



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.

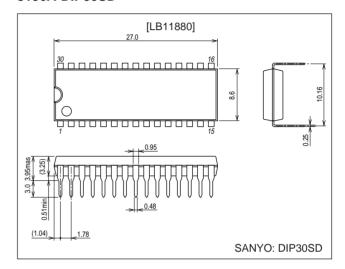
Functions and Features

- 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 $Ta = 25^{\circ}C$

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	Α
Loading current	Iomax (AVE)		0.4	А
Loading current	Iomax (peak)		1.2	А
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 \times 76.1 \times 1.6 mm glass-epoxy board

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Allowable Operating Ranges at $Ta = 25^{\circ}C$

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	Cumbal	Symbol Conditions -		Ratings			
Parameter	Symbol	Conditions	min	typ max		Unit	
Supply current 1	Icc	VC = 0 V, XIN = YIN = 0 V		3.5	5.0	mA	
Supply current 2	IccL	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 $Ta=25^{\circ}C,\,V_{CC}=V_{CC}L=12\;V,\,VREG=5\;V$

Doromator	Cymahal	Conditions	Ratings			Unit	
Parameter	Symbol	Symbol Conditions —		typ	max	Oill	
[Back EMF FG]	•		•	•	•	•	
Output on voltage	V _O L				0.4	V	
Output off voltage	V _O H		4.5			V	
[PG Amplifier]	·						
Input offset voltage	V _I O		-8		+8	mV	
Input bias current	I _B IN-		-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 _O L				0.4	V	
Output off voltage	V _O H		4.5			V	
Schmitt amplifier hysteresis	V _S hys		70	93	115	mV	

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

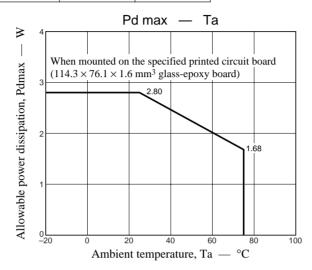
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Loading Block at Ta = 25°C, V_{CC} = $V_{CC}L$ = 12 V, VREG = 5 V

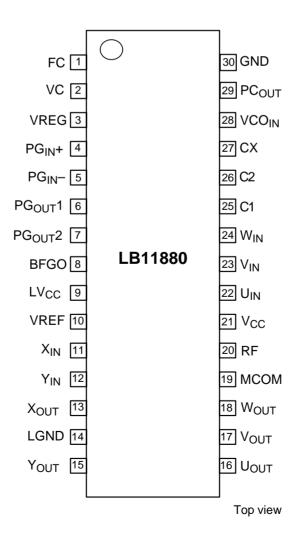
Parameter		C.,	mh al	Conditions	Ratings			Unit
		Syl	Symbol Conditions —		min	typ	max	Onit
1 (high)		V	_{IN} 1		3.5		5	V
Input voltage	2 (low)	V	_{IN} 2		0		0.8	V
Input current		ı	IN	Sink V _{IN} = 3.5 V		30	50	μA
Input hysteresis		Δ	VT			0.7		V
		Vsa	t U-1	Vref = VS, between the output and VS I _O = 0.2 A, CW/CCW mode		1.5	2.1	V
Saturation valtage		Vsa	nt L-1	Vref = VS, between the output and ground I _O = 0.2 A, CW/CCW mode		0.2	0.3	V
Saturation voltage		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		Vsa	tU-1"	Vref = 8 V, between the output and ground I _O = 0.2 A, CW/CCW mode	7.2	8.0	8.8	V
		Vsa	tL-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	μΑ
		Lower	ILL				50	μA
Diada farward valtage		Uper	VFU	IF = 0.4 A		1.3		V
Diode forward voltage		Lower	VFL	IF = 0.4 A		1.0		V
Control supply current		ı	ref		-5	-2		μΑ

