

Ordering number :ENN6210A

Monolithic Digital IC



LB1989

Three-Phase Sensorless VCR Drum Motor Driver

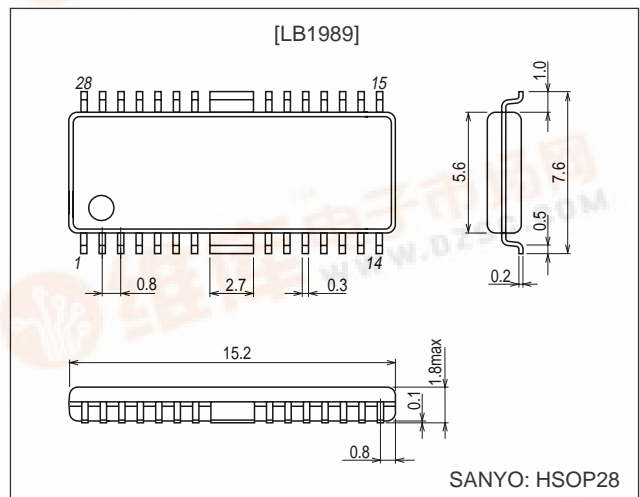
Functions and Features

- Soft switching drive
- No Hall sensors required.
- No FG sensors required.
- Built-in PG amplifier
- Thermal shutdown circuit
- Current limiter circuit

Package Dimensions

unit: mm

3222-HSOP28



Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V _{CCmax}		14.5	V
Maximum output voltage	V _{Omax}		14.5	V
Maximum input voltage	V _{I1max}		-0.3 to V _{CC1} + 0.3	V
Maximum cylinder current	I _{Omax}		1.0	A
Allowable power dissipation	P _{dmax}	Independent IC	0.6	W
Operating temperature	T _{opr}		-20 to +75	°C
Storage temperature	T _{stg}		-55 to +150	°C

Allowable Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V _{CC}		8 to 13.8	V

■ 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.



LB1989

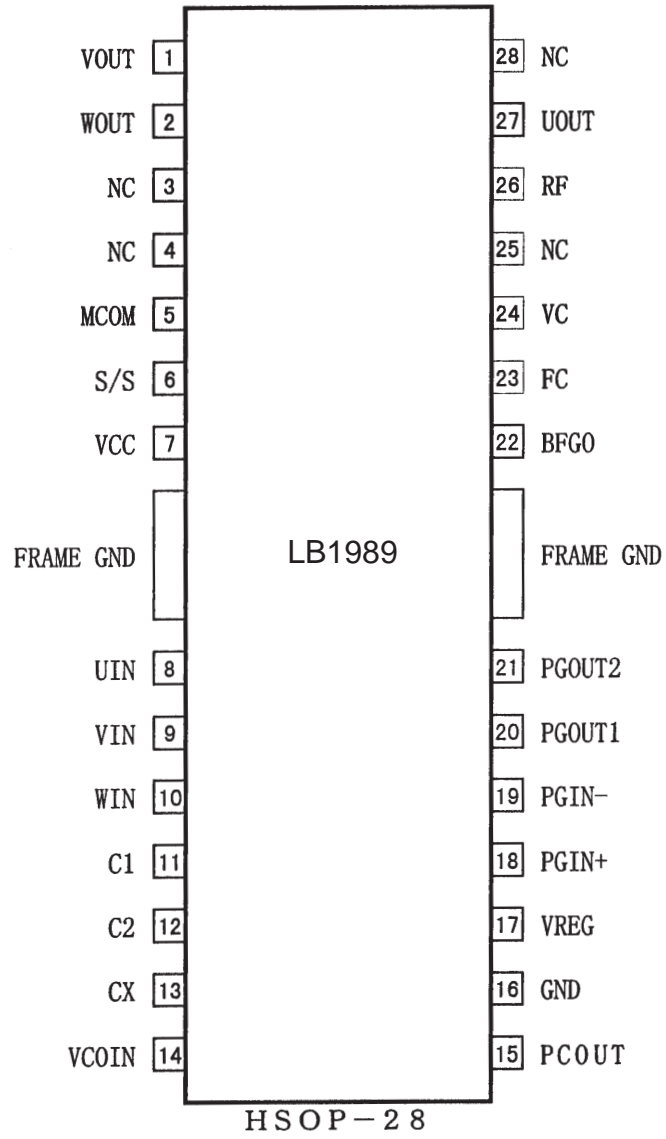
Electrical Characteristics at $T_a = 25^\circ\text{C}$, $V_{CC} = 12\text{ V}$

