Ordering number :ENN6210A

Monolithic Digital IC

LB1989

Three-Phase Sensorless VCR Drum Motor Driver

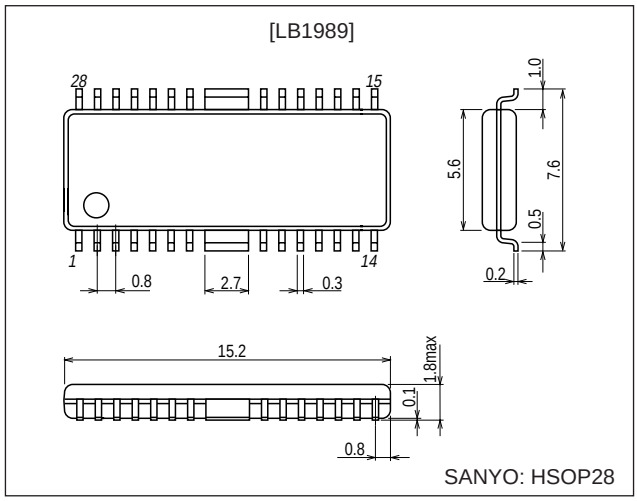
Functions and Features

- 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_{CC}max		14.5	V
Maximum output voltage	$V_O$max		14.5	V
Maximum input voltage	V_{I1}max		–0.3 to V_{CC}1 + 0.3	V
Maximum cylinder current	$I_O$max		1.0	A
Allowable power dissipation	Pdmax	Independent IC	0.6	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_{CC}		8 to 13.8	V

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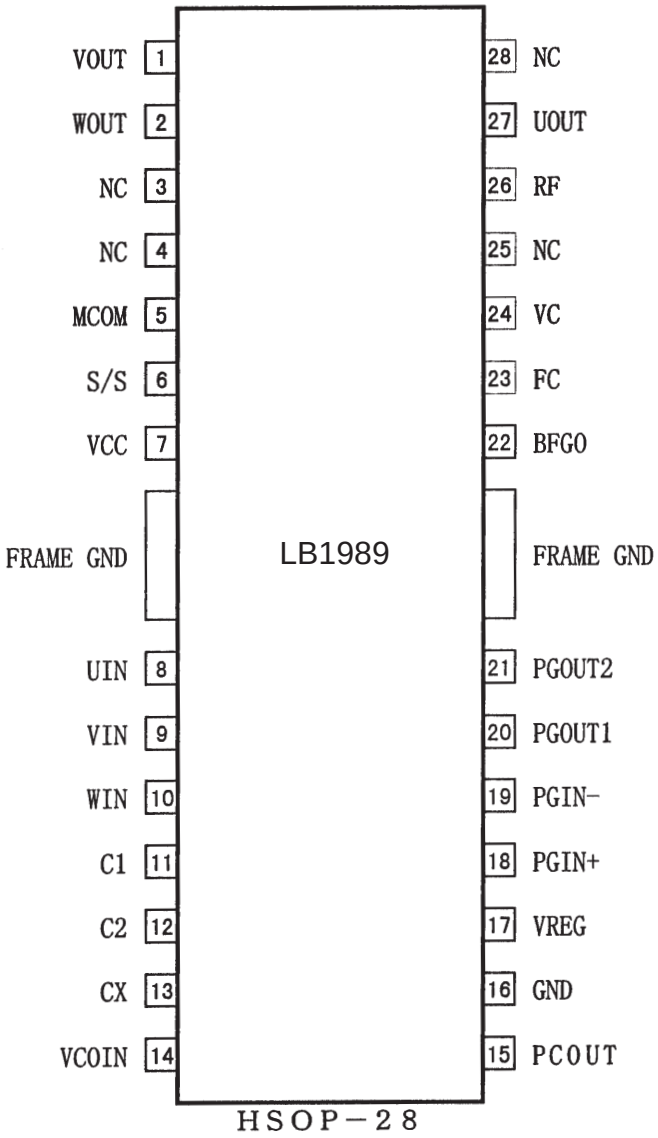
Electrical Characteristics at Ta = 25°C, V_{CC} = 12 V

