Ordering number : EN4626A

SANYO Semiconductors
DATA SHEET

LB1882V — Monolithic Digital IC Three-phase Brushless Motor Driver

Overview

LB1882V is a 3-phase brushless motor driver IC that is optimal for driving the spindle motors in portable AV equipment such as DAT, CD and MD products.

Features

- Small external capacitors due to the current linear drive scheme
- Low power enabled by motor voltage control
- Operates on supply voltage down to 1.8V
- Built-in torque ripple correction circuit
- Built-in saturation prevention circuit
- Built-in AGC circuit
- Built-in thermal shutdown circuit
- Built-in current limiter
- Built-in FG amplifier

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{CC}1$ max		8	V
	$V_{CC}2$ max		12	V
	V_S		$V_{CC}1$	V
Maximum 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

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Allowable Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Power supply voltage	$V_{CC}1$		1.8 to 6.0	V
	$V_{CC}2$		3 to 10	V
	V_S		to $V_{CC}1$	V

Electrical Characteristics at Ta = 25°C, $V_{CC}1$ = 2.5V, $V_{CC}2$ = 4.5V, V_S = 1V

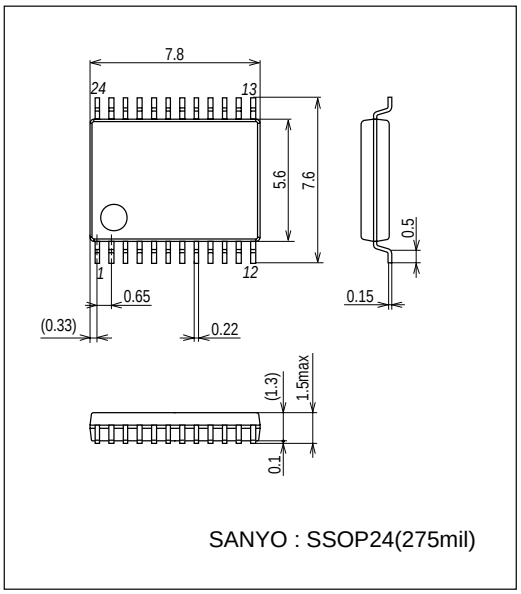
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Current drain	$I_{CC}1$			5	8	mA
	$I_{CC}2$				2	mA
	I_S	I_S -I_L			1	mA
Output quiescent current	I_{CC1OQ}	V_{STBY}=0V			10	µA
	I_{CC2OQ}	V_{STBY}=0V			10	µA
	I_{SOQ}	V_{STBY}=0V			10	µA
Output saturation voltage upper side	V_{OU}(sat)1	V_{RF}=40mV, R_L=100Ω (Y)	25		65	mV
	V_{OU}(sat)2	V_{RF}=100mV, R_L=100Ω (Y)	25		65	mV
Output saturation voltage lower side	V_{OD}(sat)1	V_{RF}=40mV, R_L=100Ω (Y)	200		280	mV
	V_{OD}(sat)2	V_{RF}=100mV, R_L=100Ω (Y)	285		365	mV
Hall amplifier input offset voltage	$V_{Hoffset}$	Design target*	-5		+5	mV
Hall amplifier common-mode input voltage range	V_{HCOM}		1.2		2.5	V
Standby pin high-level voltage	V_{STBYH}		2.0			V
Standby pin low-level voltage	V_{STBYL}				0.4	V
Standby pin input current	I_{LSTBY}	V_{STBY}=4.5V			120	µA
Standby pin leakage current	I_{LSTBY}	V_{STBY}=0V	-30			µA
FRC pin high-level voltage	V_{FRCH}		1.6			V
FRC pin low-level voltage	V_{FRCL}				0.4	V
FRC pin input current	I_{IFRC}	V_{FRC}=4.5V			100	µA
FRC pin leakage current	I_{LFRC}	V_{FRC}=0V	-30			µA
Thermal shutdown circuit operating temperature	T_{TSD}	Design target*	150	180	210	°C
Thermal shutdown hysteresis	ΔT_{TSD}	Design target*		15		°C
FG Amplifier						
Common-mode input voltage range	V_{ICR}		1.2		3.3	V
Input offset voltage	V_{IO}	Design target*	-5		+5	mV
Output saturation voltage	V_{SINK}	R_L=10kΩ			0.2	V
Output current (sink)	I_{SINK}				2	mA

*: Design target value and no measurement was made.

