Ordering number : ENN5917

Monolithic Digital IC

LB1981V

Three-Phase Brushless Motor Driver

Overview

The LB1981V is a three-phase brushless motor driver especially suited for use mainly with drum motors of portable VCRs.

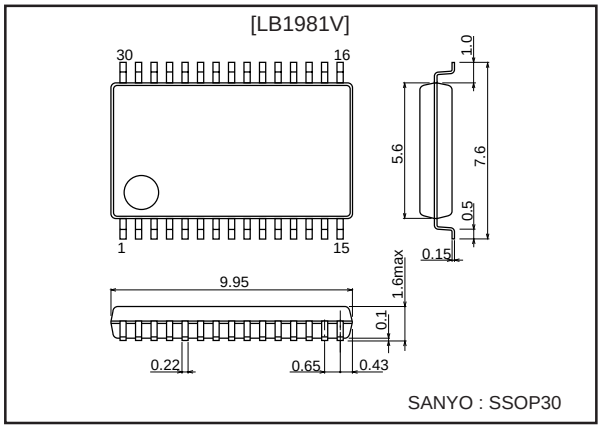
Features

- Three-phase full-wave drive brushless sensorless motor drive
- Soft switching drive
- Power-saving speed control function due to motor voltage
- Use with 3V power supply possible
- Output residual voltage can be set in 4 ways
- Forward/reverse switching possible
- Built-in standby function (FG and PG amplifier only remain operative)
- Built-in braking circuit
- Built-in thermal shutdown circuit
- Built-in FG and PG amplifiers
- Built-in saturation prevention amplifier and midpoint control circuit

Package Dimensions

unit: mm

3191-SSOP30



Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage	$V_{CC}1$ max		7	V
	$V_{CC}2$ max		12	V
	V_S max		$V_{CC}2$	V
Applied output voltage	V_O max		V_S+2	V
Applied input voltage	$V_{IN}1$ max	Control circuits	–0.3 to $V_{CC}1$+0.3	V
	$V_{IN}2$ max	U, V, W, COM	V_S+2	V
Output current	I_O max		1.0	A
Allowable power dissipation	Pd max		0.5	W
Operating temperature	Topr		–20 to +75	°C
Storage temperature	Tstg		–55 to +150	°C

Allowable Operating Ranges at Ta = 25˚C

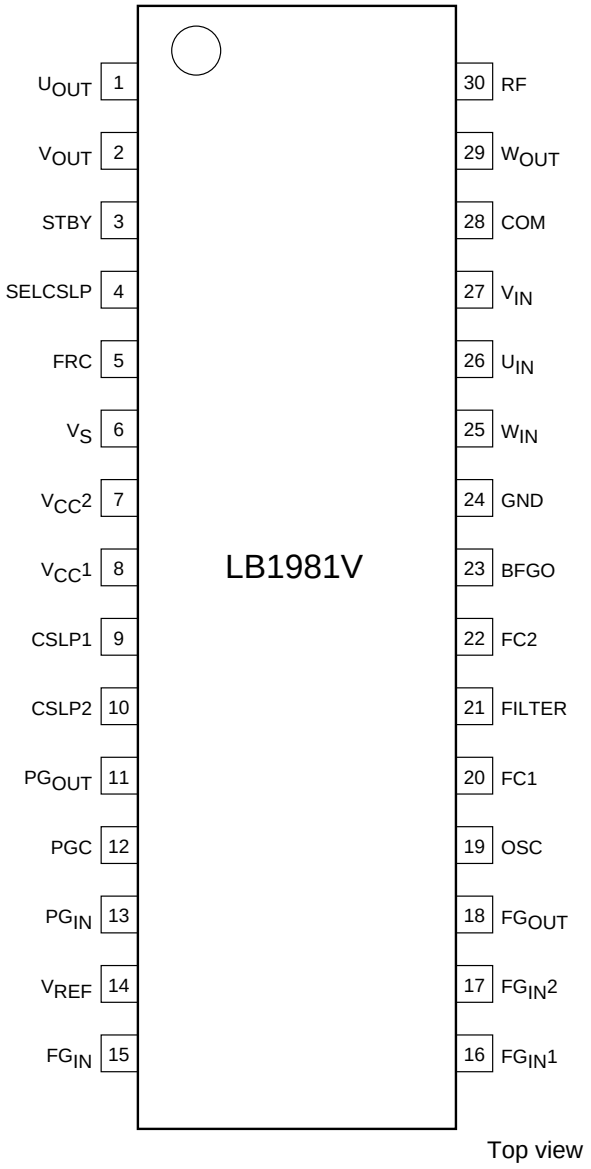
Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage	$V_{CC}1$		2.7 to 6.0	V
	$V_{CC}2$		2.7 to 10.0	V
	V_S		0 to $V_{CC}2$	V

