



SANYO Semiconductors

DATA SHEET

LB11980H

Monolithic Digital IC
— For VCR Capstan
Three-Phase Brushless Motor Driver

Overview

LB11980H is a 3-phase brushless motor driver optimal for driving the VCR capstan motors.

Features

- 3-Phase full-wave current-linear drive system.
- Torque ripple correction circuit built-in.(correction factor variable)
- Current limiter circuit built in.
- Output stage upper/lower over-saturation prevention circuit built in. (No external capacitor required)
- FG amplifier built in.
- Thermal shutdown circuit built in.

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V _{CC} max		7	V
	V _S max		25	V
Maximum output current	I _O max		1.3	A
Allowable power dissipation	Pd max	Mounted on a specified board *	1.81	W
		Independent IC	0.77	W
Operating temperature	T _{opr}		-20 to +75	°C
Storage temperature	T _{stg}		-55 to +150	°C

* Mounted on a specified board: 114mm×71.1mm×1.6mm, glass epoxy board

Allowable Operating Range at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V _S		5 to 24	V
	V _{CC}		4.5 to 5.5	V
Hall input amplitude	V _{HALL}	Between hall inputs	±30 to ±80	mVo-p
GSENSE input range	V _{GSENSE}	With respect to the control system ground	-0.20 to +0.20	V

■ Any and all SANYO Semiconductor products described or contained herein do not have specifications that can handle applications that require extremely high levels of reliability, such as life-support systems, aircraft's control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your SANYO Semiconductor representative nearest you before using any SANYO Semiconductor products described or contained herein in such applications.

■ SANYO Semiconductor 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 products described or contained herein.

SANYO Semiconductor Co., Ltd.

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

LB11980H

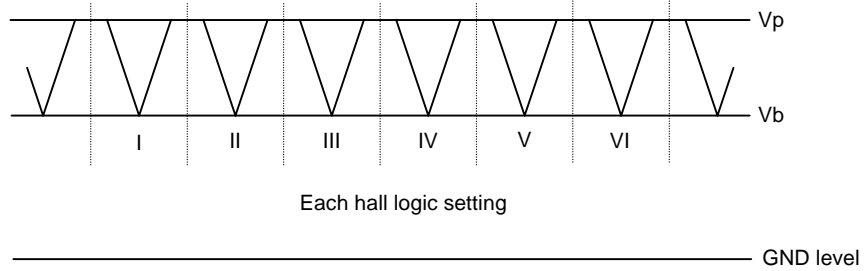
Electrical Characteristics at $T_a = 25^\circ\text{C}$, $V_{CC} = 5\text{V}$, $V_S = 15\text{V}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
V_{CC} supply current	I_{CC}	$R_L = \infty$, $V_{CTL} = 0$, $V_{LIM} = 0\text{V}$ (Quiescent)		12	18	mA
Output						
Output saturation voltage	V_{Osat1}	$I_O = 500\text{mA}$, $R_f = 0.5\Omega$, sink+source $V_{CTL} = V_{LIM} = 5\text{V}$ (With saturation prevention)		2.1	2.6	V
	V_{Osat2}	$I_O = 1.0\text{A}$, $R_f = 0.5\Omega$, sink+source $V_{CTL} = V_{LIM} = 5\text{V}$ (With saturation prevention)		2.6	3.5	V
Output leakage current	I_{Oleak}				1.0	mA
FR						
FR pin input threshold voltage	VFSR		1.0	1.25	2	V
FR pin input input bias current	I_b (FSR)	$V_{FR} = 3\text{V}$	100	150	200	μA
Control						
CTL pin input Input bias current	I_b (CTL)	$V_{CTL} = 5\text{V}$		1.5	3	μA
CTL pin input motor current	I_{mctl}	$V_{CTL} = 0\text{V}$			5	mA
CTL pin control start voltage	V_{CTL} (ST)	$R_f = 0.5\Omega$, $V_{LIM} = 5\text{V}$, $I_O \geq 10\text{mA}$ Hall input logic fixed (U, V, W = H, H, L)	2.25	2.50	2.75	V
CTL pin control Gm	Gm (CTL)	$R_f = 0.5\Omega$, $\Delta I_O = 200\text{mA}$ Hall input logic fixed (U, V, W = H, H, L)	0.86	1.06	1.26	A/V
Current limit						
LIM pin input current	I_{lim}	$V_{LIM} = 3\text{V}$		1.5	3	μA
LIM pin motor current	I_{limim}	$V_{LIM} = 0\text{V}$			5	mA
LIM current limit offset voltage	V_{off} (LIM)	$R_f = 0.5\Omega$, $V_{CTL} = 5\text{V}$, $I_O \geq 10\text{mA}$ Hall input logic fixed (U, V, W = H, H, L)	1.0	1.25	1.5	V
LIM pin control Gm	Gm (lim)	$R_f = 0.5\Omega$, $V_{CTL} = 5\text{V}$ Hall input logic fixed (U, V, W = H, H, L)	0.59	0.71	0.83	A/V
Hall amplifier						
Hall amplifier input offset voltage	V_{OFF} (HALL)		-6		+6	mV
Hall amplifier input bias current	I_b (HALL)			1.0	3.0	μA
Hall amplifier common-mode input voltage	V_{CM} (HALL)		1.3		3.3	V
TRC						
Torque ripple correction ratio	TRC	For the high and low peaks in the R_f waveform when $I_O = 200\text{mA}$ ($R_f = 0.5\Omega$, ADJ-OPEN) Note.2		13		%
ADJ pin voltage	VADJ		2.37	2.50	2.63	V
FG Amplifier						
FG amplifier input offset voltage	V_{OFF} (FG)		-8		+8	mV
FG amplifier input bias current	I_b (FG)		-100			nA
FG amplifier output saturation voltage	V_{Osat} (FG)	Sink side; With internal pull-up resistance load		0.5	0.6	V
FG amplifier voltage gain	VG (FG)	For open loop at $f = 10\text{kHz}$	41.5	44.5	47.5	dB
FG amplifier common-mode input voltage	V_{CM} (FG)		0.5		4.0	V
Schmitt amplifier						
Duty ratio	DUTY	Under specified conditions ($R_F = 39\text{k}\Omega$) Note 3	49.0	50	51.0	%
Upper side output saturation voltage	V_{satu} (SH)	$I_O = -20\mu\text{A}$	4.8			V
Lower side output saturation voltage	V_{satd} (SH)	$I_O = 100\mu\text{A}$			0.2	V
Hysteresis width	V_{hys}		32	46	60	mV
FGS output pin pull-up resistance	R_{FGout}			4.7		$\text{k}\Omega$
Saturation						
Saturation prevention circuit lower set voltage	$V_{O sat}$ (DET)	Voltage between each OUT and R_f with $I_O = 10\text{mA}$, $R_f = 0.5\Omega$, $V_{CTL} = V_{LIM} = 5\text{V}$	0.175	0.25	0.325	V
TSD						
TSD operating temperature	T-TSD	(Design target) Note.1		180		$^\circ\text{C}$

