Ordering number : ENA0707

SANYO Semiconductors
DATA SHEET

LB11970FV — Monolithic Digital IC For Fan Motor Single-phase Full-wave Driver

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=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
- FG (rotation 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

Continued on next page.

SANYO Semiconductor Co., Ltd.
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

Continued from preceding page.

Parameter	Symbol	Conditions	Ratings	Unit
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 *	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.

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

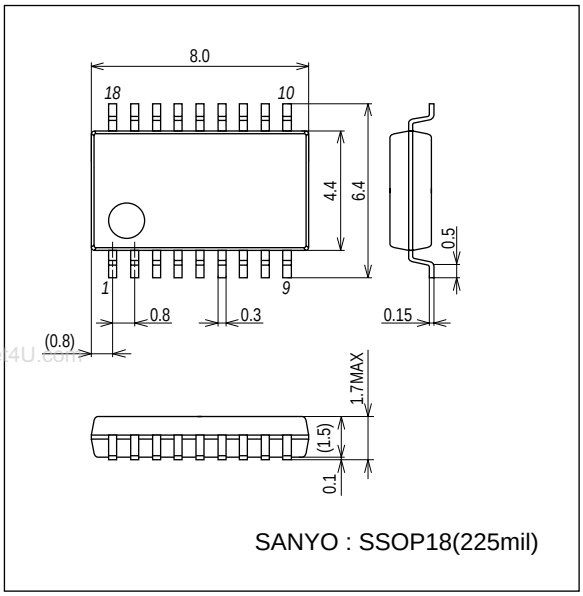
Electrical Characteristics at Ta = 25°C, V_{CC} = 12V, R_f = 0Ω, unless otherwise specified.

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
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		180		°C

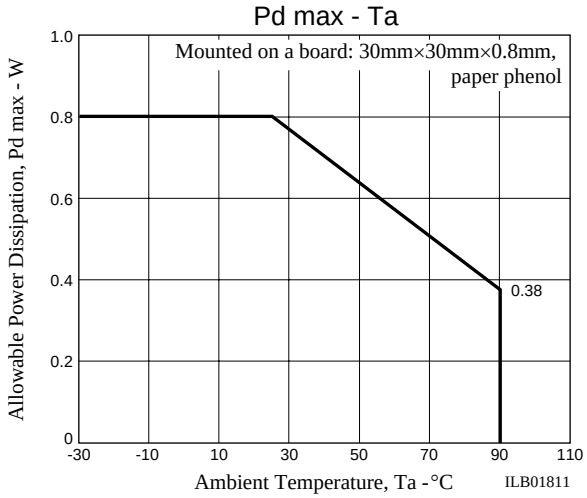
*: Design target value and no measurement was made.

Package Dimensions

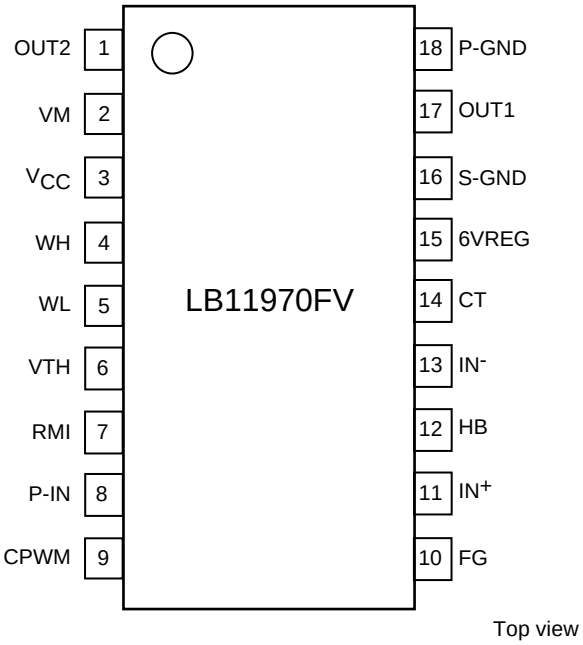
unit : mm (typ)
3338



SANYO : SSOP18(225mil)



