Ordering number : ENN6185

Monolithic Digital IC

LB1988N

Three-Phase Sensorless Motor Driver + Loading Motor Driver

Overview

The LB1988N is a sensorless motor driver that includes an on-chip loading motor driver as well. It is optimal for VCR drum motor drive.

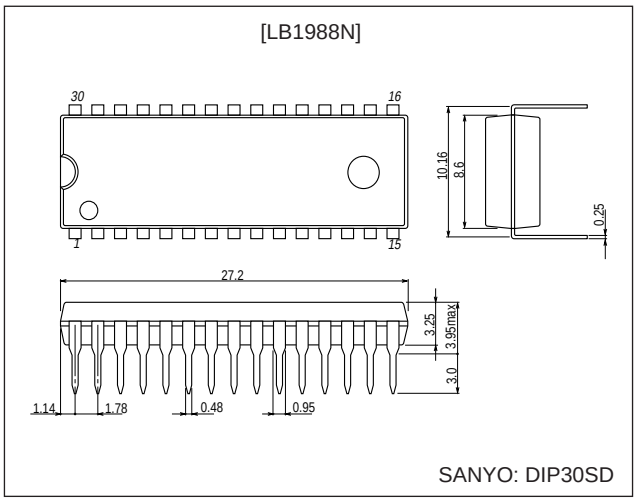
Functions and Features

- Soft switching drive
- Does not require Hall-effect sensors
- Does not require FG sensors
- PG amplifier
- Thermal shutdown circuit
- Current limiter circuit
- Loading motor driver

Package Dimensions

unit: mm

3196-DIP30SD



Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage 1	V_{CC}max		14.5	V
Maximum supply voltage 2	V_{CCL}max		14.5	V
Maximum supply voltage 3	V_{REG}max		7.0	V
Maximum applied output voltage	Vomax		14.5	V
Maximum applied input voltage	VI1max		– 0.3 to V_{REG} + 0.3	V
Maximum cylinder current	Iomax		1.0	A
Maximum loading current	Iomax (AVE)		0.4	A
	Iomax (peak)		1.2	A
Allowable power dissipation	Pdmax	When mounted on the specified printed circuit board*	2.8	W
Operating temperature	Topr		–20 to +75	°C
Storage temperature	Tstg		–55 to +150	°C

Note: * Specified printed circuit board: 114.3 × 76.1 × 1.6 mm^3, glass epoxy

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Allowable Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage 1	V_{CC}		8 to 13.8	V
Supply voltage 2	V_{CCL}		8 to 13.8	V
Supply voltage 3	V_{REG}		4 to 6	V

Electrical Characteristics at Ta = 25°C, V_{CC} = V_{CCL} = 12 V, V_{REG} = 5 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage 1	I_{CC}	VC = 0 V, XIN = YIN = 0 V		6.5	10	mA
Supply voltage 2	I_{CCL}	VC = 0 V, XIN = YIN = 0 V			1	mA
Supply voltage 3	I_{REG}	VC = 0 V, XIN = YIN = 0 V		6.5	10	mA
Output saturation voltage 1	$V_{OSAT}1$	I_O = 0.4 A, source + sink		1.4	2.0	V
Output saturation voltage 2	$V_{OSAT}2$	I_O = 0.8 A, source + sink		1.8	2.6	V
MC pin common-mode input voltage range	V_{IC}		0		V_{CC} – 2	V
VC pin input bias current	I_{VC}	VC = 0 V	–2	–1		µA
Control start voltage	VTHVC	V_{RF} = 10 mV	2.4	2.5	2.6	V
Closed loop control gain	GMVC	RF = 0.5 Ω	0.75	0.95	1.15	A/V
PCOUT output current 1	I_{PCOU}	Source side		–90		µA
PCOUT output current 2	I_{PCOD}	Sink side		90		µA
VCOIN input current	I_{VCOIN}	VCOIN = 5 V		0.1	0.2	µA
Minimum VCO frequency	fVCOMIN	CX = 0.022 µF, VCOIN = open		400		Hz
Maximum VCO frequency	fVCOMAX	CX = 0.022 µF, VCOIN = 5 V		18.5		kHz
C1/C2 source current ratio	RSOURCE	IC1SOURCE/IC2SOURCE	–12		+12	%
C1/C2 sink current ratio	RSINK	IC1SINK/IC2SINK	–12		+12	%
C1 source/sink current ratio	RC1	IC1SOURCE/IC1SINK	–35		+15	%
C2 source/sink current ratio	RC2	IC2SOURCE/IC2SINK	–35		+15	%
Thermal shutdown operating temperature	TTSD	*	150	180	210	°C
Thermal shutdown hysteresis	ΔTTSD	*		15		°C