Note 1. No measurements are made on the parameters with Note (Design target).

LB11980H

Note 2. The torque ripple compensation ratio is determined as follows from the Rf voltage waveform.



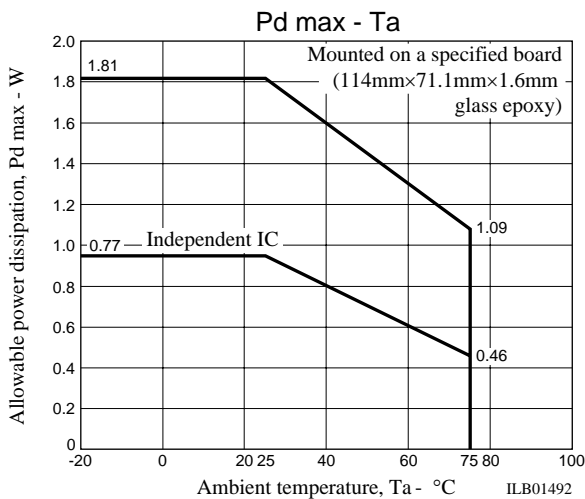
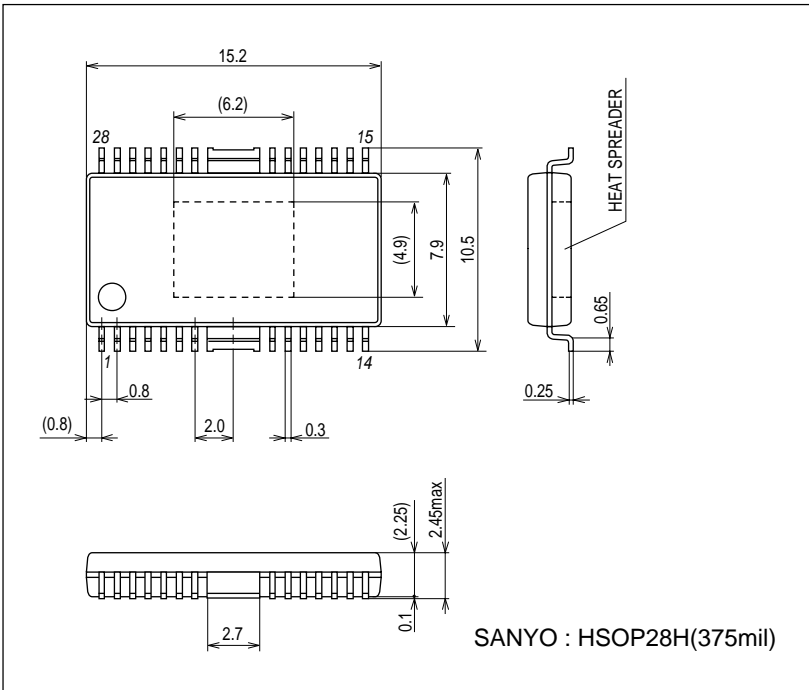
$$\text{Correnction ratio} = \frac{2 * (Vp - Vb)}{Vp + Vb} \cdot 100 * (\%)$$

