

# LB11970FV

## Single-phase Full-wave Driver for Fan Motor

### Overview

The LB11970FV is a single-phase full-wave driver for fan motor.

### 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  $I_{O}=480\text{mA}$  with  $R_L=1\Omega$  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
- FG (rotation detection) output
- Thermal shutdown circuit incorporated

### Applications

- Personal computer power supply systems
- CPU cooling fan systems

### Specifications

**Absolute Maximum Ratings** at  $T_a = 25^\circ\text{C}$  (Note1)

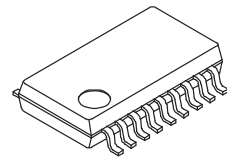
Parameter	Symbol	Conditions	Ratings	Unit
$V_{CC}$ maximum supply voltage	$V_{CC\text{ max}}$		17	V
VM maximum supply voltage	VM max		17	V
OUT pin maximum output current	$I_{OUT\text{ max}}$		1.2	A
OUT pin output withstand voltage	$V_{OUT\text{ max}}$		18	V
HB maximum output current	HB		10	mA
VTH, RMI input pin withstand voltage	VTH RMI max		7	V
P-IN input pin withstand voltage	VP-IN max		$V_{CC}$	V
FG output pin output withstand voltage	VFG max		18	V
FG output current	IFG max		10	mA
Allowable power dissipation	Pd max	Specified substrate (Note2)	0.8	W
Operating temperature range	Topr		-30 to 90	°C
Storage temperature range	Tstg		-55 to 150	°C

1. Stresses exceeding those listed in the Maximum Rating table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.
2. Specified substrate: 30mm×30mm×0.8mm, paper phenol.



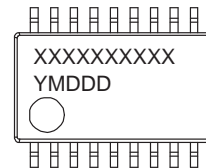
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SSOP18 (225mil)

### GENERIC MARKING DIAGRAM\*



XXXXXX = Specific Device Code  
Y = Year  
M = Month  
DDD = Additional Traceability Data

### ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

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## Recommended Operating Ranges at Ta = 25°C (Note3)

Parameter	Symbol	Conditions	Ratings	Unit
V <sub>CC</sub> supply voltage	V <sub>CC</sub>		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 <sub>CC</sub>	V
Triangular wave input range	VRM		0.5 to 4	V
Hall input common phase input voltage range	VICM		0.2 to 3	V

3. Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

## Electrical Characteristics at Ta = 25°C, V<sub>CC</sub> = 12V, R<sub>f</sub> = 0Ω, unless otherwise specified. (Note4)

Parameter	Symbol	Conditions	Ratings			unit
			min	typ	max	
Circuit current	I <sub>CC1</sub>	During drive	12	15	18	mA
	I <sub>CC2</sub>	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 <sub>CTH</sub>		3.4	3.6	3.8	V
CT pin L level voltage	V <sub>CTL</sub>		1.4	1.6	1.8	V
CT pin charge current	I <sub>CT1</sub>		1.8	2.2	2.6	μA
CT pin discharge current	I <sub>CT2</sub>		0.18	0.22	0.26	μA
CT charge/discharge current ratio	R <sub>CT</sub>		8	10	12	
OUT output L saturation voltage	V <sub>OL</sub>	I <sub>O</sub> =200mA		0.1	0.2	V
OUT output H saturation voltage	V <sub>OH</sub>	I <sub>O</sub> =200mA, R <sub>f</sub> =1Ω		0.6	0.8	V
Current limiter	VRF			480		mV
Hall input sensitivity	VHN	Zero peak value (including offset and hysteresis)		10	20	mV
FG output pin L voltage	VFG	IFG=5mA		0.2	0.3	V
FG output pin leak current	IFGL	VFG=7V			30	μA
Overheat protection circuit	THD	Design guarantee value (Note5)		180		°C

4. Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

5. Design target value and no measurement was made.

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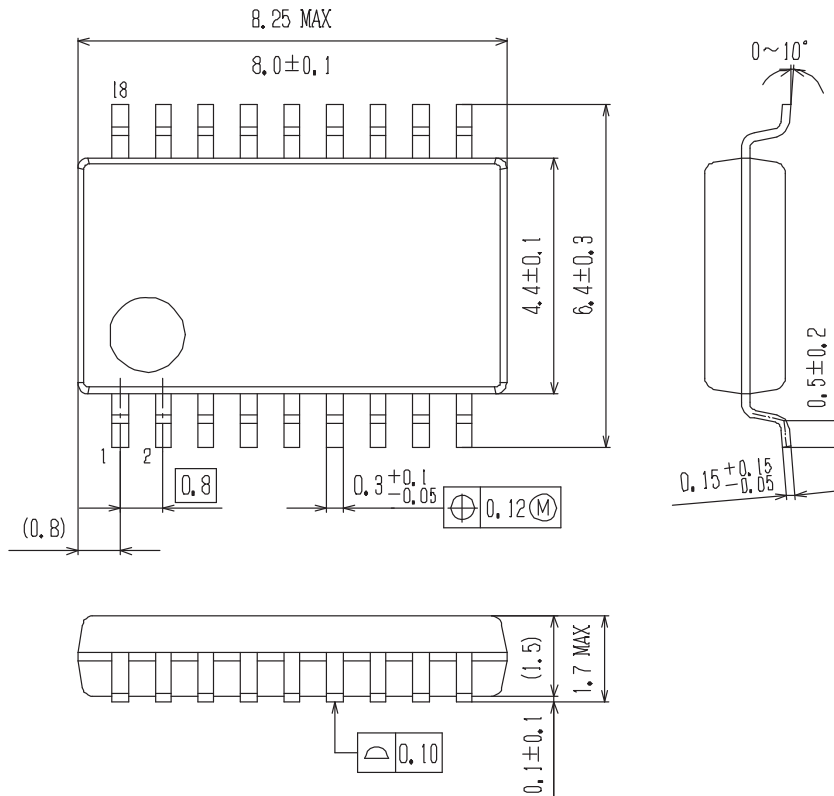
## Package Dimensions

unit : mm

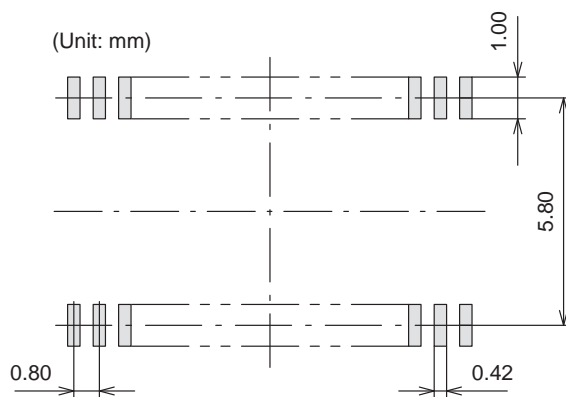
SSOP18 (225 mil)

CASE 565AX

ISSUE A



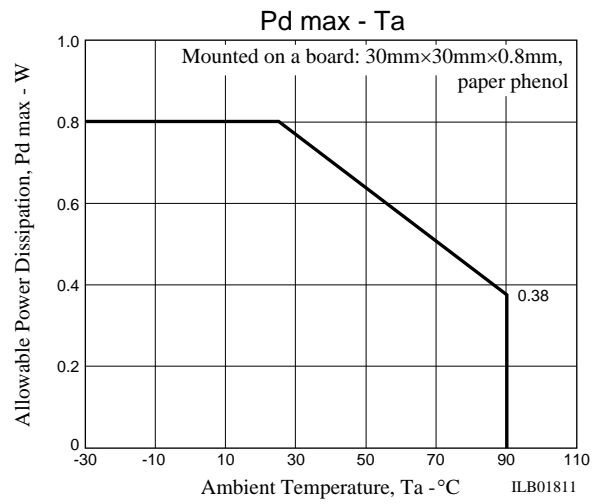
### SOLDERING FOOTPRINT\*



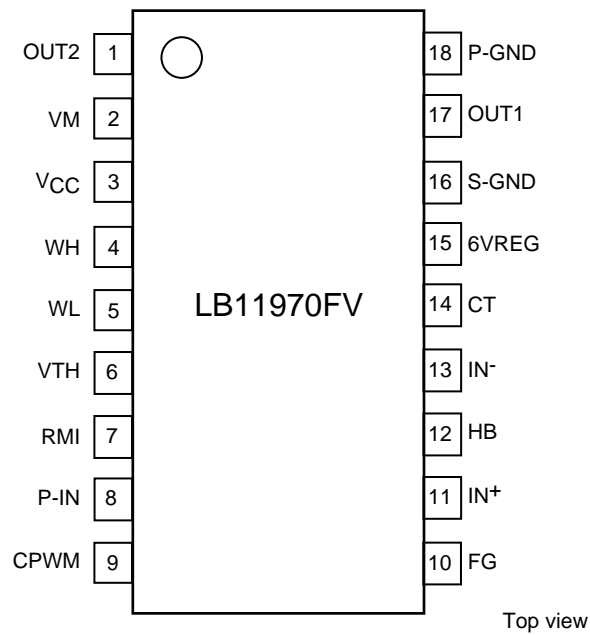
NOTE: The measurements are not to guarantee but for reference only.

