Ordering number : ENN6470

Monolithic Digital IC

LB11880

Three-Phase Sensorless Motor Driver with Loading Motor Driver

Overview

The LB11880 is a sensorless motor driver that also includes a loading motor driver. It is ideal for drum motor drive in VCR products.

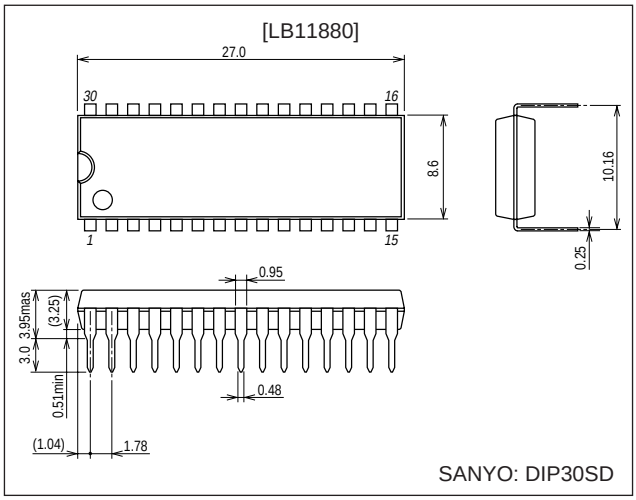
Functions and Features

- Soft switching drive
- No Hall sensors required
- No FG sensors required
- Built-in PG amplifier
- Built-in thermal shutdown circuit
- Current limiter circuit
- On-chip loading motor driver

Package Dimensions

unit: mm

3196A-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_{CC}L max		14.5	V
Maximum supply voltage 3	VREG max		7.0	V
Output voltage	Vomax		14.5	V
Input voltage	VI1max		–0.3 to VREG + 0.3	V
Cylinder current	Iomax		1.0	A
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 glass-epoxy board

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TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110-8534 JAPAN

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	$V_{CC}L$		8 to 13.8	V
Supply voltage 3	VREG		4 to 6	V

Electrical Characteristics at Ta = 25°C, V_{CC} = $V_{CC}L$ = 12 V, VREG = 5 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply current 1	I_{CC}	VC = 0 V, XIN = YIN = 0 V		3.5	5.0	mA
Supply current 2	$I_{CC}L$	VC = 0 V, XIN = YIN = 0 V			1	mA
Supply current 3	I_{REG}	VC = 0 V, XIN = YIN = 0 V		10	15	mA
Output saturation voltage 1	$V_O$sat1	IO = 0.4 A, source + sink		1.4	2.0	V
Output saturation voltage 2	$V_O$sat2	IO = 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	VRF = 10 mA	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_{PCO}U	Source side		–90		µA
PCOUT output current 2	I_{PCO}D	Sink side		90		µA
VCOIN input current	I_{VCO}IN	VCOIN = 5 V		0.1	0.2	µA
Minimum VCO frequency	f_{VCO}MIN	CX = 0.022 µF, V_{CO}IN = open		400		Hz
Maximum VCO frequency	f_{VCO}MAX	CX = 0.022 µF, V_{CO}IN = 5 V		18.5		kHz
C1/C2 source current ratio	R_{SOURCE}	$I_{C1SOURCE}/I_{C2SOURCE}$	–12		+12	%
C1/C2 sink current ratio	R_{SINK}	I_{C1SINK}/I_{C2SINK}	–12		+12	%
C1 source/sink current ratio	RC1	$I_{C1SOURCE}/I_{C1SINK}$	–35		+15	%
C2 source/sink current ratio	RC2	$I_{C2SOURCE}/I_{C2SINK}$	–35		+15	%
Thermal shutdown operating temperature	T-TSD	*	150	180	210	°C
Thermal shutdown hysteresis	ΔTTSD	*		15		°C

Note: * These values are design guarantee values, and are not tested.

