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LB11970RV

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Monolithic Digital IC
For Fan Motor
Single-phase Full-wave Driver

Overview

The LB11970RV is a motor driver of the single phase bipolar drive that a good direct PWM drive of the motor drive efficiency can come true easily. It is most suitable for the power supply fan of the personal computer, CPU air conditioner fan drive.

Functions

- Single-phase full-wave drive (16V to 1.2A output transistor incorporated)
- Variable speed function using thermistor input and external signal incorporated
  →Enables silent and low-vibration variable speed control through direct PWM control with separately-excited upper Tr
- Current limiter circuit (limit at I_O=480mA with R_L=1Ω connection, the limiter value determined with Rf)
- Kick-back absorption circuit incorporated
- Low-consumption, low-loss, and low-noise drive enabled by the soft switching circuit during phase shift
- Regeneration Di incorporated with less external parts
- HB incorporated
- Lock protection and automatic reset functions incorporated
- RD (Lock detection) output
- Thermal shutdown circuit incorporated

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
V_{CC} maximum supply voltage	V_{CC} max		17	V
VM maximum supply voltage	VM max		17	V
OUT pin maximum output current	I_{OUT} max		1.2	A
OUT pin output withstand voltage	V_{OUT} max		18	V
HB maximum output current	HB		10	mA
VTH, RMI input pin withstand voltage	VTH RMI max		7	V
P-IN input pin withstand voltage	VP-IN max		V_{CC}	V
RD output pin output withstand voltage	V_{RD} max		18	V
RD output current	I_{RD} max		10	mA
Allowable power dissipation	Pd max	Specified substrate *	0.8	W
Operating temperature range	Topr		-30 to 90	°C
Storage temperature range	Tstg		-55 to 150	°C

* Specified substrate: 30mm×30mm×0.8mm, paper phenol.

Caution 1) Absolute maximum ratings represent the value which cannot be exceeded for any length of time.

Caution 2) Even when the device is used within the range of absolute maximum ratings, as a result of continuous usage under high temperature, high current, high voltage, or drastic temperature change, the reliability of the IC may be degraded. Please contact us for the further details.

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

Recommended Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
V_{CC} supply voltage	V_{CC}		4.5 to 16	V
VM supply voltage	VM		3.5 to 16	V
VTH, RMI input level voltage range	VTH, RMI		0 to 6	V
P-IN input level voltage range	VP-IN		0 to V_{CC}	V
Triangular wave input range	VRM		0.5 to 4	V
Hall input common phase input voltage range	VICM		0.2 to 3	V

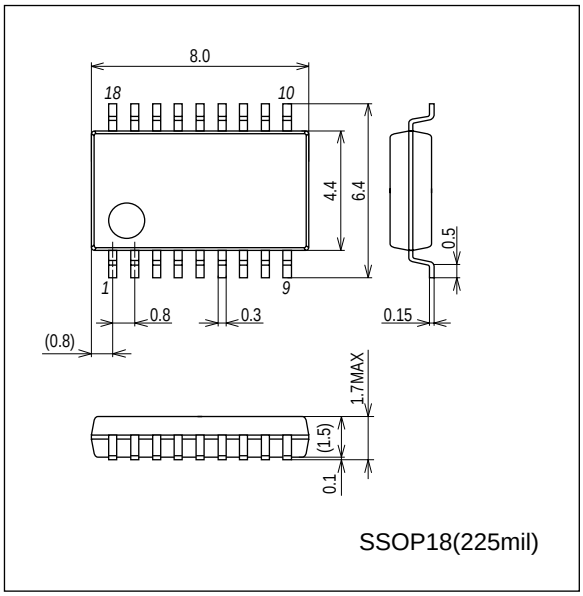
Electrical Characteristics at Ta = 25°C, V_{CC} = 12V, R_f = 0Ω, unless otherwise specified.