FG and PG Amplifier Block at Ta = 25°C, V_{CC} = V_{CCL} = 12 V, V_{REG} = 5 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Back EMF FG						
Output on voltage	V_{OL}				0.4	V
Output off voltage	V_{OH}		4.5			V
PG amplifier						
Input offset voltage	V_{IO}		–8		+8	mV
Input bias current	I_{BIN}		–250			nA
Common-mode input voltage range	V_{ICOM}	*	1		3.5	V
Open-loop gain	GVPG	f = 1 kHz		55		dB
Output on voltage	V_{OL}				0.4	V
Output off voltage	V_{OH}		4.5			V
Schmitt amplifier hysteresis	V_{SHIS}		70	93	115	mV

Note: Items marked with an asterisk are design target values and are not tested.

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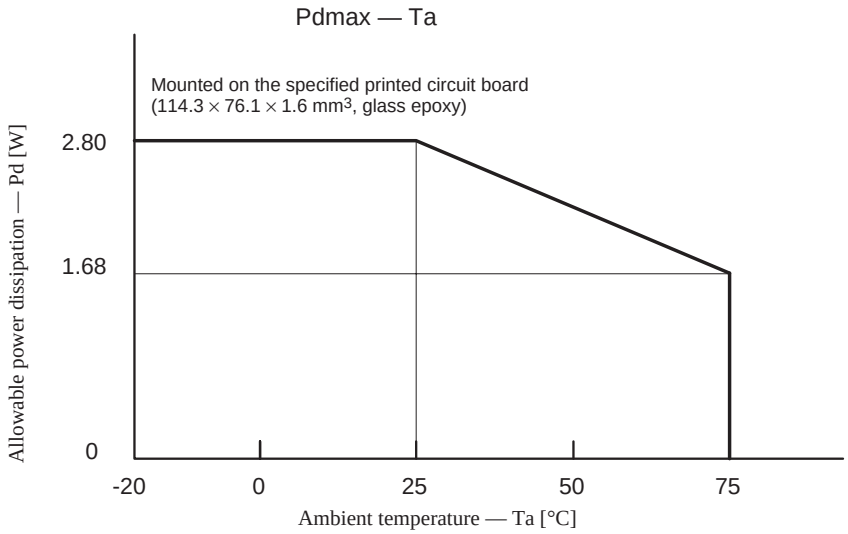
Loading Block at Ta = 25°C, V_{CC} = V_{CCL} = 12 V, V_{REG} = 5 V

