Ordering number :ENN6209B

Monolithic Digital IC

LB11985H

VCR Capstan Motor Brushless Motor Driver

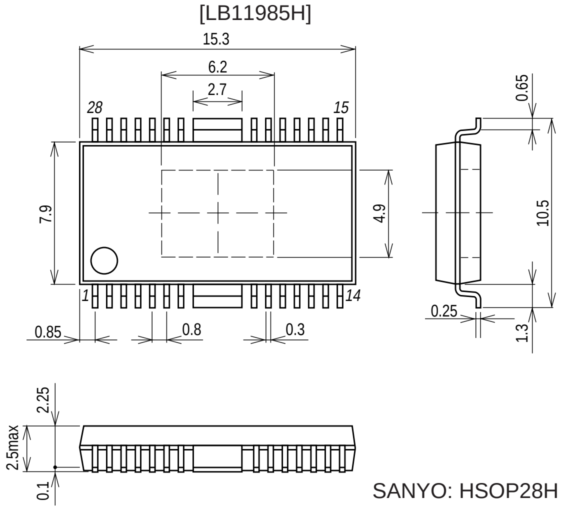
Functions

- Three-phase current linear drive with switching between full-wave and half-wave operations
- Torque ripple correction circuit
- Current limiter circuit
- Upper and lower sides output stage saturation prevention circuits
- Short brake circuit
- FG amplifier
- Thermal shutdown circuit

Package Dimensions

unit: mm

3233-HSOP28H



SANYO: HSOP28H

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC}max		6	V
	$V_S$max		15.5	V
Maximum output current	$I_O$max		1.5	A
Maximum output voltage	$V_O$max		30	V
Allowable power dissipation	Pdmax	Independent IC	0.8	W
		76.1 × 114.3 × 1.6 mm^3: With glass epoxy	2.0	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
Supply voltage	V_S		8 to 15	V
	V_{CC}		4.5 to 5.5	
Hall input amplitude	V_{HALL}	Between Hall inputs	±20 to ±100	mV 0-P
GSENSE input range	V_{GSENSE}	With respect to the control system ground	–0.20 to +0.20	V

Note : Forward/reverse switching is not possible in half-wave operation mode.

■ Any and all SANYO 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 representative nearest you before using any SANYO products described or contained herein in such applications.

■ SANYO 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 products described or contained herein.