Parameter	Symbol	Conditions	Ratings			Unit	Test circuit
			min	typ	max		
Current drain	I_{CC}	$V_C = 0\text{ V}$		15	20	mA	1
Internal power supply	V_{REG}	$V_C = 0\text{ V}$	4.6	5.0	5.4	V	2
Output saturation voltage 1	V_{OSAT1}	$I_O = 0.4\text{ A}$, Source + Sink		1.4	2.0	V	3
Output saturation voltage 2	V_{OU2}	$I_O = 0.8\text{ A}$, $R_F = 0\ \Omega$, Source + Sink		1.8	2.6	V	4
MC pin common-mode input voltage range	V_{IC}		0		$V_{CC} - 2$	V	5
VC pin input bias current	I_{VC}	$V_C = 0\text{ V}$	-2	-1		μA	6
Control start voltage	V_{THVC}		2.3	2.55	2.8	V	7
Closed-loop control gain	$GMVC$	$R_F = 0.5\ \Omega$	0.75	0.95	1.15	A/V	8
PCOUT output current 1	I_{PCOU}	Source side		-90		μA	9
PCOUT output current 2	I_{PCOD}	Sink side		90		μA	10
VCOIN input current	I_{VCOIN}	$V_{COIN} = 5\text{ V}$		0.1	0.2	μA	11
Minimum VCO frequency	f_{VCOMIN}	$C_X = 0.022\ \mu\text{F}$, With V_{COIN} open		400		Hz	12
Maximum VCO frequency	f_{VCOMAX}	$C_X = 0.022\ \mu\text{F}$, $V_{COIN} = 5\text{ V}$		18.5		kHz	13
C1/C2 source current ratio	$RSOURCE$	$IC1SOURCE / IC2SOURCE$	-12		+12	%	14
C1/C2 sink current ratio	$RSINK$	$IC1SINK / IC2SINK$	-12		+12	%	15
C1 source/sink current ratio	$RC1$	$IC1SOURCE / IC1SINK$	-35		+15	%	16
C2 source/sink current ratio	$RC2$	$IC2SOURCE / IC2SINK$	-35		+15	%	17
S/S pin high level voltage	V_{SSH}		4			V	18
S/S pin low level voltage	V_{SSL}				0.7	V	19
S/S pin input current	I_{SSI}	$V_{S/S} = 5\text{ V}$			200	μA	20
Thermal shutdown circuit operating temperature	$TTSD$		150	180	210	$^\circ\text{C}$	*
Thermal shutdown circuit hysteresis	$\Delta TTSD$			15		$^\circ\text{C}$	*
[FG/PG Amplifier Block]							
Back EMF FG							
Output on voltage	V_{OL}				0.4	V	21
Output off voltage	V_{OH}		$V_{REG} - 0.5$			V	22
PG amplifier							
Input offset voltage	V_{IO}		-8		+8	mV	23
Input bias current	I_{BIN^-}		-250			nA	24
Common-mode input voltage range	V_{ICOM}		0		$V_{REG} - 1.5$	V	*
Open-loop gain	$GVPG$	$f = 1\text{ kHz}$		55		dB	25
Output on voltage	V_{OL}				0.4	V	26
Output off voltage	V_{OH}		$V_{REG} - 0.5$			V	27
Schmitt amplifier hysteresis	V_{SHIS}		70	93	115	mV	28

Note * : These are design target values and are not measured.