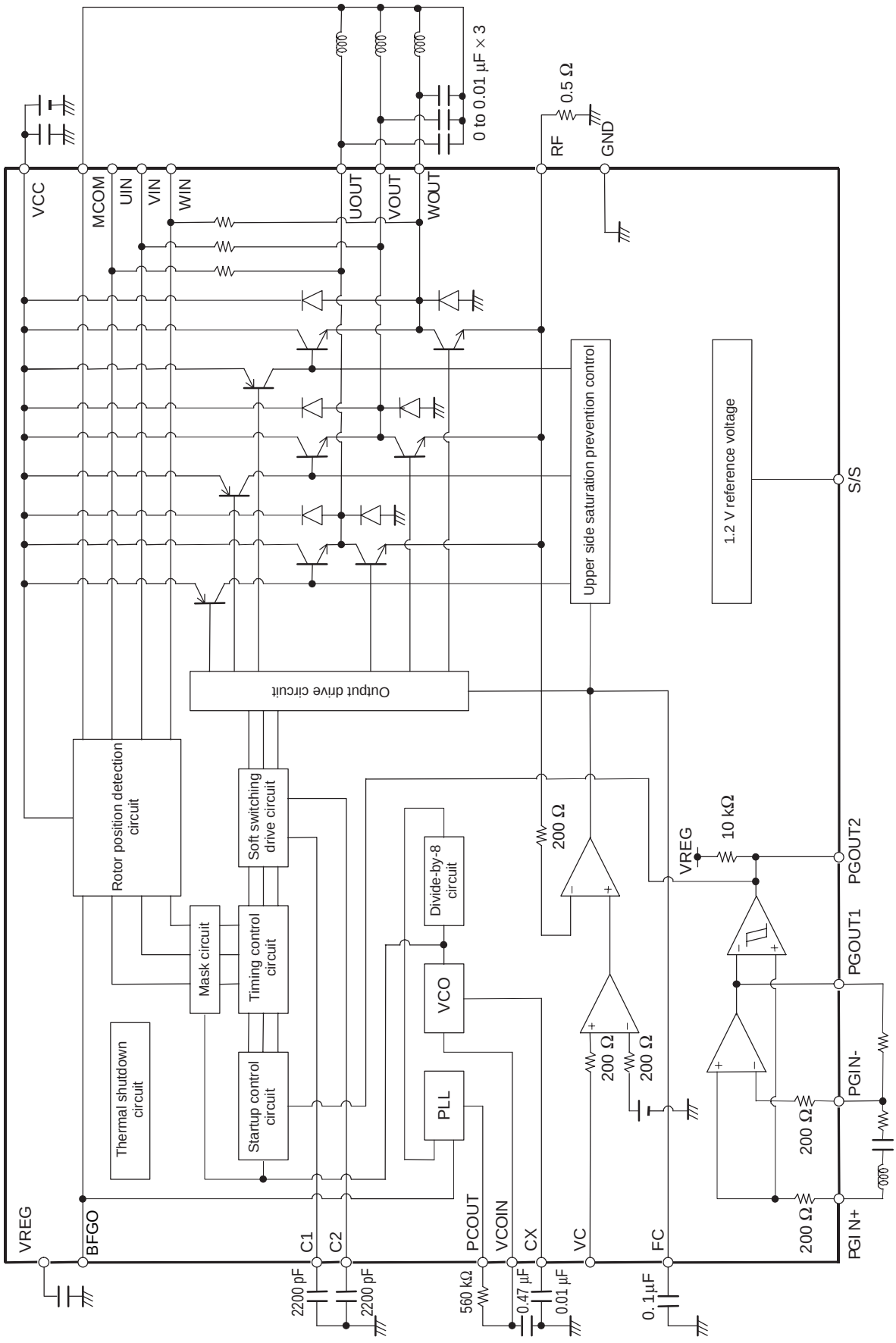
Parameter	Symbol	Conditions	Ratings			Unit	Test circuit
			min	typ	max		
Current drain	I_{CC}	V_C = 0 V		15	20	mA	1
Internal power supply	V_{REG}	V_C = 0 V	4.6	5.0	5.4	V	2
Output saturation voltage 1	$V_{OSAT}1$	I_O = 0.4 A, Source + Sink		1.4	2.0	V	3
Output saturation voltage 2	$V_{OU}2$	I_O = 0.8 A, RF = 0 Ω, 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 V	–2	–1		µA	6
Control start voltage	V_{THVC}		2.3	2.55	2.8	V	7
Closed-loop control gain	GMVC	RF = 0.5 Ω	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 V		0.1	0.2	µA	11
Minimum VCO frequency	fV_{COMIN}	Cx = 0.022 µF, With V_{COIN} open		400		Hz	12
Maximum VCO frequency	fV_{COMAX}	Cx = 0.022 µF, V_{COIN} = 5 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 V			200	µA	20
Thermal shutdown circuit operating temperature	TTSD		150	180	210	°C	*
Thermal shutdown circuit hysteresis	ΔTTSD			15		°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 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.