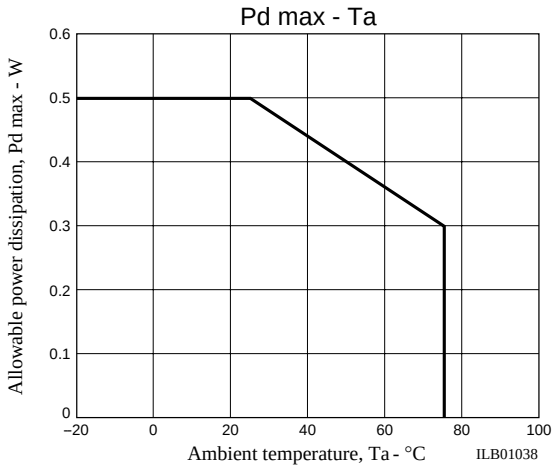
Package Dimensions

unit : mm (typ)

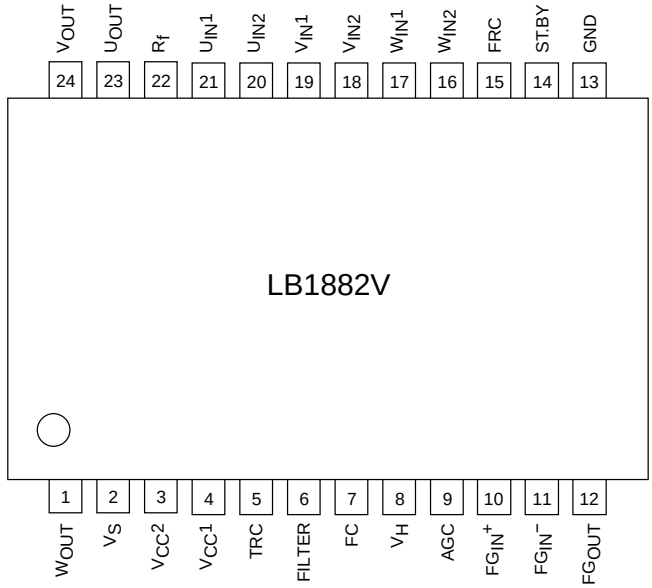
3175C



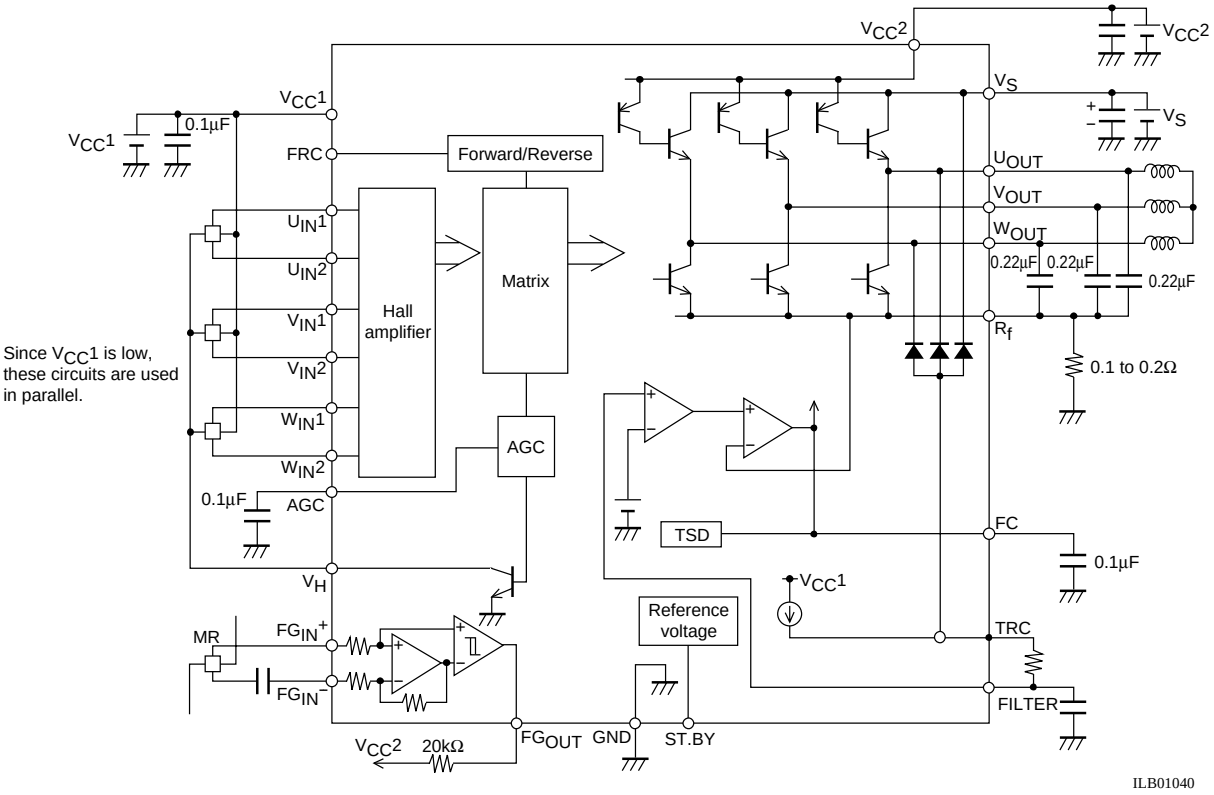
SANYO : SSOP24(275mil)