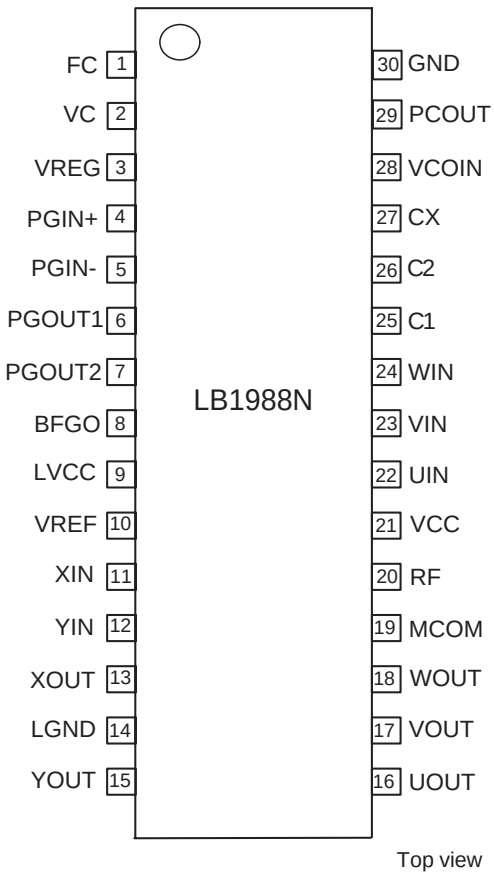
Parameter		Symbol	Conditions	Ratings			Unit
				min	typ	max	
Input voltage	1 (HIGH)	$V_{IN}1$		3.5		5	V
	2 (LOW)	$V_{IN}2$		0		0.8	V
Input current		I_{IN}	Sink, V_{IN} = 3.5 V		30	50	µA
Input hysteresis		ΔVT			0.7		V
Saturation voltage		VSAT U-1	Vref = VS, between the output and VS I_O = 0.2 A, CW/CCW mode		1.5	2.1	V
		VSAT L-1	Vref = VS, between the output and VS I_O = 0.2 A, CW/CCW mode		0.2	0.3	V
		VSAT U-1’	Vref = VS, between the output and VS I_O = 0.4 A, CW/CCW mode		1.6	2.2	V
		VSAT L-1’	Vref = VS, between the output and VS I_O = 0.4 A, CW/CCW mode		0.3	0.5	V
Upper side residual voltage		VSATU-1”	Vref = 8 V, between the output and ground I_O = 0.2 A, CW/CCW mode	7.2	8.0	8.8	V
		VSATL-1”	Vref = 8 V, between the output and ground I_O = 0.4 A, CW/CCW mode	7.2	8.0	8.8	V
Output transistor leakage current		up ILU				50	µA
		down ILL				50	µA
Diode forward voltage		up VFU	IF = 0.4 A		1.3		V
		down VFL	IF = 0.4 A		1.0		
Control supply current		Iref		–5	–2		µA

Loading Motor Truth Table

Input		Output		Mode
XIN	YIN	XOUT	YOUT	
L	L	Off	Off	Standby
H	L	H	L	Forward
L	H	L	H	Reverse
H	H	L	L	Brake