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

Electrical Characteristics at Ta = 25°C, V_{CC} = 5 V, V_S = 15 V

Parameter	Symbol	Conditions	Ratings min	Ratings typ	Ratings max	Unit
V_{CC} current drain	I_{CC}	RL = ∞, VCTL = 0 V (quiescent mode)		10	15	mA
[Output]						
Output saturation voltage	$V_{Osat}1$	I_O = 500 mA, Rf = 0.5 Ω, Sink + Source VCTL = VLIM = 5 V (with saturation prevention)		2.2	2.7	V
	$V_{Osat}2$	I_O = 1.0 A, Rf = 0.5 Ω, Sink + Source VCTL = VLIM = 5 V (with saturation prevention)		2.8	3.7	V
Output leakage current	I_{Oleak}				1.0	mA
[FR]						
FR pin input Threshold voltage	V_{FR}		1		4	V
FR pin input Input bias current	Ib (FR)	VFR = 5 V		100	150	µA
[BR]						
BR pin input Threshold voltage	V_{BRTH}		1		4	V
BR pin input Input bias current	Ib (BR)	VBR = 5 V		100	150	µA
[Control]						
CTLREF pin voltage	V_{CREF}		2.0	2.15	2.3	V
CTLREF pin input range	V_{CREF} IN		1		4	V
CTL pin input bias current	Ib (CTL)	VCTL = 5 V, with CTLREF open			5	µA
CTL pin control start voltage	V_{CTL} (ST)	Rf = 0.5 Ω, VLIM = 5 V, Io ≥ 40 mA With the Hall input logic states fixed (U, V, W = high, high, low)	2.0	2.2	2.4	V
CTL pin control Gm	G_m (CTL)	Rf = 0.5 Ω, ΔIo = 200 mA With the Hall input logic states fixed (U, V, W = high, high, low)	1.8	2.25	2.7	V
[Current Limiter]						
LIM current limit offset voltage	V_{off} (LIM)	Rf = 0.5 Ω, VCTL = 5 V, Io ≥ 40 mA With the Hall input logic states fixed (U, V, W = high, high, low)	80	200	320	mV
LIM pin input bias current	Ib (LIM)	VCTL = 5 V,VREF: OPEN, VLIM = 0 V	–2	–1		µA
LIM pin current limit level	Gm (LIM)	Rf = 0.5 Ω, VCTL = 5 V With the Hall input logic states fixed (U, V, W = high, high, low)	0.37	0.47	0.57	mA
[Hall Amplifier]						
Input offset voltage	V_{off} (HALL)		–6		+6	mV
Input bias current	I_b (HALL)			1.0	3.0	µA
Common-mode input voltage	V_{cm} (HALL)		1.3		3.3	V
Torque ripple correction ratio	TRC	At the bottom and peak that occur in the Rf waveform at 200 mA (Rf = 0.5 Ω)		14.5		%
[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)	For the sink side, at the internal pull-up resistor		0.4	0.55	V
FG amplifier common-mode input voltage	V_{CM} (FG)		1.0		4.0	V
[Saturation]						
Saturation prevention circuit lower side set voltage	V_{Osat} (DET)	Io = 10 mA, Rf = 0.5 Ω, VCTL = VLIM = 5 V The voltages between the OUT-Rf pairs at full wave.	0.13	0.25	0.42	V
[Schmitt Amplifier]						
Duty	DUTY	60 mVp-p, 1 kHz input *1	49	50	51	%
Upper side output saturation voltage	V_{satu} (SH)		4.8			V
Lower side output saturation voltage	V_{satd} (SH)				0.2	V
Hysteresis	Vhys	Design target values *2		45		mV
TSD operating temperature	T-TSD	Design target values *2		180		°C
TSD hysteresis	ΔT-TSD	Design target values *2		15		°C

Note *1 : The ratings are just the measured value with no margin afforded.
*2 : Items shown to be design target values in the conditions column are not measured.

