Ordering number : EN4626

Monolithic Digital IC

No. 4626

LB1882V

Three-Phase Brushless Motor Driver

Overview

The LB1882V is a three-phase brushless motor driver IC that is particularly well-suited for driving spindle motors in portable AV equipment such as DAT, CD and MD products.

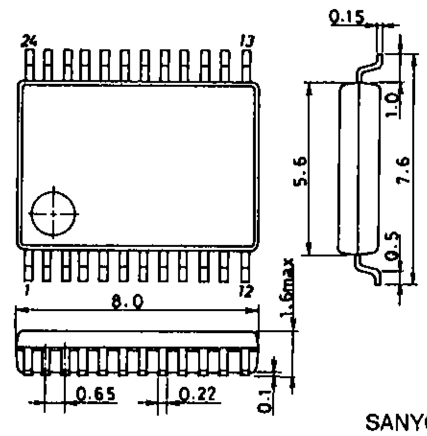
Features

- Current linear drive: allows external capacitances to be minimized.
- Motor voltage control: reduces power dissipation.
- Support for motor drive at power supply voltages as low as 1.8 V
- 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

Package Dimensions

unit: mm

3175A-SSOP24



SANYO: SSOP24

Specifications

Absolute Maximum Ratings at Ta = 25°C

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

Operating Conditions at Ta = 25°C

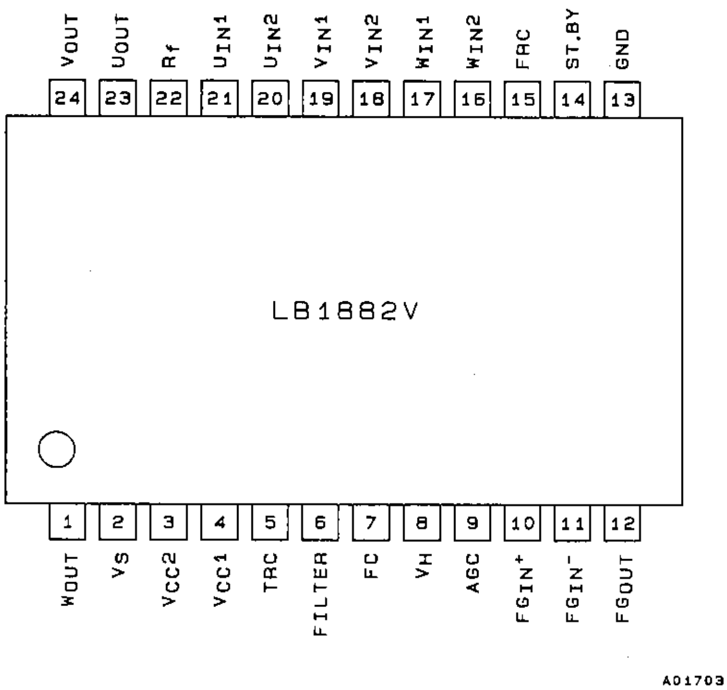
Parameter	Symbol	Ratings	Unit
Supply voltage	$V_{CC}1$	1.8 to 6.0	V
	$V_{CC}2$	3 to 10	V
	V_S	Up to $V_{CC}1$	V