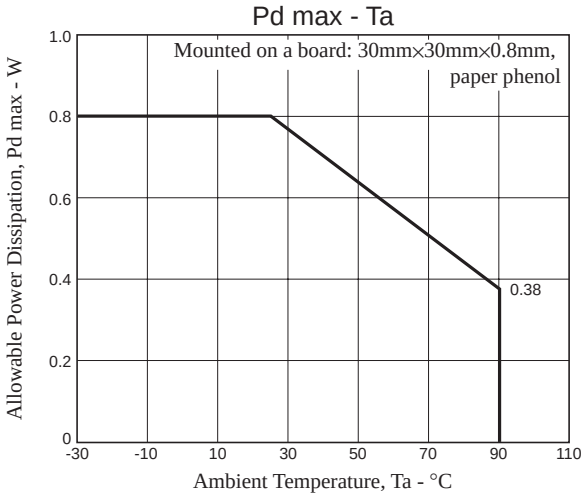
Parameter	Symbol	Conditions	Ratings			unit
			min	typ	max	
Circuit current	$I_{CC}1$	During drive	12	15	18	mA
	$I_{CC}2$	During lock protection	11	14	17	mA
HB voltage	VHB	IHB=5mA	1.12	1.22	1.32	V
6VREG voltage	V6VREG	I6VREG=5mA	5.85	5.95	6.10	V
CT pin H level voltage	$V_{CT}H$		3.4	3.6	3.8	V
CT pin L level voltage	$V_{CT}L$		1.4	1.6	1.8	V
CT pin charge current	$I_{CT}1$		1.8	2.2	2.6	μA
CT pin discharge current	$I_{CT}2$		0.18	0.22	0.26	μA
CT charge/discharge current ratio	R_{CT}		8	10	12	
OUT output L saturation voltage	$V_O L$	I_O=200mA		0.1	0.2	V
OUT output H saturation voltage	$V_O H$	I_O=200mA, R_f=1Ω		0.6	0.8	V
Current limiter	VRF			480		mV
RD output pin L voltage	V_{RD}	I_{RD}=5mA		0.2	0.3	V
RD output pin leak current	$I_{RD}L$	V_{RD}=18V			30	μA
Overheat protection circuit	THD	* Design guarantee value		180		°C

*: Design target value and no measurement were made.