Note 3. Apply the sine wave of 1kHz, 20mVP-P under conditions with a sample circuit installed externally as shown above.

Package Dimensions

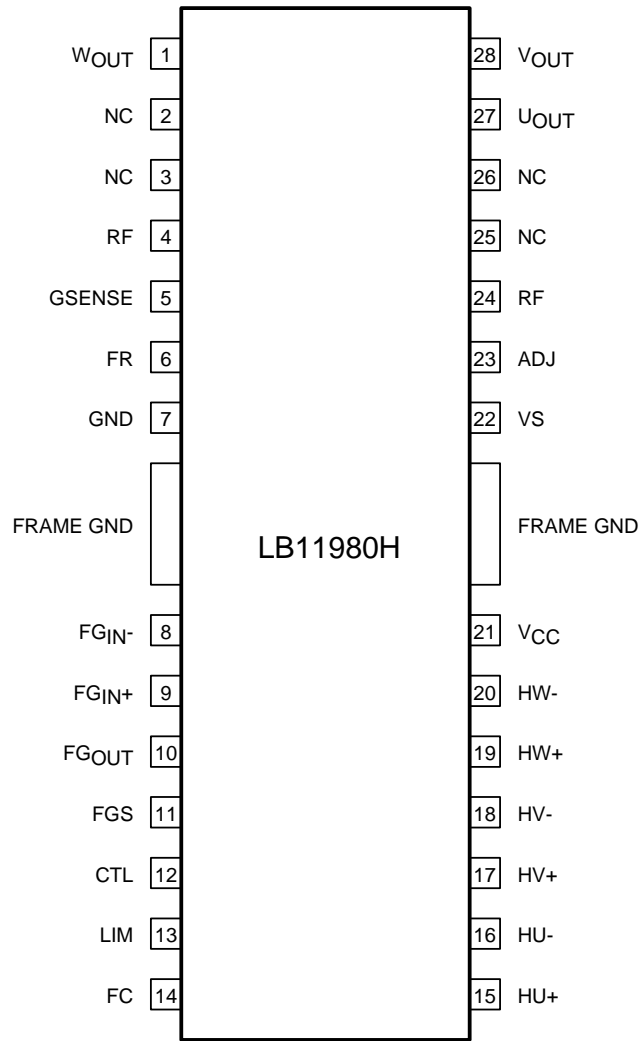
unit : mm (typ)