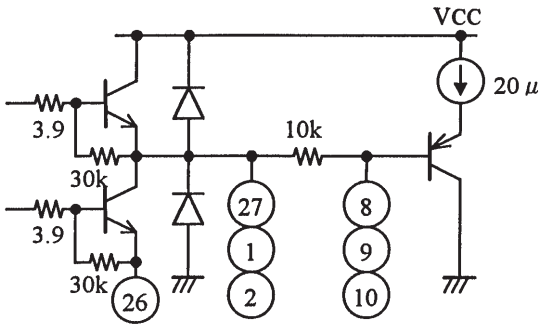
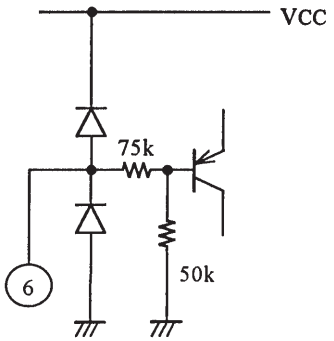
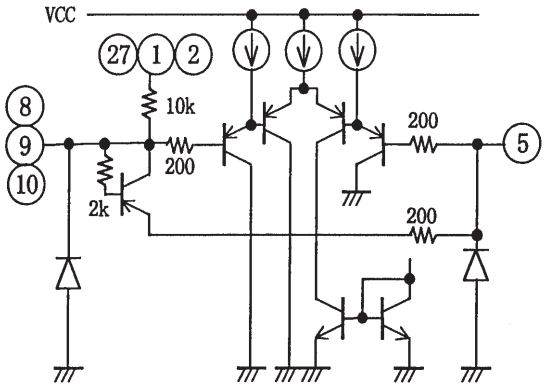
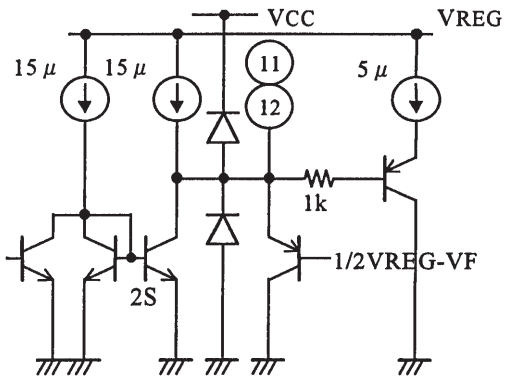
Pin Assignment



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			The lowest potential of the drum motor driver output transistors. Constant-current control is implemented by detecting this voltage. The current limiter also operates by detecting this voltage.
26	S/S			Driver start/stop control High: Motor drives operating state Low: Standby state (power saving mode)
7	V_{CC}	8 to 13.8 V		Power supply
5	MCOM			Motor coil center input The coil voltage waveform is detected referenced to this voltage.
8	UIN			Coil waveform detection comparator inputs Each phase output is connected through an internal 10 kΩ resistor.
9	VIN			
10	WIN			
11	C1			Sawtooth waveform generator capacitor connection This sawtooth waveform is used for soft switching in the coil output waveform.
12	C2			

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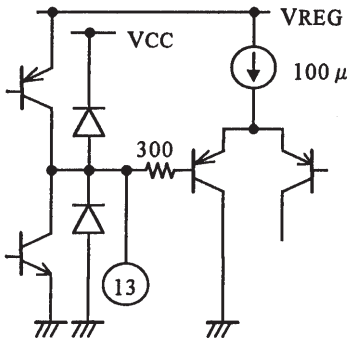
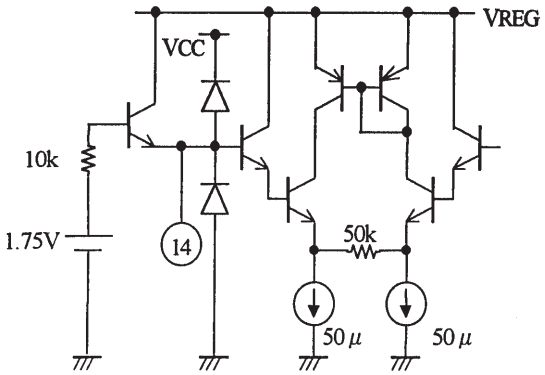
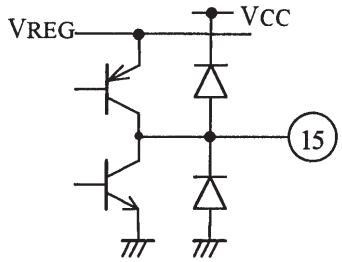
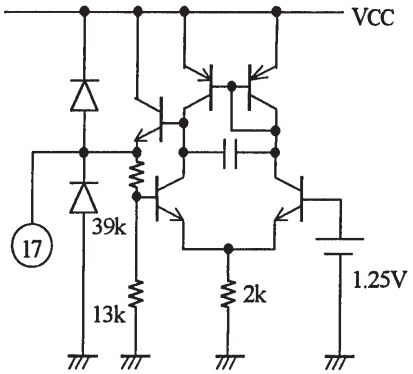
Pin No.	Pin	Pin voltage	Equivalent circuit	Function
13	CX			The value of the capacitor connected between this pin and ground determines the operating frequency range and the minimum operating frequency for the VCO circuit.
14	VCOIN			VCO circuit voltage input The PCOUT pin voltage is RC filtered and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

