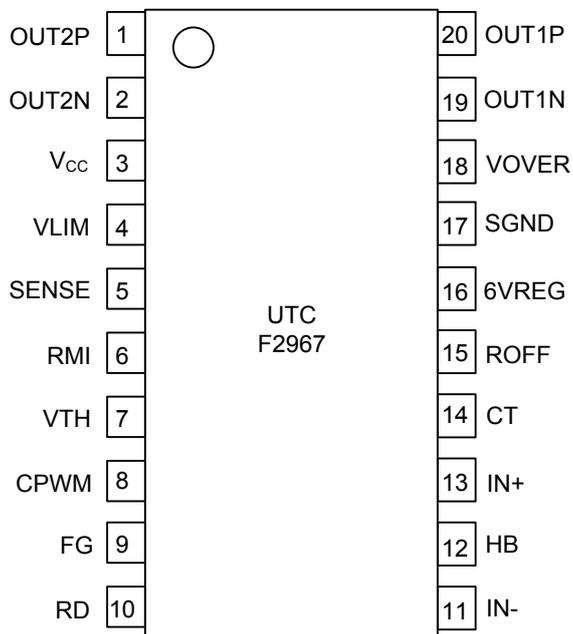
Ordering Number	Package	Packing
F2967G-R20-R	SSOP-20	Tape Reel
F2967G-P20-R	TSSOP-20	Tape Reel

<p>F2967G-R20-R</p> <p>(1) Packing Type</p> <p>(2) Package Type</p> <p>(3) Green Package</p>	<p>(1) R: Tape Reel</p> <p>(2) R20: SSOP-20, P20: TSSOP-20</p> <p>(3) G: Halogen Free and Lead Free</p>
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MARKING



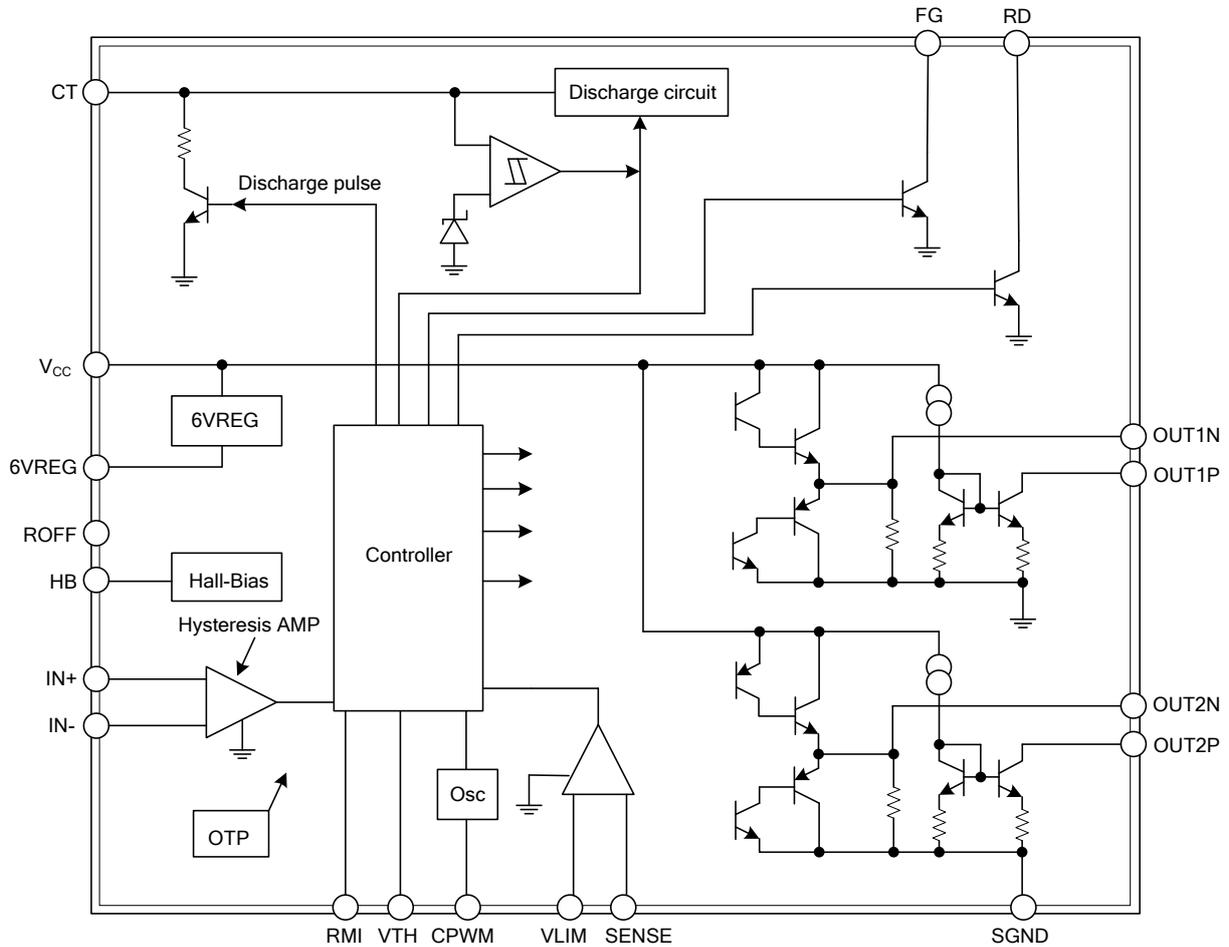
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	OUT2P	Output2P
2	OUT2N	Output2N
3	VCC	Power supply
4	VLIM	Setting limit current pin
5	SENSE	Sense pin of current limiter
6	RMI	Lowest speed setting voltage
7	VTH	Variable speed function input
8	CPWM	PWM oscillator frequency setting capacitor
9	FG	Speed detection output
10	RD	lock detection output
11	IN-	The hall sensor input
12	HB	Power the hall sensor 1.25V
13	IN+	The hall sensor input
14	CT	Setting lock protection time
15	ROFF	The pin sets soft switching time
16	6VREG	V _{REF} 6V
17	SGND	Logic GND
18	VOVER	The pin for constant VCC voltage
19	OUT1N	Output2P
20	OUT1P	Output2N