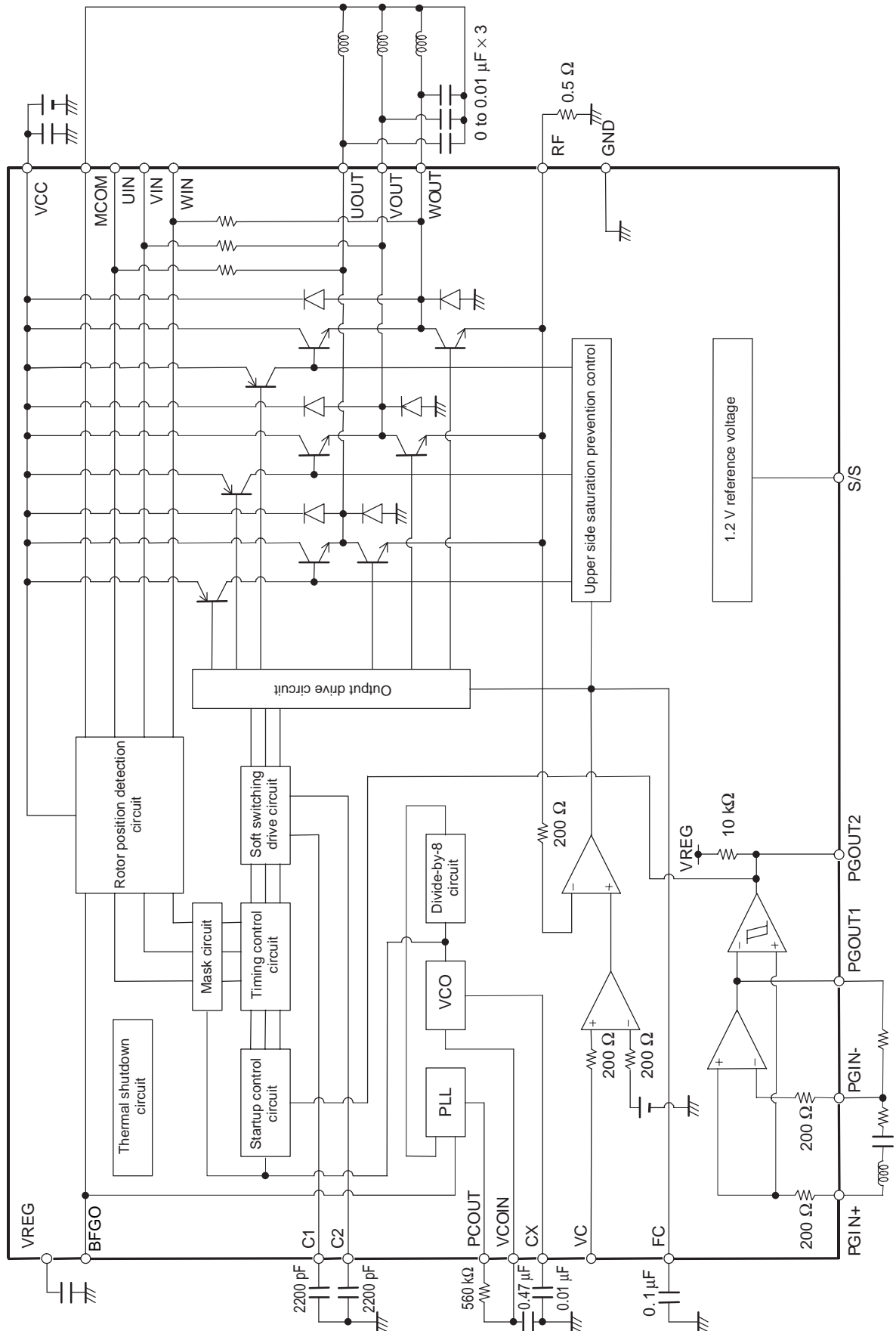
LB1989

Pin Assignment



LB1989

Block Diagram (Note that the external constants will vary depending on the motor used.)