Electrical Characteristics at Ta = 25°C, $V_{CC}1$ = 3V, $V_{CC}2$ = 4.75V, V_S = 3V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Power supply current	$I_{CC}1$	I_O = 76 mA		5	7.5	mA
	$I_{CC}2$	I_O = 76 mA		1.2	2.5	mA
Output idle current	$I_{CC}10Q$	V_{STBY} = 0V		1.0	1.5	mA
	$I_{CC}20Q$	V_{STBY} = 0V			10	µA
	$I_{S30}Q$	V_{STBY} = 0V		60	120	µA
Output saturation voltage, upper side 1	$V_{OU}1$	I_O = 0.1A		0.2	0.5	V
Output saturation voltage, lower side 1	$V_{OD}1$	I_O = 0.1A		0.2	0.5	V
Output saturation voltage, upper side 2	$V_{OU}2$	I_O = 0.4A		0.4	0.8	V
Output saturation voltage, lower side 2	$V_{OD}2$	I_O = 0.4A		0.4	0.8	V
COM pin common mode input voltage range	V_{IC}		0.3		$V_{CC}2$–0.9	V
Standby pin High level voltage	V_{STBYH}		2		$V_{CC}1$	V
Standby pin Low level voltage	V_{STBYL}		–0.2		+0.7	V
Standby pin input current	I_{STBYH}	V_{STBY} = 3V			50	µA
Standby pin leakage current	I_{STBYL}	V_{STBY} = 0V	–10			µA
FRC pin High level voltage	V_{FRCH}		2		$V_{CC}1$	V
FRC pin Low level voltage	V_{FRCL}		–0.2		+0.7	V
FRC pin input current	I_{FRCI}	V_{FRC} = 3V			50	µA
FRC pin leakage current	I_{FRCL}	V_{FRC} = 0V	–10			µA
Slope pin source current ratio	R_{SOURCE}	$I_{CSLP}1$ source/$I_{CSLP}2$ source	–12		+12	%
Slope pin sink current ratio	R_{SINK}	$I_{CSLP}1$ sink/$I_{CSLP}2$ sink	–12		+12	%
CSLP1 source - sink current ratio	$R_{CSLP}1$	$I_{CSLP}1$ source/$I_{CSLP}1$ sink	–35		+15	%
CSLP2 sink - source current ratio	$R_{CSLP}2$	$I_{CSLP}2$ source/$I_{CSLP}2$ sink	–35		+15	%
Startup frequency	Freq	C_{OSC} = 0.1 µF, OSC frequency *1		11.5		Hz
Phase delay width	Dwidth	*1		30		deg
Thermal shutdown operating temperature	T_{TSD}	*1	150	180	210	˚C
Thermal shutdown hysteresis	ΔT_{TSD}	*1		15		°C
SELCSLP pin High level voltage	$V_{SEL}H$		2		V_{CC}	V
SELCSLP pin Low level voltage	$V_{SEL}L$		–0.2		+0.7	V
SELCSLP input current	$I_{SEL}H$	$V_{SELCSLP}$ = 3V			50	µA
SELCSLP pin leakage current	$I_{SEL}L$	$V_{SELCSLP}$ = 0V	–10			µA
[FG amplifier]						
Input offset voltage	V_{IO}	*1		±1	±5	mV
Input bias current	I_{BIN}–				250	nA
Common mode input voltage range	V_{ICOM}	*1	1		2	V
Open loop gain	G_{VFG}	f = 1 kHz *1		55		dB
Input ON voltage	V_{OL}	I_O = 10 µA			0.4	V
Input OFF voltage	V_{OH}	I_O = 10 µA	$V_{CC}1$–0.5			V
Schmitt amplifier hysteresis width	V_{SHIS}	*1		20		mV
Output duty	Duty	f = 720 Hz, V_{IN} = 20 mVp-p	30		70	%
Reference voltage	V_{REF}		1.15	1.30	1.45	V
[PG amplifier]						
Input offset voltage	V_{IO}	*1		±1	±5	mV
Input bias voltage	I_{BIN}–	*1			250	nA
Common mode input voltage range	V_{ICOM}	*1	1		2	V
Open loop gain	G_{VPG}	f = 1 kHz *1		55		dB
Output ON voltage	V_{OL}	I_O = 10 µA			0.4	V
Output OFF voltage	V_{OH}	I_O = 10 µA	$V_{CC}1$–0.5			V
Schmitt amplifier hysteresis width	V_{SHIS}	*1		50		mV