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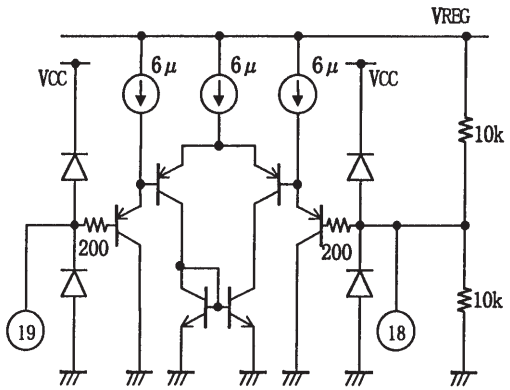
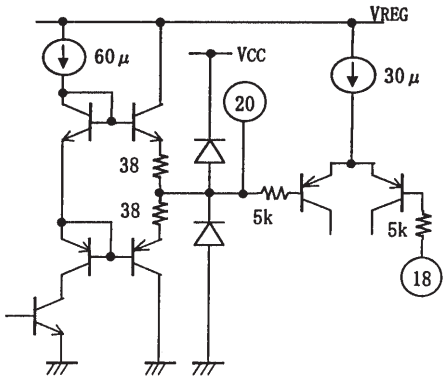
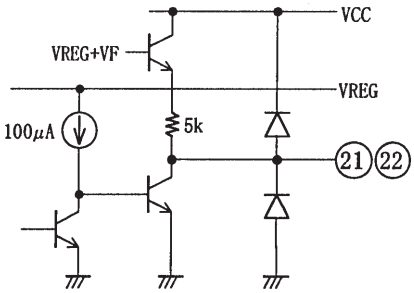
Pin No.	Pin	Pin voltage	Equivalent circuit	Function
18	PGIN+			PG amplifier positive (+) input This pin is biased internally by 1/2 VREG.
19	PGIN–			PG amplifier negative (–) input
20	PGOUT1			PG amplifier linear output
21	PGOUT2			PG Schmitt amplifier output
22	BFGO			Motor back EMF detection FG output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

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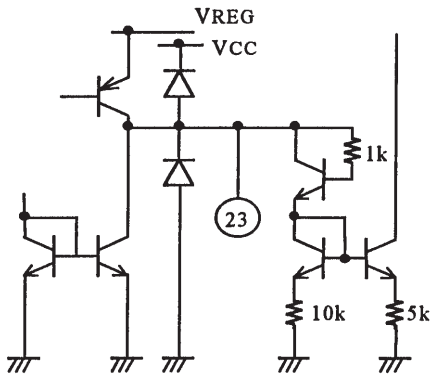
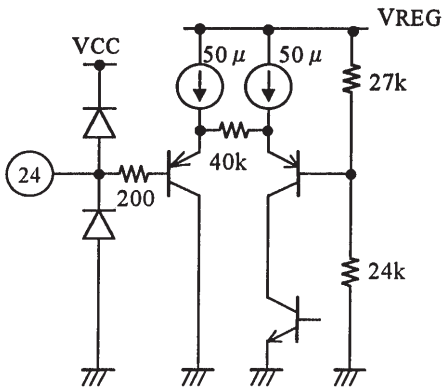
Pin No.	Pin	Pin voltage	Equivalent circuit	Function
23	FC			Frequency characteristics correction Current control system closed loop oscillation can be stopped by inserting a capacitor between this pin and ground.
24	VC	0 to V_{CC}		Speed control This IC implements constant-current control by applying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

Allowable Internal Power Dissipation