Pin Assignment



Block Diagram and Sample Application Circuit



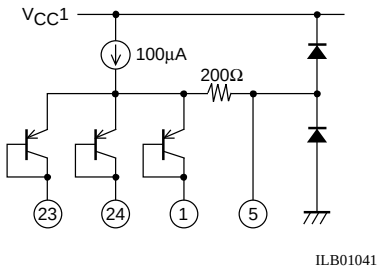
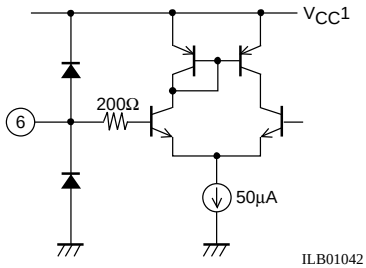
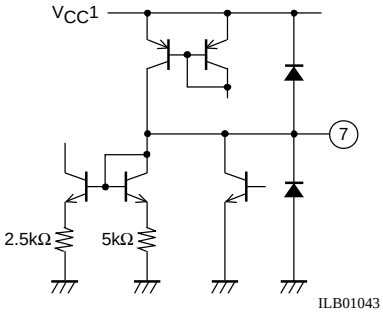
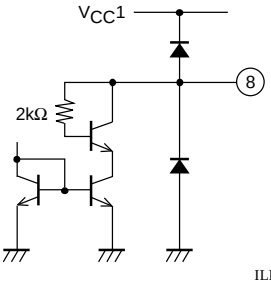
Truth Table

	Source → Sink	Input			Forward/reverse control
		U	V	W	
1	W → V	H	H	L	L
	V → W				H
2	W → U	H	L	L	L
	U → W				H
3	V → W	L	L	H	L
	W → V				H
4	U → V	L	H	L	L
	V → U				H
5	V → U	H	L	H	L
	U → V				H
6	U → W	L	H	H	L
	W → U				H

Inputs: “H” means that the input 1 potential for the corresponding phase is at least 0.2V higher than the input 2 potential.
“L” means that the input 1 potential for the corresponding phase is at least 0.2V lower than the input 2 potential.

Forward/reverse control: “H”: 1.6V to $V_{CC}2$
“L”: 0V to 0.4 V

Pin Functions

Pin No.	Symbol	Pin Voltage	Pin Function	Equivalent Circuit
2	V_S	≤$V_{CC}1$	Power supply that provides the motor voltage and determines the output amplitude. This voltage must be lower than $V_{CC}1$.	
3	$V_{CC}2$	≥$V_{CC}1$ 3V to 10V	Power supply that provides the voltage for the source side pre-drive PNP transistor and the FG amplifier.	
4	$V_{CC}1$	1.8V to 6V	Power supply that provides all voltages other than the motor voltage, the source side pre-drive voltage, and the FG amplifier voltage.	
5	TRC		Coil output waveform lower side envelope waveform detection.	 ILB01041
6	FILTER		The coil output saturation prevention function operates using an RC filter (a resistor between this pin and the TRC pin and a capacitor between this pin and ground) connected at this pin. Motor speed (r.p.m.) control can then be achieved by adjusting the voltage on pin VS. The torque ripple correction amount can be adjusted by adjusting the external RC constant.	 ILB01042
7	FC		Frequency characteristics correction. The capacitor connected between this pin and ground stops closed-loop oscillation in the current control system.	 ILB01043
8	VH		The Hall elements are connected between this pin and $V_{CC}1$. The AGC circuit adjusts the Hall bias current so that the amplitude of the Hall element remains fixed. Since the Hall amplifier common-mode voltage range is reduced when a low voltage is used for $V_{CC}1$, the Hall elements should be connected in parallel.	 ILB01044