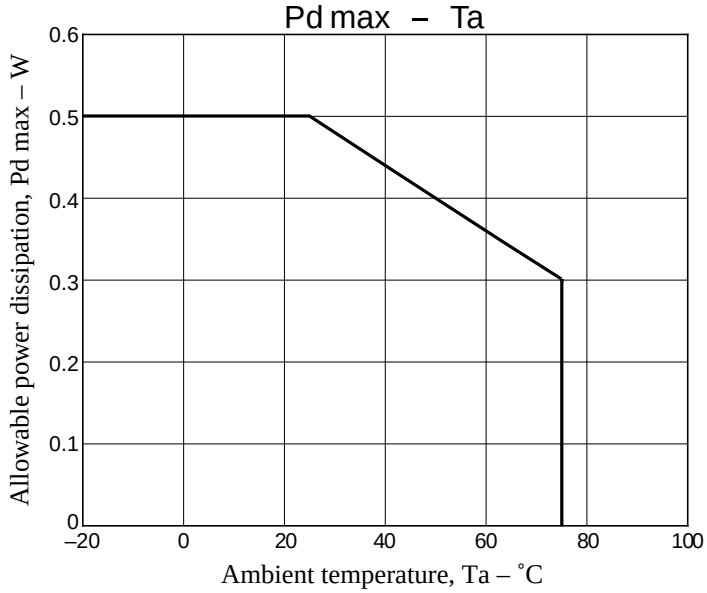
Note: Items shown to be “*1” are not measured.

Pin Assignment

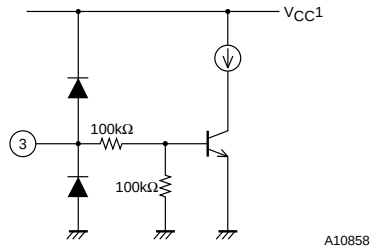
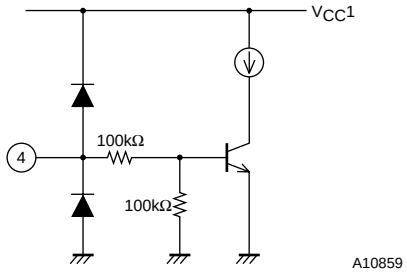
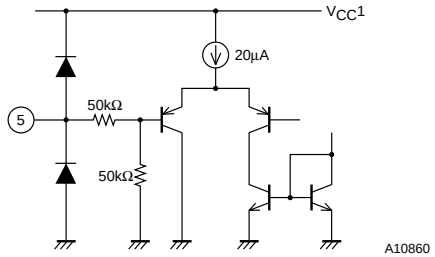
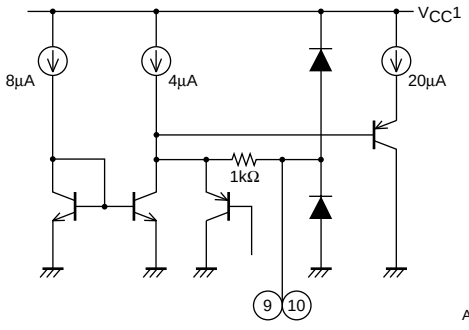


Top view

A10857



Pin Descriptions

Pin number	Pin name	Pin voltage	Equivalent circuit	Pin function
3	STBY	$V_{CC}1$ max –0.2V min		When this pin is at 0.7V or less or when it is open, only the FG/PG amplifier operates. In the motor drive state, the pin should be at 2V or higher.
4	SEL CSLP	$V_{CC}1$ max –0.2V min		CSLP pin charge/discharge current switching pin. Setting this pin to 2V or higher switches the triangular wave slope that determines soft switching.
5	FRC	$V_{CC}1$ max –0.2V min		Motor forward/reverse switching pin. Low: reverse (–0.2V to +0.7V or open) High: forward (2V to $V_{CC}1$)
6	V_S	0V to $V_{CC}2$		Power supply pin for determining output amplitude by supplying motor voltage. Must be lower than $V_{CC}2$ voltage.
7	$V_{CC}2$	2.7V to 10V		Power supply pin for supplying source side predriver voltage and coil waveform detect comparator voltage.
8	$V_{CC}1$	2.7V to 6V		Power supply pin for circuits except motor voltage, source side predriver voltage, and coil waveform detect comparator voltage.
9 10	CLSP1 CLSP2			Pins for connecting triangular wave oscillator capacitor. This triangular wave coil output performs waveform soft switching.