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

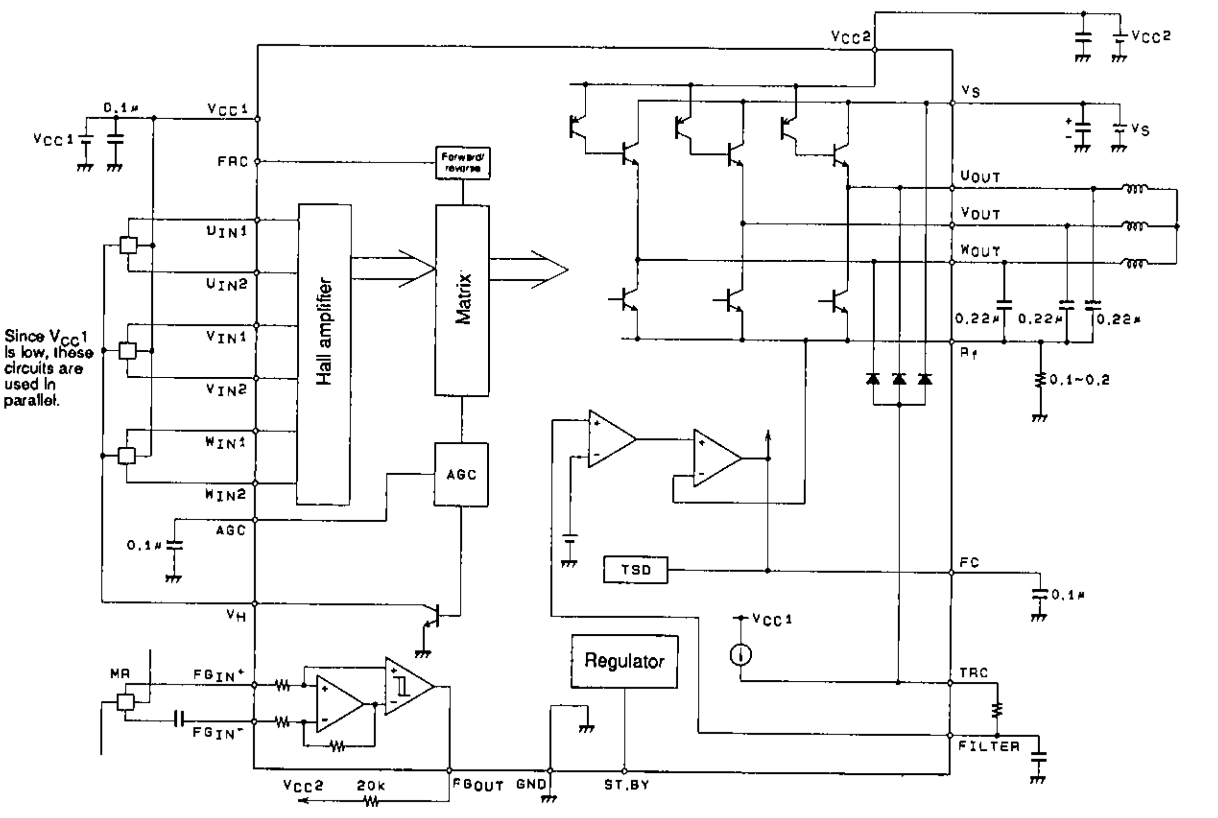
Parameter	Symbol	Conditions	min	typ	max	Unit	Note
Current drain	$I_{CC}1$			5	8	mA	
	$I_{CC}2$				2	mA	
	I_S	$I_S - I_L$			1	mA	
Output quiescent current	$I_{CC\,1OQ}$	V_{STBY} = 0 V			10	µA	
	$I_{CC\,2OQ}$	V_{STBY} = 0 V			10	µA	
	I_{SOQ}	V_{STBY} = 0 V			10	µA	
Output saturation voltage upper side	$V_{OU\,(sat)}1$	V_{RF} = 40 mV, R_L = 100 Ω (Y)	25		65	mV	
	$V_{OU\,(sat)}2$	V_{RF} = 100 mV, R_L = 100 Ω (Y)	25		65	mV	
Output residual voltage lower side	$V_{OD\,(sat)}1$	V_{RF} = 40 mV, R_L = 100 Ω (Y)	200		280	mV	
	$V_{OD\,(sat)}2$	V_{RF} = 100 mV, R_L = 100 Ω (Y)	285		365	mV	
Hall amplifier input offset voltage	$V_{Hoffset}$		–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} = 4.5 V			120	µA	
Standby pin leakage current	I_{LSTBY}	V_{STBY} = 0 V	–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} = 4.5 V			100	µA	
FRC pin leakage current	I_{LFRC}	V_{FRC} = 0 V	–30			µA	
Thermal shutdown operating temperature	T_{TSD}		150	180	210	°C	*
Thermal shutdown hysteresis	ΔT_{TSD}			15		°C	*
[FG Amplifier]							
Common-mode input voltage range	V_{ICR}		1.2		3.3	V	
Input offset voltage	V_{IO}		–5		+5	mV	*
Output saturation voltage	V_{SINK}	R_L = 10 kΩ			0.2	V	
Output current (sink)	I_{SINK}				2	mV	