FG/PG Amplifier Block at Ta = 25°C, V_{CC} = $V_{CC}L$ = 12 V, VREG = 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	$V_S$hys		70	93	115	mV

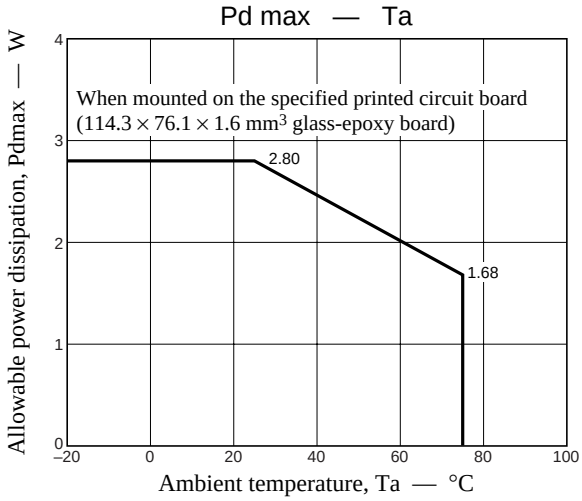
Note: * These values are design guarantee values, and are not tested.

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

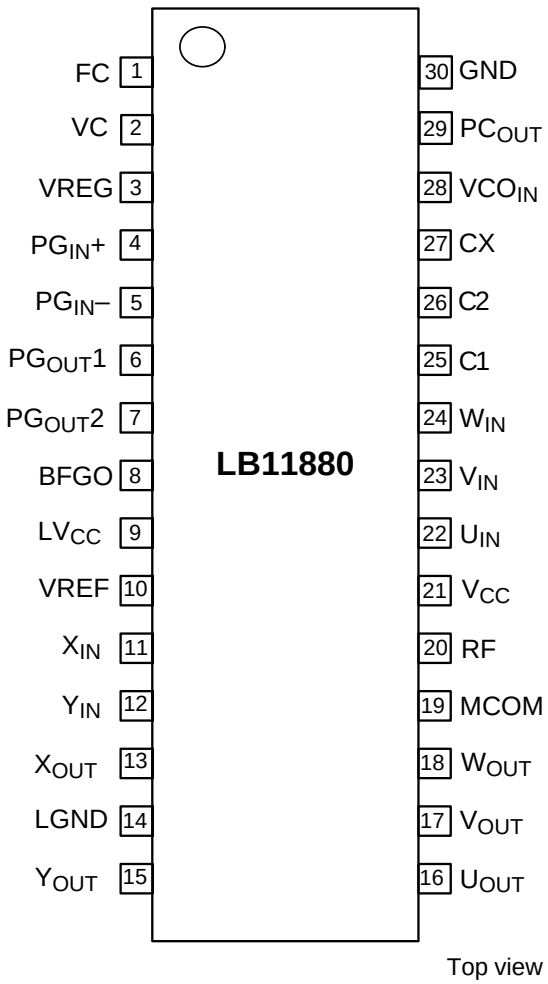
Parameter		Symbol		Conditions	Ratings			Unit
					min	typ	max	
Input voltage	1 (high)	$V_{IN}1$			3.5		5	V
	2 (low)	$V_{IN}2$			0		0.8	V
Input current		I_{IN}		Sink V_{IN} = 3.5 V		30	50	µA
Input hysteresis		ΔVT				0.7		V
Saturation voltage		Vsat U-1		Vref = VS, between the output and VS I_O = 0.2 A, CW/CCW mode		1.5	2.1	V
		Vsat L-1		Vref = VS, between the output and ground 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 ground 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		Upper	ILU				50	µA
		Lower	ILL				50	µA
Diode forward voltage		Uper	VFU	IF = 0.4 A		1.3		V
		Lower	VFL	IF = 0.4 A		1.0		V
Control supply current		Iref			–5	–2		µA

Loading Motor Truth Table

Input		Output		Mode
X_{IN}	Y_{IN}	X_{OUT}	Y_{OUT}	
L	L	Off	Off	Standby
H	L	H	L	Forward
L	H	L	H	Reverse
H	H	L	L	Brake

