UNISONIC TECHNOLOGIES CO., LTD
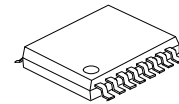
F2867

LINEAR INTEGRATED CIRCUIT

VARIABLE SPEED SINGLE-PHASE FULL-WAVE PRE-DRIVER
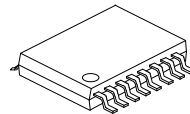
SSOP-16

TSSOP-16

■ DESCRIPTION

The UTC **F2867** is a single-phase bipolar variable speed driving motor pre-driver that works with external PWM signal. A highly efficient, highly silent and low power consumption motor driver circuit can be achieved with a few external parts. This product is optimal for driving large scale fan motors requiring large air flow and large current such as servers and consumer appliances. UTC **F2867-R** is with RD option and UTC **F2867-F** with FG.

■ FEATURES

* Pre-driver for single-phase full-wave drive
  Low-saturation drive using external PMOS-NMOS enables
  high-efficiency low power-consumption drive
* External PWM input enabling variable speed control
  Separately-excited upper direct PWM (f=30kHz) control method
  enabling highly silent speed control
* Current limiting 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 power-consumption drive
* Minimum speed setting pin
  Minimum speed can be set by set with external resistor
* Soft start setting pin
* Lock protection and automatic reset functions incorporated
* Thermal shutdown circuit incorporated
* FG (rotation speed detection) output (**F2867-F**)
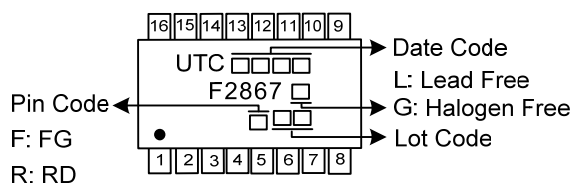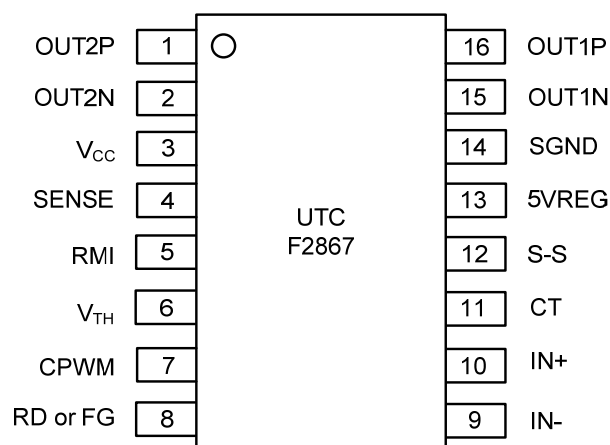* RD(latch-type lockup detection) output (**F2867-R**)

■ **ORDERING INFORMATION**

Ordering Number		Package	Packing
Lead Free	Halogen Free		
F2867L-R16-F-R	F2867G-R16-F-R	SSOP-16	Tape Reel
F2867L-R16-R-R	F2867G-R16-R-R	SSOP-16	Tape Reel
F2867L-P16-F-R	F2867G-P16-F-R	TSSOP-16	Tape Reel
F2867L-P16-R-R	F2867G-P16-R-R	TSSOP-16	Tape Reel

F2867G-R16-F-R

     (1)Packing Type

     (2)Pin Code

     (3)Package Type

     (4)Green Package

(1) R: Tape Reel

(2) F: FG, R: RD

(3) R16: SSOP-16, P16: TSSOP-16

(4) G: Halogen Free and Lead Free, L: Lead Free

■ **MARKING**

Date Code

L: Lead Free

G: Halogen Free

Lot Code

Pin Code

F: FG

R: RD

■ PIN CONFIGURATION

```
OUT2P   1  ○        16  OUT1P
OUT2N   2           15  OUT1N
Vcc     3           14  SGND
SENSE   4    UTC    13  5VREG
RMI     5   F2867   12  S-S
VTH     6           11  CT
CPWM    7           10  IN+
RD or FG 8           9  IN-
```