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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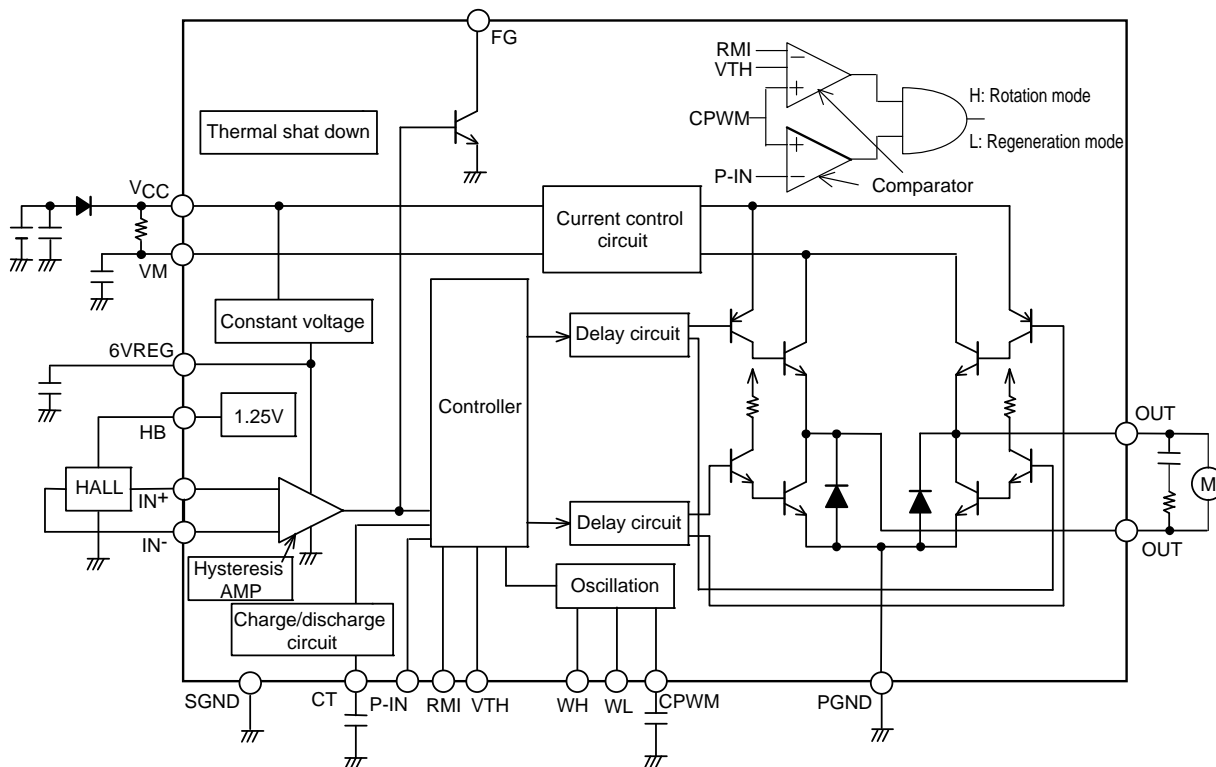
## Pin Assignment



PGND: Motor system GND  
SGND: Control system GND

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## Equivalent Circuit Diagram