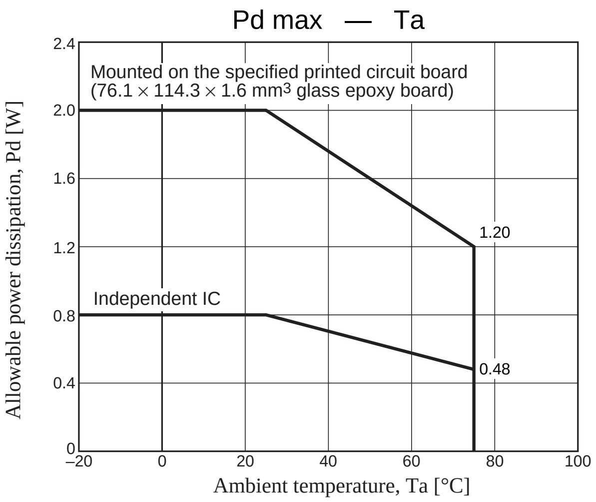
Truth Table and Control Functions

	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

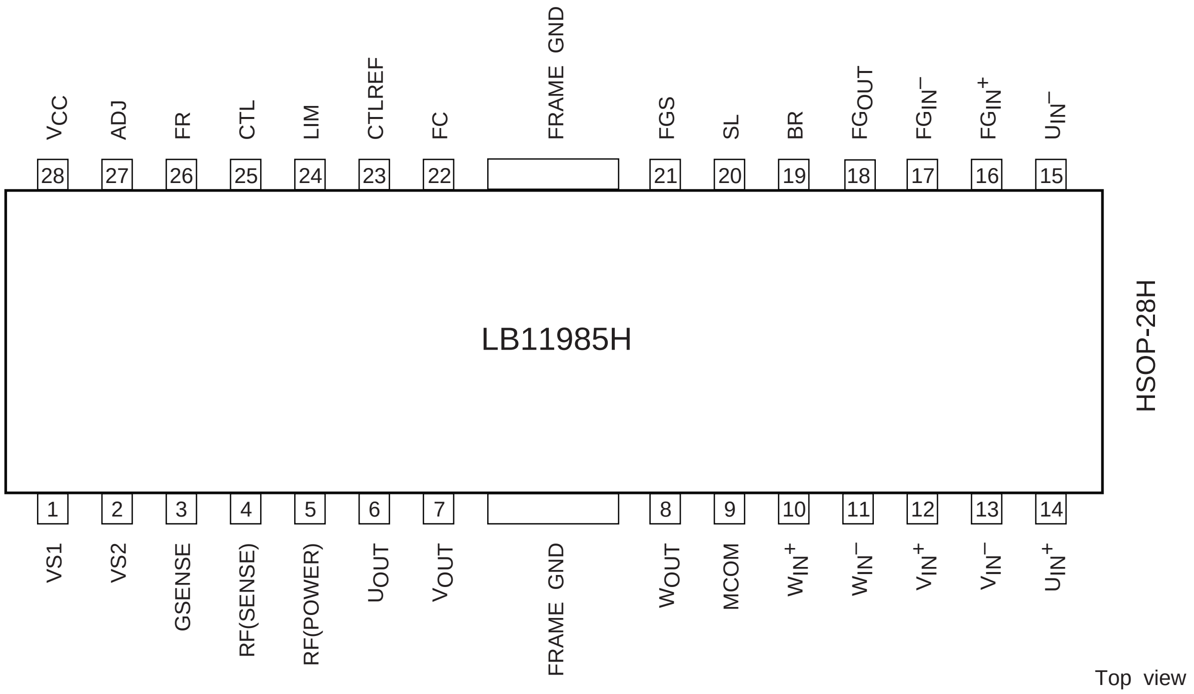
Note: 1. In the FR column, “H” indicates a voltage of 2.75 V or higher, and “L” indicates a voltage of 2.25 V or lower. (When V_{CC} is 5 V.)

2. For the Hall inputs, the input high state is defined to be the state where the (+) input is higher than the corresponding (–) input by at least 0.02 V, and the input low state is defined to be the state where the (+) input is lower than the corresponding (–) input by at least 0.02 V.