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING ($T_A=25^{\circ}\text{C}$, unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT
Maximum Supply Voltage V_{CC}		$V_{CC\ max}$	18	V
Maximum Output Current		$I_{OUT\ max}$	50	mA
Output Withstand Voltage		$V_{OUT\ max}$	18	V
HB Maximum Output Current		HB	10	mA
VTH Input Pin Withstand Voltage		$V_{TH\ max}$	8	V
RD/FG Output Pin Output Withstand Voltage		$F_{G\ max}$	18	V
RD/FG Output Current		$F_{G\ max}$	10	mA
Allowable Power Dissipation	Mounted on a specified board (Note 2)	$P_{D\ (max)}$	800	mW
Operating Temperature		T_{OPR}	-30 ~ +95	$^{\circ}\text{C}$
Storage Temperature		T_{STG}	-55 ~ +150	$^{\circ}\text{C}$

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

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

■ RECOMMENDED OPERATING RANGE ($T_A=25^{\circ}\text{C}$, unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT
V_{CC} Supply Voltage		V_{CC}	6 ~ 16	V
VTH Input Level Voltage Range	Full Speed Mode	V_{TH}	0 ~ 7	V
Hall Input Common Phase Input Voltage Range		V_{ICM}	0.2 ~ 3	V

■ ELECTRICAL CHARACTERISTICS ($T_A=25^{\circ}\text{C}$, $V_{CC}=12\text{V}$, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Circuit Current	I_{CC1}	During Drive	6	10	14	mA
	I_{CC2}	During Lock Protection	6	10	14	mA
6VREG Voltage	$6V_{REG}$	$I_{6VREG}=5\text{mA}$	5.80	6.0	6.15	V
VOVER Voltage	V_{OVER}		12.0	12.8	13.6	V
CPWM-H Voltage	V_{CRH}		4.35	4.55	4.75	V
CPWM-L Voltage	V_{CRL}		1.45	1.65	1.85	V
CPWM Oscillation Frequency	F_{PWM}	$C=100\text{pF}$	18	25	32	kHz
CT Pin H Voltage	V_{CTH}		3.4	3.6	3.8	V
CT Pin L Voltage	V_{CTL}		1.4	1.6	1.8	V
ICT Pin Charge Current	I_{CT1}		1.6	2.0	2.5	μA
ICT Pin Discharge Current	I_{CT2}		0.16	0.20	0.28	μA
ICT Charge/Discharge Current Ratio	R_{CT}		8	10	12	deg
OUT-N Output Voltage	V_{ON}	$I_O=20\text{mA}$	4	10		V
OUT-P Sink Current	I_{OP}		15	20		mA
Sensitivity of Hall Input	V_{HN}	Zero Peak Value (Including Offset and Hysteresis)		10	20	mV
RD/FG Output Pin L Voltage	V_{FG}	$I_{FG}=5\text{mA}$		0.15	0.3	V
RD/FG Output Pin Leak Current	I_{FGL}	$V_{FG}=16\text{V}$			30	μA

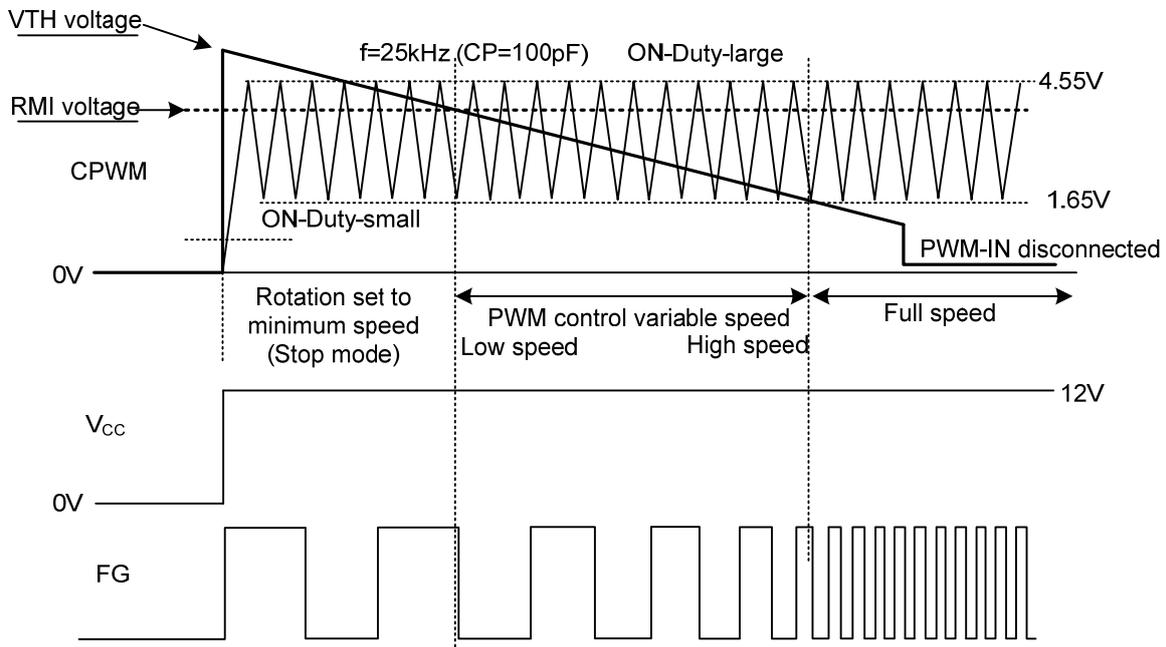
■ TRUTH TABLE

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 Regeneration in Lower TR
		L	H	-	H	OFF	-	

■ CONTROL TIMING CHART



(1) Minimum speed setting (stop) mode

Input of PWM-IN 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.