3233B



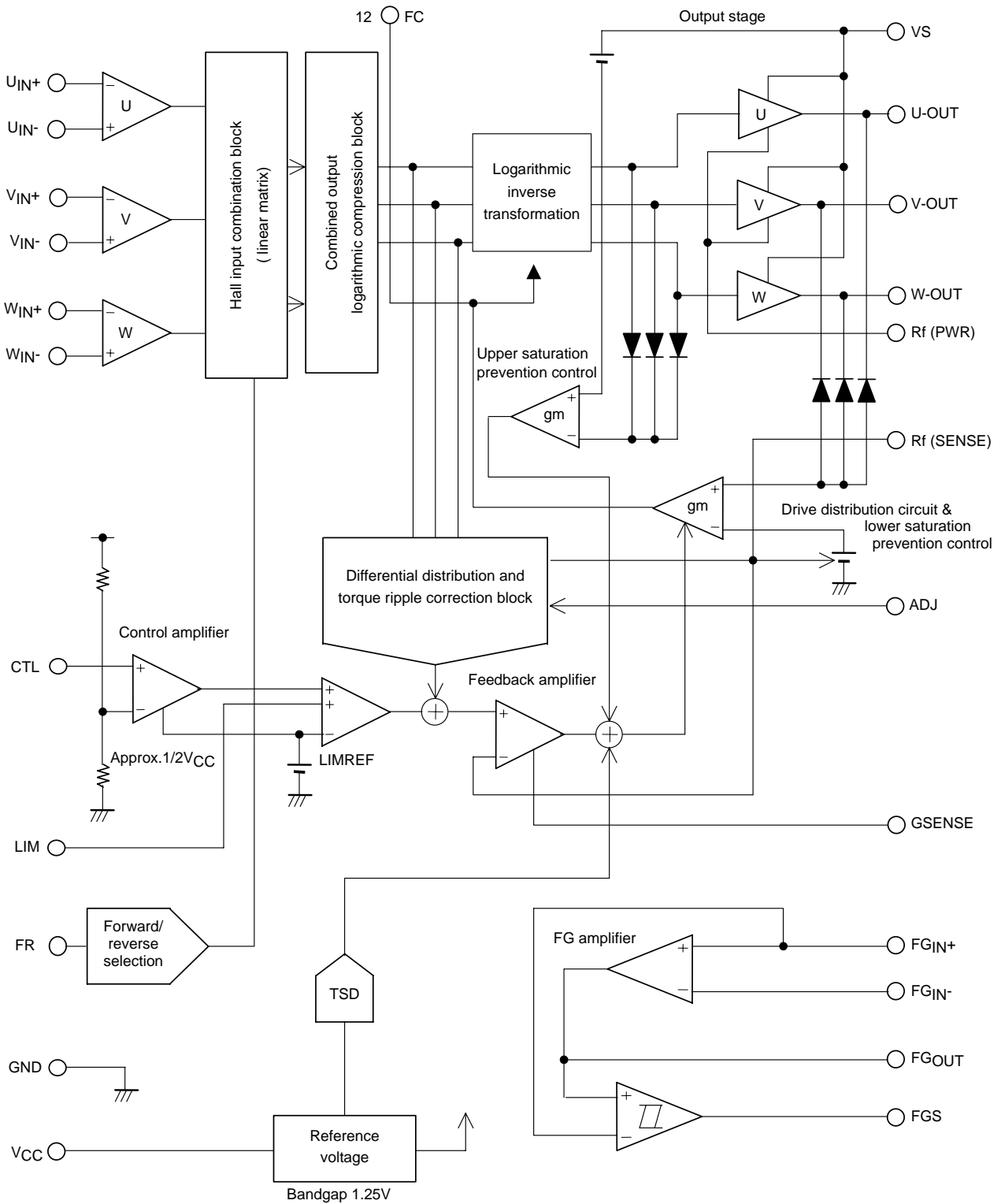
LB11980H

Pin Assignment



Top view

Block Diagram



Truth Table and Control Function

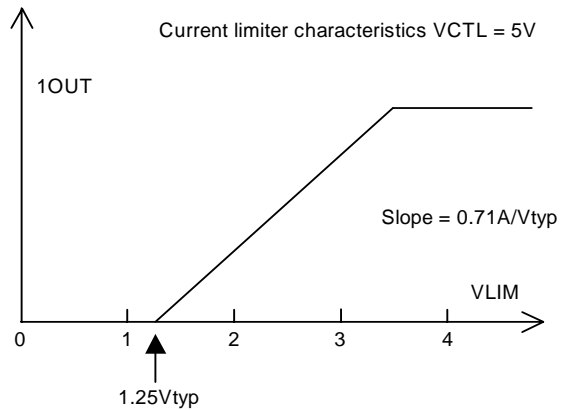
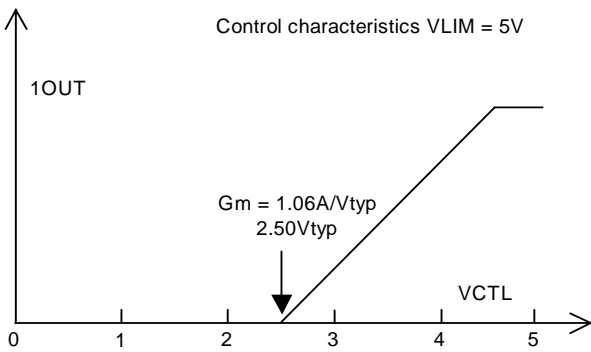
	Source → Sink	Hall input			FR
		U	V	W	
1	V → W	H	H	L	H
	W → V				L
2	U → W	H	L	L	H
	W → U				L
3	U → V	H	L	H	H
	V → U				L
4	W → V	L	L	H	H
	V → W				L
5	W → U	L	H	H	H
	U → W				L
6	V → U	L	H	L	H
	U → V				L