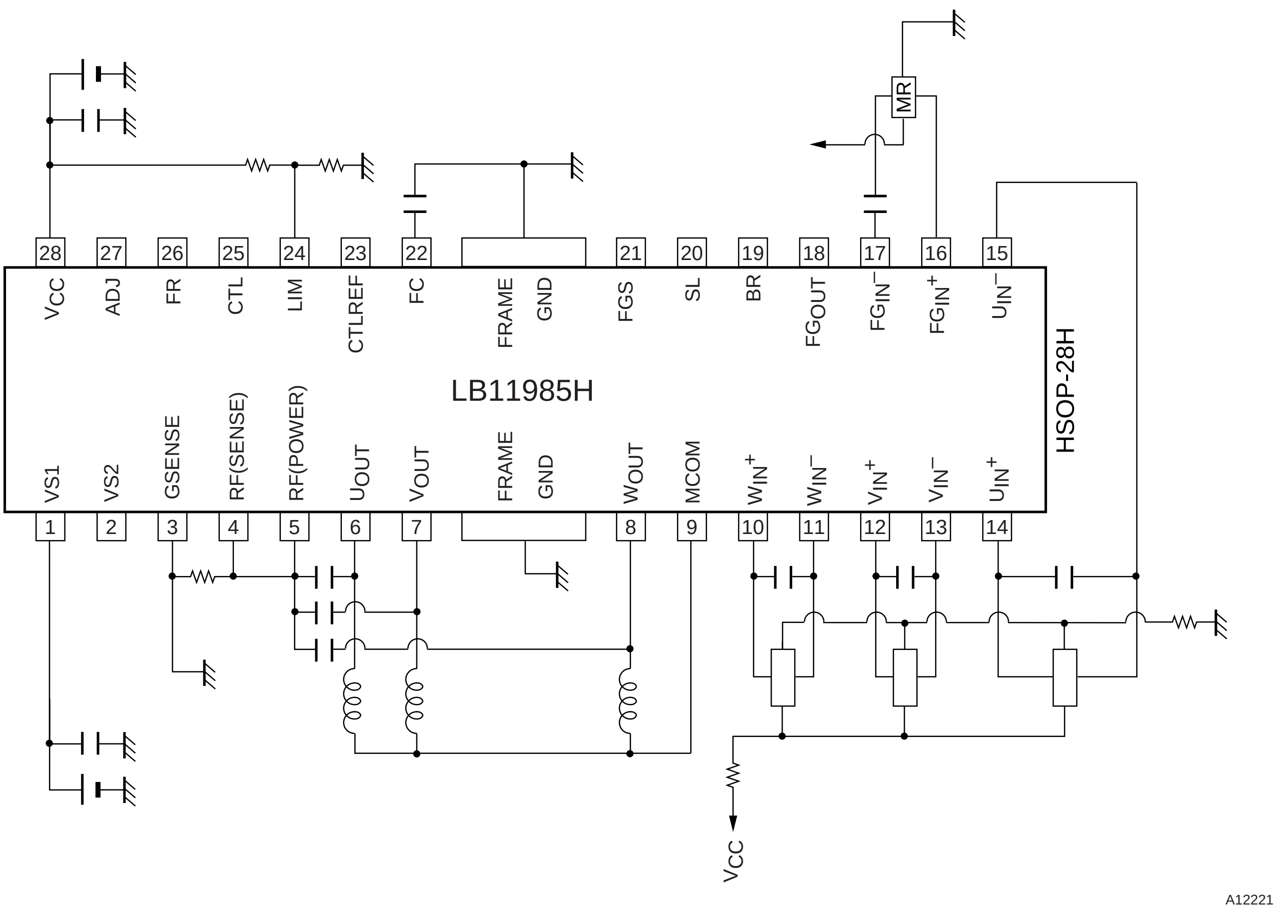
Allowable Power Dissipation



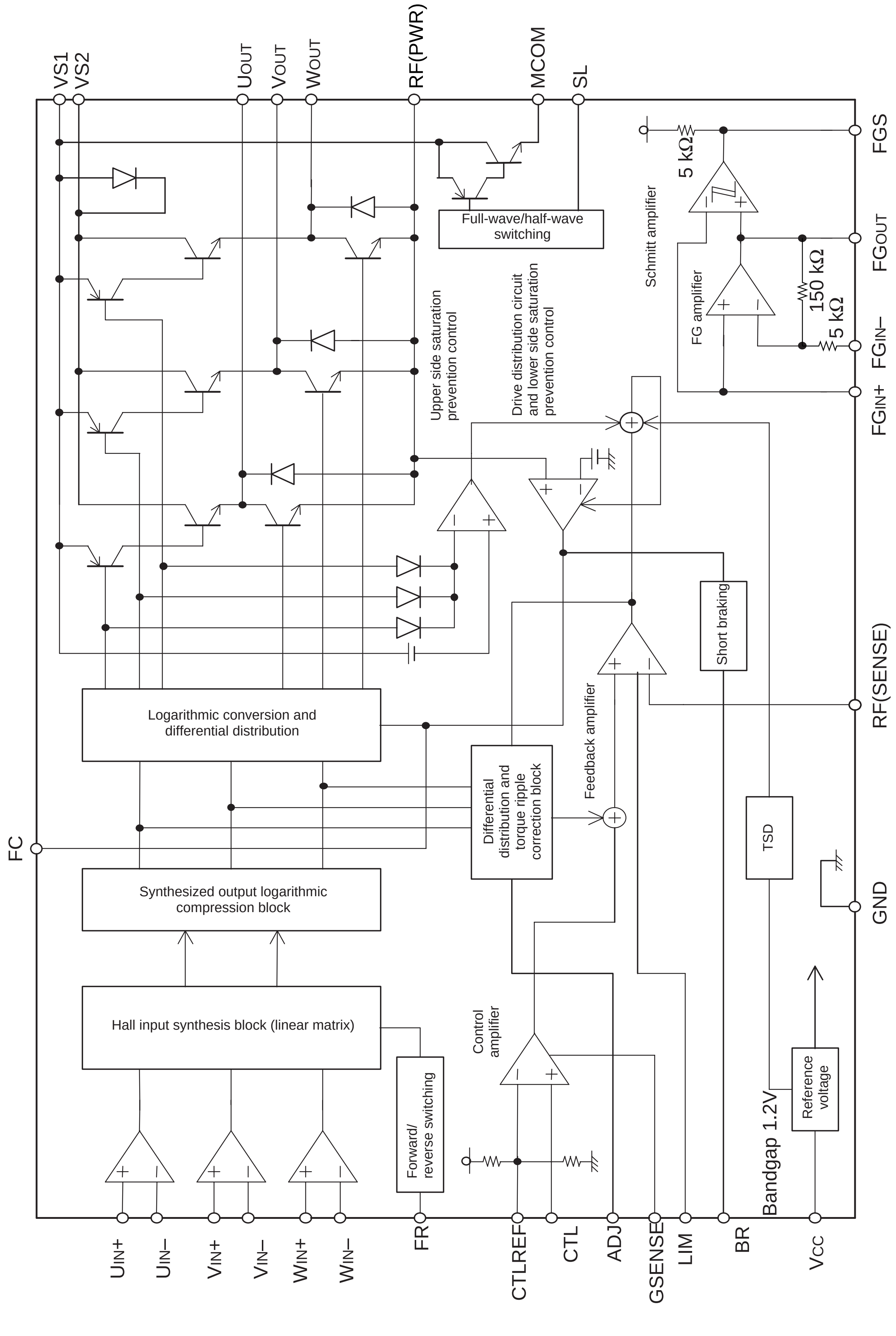
Pin Assignment



Sample Application Circuit

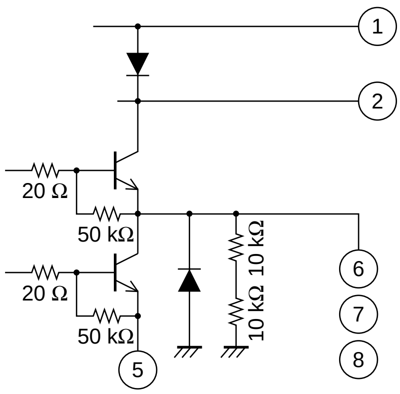
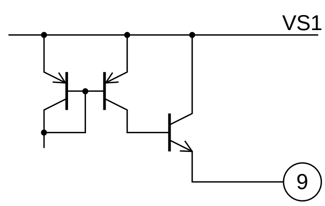