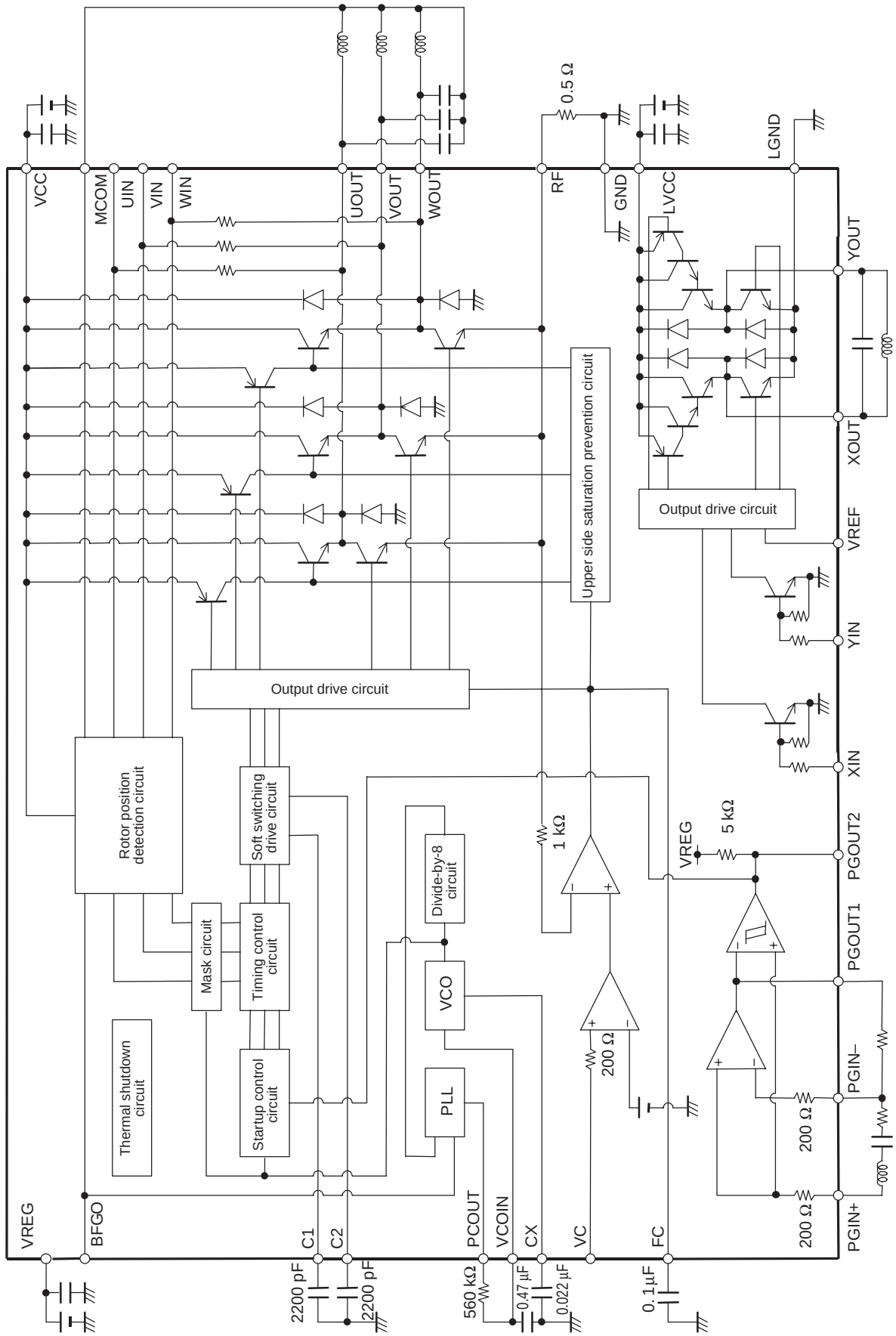


Pin Assignment

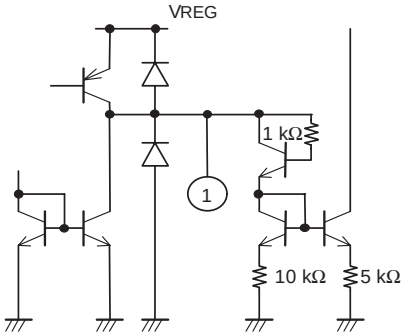
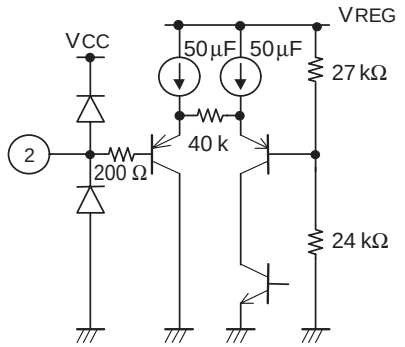
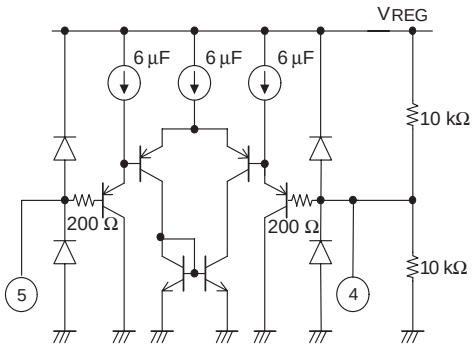
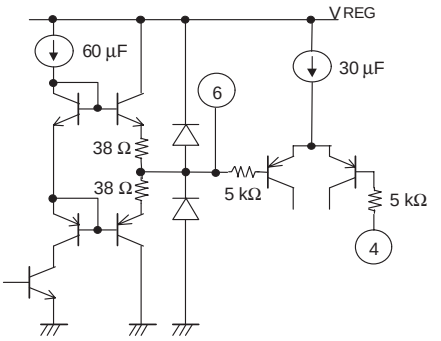