Note: “H” in the FR column represents a voltage of 2.75V or more. “L” represents a voltage of 2.25V or less.
(At $V_{CC} = 5V$)

Note: “H” under the Hall Input columns represents a state in which “+” has a potential which is higher by 0.01V or more than that of the “-” phase inputs. Conversely “L” represents a state in which “+” has a potential which is lower by 0.01V or more than that of the “-” phase inputs.

Note: Since a 180° energized system is used as a drive system, other phases than the sink and source are not OFF.

[Control Function & Current Limiter Function]



LB11980H

Pin Functions

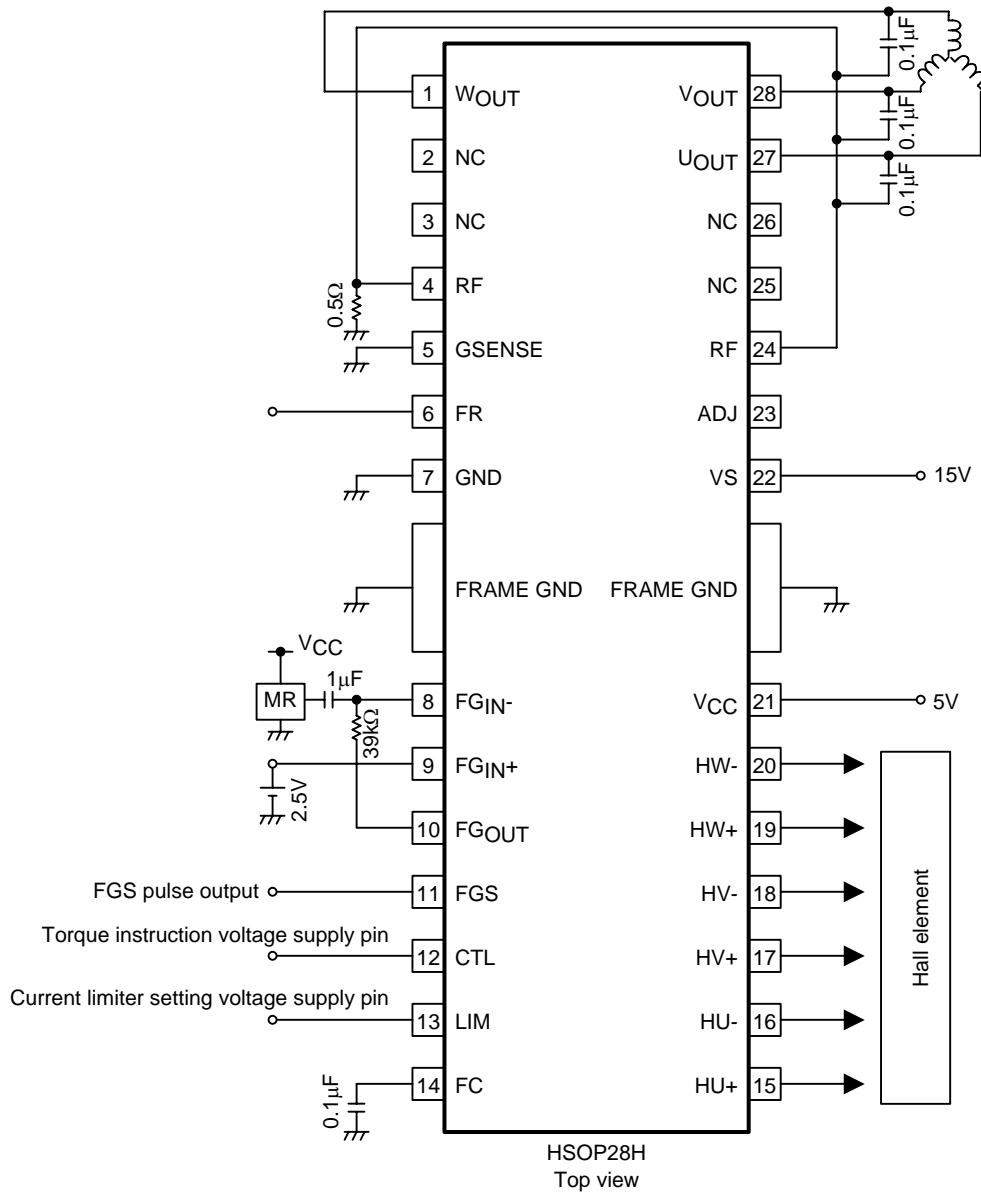
Pin name	Pin no	Functions
FR	6	Forward/reverse select pin. This pin voltage determines forward/reverse. ($V_{th} = 1.25V$ TYP at $V_{CC} = 5V$)
GND	7	GND for others than the output transistor. Minimum potential of output transistor is at Rf pin.
FG _{IN} (-)	8	Input pin for the FG amplifier to be used with inverted input. A feedback resistor is connected between this pin and FG OUT.
FG _{IN} (+)	9	Non-inverted input pin for the FG amplifier to be used as differential input. No bias is applied internally.
FG-OUT	10	FG amplifier output pin. Resistive load provided internally.
CTL	12	Speed control pin. Control is performed by means of constant current drive which is applied by current feedback from Rf. $G_m = 1.06A/VTYP$ at $R_f = 0.5\Omega$
LIM	13	Current limiter function control pin. This pin voltage is capable of varying the output current linearly. Slope = $0.71A/VTYP$ at $R_f = 0.5\Omega$
FC	14	Speed control loop's frequency characteristics correction pin.
U _{IN+} , U _{IN-} V _{IN+} , V _{IN-} W _{IN+} , W _{IN-}	15, 16 17, 18 19, 20	U-phase Hall device input pin; logic "H" presents IN+>IN- V-phase Hall device input pin; logic "H" presents IN+>IN- W-phase Hall device input pin; logic "H" presents IN+>IN-
V _{CC}	21	Power supply pin for supplying power to all circuits except output section in IC; this voltage must be stabilized so as to eliminate ripple and noise.
VS	22	Power supply pin for supplying power to output section in IC.
ADJ	23	Pin to be used to adjust the torque ripple correction factor externally. When adjusting the correction factor, apply voltage externally to the ADJ pin through a low impedance. Increasing the applied voltage decreases the correction factor; lowering the applied voltage increases the correction factor. The rate of change, when left open, ranges approximately from 0 to 2 times. (Approximately $V_{CC}/2$ is set internally and the input impedance is approximately $5k\Omega$.)