Note: * Items marked with an asterisk are design target values and are not tested.

Pin Assignment (top view)



Block Diagram and Sample Application Circuit



Unit (resistance: Ω, capacitance: F)

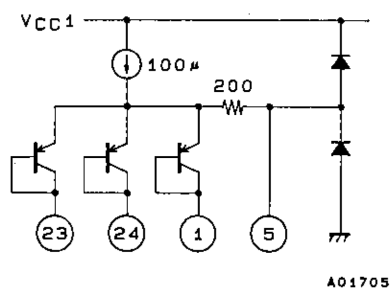
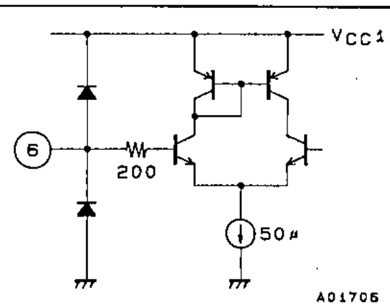
Truth Table

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

Inputs: "H" means that the input 1 potential for the corresponding phase is at least 0.2 V higher than the input 2 potential.
"L" means that the input 1 potential for the corresponding phase is at least 0.2 V lower than the input 2 potential.
Forward/reverse control: "H": 1.6 V to $V_{CC}2$
"L": 0 V to 0.4 V

Pin Functions

Unit (resistance: Ω, current: A)

Pin No.	Symbol	Pin voltage	Equivalent circuit	Pin function
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	$V_{CC}2$	≥ $V_{CC}1$ 3 V to 10 V		Power supply that provides the voltage for the source side pre-drive PNP transistor and the FG amplifier
4	$V_{CC}1$	1.8 V to 6 V		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 saturation waveform detection
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 V_S. The torque ripple correction amount can be adjusted by adjusting this RC constant.

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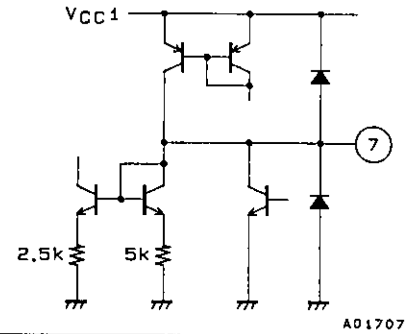
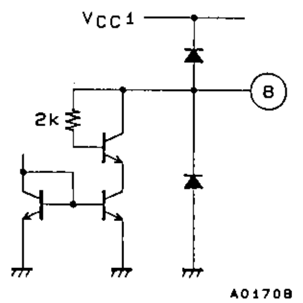
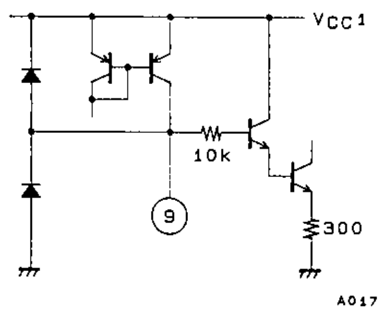
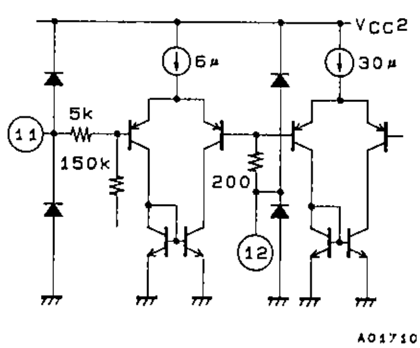
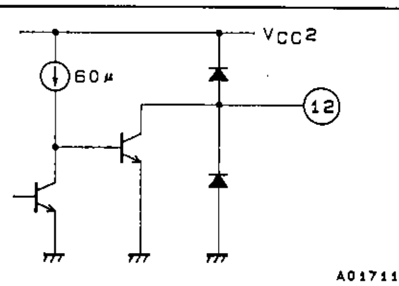
Unit (resistance: Ω, current: A)