■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	OUT2P	Output2 PMOS drive
2	OUT2N	Output2 NMOS drive
3	V_{CC}	Power supply
4	SENSE	Current limiting detection pin
5	RMI	Minimum speed setting pin
6	V_{TH}	Speed control pin
7	CPWM	Pin to connect the capacitor for generation of the PWM basic frequency
8	FG or RD	Rotation speed detection pin/latch-type lockup detection pin
9	IN-	Hall signal input
10	IN+	Hall signal input
11	CT	Pin to connect the lock detection capacitor
12	S-S	Pin to connect the soft-start setting capacitor
13	5VREG	5V reference voltage
14	SGND	Power-GND
15	OUT1N	Output1 NMOS drive
16	OUT1P	Output1 PMOS drive

F2867 *LINEAR INTEGRATED CIRCUIT*

■ BLOCK DIAGRAM
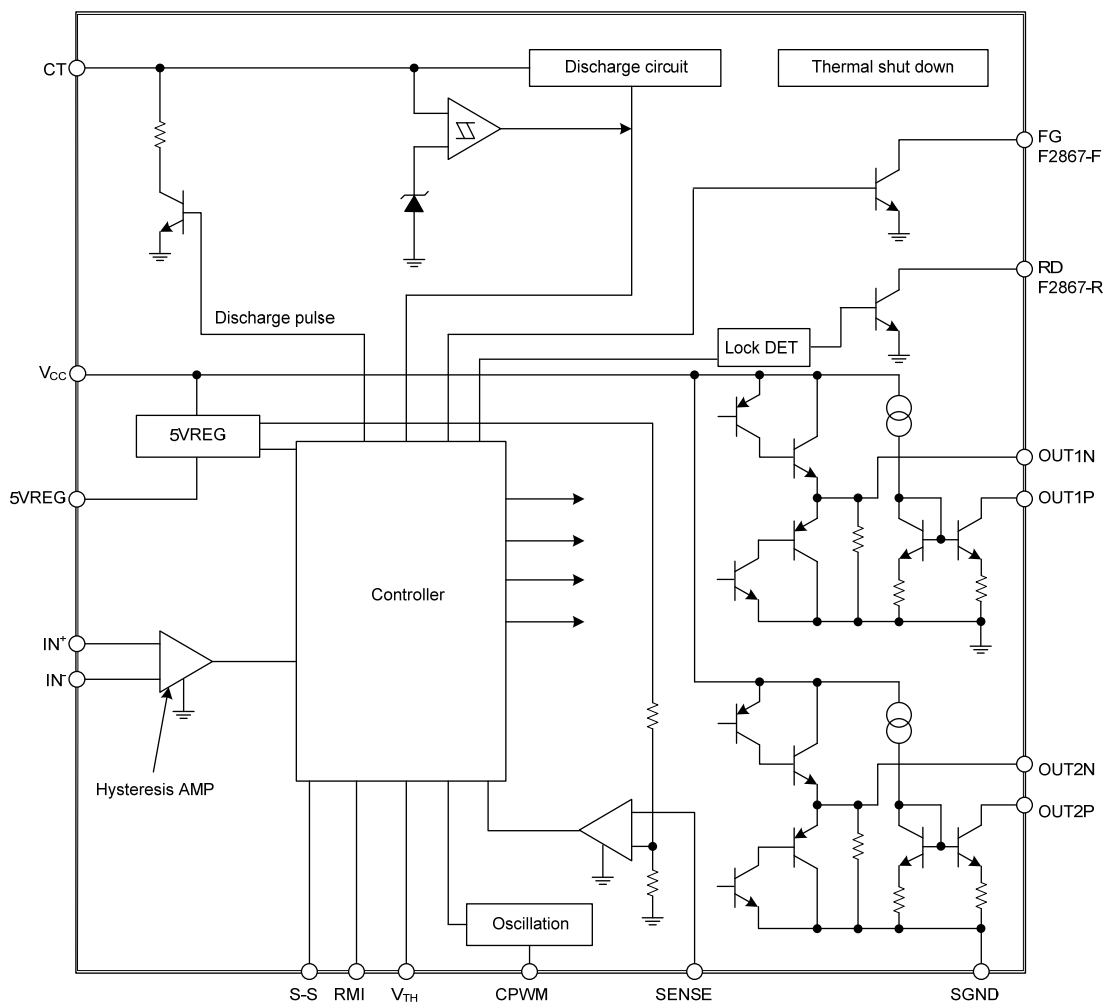
■ TRUTH TABLE

Table 1.DRIVE LOCK CPWM = H VTH, RMI, S−S = L

IN-	IN+	CT	OUT1P	OUT1N	OUT2P	OUT2N	FG	RD	MODE
H	L	L	L	L	OFF	H	L	ON	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		

Table 2.SPEED CONTROL CT, S−S = L

V_{TH}, RMI	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	Regeneration mode
		L	H	OFF	H	OFF	L	

Note: For V_{TH}, RMI, and S-S pins, refer to the timing chart.