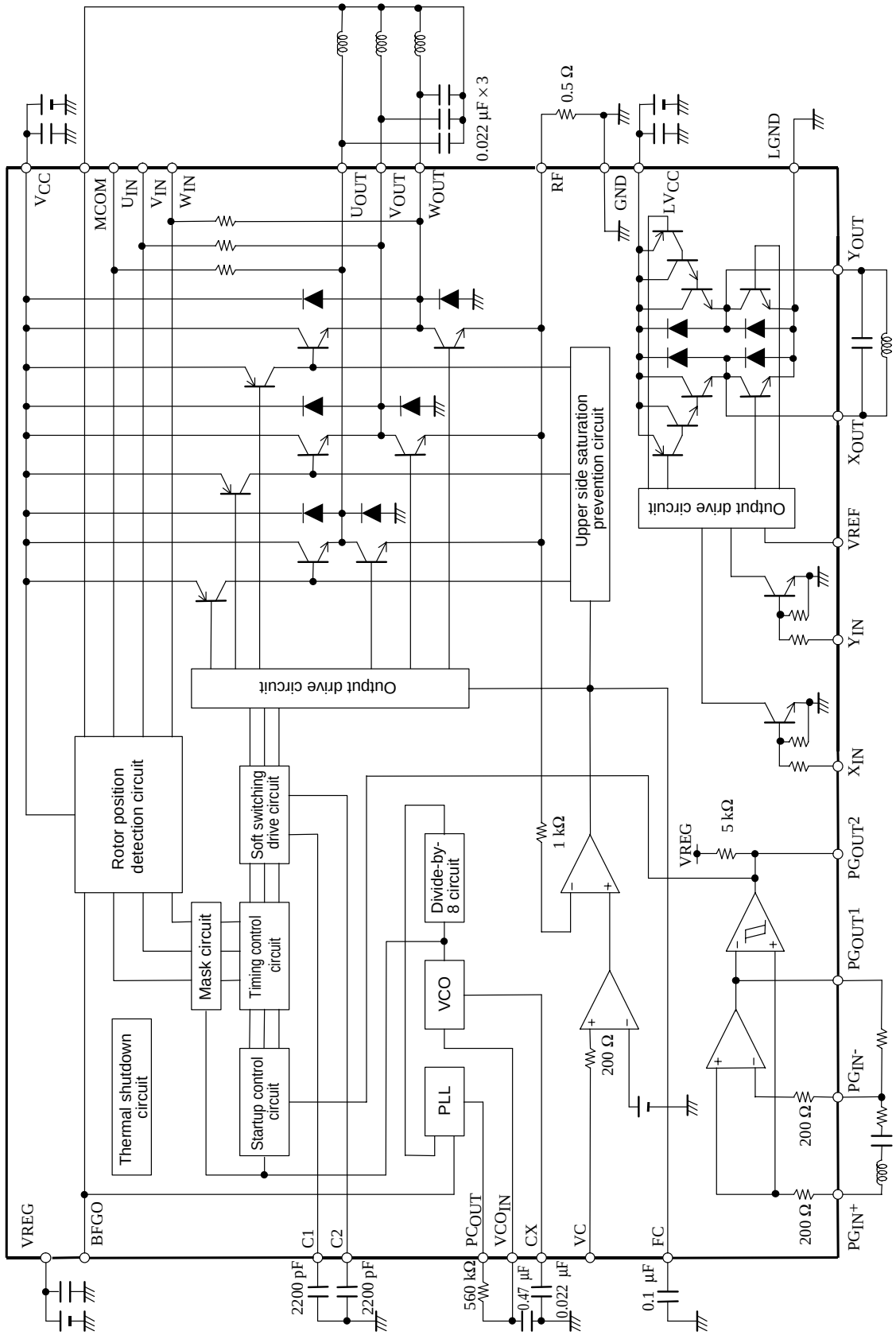


Pin Assignment

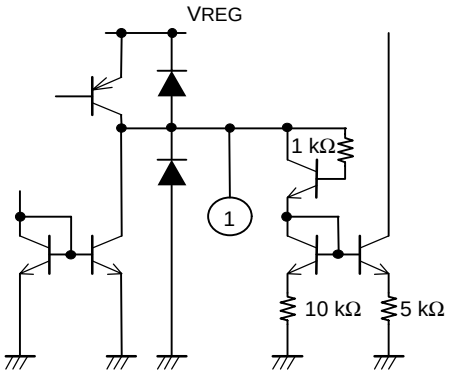
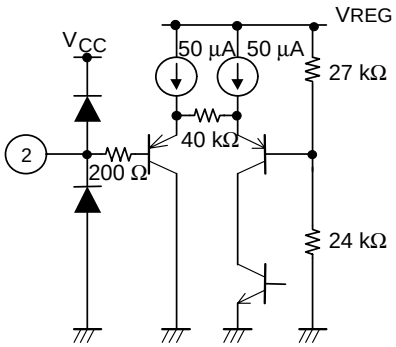
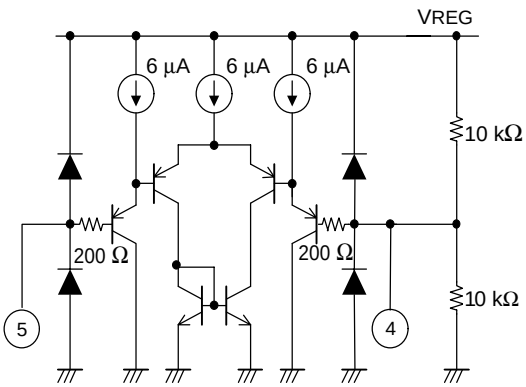
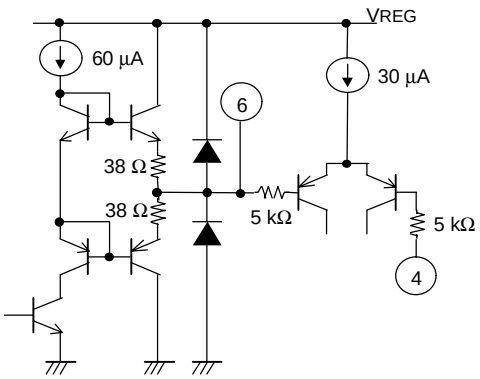