Rf (PWR) Rf (SNS)	24 4	Output current detection pins. Current feedback is provided to the control blocks by connecting Rf between the pins and GND. The operation of the lower over-saturation prevention circuit and torque ripple correction circuit depends on the pin voltage. In particular, since the oversaturation prevention level is set by the pin voltage, decreasing the Rf value externally may cause the lower over-saturation prevention to work less efficiently in the large current region. The PWR pin and SENSE pin must be connected.
FGS	11	FG Schmidt amp output pin, that is pulled up with $4.7k\Omega$.
U _{OUT} V _{OUT} W _{OUT}	27 28 1	U-phase output pin. V-phase output pin. W-phase output pin. } (Built-in spark killer diode)
GSENSE	5	GND sensing pin. By connecting this pin to GND in the vicinity of the Rf resistor side of the Rf included motor GND wiring, the influence that the GND common impedance exerts on Rf can be excluded. (Must not be left open.)

LB11980H

Continued from preceding page.

Pin No.	Pin name	Input/output equivalent circuit
8 9	FG _{IN} (-) FG _{IN} (+)	
10 14	FG _{OUT} FC	
11	FGS	

Sample Application Circuit



Note) The constant shown in this example is only for reference and does not guarantee the characteristics.
Connect a capacitor between power supply and GND and between Hall inputs as required.

- Specifications of any and all SANYO Semiconductor products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.
- SANYO Semiconductor Co., Ltd. strives to supply high-quality high-reliability products. However, any and all semiconductor products fail with some probability. It is possible that these probabilistic failures could give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or 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 products (including technical data, services) described or contained herein are controlled under any of applicable local export control laws and regulations, such products must not be exported without obtaining 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 permission 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 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. SANYO Semiconductor believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.

This catalog provides information as of December, 2006. Specifications and information herein are subject to change without notice.