■ **ABSOLUTE MAXIMUM RATING** (T_A=25°C unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
V_{CC} Pin Maximum Supply Voltage	V_{CC}	18	V
OUTN Pin Maximum Output Current	I_{OUTN}	20	mA
OUTP Pin Maximum Sink Current	I_{OUTP}	20	mA
OUT Pin Output Withstand Voltage	V_{OUT}	18	V
V_{TH}, RMI Pins Withstand Voltage	V_{VTH}, V_{RMI}	7	V
S-S Pin Withstand Voltage	V_{S-S}	7	V
FG/RD Output Pin Withstand Voltage	V_{FG} / V_{RD}	19	V
FG/RD Pin Maximum Output Current	I_{FG} / I_{RD}	10	mA
5VREG Pin Maximum Output Current	$I5V_{REG}$	20	mA
Allowable Power Dissipation (with specified substrate (Note 2))	P_D	800	mW
Junction Temperature	T_J	+150	°C
Operating Temperature (Note 3)	T_{OPR}	-30 ~ +95	°C
Storage Temperature	T_{STG}	-55 ~ +150	°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. Specified substrate: 114.3mm×76.1mm×1.6mm, glass epoxy board.

■ **RECOMMENDED OPERATING CONDITIONS** (T_A=25°C unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNIT
V_{CC} Supply Voltage	V_{CC}	5.5 ~ 16	V
V_{TH}, RMI Input Voltage Range	V_{TH}, R_{MI}	0 ~ 5	V
Hall Input Common-Phase Input Voltage Range	V_{ICM}	0.2 ~ 3	V

■ **ELECTRICAL CHARACTERISTICS** (V_{CC}=12V, T_A=25°C unless otherwise specified)