Top view

Block Diagram (Note that the values of the external components depend on the motor used.)



Pin Description

Pin No.	Pin	Pin voltage	Function	Equivalent circuit
1	FC		Frequency characteristics compensation Oscillation in the current control system closed loop can be prevented by connecting a capacitor between this pin and ground.	
2	VC	0 V to VREG	Speed control This circuit implements constant-current control in which current feedback is applied from the RF system.	
3	VREG	4 V to 6 V	Control system power supply This power supply must be stabilized so that ripple and noise do not enter the IC.	
4	$PG_{IN}+$		PG amplifier plus side input This pin is biased to 1/2 VREG internally.	
5	$PG_{IN}-$		PG amplifier minus side input	
6	$PG_{OUT}1$		PG amplifier linear output	

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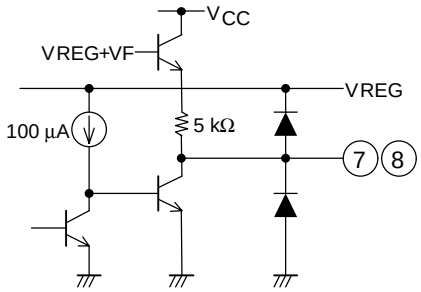
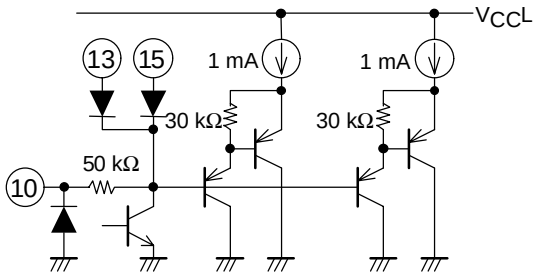
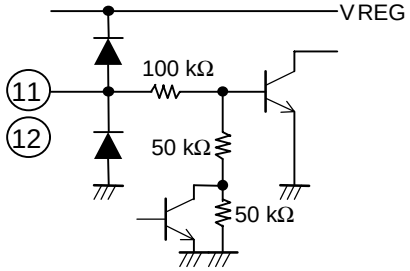
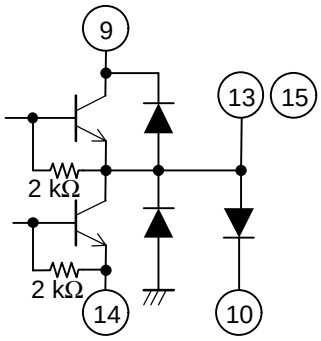
Pin No.	Pin	Pin voltage	Function	Equivalent circuit
7	$PG_{OUT}2$		PG Schmitt amplifier output	
8	BFGO		Motor back EMF voltage detection FG output (synthesized from three phases)	
9	LV_{CC}	8 to 13.8 V	Loading motor driver output transistor power supply	
10	VREF	0 to $V_{CC}L$	Loading motor driver output voltage setting	
11	X_{IN}	0 V to VREG	Loading motor driver logic input	
12	Y_{IN}			
13	X_{OUT}		Loading motor driver output	
15	Y_{OUT}			
14	LGND		Loading motor driver output transistor ground	