Loading Motor Truth Table

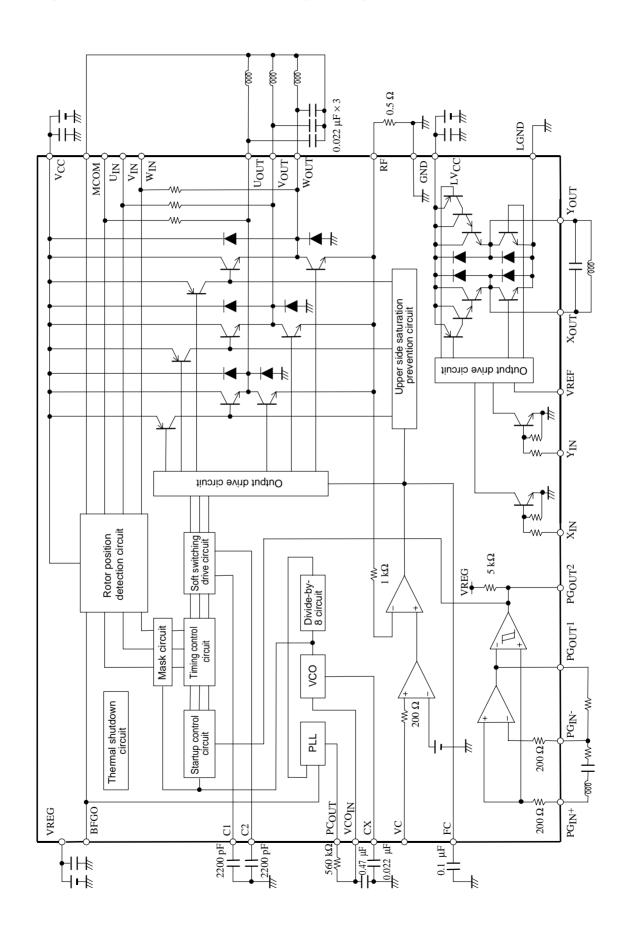
In	put	Ou	Mode	
X _{IN}	Y _{IN}	X _{OUT}	Y _{OUT}	iviode
L	L	Off	Off	Standby
Н	L	Н	L	Forward
L	Н	L	Н	Reverse
Н	Н	L	L	Brake



Pin Assignment



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.	VREG 1 kΩ 10
2	VC	0 V to VREG	Speed control This circuit implements constant-current control in which current feedback is applied from the RF system.	VREG 50 μA 50 μA 27 kΩ 40 kΩ 24 kΩ
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.	VREG 6 μΑ 6 μΑ 6 μΑ \$10 kΩ
5	PG _{IN} –		PG amplifier minus side input	200 Ω 2 10 kΩ
6	PG _{OUT} 1		PG amplifier linear output	VREG 38 Ω 30 μA 38 Ω 5 kΩ 4

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Pin No.	Pin	Pin voltage	Function	Equivalent circuit
7	PG _{OUT} 2		PG Schmitt amplifier output	VREG+VF—VCC VREG+VF—VREG 100 μΑ VREG
8	BFGO		Motor back EMF voltage detection FG output (synthesized from three phases)	(7)(8)
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	13 (15) 1 mA (V) 1 mA (V) 30 kΩ 50 kΩ 10
11	X _{IN}	0.1/ to 1/PEC	Loading motor driver logic input	VREG 100 kΩ 100 kΩ
12	Y _{IN}	O VIO VILG	Loading motor driver logic input	12) \$50 kΩ \$ /// / / \$50 kΩ
13	X _{OUT}		Loading motor driver output	9 (13) (15)
15	Youт		Ecosing motor driver output	2 kΩ 14 //// 10
14	LGND		Loading motor driver output transistor ground	

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Pin No.	Pin	Pin voltage	Function	Equivalent circuit
16	U _{OUT}			Vcc
17	V _{OUT}		Drum motor driver output	
18	W _{OUT}			3.9 Ω 10 kΩ 20 μA
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.	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$
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	МСОМ		Motor coil center input The coil voltage waveform is detected with this voltage as the reference.	Vcc (16(7)(18) (V) (V)
22	U _{IN}			22 \$ 10 kΩ 200 Ω 19 (24) \$ 200 Ω
23	V _{IN}		Coil waveform detection comparator input Each phase output is connected by an internal 10 k Ω resistor.	2 κΩν 200 Ω
24	W _{IN}			
25	C1		Triangular wave generating capacitor connection	VREG 15 μΑ 15 μΑ 25 5 μΑ 26
26	C2		This triangular wave is used to implement soft switching in the coil output waveform.	1 kΩ 1/2VREG -VF
27	СХ		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.	VREG 100 μΑ

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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.	1.75 V 28 50 kΩ 50 μA 50 μA
29	PC _{OUT}		VCO circuit PLL output	VREG
30	GND		Ground for all circuits other than the drum and loading driver output transistors.	

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