Top view

Block Diagram (Note that the values of the external components will vary with the motor actually used.)



Pin Functions

Pin No.	Symbol	Voltage	Function	Equivalent circuit diagram
1	FC		Frequency characteristics correction. Insert a capacitor between this pin and ground to prevent closed-loop oscillation in the current control system.	
2	VC	0 V to V_{REG}	Speed control. This circuit implements a constant-current control scheme in which current feedback from the RF pin is applied.	
3	VREG	4 V to 6 V	Control system power supply. This power supply must be stabilized to prevent ripple or other noise entering the circuit.	
4	PGIN+		PG amplifier + input. This input is biased at 1/2 VREG internally.	
5	PGIN–		PG amplifier - input.	
6	PGOUT1		PG amplifier linear output.	

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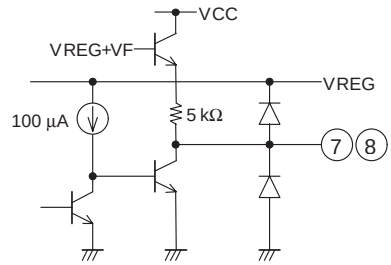
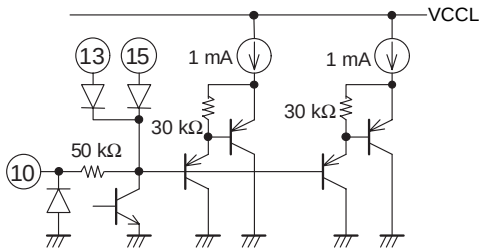
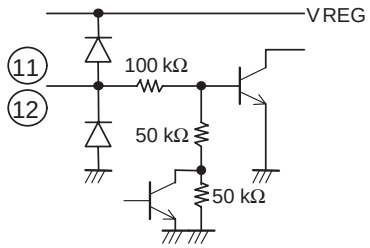
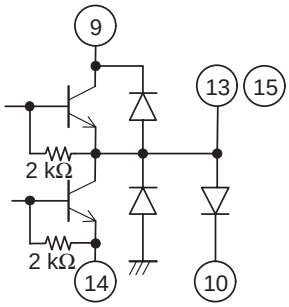
Pin No.	Symbol	Voltage	Function	Equivalent circuit diagram
7	PGOUT2		PG Schmitt amplifier output.	
8	BFGO		Motor back EMF detection FG output (3-phase synthesized).	
9	LVCC	8 to 13.8 V	Loading motor driver output transistor power supply.	
10	VREF	0 to V_{CCL}	Loading motor driver output voltage setting.	
11	XIN	0 V to V_{REG}	Loading motor driver logic input.	
12	YIN			
13	XOUT		Loading motor driver output.	
15	YOUT			
14	LGND		Loading motor driver output transistor ground.	