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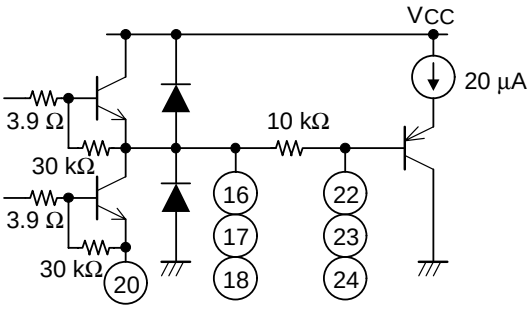
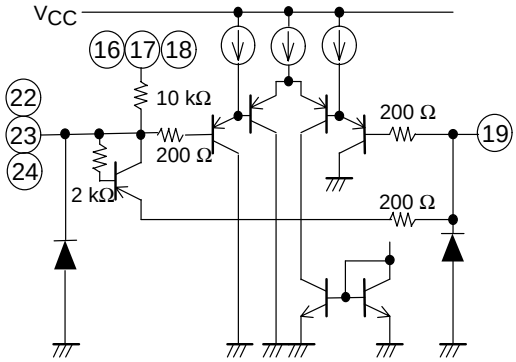
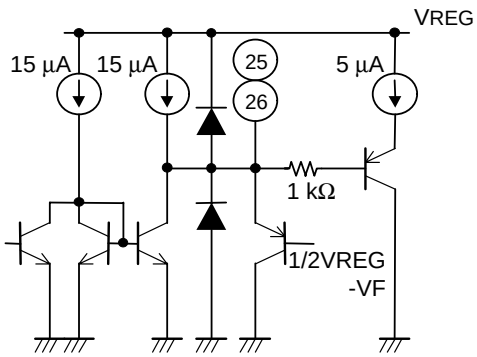
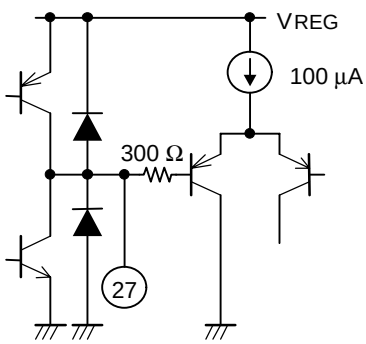
Pin No.	Pin	Pin voltage	Function	Equivalent circuit
16	U_{OUT}		Drum motor driver output	
17	V_{OUT}			
18	W_{OUT}			
20	RF		Lowest potential of the drum motor driver output transistor This IC implements constant-current control by detecting this voltage. The current limiter also operates by detecting this voltage.	
21	V_{CC}	8 to 13.8 V	Internal reference voltage and power supply for both the drum motor driver output block and the coil waveform detection circuit.	
19	MCOM		Motor coil center input The coil voltage waveform is detected with this voltage as the reference.	
22	U_{IN}		Coil waveform detection comparator input Each phase output is connected by an internal 10 kΩ resistor.	
23	V_{IN}			
24	W_{IN}			
25	C1		Triangular wave generating capacitor connection This triangular wave is used to implement soft switching in the coil output waveform.	
26	C2			
27	CX		The value of the capacitor connected between this pin and ground determines the operating frequency range and the minimum operating frequency of the VCO circuit.	

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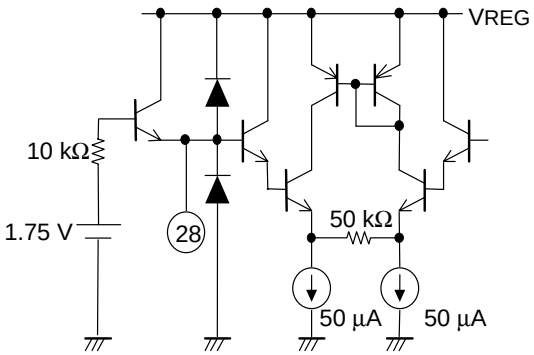
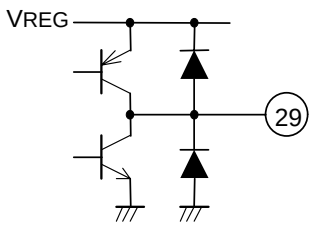
Pin No.	Pin	Pin voltage	Function	Equivalent circuit
28	VCO_{IN}		VCO circuit voltage input The PCOUT pin voltage is filtered by an RC circuit and input to this pin.	
29	PC_{OUT}		VCO circuit PLL output	
30	GND		Ground for all circuits other than the drum and loading driver output transistors.	