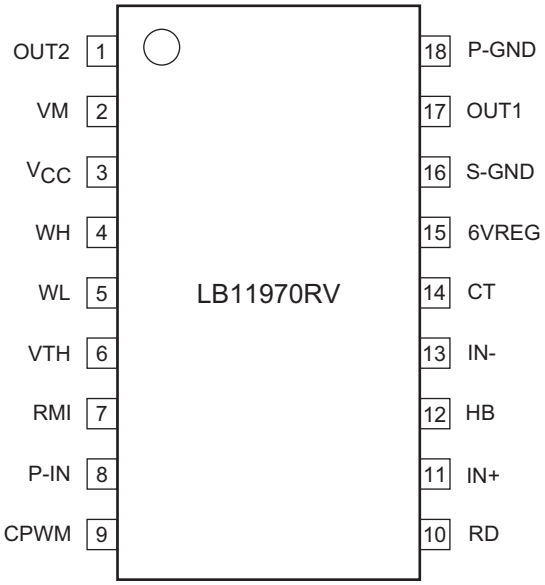
Package Dimensions

unit : mm (typ)
3338





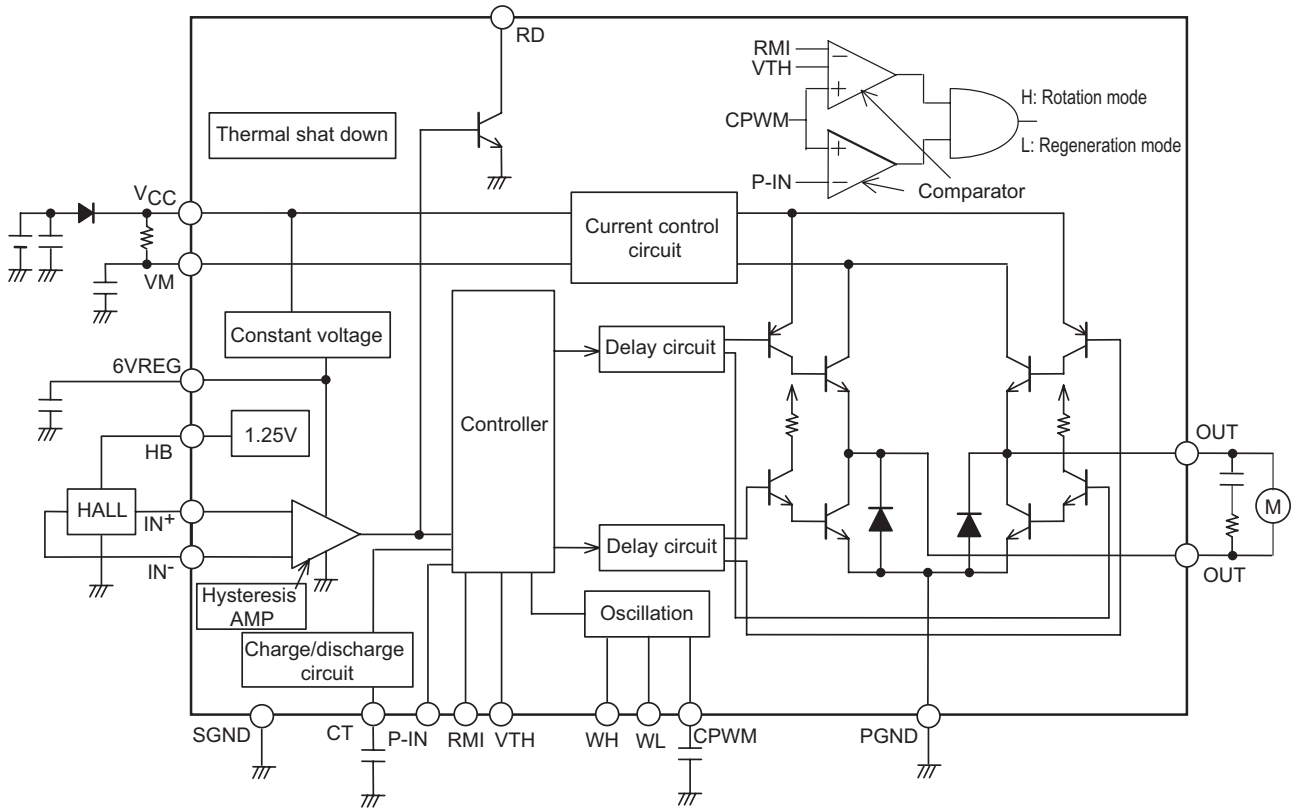
Pin Assignment



(Top view)

