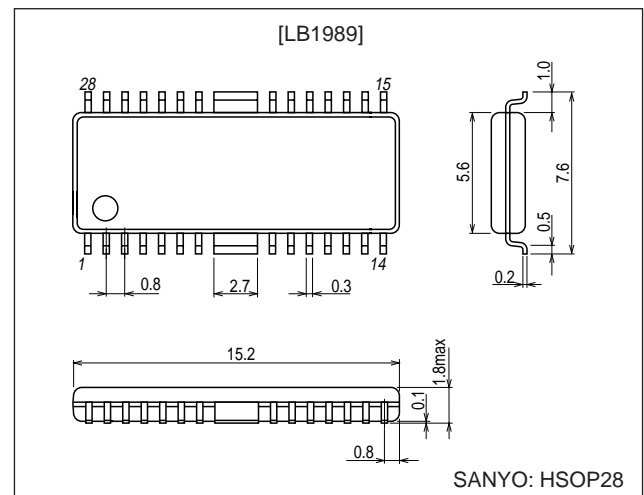


**LB1989****Three-Phase Sensorless VCR Drum Motor Driver****Functions and Features**

- 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 _{CC} + 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

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■ 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.

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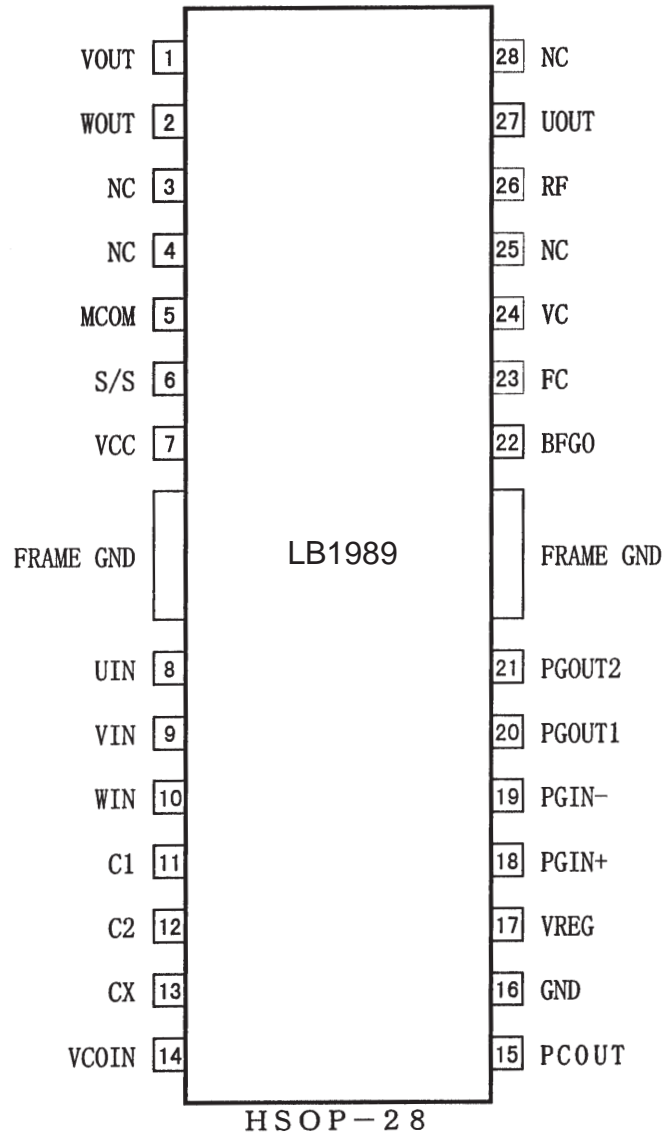
Electrical Characteristics at $T_a = 25^\circ\text{C}$, $V_{CC} = 12\text{ V}$

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	G_{VPG}	$f = 1\text{ kHz}$		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