Block Diagram



Pin Functions

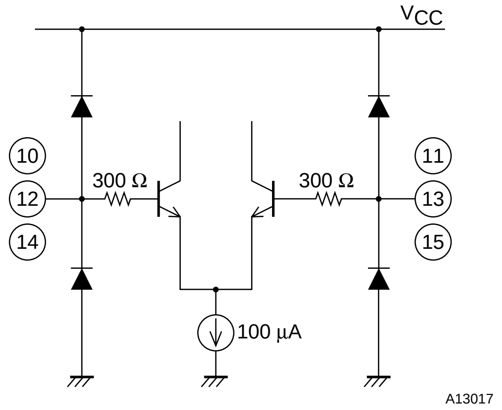
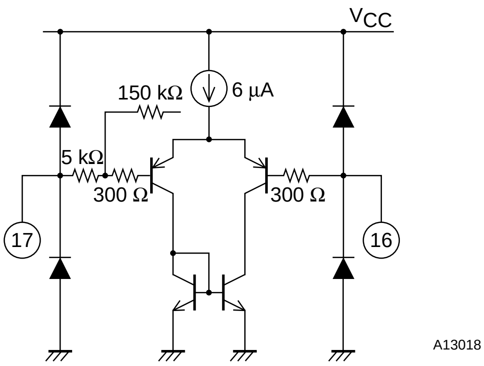
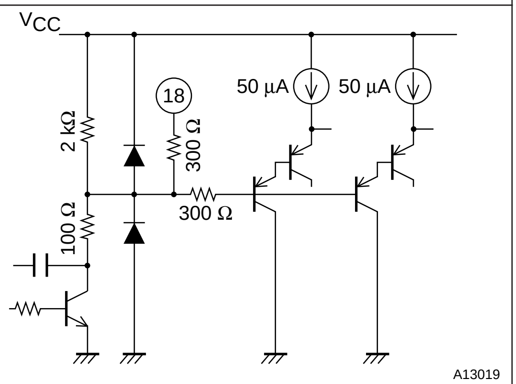
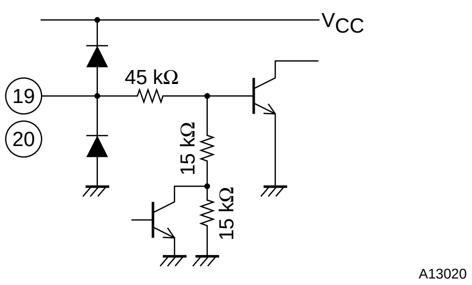
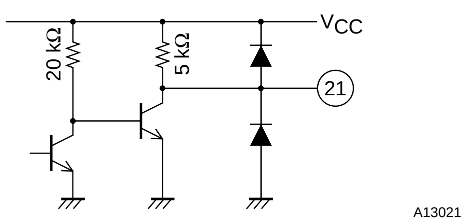
Unit (resistance : Ω)

Pin No.	Symbol	Pin Voltage	Description	Equivalent circuit
	FRAME GND		Ground for circuits other than the output transistors. The lowest potential of the output transistors will be the that of the RF pin.	
1	VS1	8 V to 15 V	Output block power supply	
2	VS2		A diode is internally connected between VS1 and this pin to prevent reverse current flow in half-wave operating mode.	
3	GSENSE		Ground sensing. The influence of the common ground impedance on Rf can be excluded by connecting this pin to the ground near the Rf resistor in the motor ground lines that include RF. (This pin must not be left open.)	
4 5	RF(SENSE) RF(POWER)		Output current detection. Current feedback is applied to the control block by inserting the resistor Rf between these pins and ground. Also, both the lower side saturation prevention circuit and the torque ripple correction circuit operate according to the voltage on this pin. In particular, since this voltage sets the oversaturation prevention level, the lower side oversaturation prevention operation can be degraded if the value of this resistor is set too low. Note that the POWER pin and the SENSE pin must be connected together.	
6	U_{OUT}		Coil output	 A13015
7	V_{OUT}			
8	W_{OUT}			
9	MCOM		Motor midpoint connection. Half-wave drive is implemented by connecting the motor midpoint to this pin.	 A13016

Continued on next page.

Continued from preceding page.