PGND: Motor system GND
SGND: Control system GND

Equivalent Circuit Diagram

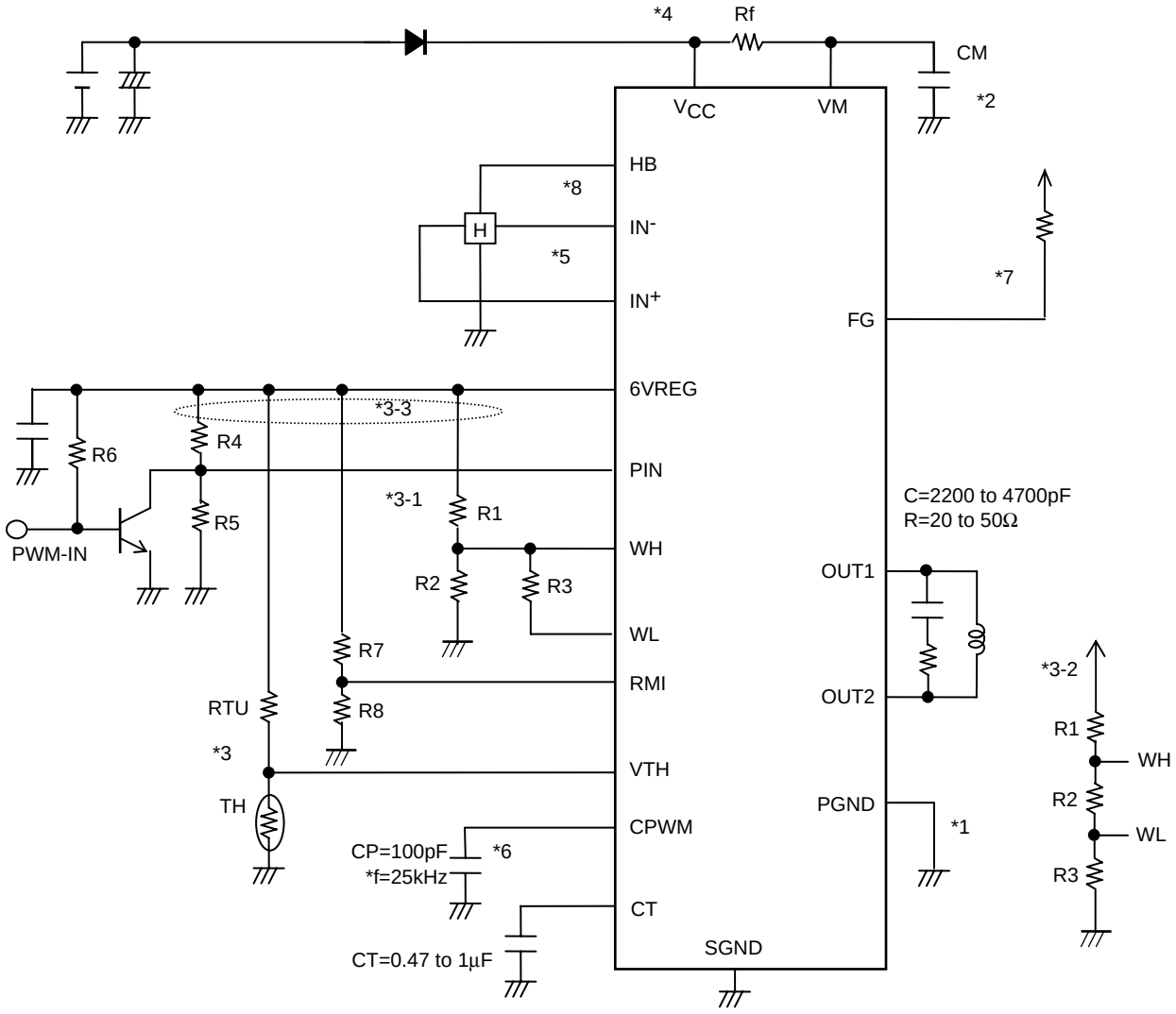


Truth Table

VTH	PIN	IN-	IN+	CT	OUT1	OUT2	RD	Mode
L (OPEN)	L	H	L	L	H	L	L	Running - drive
	L	L	H		L	H		
H	L	H	L		OFF	L		Running - regeneration
	L	L	H		L	OFF		
-	H	H	L	L	OFF	L		Output regeneration mode with external signal
-	H	L	H		L	OFF		
-	-	H	L	H	OFF	L	OFF	Lock protection
-	-	L	H	H	L	OFF		

VTH, P-IN = L means VTH, P-IN < CPWM VTH, P-IN = H means VTH, P-IN > CPWM

Application Circuit Example



*1. Power supply - GND wiring
PGND is connected to the motor power system while SGND is connected to the control circuit power system. Wiring is made separately for PGND and SGND, and external parts of each control system are connected to SGND.

*2. Power stabilization capacitor for regeneration
CM capacitor is a power stabilizing capacitor for PWM drive and kick-back absorption and has the capacitance of 4.7μF or more. Since this IC performs current regeneration with the lower Tr through switching of the upper Tr, connect CM with the thick and shortest possible pattern between VM and PGND.

*3. Setting of the temperature detection variable speed
Setting of the triangular wave oscillation voltage
The rotation speed variable range for the temperature is set with the triangular wave oscillation voltage. There are two setting methods as follows:

3-1 The upper voltage (VCPH) of triangular wave is determined by V[voltage of the R1 connection counterpart]× (R2/(R1+R2)) and the lower voltage (VCPL) of triangular wave is determined by V× ((R2//R3) / (R1+R2//R3)).
3-2 The upper voltage (VCPH) of triangular wave is determined by V× ((R2+R3) / (R1+R2+R3)) and the lower voltage (VCPL) of triangular wave is determined by V× (R2/(R1+R2)).

Setting of the thermostat
The resistance (RTU from V_{CC} or 6VREG and the voltage generated through division of thermostat (TH) are input in the VTH pin. When the voltage at the VTH pin drops below VCPL due to temperature change, the full speed (thermostat input speed control side only) is obtained.
To set the full speed with the thermostat tripping, connect each pin of 3-3 to V_{CC} and each input voltage is generated by divided resistance from V_{CC}. When the thermostat trips and the VTH pin is pulled up to VCC, the full speed (thermostat input speed control side only) is obtained.

*4. Setting the current limiter
The current limiter is activated when the voltage between current detection resistors exceeds 0.48V between V_{CC} and VM.
The current limiter is activated at I_O = 480mA when R_L = 1Ω. Setting is made with the Rf resistance.
Short-circuit V_{CC} and VM when the current limiter is not to be used.
When 12V is used, the current limiter must be applied at 1A or less if the coil resistance is 10Ω or less.

*5. Hall input
Wiring must be as short as possible to prevent carrying of noise. The Hall input circuit is a comparator with hysteresis of 20mV. The Hall input level is recommended to be three times (60mVp-p) or more of this hysteresis.

*6. Capacitor to set the PWM oscillation frequency
Oscillation with f = 25kHz occurs at CP = 100pF and PWM voltage width of 1.6V, and becomes the reference frequency of PWM.

*7. RD output
This is the open collector output, the output "H (OFF)" at the time of "L", and a stop at the time of a turn. Keep this output OPEN when not used.

*8. HB pin
Hall element bias pin, which is a 1.22V constant-voltage output pin

*9. RMI pin
Minimum speed setting pin for thermostat speed control, which must be pulled up with 6 VREG when not used. By connecting the capacitor, the time to ignore thermostat input at startup can be set.

*10. PIN pin
Direct PWM speed control pin. Pull down the P-IN input to GND when not using this pin.
The lowest output DUTY setting is made with R4 and R5. Keep R5 open for stop with DUTY at 0%.

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