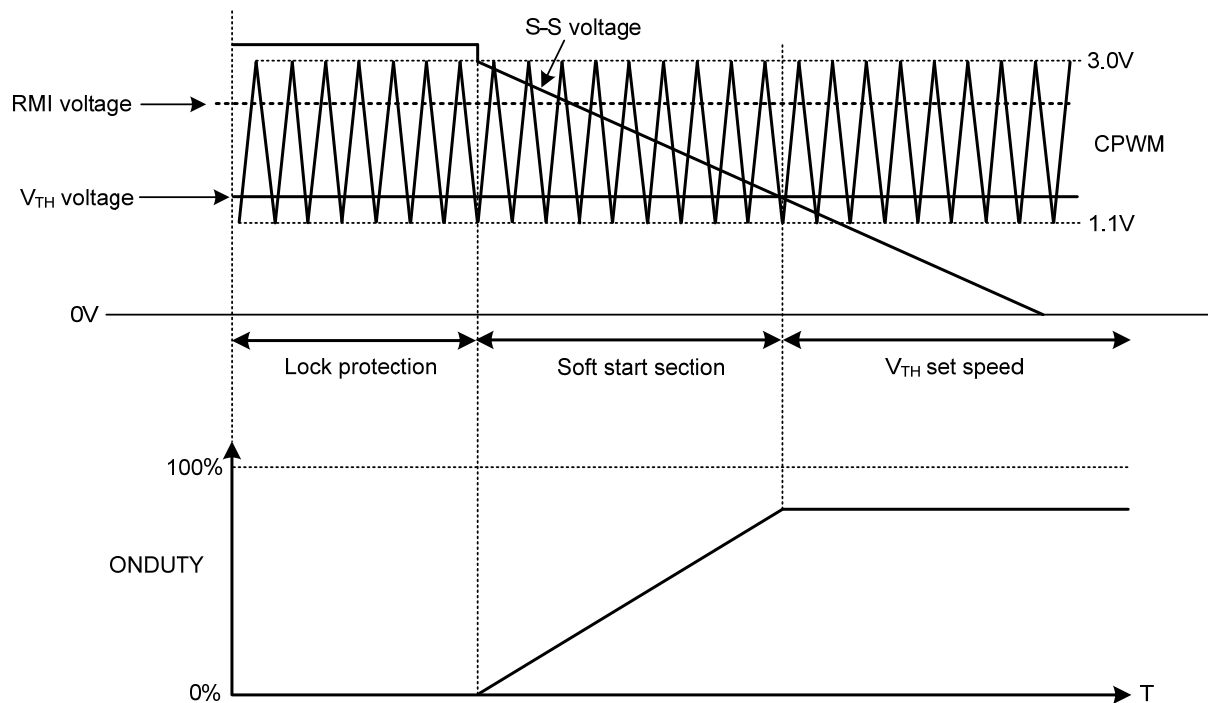| PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Circuit Current	I_{CC1}	During drive	5.5	7.5	9.5	mA
	I_{CC2}	During lock protection	5.5	7.5	9.5	mA
5VREG Voltage	$5V_{REG}$	I5VREG = 5mA	4.80	4.95	5.10	V
Current Limiting Voltage	V_{LIM}		185	200	215	mV
CPWM Pin "h" Level Voltage	V_{CPWM_H}		2.8	3.0	3.2	V
CPWM Pin "L" Level Voltage	V_{CPWM_L}		0.9	1.1	1.3	V
CPWM Pin Charge Current	I_{CPWM1}	V_{CPWM}=0.5V	24	30	36	µA
CPWM Pin Discharge Current	I_{CPWM2}	V_{CPWM}=3.5V	21	27	33	µA
CPWM Oscillation Frequency	F_{PWM}	C=220PF		30		kHz
CT Pin "H" Level Voltage	V_{CTH}		2.8	3.0	3.2	V
CT Pin "L" Level Voltage	V_{CTL}		0.9	1.1	1.3	V
CT Pin Charge Current	I_{CT1}	V_{CT}=0.5V	1.6	2.0	2.5	µA
CT Pin Discharge Current	I_{CT2}	V_{CT}=3.5V	0.16	0.20	0.25	µA
CT Pin Charge/Discharge Ratio	R_{CT}	$I_{CT}1/I_{CT}2$	8	10	12	times
S-S Pin Discharge Current	I_{S-S}	V_{S-S}=1V	0.4	0.5	0.6	µA
OUTN Output H-level Voltage	V_{ONH}	I_O=10mA		V_{CC}-0.85	V_{CC}-1.00	V
OUTN Output L-level Voltage	V_{ONL}	I_O=10mA		0.9	1.2	V
OUTP Output L-level Voltage	V_{OPL}	I_O=10mA		0.5	0.65	V
Hall Input Sensitivity	V_{HN}	IN+, IN- differential voltage (including offset and hysteresis)		±10	±20	mV

■ **ELECTRICAL CHARACTERISTICS (Cont.)**

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
FG Output L-level Voltage	V_{FGL}	I_{FG}=5mA		0.15	0.40	V
FG Pin Leakage Current	I_{FGL}	V_{FG}=19V			20	µA
RD Output L-level Voltage	V_{RDL}	I_{RD}=5mA		0.15	0.40	V
RD Pin Leakage Current	I_{RDL}	V_{RD}=19V			20	µA
V_{TH}/RMI Pin Bias Current	I_{VTH}/I_{RMI}	CPWM=V_{TH}/RMI=2V			0.2	µA

■ **CONTROL TIMING CHART** (Speed Control)

V$_{TH}$ voltage

f=30kHz (CP=220pF)

RMI voltage

3.0V

CPWM

1.1V

0V

Minimum speed setting rotation (stop mode)