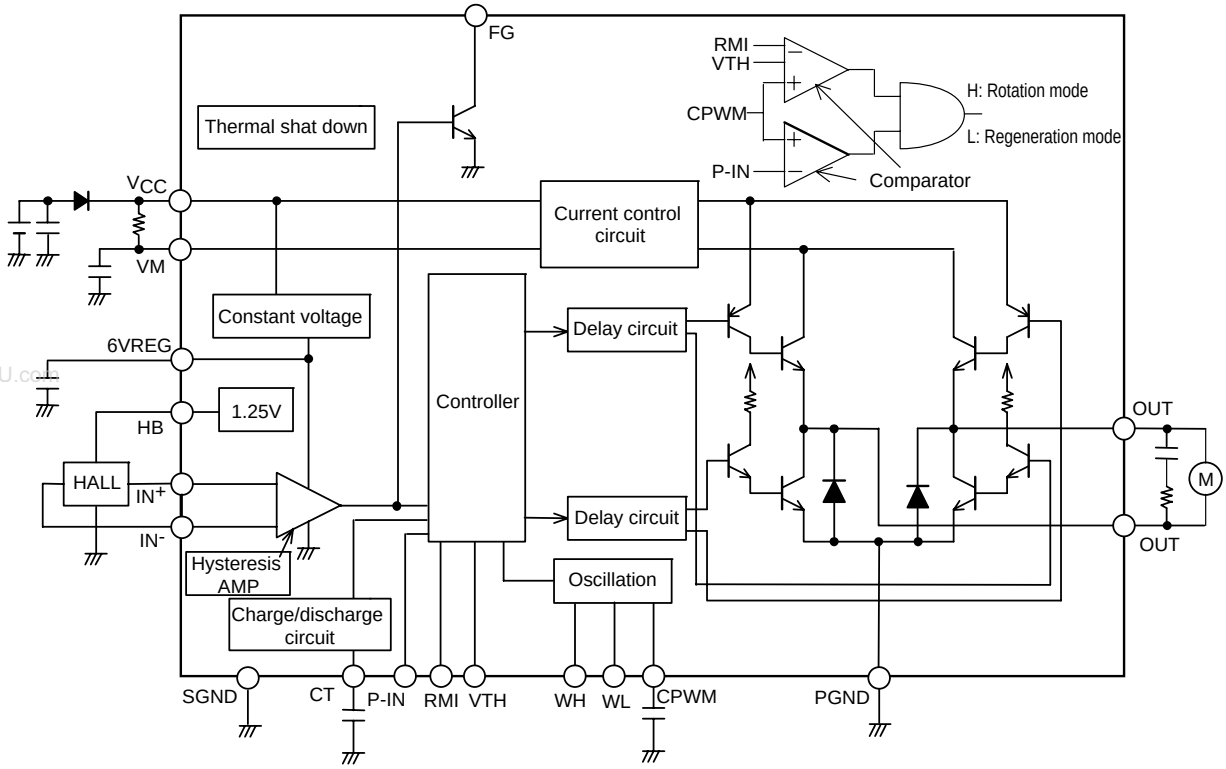
Pin Assignment



Top view

PGND: Motor system GND
SGND: Control system GND

Equivalent Circuit Diagram

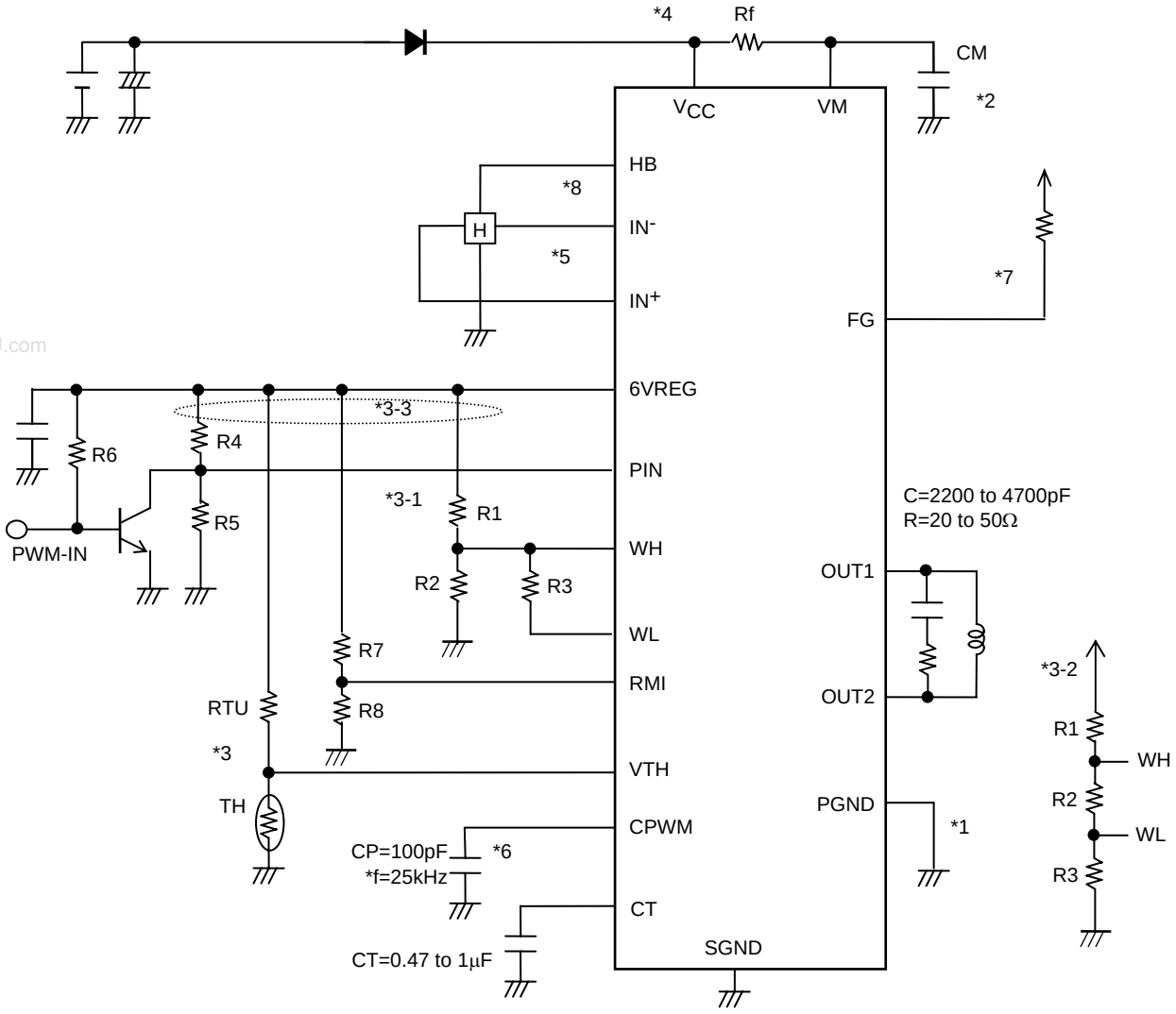


Truth Table

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

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 thermistor

The resistance (RTU from V_{CC} 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 V_{CC} and each input voltage is generated by divided resistance from V_{CC}. 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 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. 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%.

- SANYO Semiconductor Co.,Ltd. assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all SANYO Semiconductor Co.,Ltd. products described or contained herein.
- SANYO Semiconductor Co.,Ltd. strives to supply high-quality high-reliability products, however, any and all semiconductor products fail or malfunction with some probability. It is possible that these probabilistic failures or malfunction could give rise to accidents or events that could endanger human lives, trouble that could give rise to smoke or fire, or accidents that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any or all SANYO Semiconductor Co.,Ltd. products described or contained herein are controlled under any of applicable local export control laws and regulations, such products may require the export license from the authorities concerned in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written consent of SANYO Semiconductor Co.,Ltd.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the SANYO Semiconductor Co.,Ltd. product that you intend to use.
- Information (including circuit diagrams and circuit parameters) herein is for example only; it is not guaranteed for volume production.
- Upon using the technical information or products described herein, neither warranty nor license shall be granted with regard to intellectual property rights or any other rights of SANYO Semiconductor Co.,Ltd. or any third party. SANYO Semiconductor Co.,Ltd. shall not be liable for any claim or suits with regard to a third party's intellctual property rights which has resulted from the use of the technical information and products mentioned above.

This catalog provides information as of March, 2007. Specifications and information herein are subject to change without notice.