Pin No.	Symbol	Pin voltage	Equivalent circuit	Pin function
7	FC			Frequency characteristics correction The capacitor connected between this pin and ground stops closed-loop oscillation in the current control system.
8	V_H			The Hall elements are connected between this pin and $V_{CC}1$. The AGC circuit adjusts the Hall bias current so that the coil output slope 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.
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}^-	1.2 V min 3.3 V max		FG amplifier input
12	FG_{OUT}	$V_{CC}2$ max		FG amplifier output

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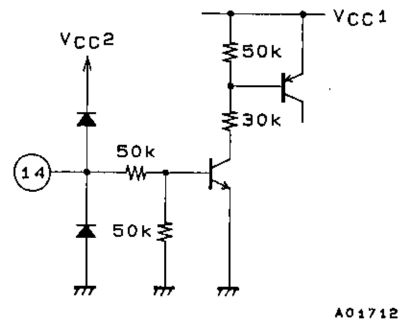
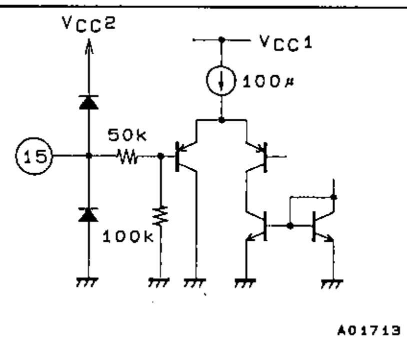
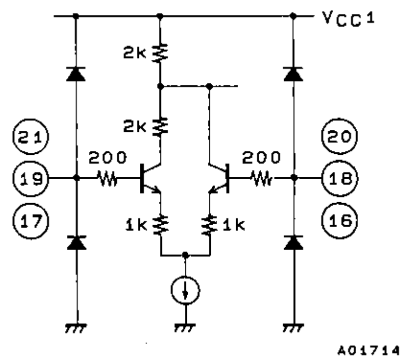
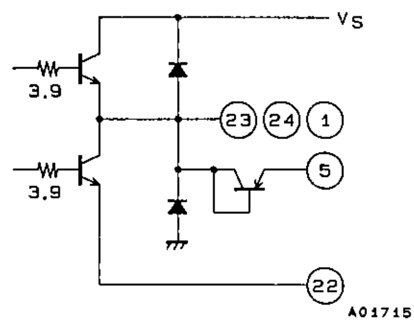
Unit (resistance: Ω, current: A)

Pin No.	Symbol	Pin voltage	Equivalent circuit	Pin function
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 0.4 V or is open. In this state, the circuit current will be 10 µA or lower. Set this pin to 2 V 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 0.4 V) High level: Reverse (1.6 V to $V_{CC}2$)
16 17 18 19 20 21	$W_{IN}2$ $W_{IN}1$ $V_{IN}2$ $V_{IN}1$ $U_{IN}2$ $U_{IN}1$	1.2 V min 2.5 V max ($V_{CC}1$ is 2.5 V when Ta is 25°C.)		W-phase Hall device 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

LB1882V Operating Principles

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 1/2π·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 lower-side 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