When the VTH voltage is lower, the IC switches to drive mode. When the VTH voltage is higher, the p-channel FET is turned off and coil current is regenerated through the low-side FET. 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

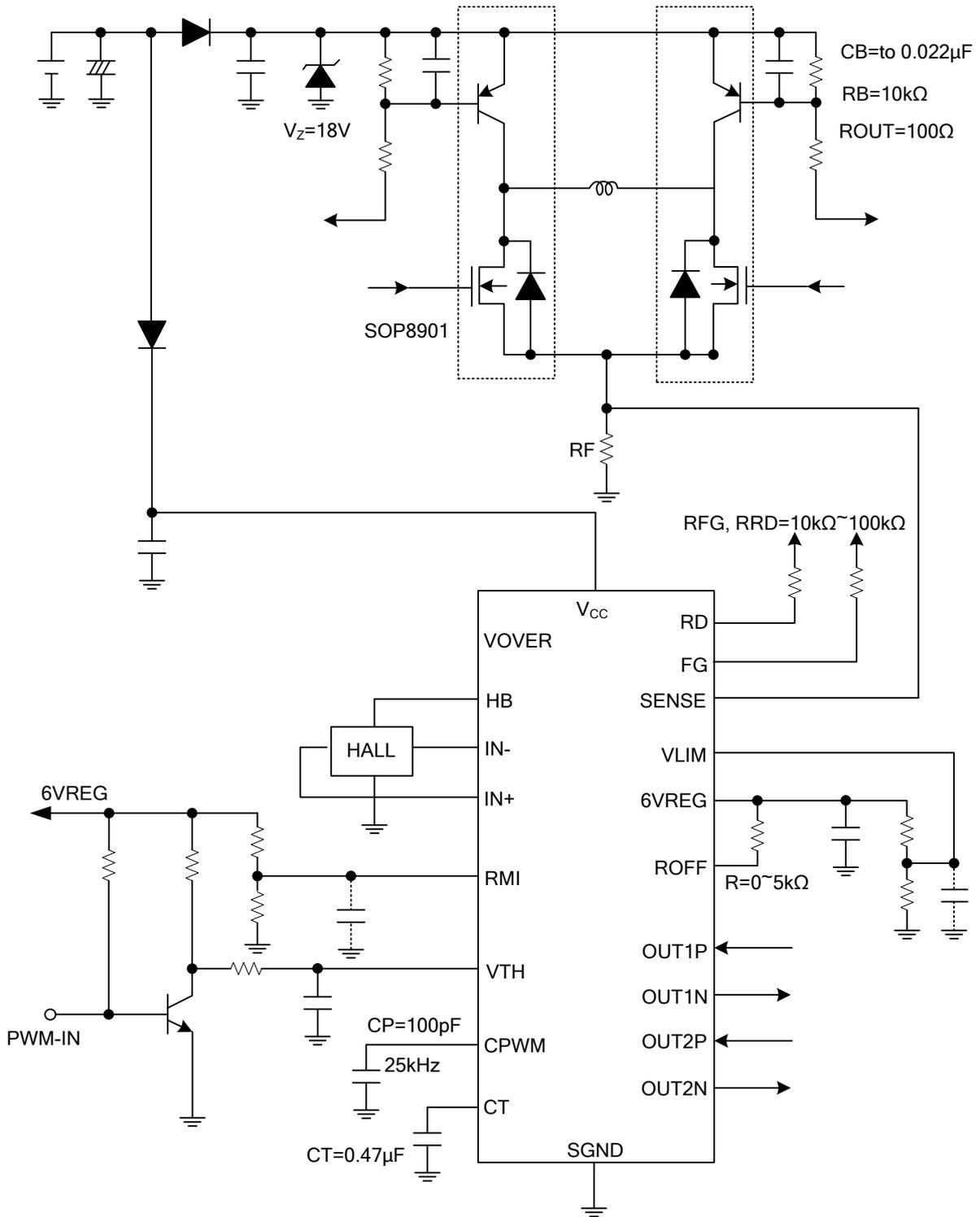
The full-speed mode becomes effective with the VTH voltage of 1.65V or less. (VTH must be equal to GND when the speed control is not to be made.)

(4) PWM-IN input disconnection mode

While the input pin of PWM-IN 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.)