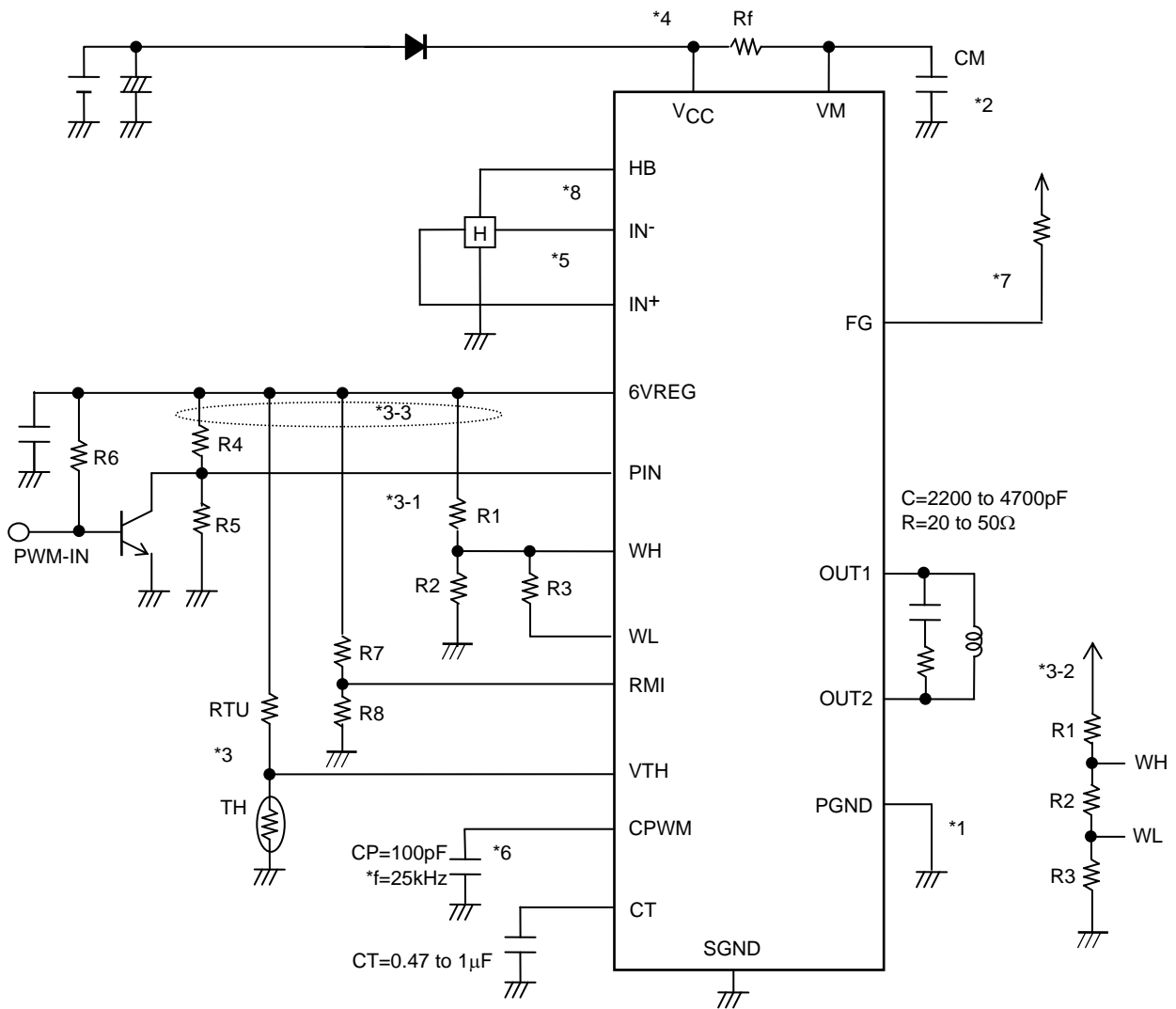
## Truth Table

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

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

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## Application Circuit Example



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### \*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 4.7 $\mu$ F 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  $V[\text{voltage of the R1 connection counterpart}] \times (R2/(R1+R2))$  and the lower voltage (VCPL) of triangular wave is determined by  $V \times ((R2/R3) / (R1+R2/R3))$ .

3-2 The upper voltage (VCPH) of triangular wave is determined by  $V \times ((R2+R3) / (R1+R2+R3))$  and the lower voltage (VCPL) of triangular wave is determined by  $V \times (R2/(R1+R2))$ .

Setting of the thermistor

The resistance (RTU from VCC or 6VREG and the voltage generated through division of thermistor (TH) are input in the VTH pin. When the voltage at the VTH pin drops below VCPL due to temperature change, the full speed (thermistor input speed control side only) is obtained.

To set the full speed with the thermistor tripping, connect each pin of 3-3 to VCC and each input voltage is generated by divided resistance from VCC. When the thermistor trips and the VTH pin is pulled up to VCC, the full speed (thermistor 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 VCC and VM.

The current limiter is activated at  $I_O = 480\text{mA}$  when  $R_L = 1\Omega$ . Setting is made with the Rf resistance.

Short-circuit VCC 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 10 $\Omega$  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  $f = 25\text{kHz}$  occurs at  $CP = 100\text{pF}$  and PWM voltage width of 1.6V, and becomes the reference frequency of PWM.

### \*7. FG output

This is the open collector output, enabling detection of the rotation speed using the FG output corresponding to the phase shift. 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 thermistor speed control, which must be pulled up with 6 VREG when not used.

By connecting the capacitor, the time to ignore thermistor 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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## ORDERING INFORMATION

Device	Package	Wire Bond	Shipping(Qty/Packing)
LB11970FV-MPB-H	SSOP18(225mil) (Pb-Free / Halogen Free)	Au-wire	60 / Fan-fold
LB11970FV-TLM-H	SSOP18(225mil) (Pb-Free / Halogen Free)	Au-wire	2000 / Tape & Reel
LB11970FV-W-AH	SSOP18(225mil) (Pb-Free / Halogen Free)	Cu-wire	2000 / Tape & Reel

† For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D. [http://www.onsemi.com/pub\\_link/Collateral/BRD8011-D.PDF](http://www.onsemi.com/pub_link/Collateral/BRD8011-D.PDF)

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