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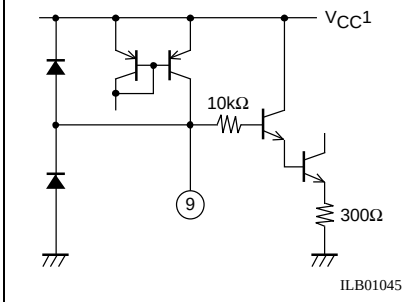
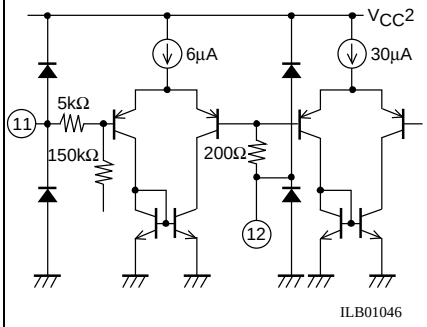
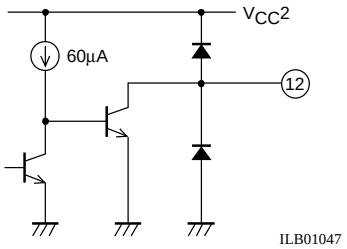
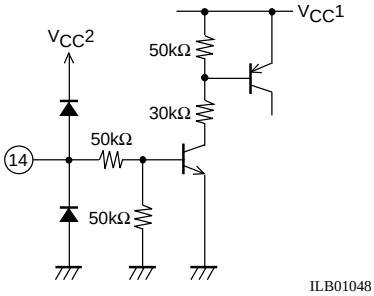
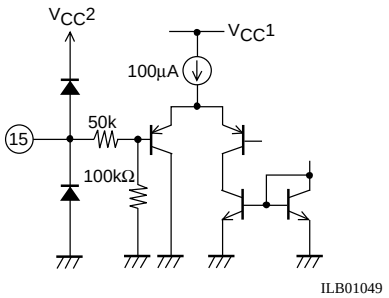
Pin No.	Symbol	Pin Voltage	Pin Function	Equivalent Circuit
9	AGC		A capacitor is inserted between this pin and ground. The AGC circuit controls the Hall bias current so that the coil output slope remains fixed.	
10 11	FG_{IN}^+ FG_{IN}^-	1.2V min 3.3V max	FG amplifier input.	
12	FG_{OUT}	$V_{CC}2$ max	FG amplifier output.	
13	GND		Ground for all circuits other than the output circuits.	
14	ST, BY	$V_{CC}2$ max	All circuits stop when this pin falls below 0.4V or is open. In this state, the circuit current will be 10μA or lower. Set this pin to 2V or higher to operate the LB1882V in the motor drive state.	
15	FRC	$V_{CC}2$ max	Motor forward/reverse switching. Low level: Forward (0 to 0.4V) High level: Reverse (1.6V to $V_{CC}2$)	

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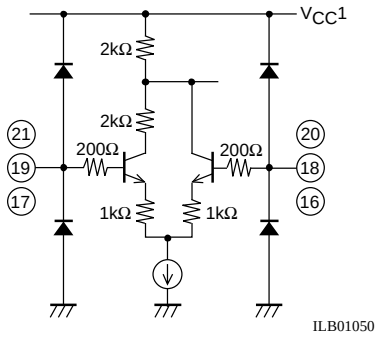
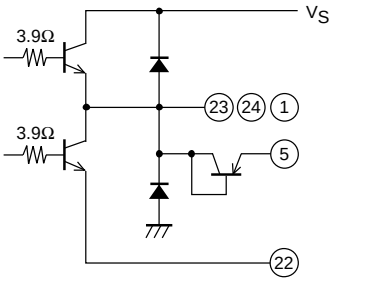
Pin No.	Symbol	Pin Voltage	Pin Function	Equivalent Circuit
16 17 18 19 20 21	$W_{IN}2$ $W_{IN}1$ $V_{IN}2$ $V_{IN}1$ $U_{IN}2$ $U_{IN}1$	1.2V min 2.5V max (Ta=25 °C $V_{CC}1$=2.5V)	W-phase Hall element input. The logic high level is the state where $W_{IN}1 > W_{IN}2$. V-phase Hall device input. The logic high level is the state where $V_{IN}1 > V_{IN}2$. U-phase Hall device input. The logic high level is the state where $U_{IN}1 > U_{IN}1$.	
22 23 24 1	RF U_{OUT} V_{OUT} W_{OUT}		Output transistor ground. Detecting the voltage on this pin is used to implement fixed current drive and the current limiter function. U-phase output V-phase output W-phase output	