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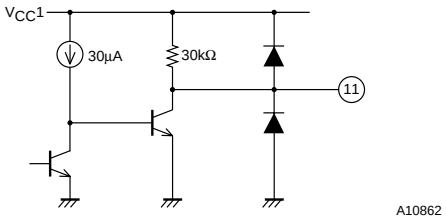
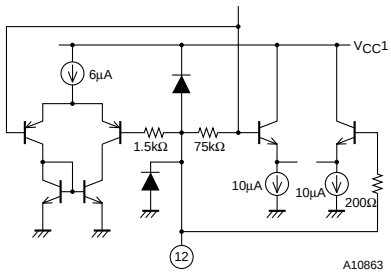
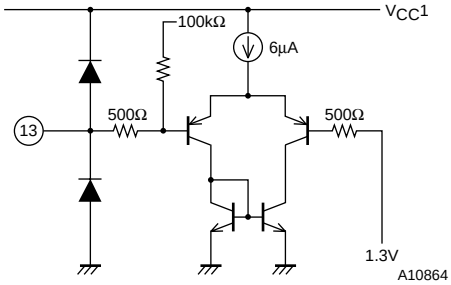
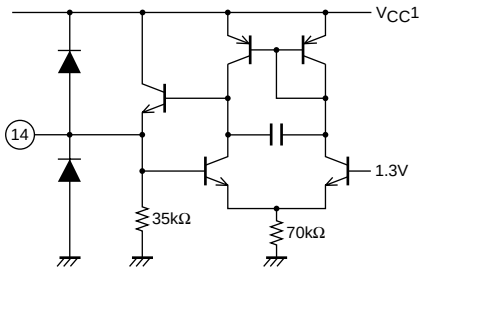
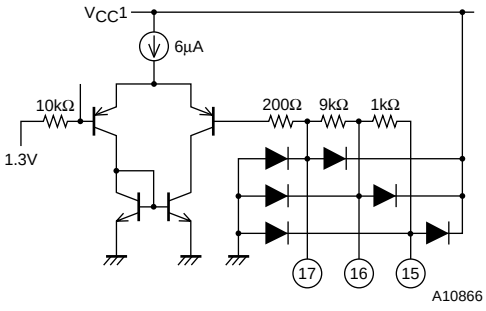
Pin number	Pin name	Pin voltage	Equivalent circuit	Pin function
11	PG_{OUT}			PG amplifier output pin.
12	PGC			PG amplifier peak hold capacitor connection pin.
13	PGIN	2.0V max 1.0V min (V_{CC} = 3V)		PG amplifier input pin. Connect PG coil between this pin and V_{REF}.
14	V_{REF}			Internal 1.3V reference voltage. Used as reference voltage for FG and PG amplifiers.
15	FG_{IN}	2.0V max 1.0V min (V_{CC}1 = 3V)		FG amplifier input pin. Connect FG coil between this pin and V_{REF}.
16	FG_{IN}1			FG amplifier input signal noise filter capacitor connection pin.
17	FG_{IN}2			FG amplifier input signal noise filter capacitor pin.