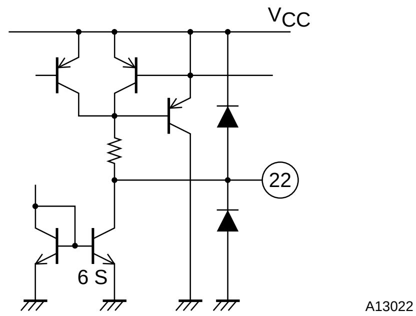
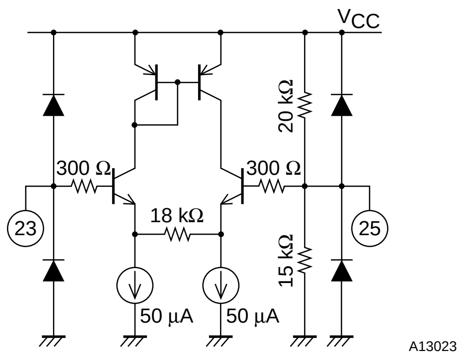
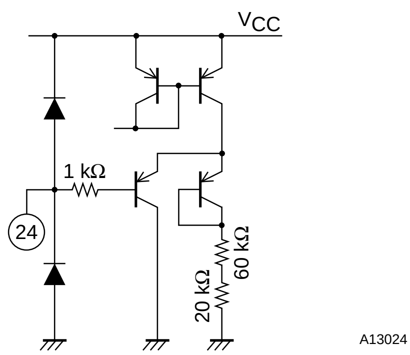
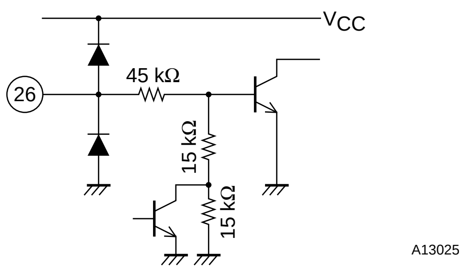
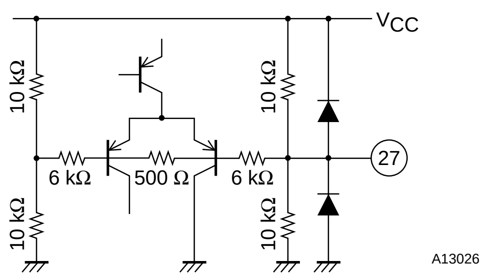
Unit (resistance : Ω, current : A)

Pin No.	Symbol	Pin Voltage	Description	Equivalent circuit
10	$W_{IN}+$	1.3 V to 3.3 V (V_{CC} = 5 V)	W phase Hall element input. Logic “H” is defined as the state where $W_{IN}+ > W_{IN}-$.	
11	$W_{IN}-$			
12	$V_{IN}+$		V phase Hall element input. Logic “H” is defined as the state where $V_{IN}+ > V_{IN}-$.	
13	$V_{IN}-$			
14	$U_{IN}+$		U phase Hall element input. Logic “H” is defined as the state where $U_{IN}+ > U_{IN}-$.	
15	$U_{IN}-$			
16	$FG_{IN}+$		FG amplifier + input. This is the + input to the Schmitt amplifier. There is no bias applied internally.	
17	$FG_{IN}-$		FG amplifier – input. The input resistance is 5 kW and a 150 kW feedback resistor is built in. (The gain is 30×.)	
18	FG_{OUT}		FG amplifier linear output.	
19	BR	0 V to V_{CC}	Short braking control input. High: Short braking Low: Normal motor drive	
20	SL		Full-wave/half-wave control input. High: Half-wave drive Low: Full-wave drive	
21	FGS		FG Schmitt amplifier output.	

Continued on next page.

Continued from preceding page.

Unit (resistance : Ω, current : A)

Pin No.	Symbol	Pin Voltage	Description	Equivalent circuit
22	FC		Frequency characteristics correction. Oscillation in the current control system closed loop can be prevented by inserting a capacitor between this pin and ground.	
23	CTLREF	1 V to 4 V (V_{CC} = 5 V)	Control reference voltage. Although this voltage is set to $V_{CC} \times$ (15/35) internally, it can be modified by applying a voltage from a low-impedance circuit.	
25	CTL	0 V to V_{CC}	Speed control. Control consists of a constant current drive scheme implemented by applying current feedback from RF.	
24	LIM	0 V to V_{CC}	Current limiter function control. The voltage applied to this pin modifies the output current linearly.	
26	FR	0 V to V_{CC}	Forward/reverse control. The voltage applied to this pin selects forward or reverse operation.	
27	ADJ		External torque ripple correction ratio adjustment. To adjust the correction ratio, apply the stipulated voltage to the ADJ pin from a low-impedance external circuit. If the applied voltage is increased, the correction ratio rises, and if the applied voltage is lowered, the correction ratio falls.	
28	V_{CC}	4.5 V to 5.5 V	Power supply for all circuits other than the IC internal output block. This voltage must be stabilized so that ripple and noise do not enter the IC.	

- Specifications of any and all SANYO 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 Electric 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 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 Electric 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 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 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 January, 2000. Specifications and information herein are subject to change without notice.