LB1989

Pin Functions

Pin No.	Pin	Pin voltage	Equivalent circuit	Function
27	UOUT			Drum motor driver outputs
1	VOUT			
2	WOUT			
26	RF			<p>The lowest potential of the drum motor driver output transistors. Constant-current control is implemented by detecting this voltage.</p> <p>The current limiter also operates by detecting this voltage.</p>
26	S/S			<p>Driver start/stop control</p> <p>High: Motor drives operating state</p> <p>Low: Standby state (power saving mode)</p>
7	V _{CC}	8 to 13.8 V		Power supply
5	MCOM			<p>Motor coil center input</p> <p>The coil voltage waveform is detected referenced to this voltage.</p>
8	UIN			
9	VIN			
10	WIN			
11	C1			<p>Sawtooth waveform generator capacitor connection</p> <p>This sawtooth waveform is used for soft switching in the coil output waveform.</p>
12	C2			

Continued on next page.

LB1989

Continued from preceding page.

Pin No.	Pin	Pin voltage	Equivalent circuit	Function
13	CX			<p>The value of the capacitor connected between this pin and ground determines the operating frequency range and the minimum operating frequency for the VCO circuit.</p>
14	VCOIN			<p>VCO circuit voltage input The PCOUT pin voltage is RC filtered and the result is input to this pin.</p>
15	PCOUT			<p>VCO circuit PLL output</p>
16	GND			<p>Ground for all circuits other than the output transistor</p>
17	VREG			<p>Internal 5 V regulator This pin provides the control system power.</p>

Continued on next page.

LB1989

Continued from preceding page.

Pin No.	Pin	Pin voltage	Equivalent circuit	Function
18	PGIN+			PG amplifier positive (+) input This pin is biased internally by 1/2 VREG.
19	PGIN-			PG amplifier negative (-) input
20	PGOUT1			PG amplifier linear output
21	PGOUT2			PG Schmitt amplifier output
22	BFGO			Motor back EMF detection FG output (synthesized from 3 phases)

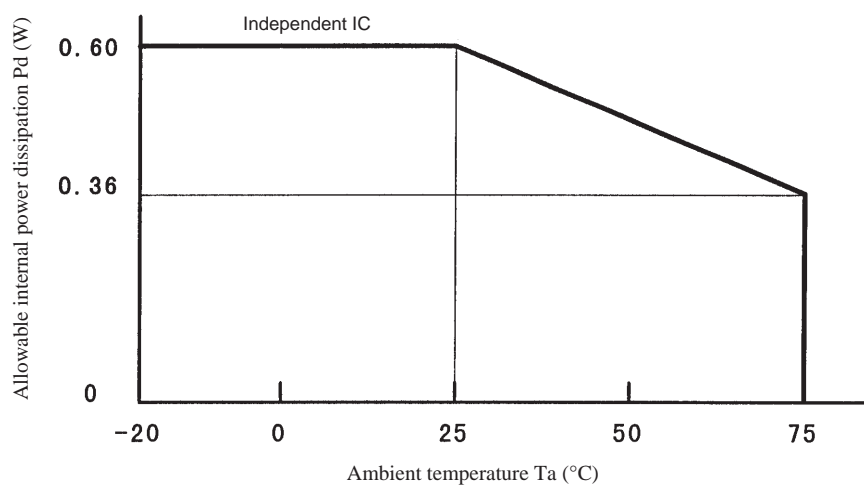
Continued on next page.

LB1989

Continued from preceding page.

Pin No.	Pin	Pin voltage	Equivalent circuit	Function
23	FC			<p>Frequency characteristics correction</p> <p>Current control system closed loop oscillation can be stopped by inserting a capacitor between this pin and ground.</p>
24	VC	0 to V _{CC}		<p>Speed control</p> <p>This IC implements constant-current control by applying feedback from RF.</p>

Allowable Internal Power Dissipation



- 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.