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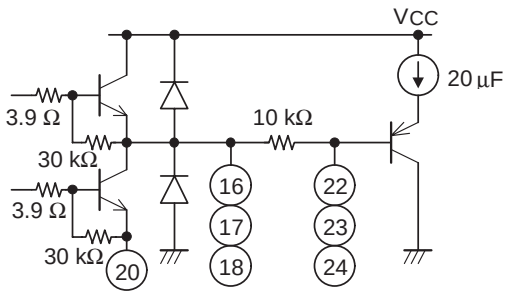
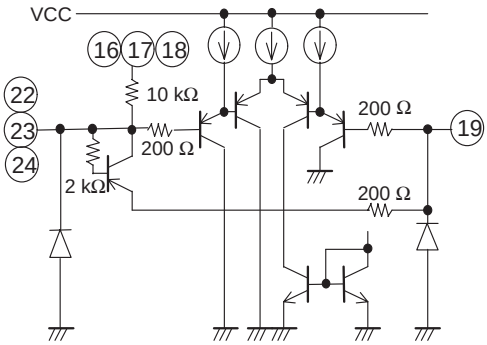
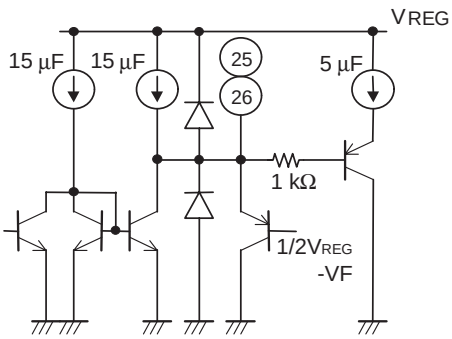
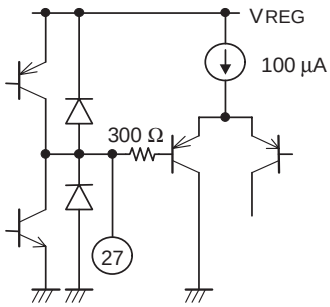
Pin No.	Symbol	Voltage	Function	Equivalent circuit diagram
16	UOUT		Drum motor driver output.	
17	VOUT			
18	WOUT			
20	RF		Lowest potential of the drum motor driver output transistor. Constant-current control is implemented by detecting this voltage. The current limiter also functions by detecting this voltage.	
21	VCC	8 to 13.8 V	Internal reference voltage and power supply for the drum motor driver output block and coil waveform detection circuit.	
19	MCOM		Motor coil midpoint input. This voltage is used as the reference voltage in coil voltage waveform detection.	
22	UIN		Coil waveform detection comparator inputs. These are connected to each of the phase outputs though internal 10-kΩ resistors.	
23	VIN			
24	WIN			
25	C1		Triangular waveform generator capacitor connection. The triangular waveform generated using this pin is used to implement soft switching for the coil output waveforms.	
26	C2			
27	CX		The value of the capacitor connected between this pin and ground in the VCO circuit determines the operating frequency range and the minimum operating frequency.	

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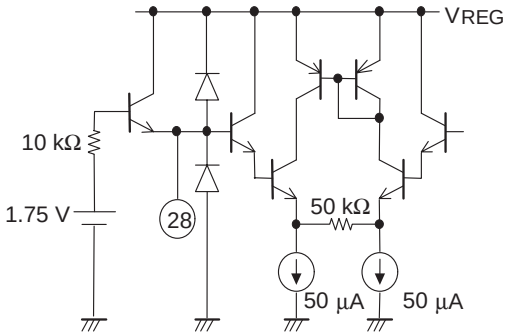
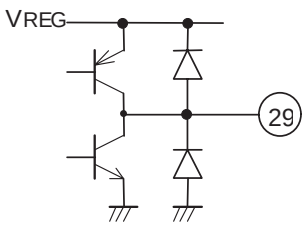
Pin No.	Symbol	Voltage	Function	Equivalent circuit diagram
28	VCOIN		VCO circuit control voltage input. The PCOUT pin voltage is applied to this pin through an RC filter.	
29	PCOUT		VCO circuit PLL output.	
30	GND		Ground used for all circuits other than the drum and loading motor driver output transistors.	