Low speed   High speed

Full speed

PWM control speed variable

FG

100%

ONDUTY

0%
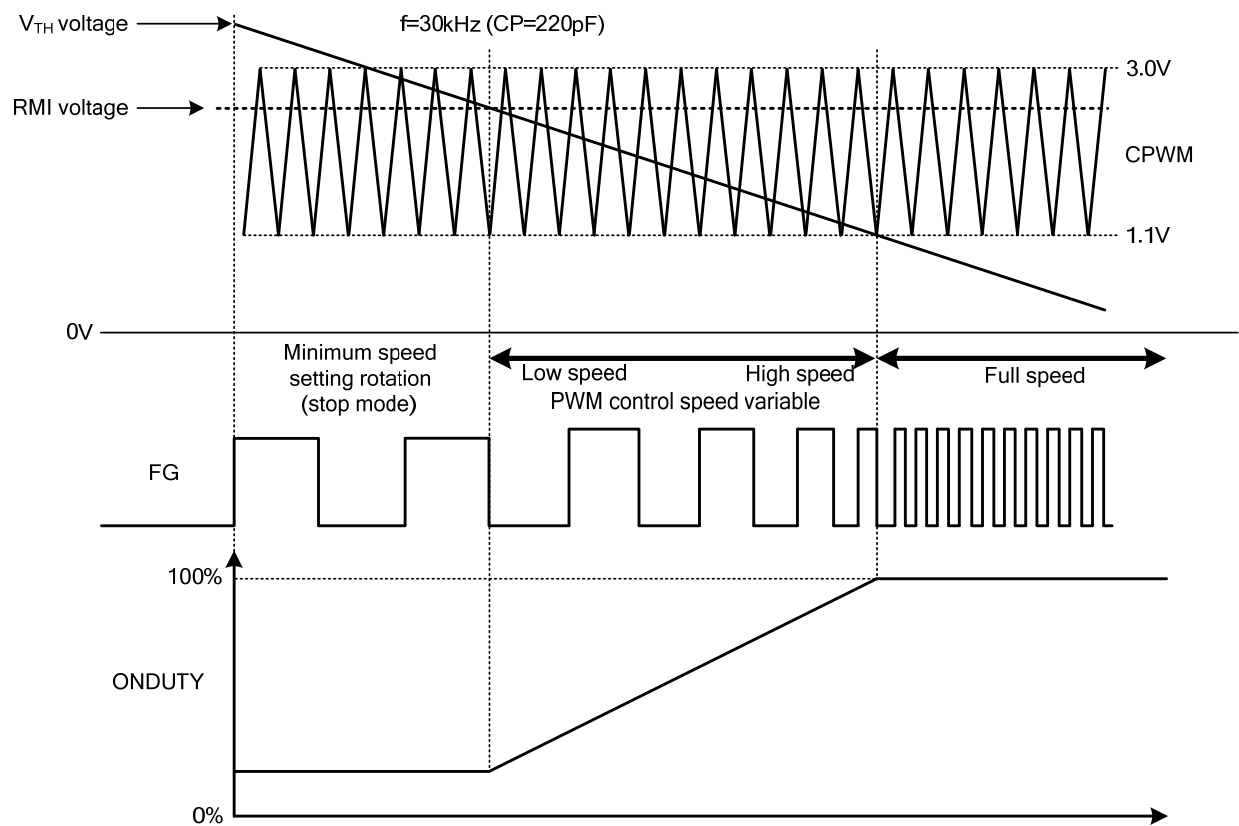