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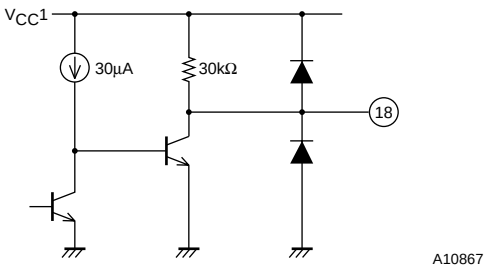
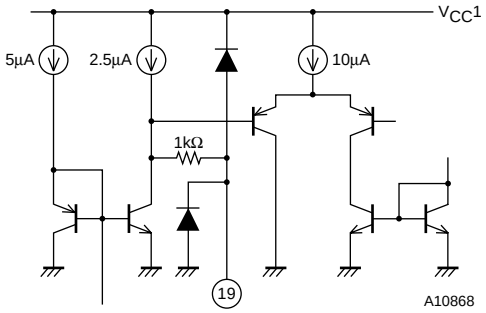
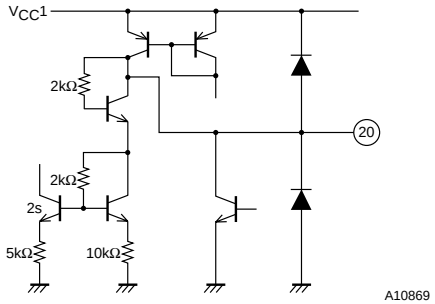
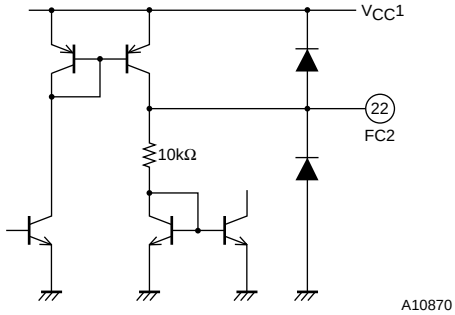
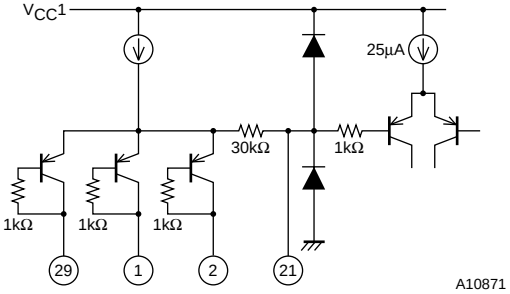
Pin number	Pin name	Pin voltage	Equivalent circuit	Pin function
18	PG_{OUT}			FG amplifier output pin.
19	OSC			Pin for connecting triangular wave oscillator capacitor. Serves for forced startup waveform generation.
20	FC1			Frequency characteristics pin. Connecting a capacitor between this pin and ground serves to prevent closed-loop oscillation in the current control circuitry. (Lower-side output transistor drive current)
22	FC2			Frequency characteristics pin. Connecting a capacitor between this pin and ground serves to prevent closed-loop oscillation in the current control circuitry. (Lower-side output transistor drive current)
21	FILTER			Connecting a capacitor between this pin and ground activates the coil output saturation prevention function. In this condition, the VS pin is controlled for motor voltage control. By adjusting the external capacitor, torque ripple compensation can be varied.

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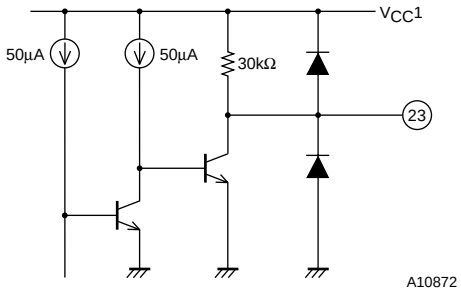
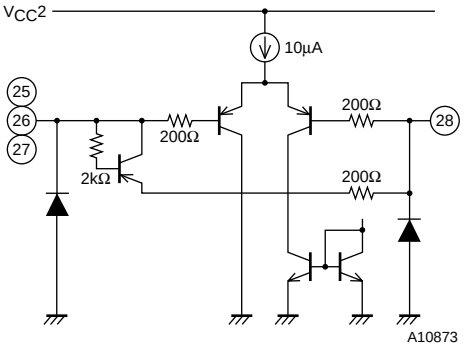
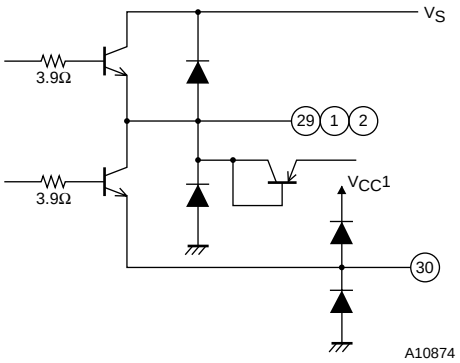
Pin number	Pin name	Pin voltage	Equivalent circuit	Pin function
23	BFG0			Motor counterelectromotive voltage FG pulse pin. Outputs a pulse using W phase counterelectromotive voltage as FG. Connect to ground if not used.
24	GND			Ground for all circuits except output.
25 26 27	W_{IN} U_{IN} V_{IN}			Coil waveform detect comparator input pins.
28	COM			Motor coil midpoint input pin. Using this voltage as a reference, the coil voltage waveform is detected.
29 1 2	W_{OUT} U_{OUT} V_{OUT}			W phase coil output pin. U phase coil output pin. V phase coil output pin.
30	RF			Output transistor ground. Constant current drive is performed by detecting the voltage at this pin.

Block Diagram (Constants for external components depend on motor.)