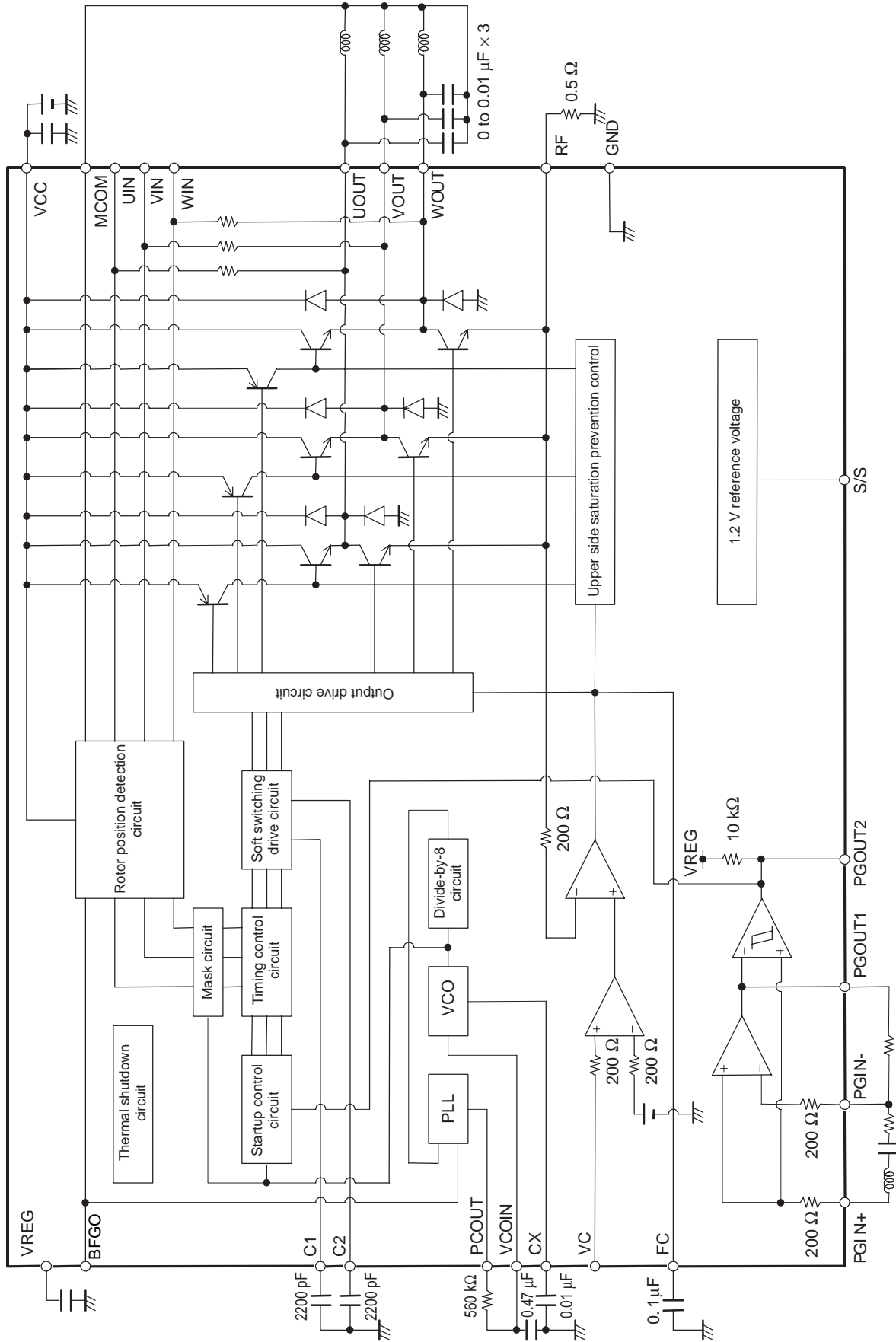
Note * : These are design target values and are not measured.

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Pin Assignment



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



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				<p>Coil waveform detection comparator inputs</p> <p>Each phase output is connected through an internal 10 kΩ resistor.</p>
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				

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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>

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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)

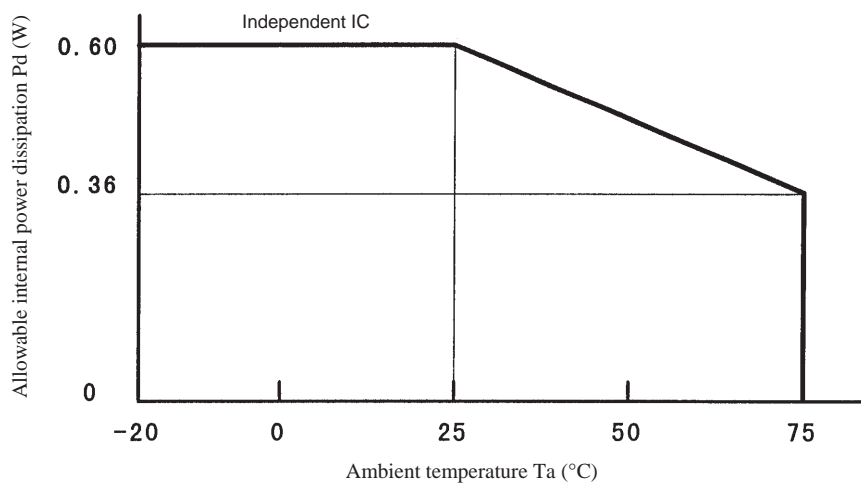
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Pin No.	Pin	Pin voltage	Equivalent circuit	Function
23	FC			<p>Frequency characteristics correction</p> <p>Current control system closed loop oscillation can be stopped by inserting a capacitor between this pin and ground.</p>
24	VC	0 to V _{CC}		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

Allowable Internal Power Dissipation



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