■ **CONTROL TIMING CHART (Cont.)** (Soft start)
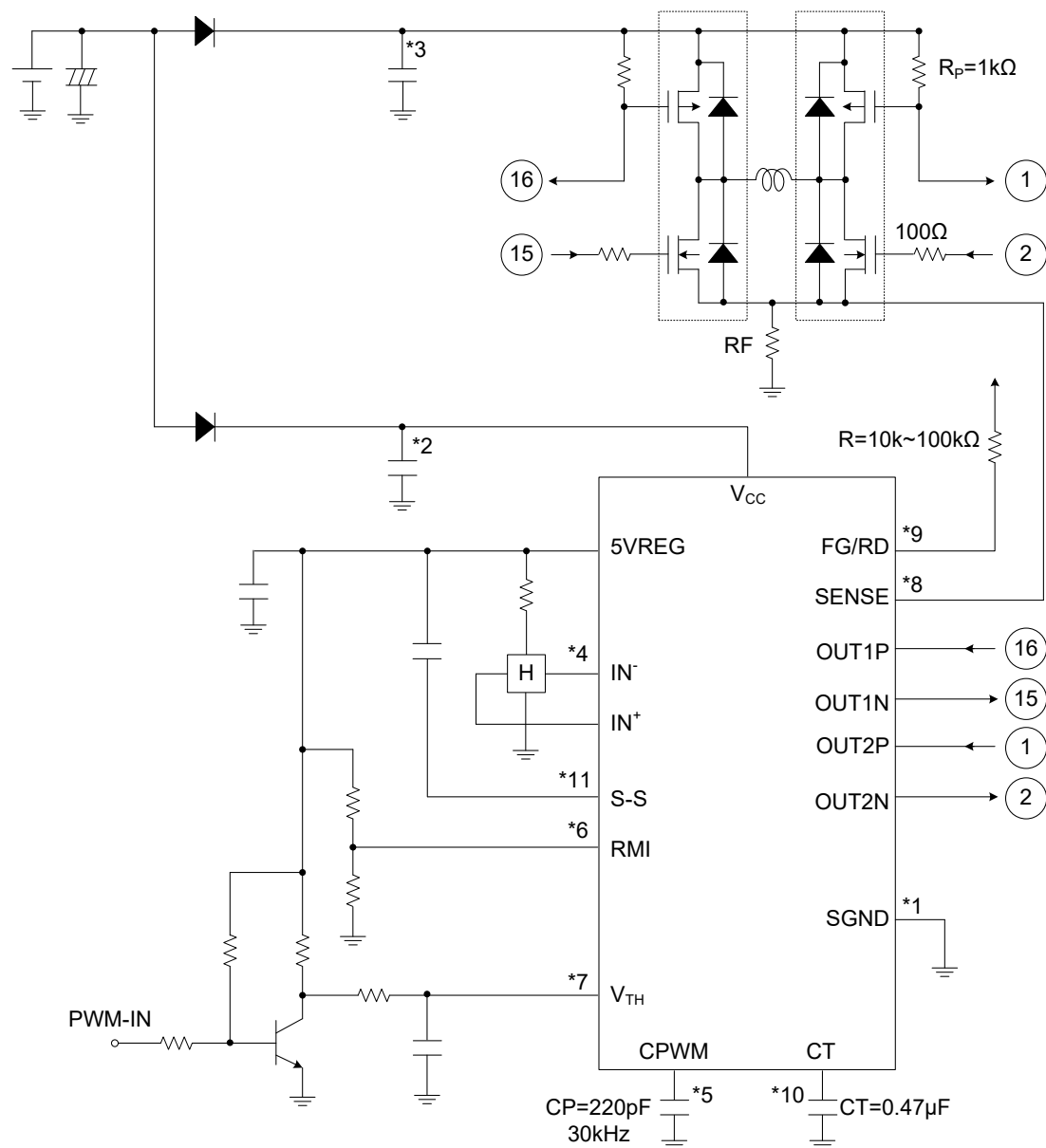
(1) At V_{TH} < RMI voltage