Functional Description

The LB1882V implements a current linear drive method, and controls the motor speed with the motor power supply voltage by always preventing coil output saturation and holding the output saturation voltage fixed.

(1) Control system (see page 8)

- The TRC pin outputs a signal consisting of the coil output voltage lower-side envelope plus the diode rising voltage.
- The TRC waveform, after the high-frequency components are reduced by a low-pass filter consisting of an RC circuit connected to the FILTER pin, is input to the FILTER pin. The cutoff frequency is $1/2\pi \cdot RC$.
- The FILTER pin voltage is input to the control amplifier plus side. The control amplifier minus side is connected to the reference voltage and the control amplifier operates to hold the FILTER pin at the same potential as this reference voltage. As long as this reference voltage exceeds the output transistor saturation voltage, the coil output will operate in the unsaturated state.
- The output current (the RF current) operates as a fixed current drive since the RF voltage is held at a fixed level by the second stage of the control amplifier.

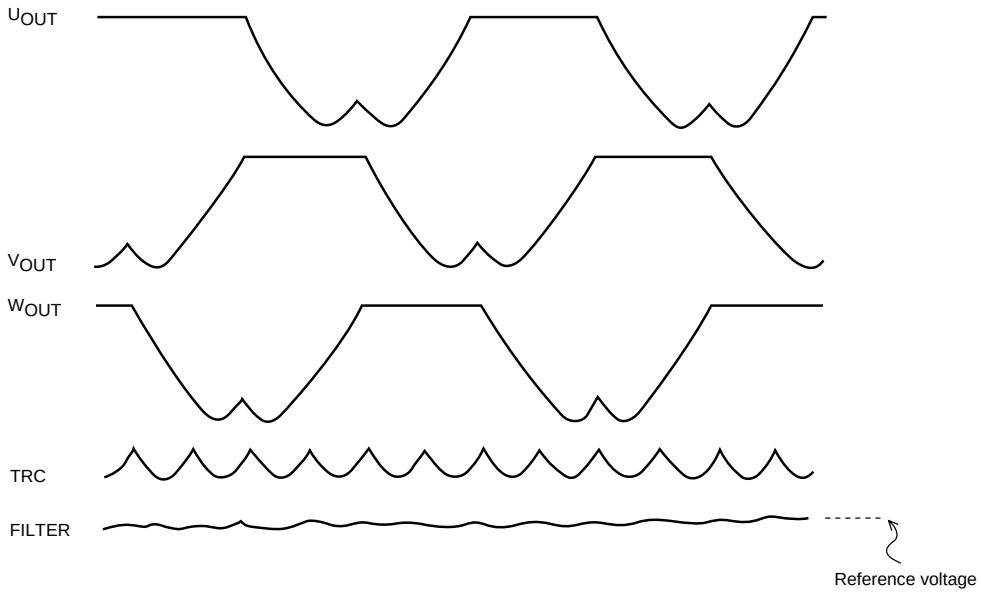
Note: The low-frequency components that are not removed by the TRC pin RC filter function as motor torque ripple correction signals.

(2) Drive system (See page 8.)

- The Hall element output is wave shaped by the first stage of the Hall amplifier.
- The Hall amplifier output waveform is synthesized by the matrix amplifier, which creates a waveform phase delayed by 30°.
- This waveform is voltage-to-current converted and is then further current amplified and output as the coil current by the power amplifier. Since the upper and lower transistor drive ratios differ here (the upper transistor drive ratio is larger), the upper side voltage waveform is saturated, and the lower-side voltage waveform is unsaturated.

Note: The AGC circuit controls the Hall bias current so that the matrix amplifier output waveform has a fixed amplitude.

Control System Signal Flow



Drive System Signal Flow