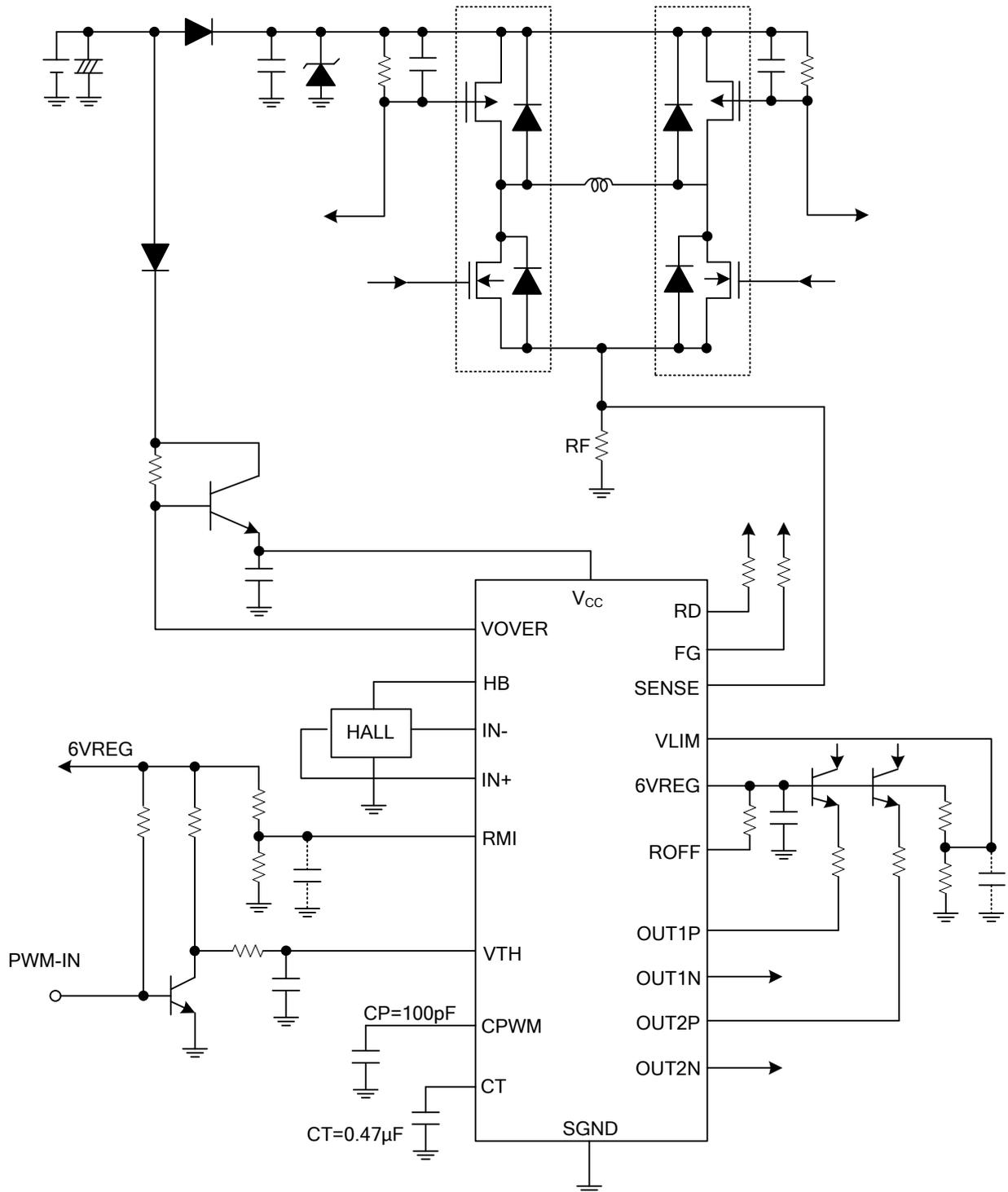
■ TYPICAL APPLICATION CIRCUIT

12V Sample Application Circuit



■ TYPICAL APPLICATION CIRCUIT(Cont.)

24V, 48V Sample Application Circuit



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