(2) At V_{TH} > RMI voltage
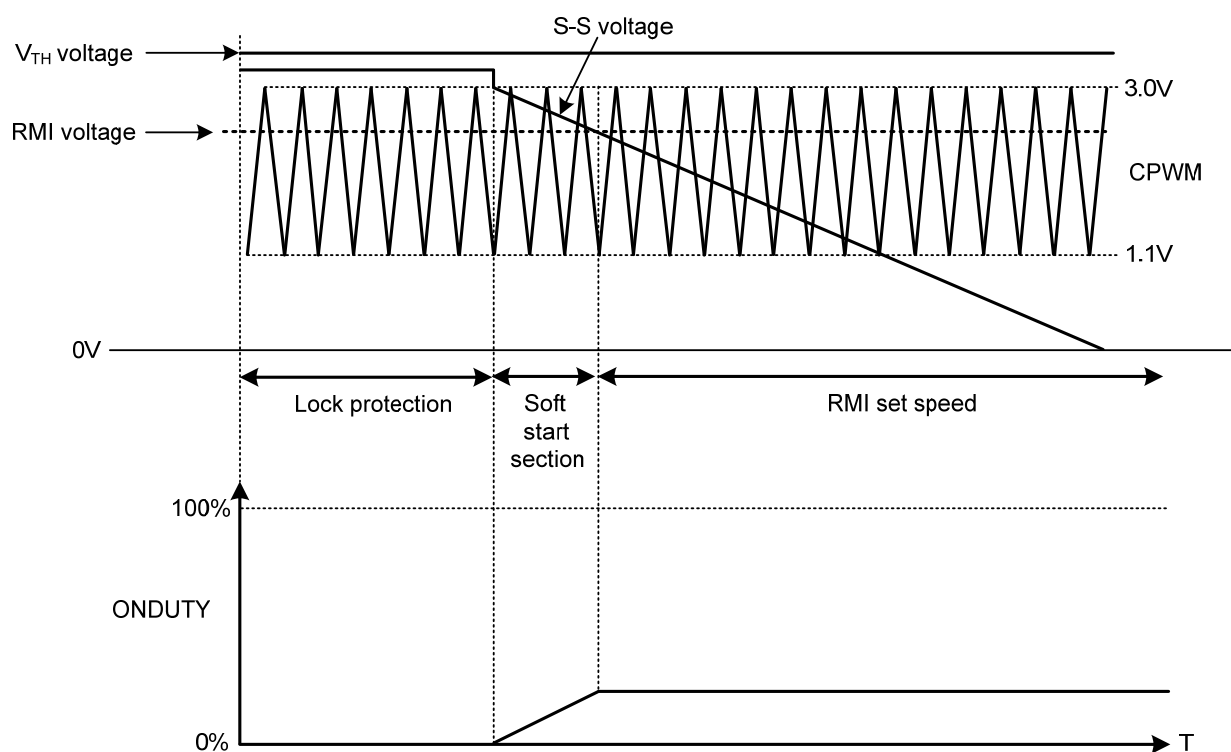
■ **LOCKUP PROTECTION / AUTOMATIC RECOVERY**
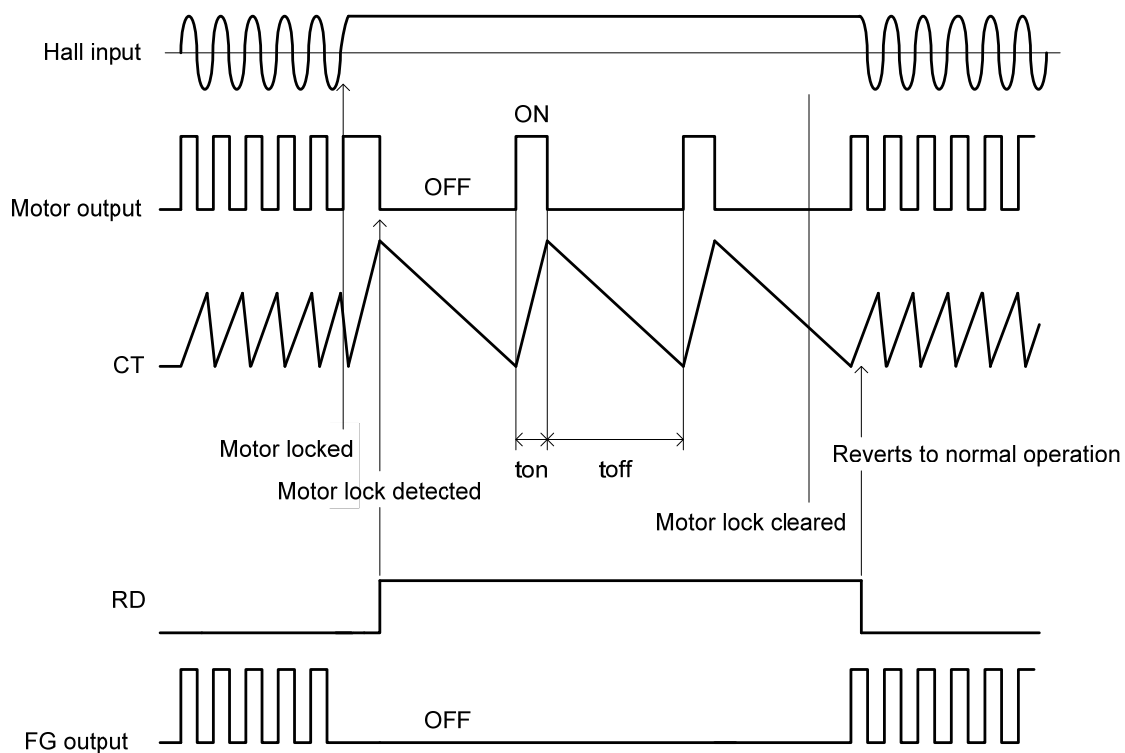
■ **TYPICAL APPLICATION CIRCUIT**

Notes: *1. Power−GND wiring

SGND is connected to the control circuit power supply system.

*2. Power stabilization capacitor

For the power stabilization capacitor on the signal side, use the capacitance of 1μF or more.

Connect V_{CC} and GND with a thick and shortest pattern.

*3. Power stabilization capacitor on the power side

For the power stabilization capacitor on the power side, use the capacitance of 1μF or more

Connect the power supply on the power side and GND with a thick and shortest pattern.

*4. IN+, IN- pins

Hall signal input pin.

Wiring should be short to prevent carrying of noise.

If noise is carried, insert the capacitor between IN+ and IN- pins.

The Hall input circuit functions as a comparator with hysteresis (15mV).

This also has a soft switch section with ±30mV (input signal differential voltage).

It is also recommended that the Hall input level is minimum 100mV (p-p).

■ **TYPICAL APPLICATION CIRCUIT (Cont.)**

Notes: *5. CPWM pin

    Pin to connect the capacitor for generation of the PWM basic frequency.

    The use of CP=220pF causes oscillation at f=30kHz, which is the basic frequency of PWM.

    As this is used also for the current limiting canceling signal, be sure to connect the capacitor even when the speed control is not made.

    *6. RMI pin

    Minimum speed setting pin.

    Perform pull-up with 5VREG when this pin is not to be used.

    If the IC power supply is likely to be turned OFF first when the pin is used with external power supply, be sure to insert the current limiting resistor to prevent inflow of large current. (The same applies to the V_{TH} pin.)

    *7. V_{TH} pin

    Speed control pin.

    Connect this pin to GND when it is not used (at full speed).

    For the control method, refer to the timing chart.

    For control with pulse input, insert the current limiting resistor and use the pin with the frequency of 20k~100kHz (20kHz~50kHz recommended).

    *8. SENSE pin

    Current limiting detection pin.

    When the pin voltage exceeds 0.2V, the current is limited and the operation enters the lower regeneration mode.

    Connect this pin to GND when it is not to be used.

    *9. FG/RD pin

    "FG" means pin 8 is an output pin of FG signal which is used for detecting rotation speed. "RD" means pin 8 is an output pin of RD signal, and is used for detecting fan rotate-stop state. "FG" and "RD" can be selected according to the requirement. This pin need to be connected with pull-up resistor when used. A new pulse will be generated once input signal changed. Keep this pin open when it is not to be used.

    *10. CT pin

    Pin to connect the lock detection capacitor.

    The constant-current charge and discharge circuits incorporated cause locking when the pin voltage becomes 3.0V and unlocking when it is 1.1V. Connect the pin to GND when it is not to be used (locking not necessary).

    *11. S-S pin

    Pin to connect the soft-start setting capacitor.

    Connect the capacitor between 5VREG and S-S pin.

    This pin enables setting of the soft start time according to the capacity of the capacitor.

    See the timing char.

    Connect the pin to GND when it is not to be used.